City & Guilds Level 2 and Level 3 Diploma in Light Vehicle Maintenance and Repair Competence (7270-12/13)

(610/0068/5 and 610/0069/6)

June 2021 Version 1.2

Qualification Handbook

Qualification at a glance

Subject area	Vehicle Maintenance and Repair
City & Guilds number	7270 -12/13
Age group approved	16+
Entry requirements	There are no entry requirements
Assessment	Online multiple-choice tests and assignments
Approvals	Fast track or Full approval applies
Support materials	Centre handbook, Qualification handbook, Assessment Packs, Sample test materials, SmartScreen
Registration and certification	Consult the Walled Garden/online catalogue for registration and certification end dates

Title and level	City & Guilds number	Qualification number	Total GLH	TQT
City & Guilds Level 2 Diploma in Light Vehicle Maintenance and Repair Competence	7270-12	610/0068/5	815	980
City & Guilds Level 3 Diploma in Light Vehicle Maintenance and Repair Competence	7270-13	610/0069/6	748	870

Version and date	Change detail	Section
V1.0	n/a	n/a
V1.1 April 2022	Updated City & Guilds address	Last page
V1.2 May 2022	Added details re RA/SC and grading to include fail details	Appendix 1 and Grading section

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1 Introduction

This document tells you what you need to do to deliver the qualifications:

Area	Description
Who are the qualifications for?	The qualifications are aimed at learners aged 16+ and are for anyone developing a career in the motor industry. These practical qualifications allow the student to demonstrate on the job skills in the students' own workplace, showing how they meet the national standards for automotive workers.
What do the qualifications cover?	These qualifications allow learners to learn, develop and practise the skills required for employment and/or career progression in the automotive industry. Learners cover areas such as routine vehicle maintenance, removal and replacement of vehicle units and components and diagnosis and rectification of vehicle faults. They are assessed in the workplace by using the following methods: • Workplace observation • Witness testimony • Verbal questioning • Evolve multiple choice test.
Are the qualifications part of a framework/Standard	These qualifications form part of the Apprenticeship Frameworks for Wales and Northern Ireland.
What opportunities for progression are there?	Upon successful completion of these qualifications, learners will be equipped with the knowledge and skills required as a competent technician for progression in the automotive industry, or progress on to the suite of Level 3 and Level 4 City & Guilds Electric Vehicle and ADAS qualifications and/or working towards a Level 4 related qualification or other Automotive Management qualifications. • 7290-01 City & Guilds Level 1 Award in Introduction to Electric and Hybrid Vehicle High Energy Systems • 7290-02 City & Guilds Level 2 Award in Safe Maintenance of Electric and Hybrid Vehicles • 7290-72 City & Guilds Level 2 Award in Hazard Management of Electric and Hybrid Vehicles • 7290-03 City & Guilds Level 3 Award in Component Removal and Replacement in Electric and Hybrid Vehicles • 7290-04 City & Guilds Level 4 Award in Diagnosis and Rectification of Faults in Electric and Hybrid Vehicles

	• 7290-63 City & Guilds Level 3 Award in Component Removal and Replacement in Hydrogen Fuel Cell Electric Vehicles • 7290-64 City & Guilds Level 4 Award in Diagnosis and Rectification of Faults in Hydrogen Fuel Cell Electric Vehicles • 7290-83 City & Guilds Level 3 Award in Diagnosis, Repair and Recalibration of Advanced Driver Assist Systems Including Apprenticeship standard EPAs in England • Level 3 Motor Vehicle Service and Maintenance Technician (9301-12/13) • Level 2 Autocare Technician (9301-12/13)
Who did we develop the qualification with?	This qualification has been developed using the National Occupational Standards as set by automotive industry experts.

Structure

Full qualification certificates will be awarded to successful candidates on completion of the required rules of combination, as indicated below.

To achieve the **City & Guilds Level 2 Diploma in Light Vehicle Maintenance and Repair Competence (7270-12)** candidates must achieve the following rules of combination:

All **sixteen** mandatory units 001, 003, 004, 051, 053, 054, 101, 102, 103, 104, 151, 152, 153, 154, 162, 172

In addition, **one** optional unit group (comprising of one or two units) from the following:

(008 and 058)
Or (105 and 155)
Or (111 and 161)
Or (121 and 171)
Or (131 and 181)
Or (218 and 268)
Or (112)

In addition, candidates can also choose the following Electric Vehicle elective unit: 601.

This unit does not form part of the rules of combination to achieve the full Diploma but can be taken as supplementary unit. On successful completion of the Electric Vehicle elective unit a CUC will be awarded.

City & Guilds unit number	Unit title	GLH
Mandatory		
001	Competency in Health, Safety and Good Housekeeping in the Automotive Environment	60
003	Competency in Supporting Job Roles in the Automotive Work Environment	40
004	Competency in Materials, Fabrication, Tools and Measuring Devices in the Automotive Environment	60
051	Knowledge of Health, Safety and Good Housekeeping in the Automotive Environment	30
053	Knowledge of Support For Job Roles in the Automotive Work Environment	20
054	Knowledge of Materials, Fabrication, Tools and Measuring Devices Used in the Automotive Environment	40
101	Competency in Routine Light Vehicle Maintenance	60
102	Competency in Removing and Replacing Light Vehicle Combustion Engine Units and Components	90

City & Guilds unit number	Unit title	GLH
103	Competency in Removing and Replacing Light Vehicle Electrical Units and Components	90
104	Competency in Removing and Replacing Light Vehicle Chassis Units and Components	90
151	Knowledge of Routine Light Vehicle Maintenance	20
152	Knowledge of Light Vehicle Combustion Engine Mechanical, Lubrication and Cooling System Units and Components	20
153	Knowledge of Removing and Replacing Light Vehicle Electrical Units and Components	45
154	Knowledge of Removing and Replacing Light Vehicle Chassis Units and Components	45
162	Knowledge of Light Vehicle Transmission and Driveline Units and Components	45
172	Knowledge of Light Vehicle Fuel, Ignition, Air and Exhaust System Units and Components	20
Optional groups	**(Combinations)**	
008	Competency in Identifying and Agreeing Motor Vehicle Customer Service Needs	40
058	Knowledge of How To Identify and Agree Motor Vehicle Customer Service Needs	45
105	Competency in Inspecting Light Vehicles Using Prescribed Methods	80
155	Knowledge of Inspecting Light Vehicles Using Prescribed Methods	40
111	Competency in Overhauling Light Vehicle Combustion Engine Mechanical Units	20
161	Knowledge of Overhauling Light Vehicle Combustion Engine Mechanical Units	20
121	Competency in Overhauling Light Vehicle Transmission Units	20
171	Knowledge of Overhauling Light Vehicle Transmission Units	20

City & Guilds unit number	Unit title	GLH
131	Competency in Overhauling Light Vehicle Steering and Suspension Units	20
181	Knowledge of Overhauling Light Vehicle Steering and Suspension Units	20
218	Competency in Removing and Fitting Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non-permanently Fixed Vehicle Body Panels	40
268	Knowledge of Removing and Fitting Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non-permanently Fixed Vehicle Body Panels	20
112	Competency in Removing and Replacing Light Vehicle Driveline Units and Components	90
Elective	**(Electrical Vehicle)**	
601	Knowledge of Carrying Out Non-High Voltage Operations On, Near or With an Electric Vehicle	8

To achieve the **City & Guilds Level 3 Diploma in Light Vehicle Maintenance and Repair Competence (7270-13)** candidates must achieve the following rules of combination:

All **fourteen** mandatory units: 001, 003, 004, 051, 053, 054, 107, 108, 157, 158, 163, 407, 457, 601

In addition, **one** optional unit group (comprising of one or two units) from the following:

(008 and 058)
Or (105 and 155)
Or (111 and 161)
Or (121 and 171)
Or (131 and 181)
Or (218 and 268)
Or (113)

In addition, candidates can also choose the following Electric Vehicle elective units: 602, 603, 612, 613 or the following ADAS elective units: 830 and 831

These units do not form part of the rules of combination to achieve the full Diploma but can be taken as supplementary unit. On successful completion of the unit a CUC will be awarded.

City & Guilds unit number	Unit title	GLH
Mandatory		
001	Competency in Health, Safety and Good Housekeeping in the Automotive Environment	60
003	Competency in Supporting Job Roles in the Automotive Work Environment	40
004	Competency in Materials, Fabrication, Tools and Measuring Devices in the Automotive Environment	60
051	Knowledge of Health, Safety and Good Housekeeping in the Automotive Environment	30
053	Knowledge of Support For Job Roles in the Automotive Work Environment	20
054	Knowledge of Materials, Fabrication, Tools and Measuring Devices Used in the Automotive Environment	40
107	Competency in Diagnosing and Rectifying Light Vehicle Combustion Engine Faults	90
108	Competency in Diagnosing and Rectifying Light Vehicle Chassis System Faults	90
157	Knowledge of Diagnosis and Rectification of Light Vehicle Combustion Engine Faults	45
158	Knowledge in Diagnosis and Rectification of Light Vehicle Chassis Faults	45
163	Knowledge of Diagnosis and Rectification of Light Vehicle Transmission and Driveline Faults	45
407	Competency in the Diagnosing and Rectifying of Automotive Vehicle Auxiliary Electrical Faults	90
457	Knowledge of Diagnosis and Rectification of Vehicle Auxiliary Electrical Faults	45
601	Knowledge of Carrying Out Non-High Voltage Operations On, Near or With an Electric Vehicle	8
Optional groups	**(Combinations)**	
008	Competency in Identifying and Agreeing Motor Vehicle Customer Service Needs	40
058	Knowledge of How To Identify and Agree Motor Vehicle Customer Service Needs	45

City & Guilds unit number	Unit title	GLH
105	Competency in Inspecting Light Vehicles Using Prescribed Methods	80
155	Knowledge of Inspecting Light Vehicles Using Prescribed Methods	40
111	Competency in Overhauling Light Vehicle Combustion Engine Mechanical Units	20
161	Knowledge of Overhauling Light Vehicle Combustion Engine Mechanical Units	20
121	Competency in Overhauling Light Vehicle Transmission Units	20
171	Knowledge of Overhauling Light Vehicle Transmission Units	20
131	Competency in Overhauling Light Vehicle Steering and Suspension Units	20
181	Knowledge of Overhauling Light Vehicle Steering and Suspension Units	20
218	Competency in Removing and Fitting Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non-permanently Fixed Vehicle Body Panels	40
268	Knowledge of Removing and Fitting Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non-permanently Fixed Vehicle Body Panels	20
113	Competency in Diagnosing and Rectifying Light Vehicle Transmission and Driveline Faults	90
Elective	**(Electrical Vehicle)**	
602	Knowledge of Isolating and Re-energising High Voltage Systems in an Electric Vehicle	14
603	Knowledge of Removing and Replacing Components in an Electric Vehicle High Voltage Powertrain and Ancillary Systems	28
612	Skills in Isolating and Re-energising High Voltage Systems in an Electric Vehicle	3

City & Guilds unit number	Unit title	GLH
613	Skills in Removing and Replacing Components in an Electric Vehicle High Voltage Powertrain and Ancillary Systems	5
Elective	**(ADAS)**	
830	Knowledge of Diagnosing, Removing, Replacing and Recalibrating Motor Vehicle Advanced Driver Assistance System Components	20
831	Skills in Diagnosing, Removing, Replacing and Recalibrating Motor Vehicle Advanced Driver Assistance System Components	7

Full qualification certificates will be awarded to successful candidates on completion of the required combinations of units. Candidates completing one or more units, rather than the full qualification(s), will receive a Certificate of Unit Credit (CUC).

Total Qualification Time

Total Qualification Time (TQT) is the number of notional hours which represents an estimate of the total amount of time that could reasonably be expected for a learner to achieve and demonstrate the achievement of the level of attainment necessary for the award of a qualification.

TQT is comprised of the following two elements:

1. The number of hours which an awarding organisation has assigned to a qualification for Guided Learning, and

2. An estimate of the number of hours a Learner will reasonably be likely to spend in preparation, study or any other form of participation in education or training, including assessment, which takes place as directed by - but, unlike Guided Learning, not under the Immediate Guidance or Supervision of - a lecturer, supervisor, tutor or other, appropriate provider of education or training

Title and level	GLH	TQT
City & Guilds Level 2 Diploma in Light Vehicle Maintenance and Repair Competence (7270-12)	315	980
City & Guilds Level 3 Diploma in in Light Vehicle Maintenance and Repair Competence (7270-13)	748	370

2 Centre requirements

Approval

If your Centre is approved to offer the qualification 4270-12/13 you can apply for the new approval using the **fast-track approval form**, available from the City & Guilds website.

Centres should use the fast-track form if:

- there have been no changes to the way the qualifications are delivered, and
- they meet all the approval criteria in the fast-track form guidance notes.

Fast track approval is available for 12 months from the launch of the qualification. After 12 months, the Centre will have to go through the standard Qualification Approval Process. The centre is responsible for checking that fast-track approval is still current at the time of application.

To offer these qualifications, new centres will need to gain both centre and qualification approval. Please refer to the City & Guilds website for further information on the approval process: **www.cityandguilds.com**

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualifications before designing a course programme.

Resource requirements

Physical resources and site agreements

Centres must have access to sufficient equipment in the college, training centre or workplace to ensure candidates have the opportunity to cover all the practical activities.

Centre staffing

Staff delivering these qualifications must be able to demonstrate that they meet the following occupational expertise requirements. They should:

- be occupationally competent or technically knowledgeable in the area[s] for which they are delivering training and/or have experience of providing training. This knowledge must be to the same level as the training being delivered
- have recent relevant experience in the specific area they will be assessing
- have credible experience of providing training.

Centre staff may undertake more than one role, e.g., tutor and assessor or internal verifier, but cannot internally verify their own assessments.

Internal quality assurance

Approved centres must have effective quality assurance systems to ensure optimum delivery and assessment of qualifications.

Quality assurance includes initial centre approval, qualification approval and the centre's own internal procedures for monitoring quality. Centres are responsible for internal quality assurance and City & Guilds is responsible for external quality assurance.

Standards and rigorous quality assurance are maintained by the use of:

- internal quality assurance
- City & Guilds external quality assurance.

In order to carry out the quality assurance role, Internal Quality Assurers must have appropriate teaching and vocational knowledge and expertise. Assessor/Verifier (A/V) units are valued as qualifications for the centre, but they are not currently a requirement for this qualification.

Staff must:

- be familiar with the occupation and technical content covered within the qualification.

Learner entry requirements

City & Guilds does not set entry requirements for these qualifications. However, centres must ensure that candidates have the potential and opportunity to gain the qualifications successfully.

Recognition of Prior Learning (RPL)

Recognition learning means using a person's previous experience or qualifications which have already been achieved to contribute to a new qualification. RPL is not allowed for any previous units contained in the 4270 suite or equivalent units taken with other awarding organisations for the new 7270 suite of qualifications.

However, RPL is available for any elective units taken and will be recognised for Electric Vehicle/ADAS qualification(s), full registration to the EV/ADAS qualification must take place to claim RPL for elective units achieved in Light Vehicle qualifications.

Age restrictions

City & Guilds cannot accept any registrations for candidates under 16 as these qualifications are not approved for under 16s.

3 Delivering the qualification

Initial assessment and induction

An initial assessment of each candidate should be made before the start of their programme to identify:

- if the candidate has any specific training needs
- support and guidance they may need when working towards their qualifications
- any units they have already completed, or credit they have accumulated which is relevant to the qualifications
- the appropriate type and level of qualification.

We recommend that centres provide an induction programme, so the candidate fully understands the requirements of the qualifications, their responsibilities as a candidate, and the responsibilities of the centre. This information can be recorded on a learning contract.

Support materials

The following resources are available for these qualifications:

Description	How to access
Fast track approval form	www.cityandguilds.com
Assessment pack	www.cityandguilds.com
Sample test materials	www.cityandguilds.com
SmartScreen	www.smartscreen.co.uk
Learning Assistant	www.cityandguilds.com

Recording documents

Candidates and centres may decide to use a paper-based or electronic method of recording evidence.

City & Guilds endorses several ePortfolio systems, including our own, **Learning Assistant**, an easy-to-use and secure online tool to support and evidence learners' progress towards achieving qualifications. Further details are available at **www.cityandguilds.com/eportfolios**.

City & Guilds has developed a set of *Recording forms* including examples of completed forms, for new and existing centres to use as appropriate. *Recording forms* are available on the City & Guilds website.

Although new centres are expected to use these forms, centres may devise or customise alternative forms, which must be approved for use by the external verifier, before they are used by candidates and assessors at the centre. Amendable (MS Word) versions of the forms are available on the City & Guilds website.

4 Assessment

Summary of assessment methods

City & Guilds has written the following assessments to use with these Qualification(s):

- Online multiple choice tests to assess essential knowledge criteria.
- Practical Assignments to assess essential skills: comprising of practical tasks, workplace observation, verbal questioning and short answer questions to cover all learning outcomes.
  These are carried out in the workplace and must be completed to current industry standards and practice.

Practical Assignment requirements and relevant documentation are available in the corresponding qualification(s) Assessment Packs, which can be downloaded from the 7270 qualification web page.

Time constraints

Candidates must complete their assessments within their registration period.

Test specifications

Summary test specifications for all 7270 evolve online knowledge tests can be found in the *7290/7270 Evolve Test Specification* Document downloadable from www.cityandguilds.com**.**

Unit Assessment Types

Unit	Level	Unit title	Assessment method	Where to obtain assessment materials
7270-001	Level 2	Competency in Health, Safety and Good Housekeeping in the Automotive Environment	Assignment	www.cityandguilds.com
7270-003	Level 3	Competency in Supporting Job Roles in the Automotive Work Environment	Assignment	www.cityandguilds.com
7270-004	Level 2	Competency in Materials, Fabrication, Tools and Measuring Devices in the Automotive Environment	Assignment	www.cityandguilds.com
7270-008	Level 2	Competency in Identifying and Agreeing Motor Vehicle Customer Service Needs	Assignment	www.cityandguilds.com
7270-051	Level 2	Knowledge of Health, Safety and Good Housekeeping in the Automotive Environment	Assignment	www.cityandguilds.com
7270-053	Level 3	Knowledge of Support For Job Roles in the Automotive Work Environment	Assignment	www.cityandguilds.com
7270-054	Level 2	Knowledge of Materials, Fabrication, Tools and Measuring Devices Used in the Automotive Environment	Assignment	www.cityandguilds.com
7270-058	Level 2	Knowledge of How To Identify and Agree Motor Vehicle Customer Service Needs	Assignment	www.cityandguilds.com
7270-101	Level 2	Competency in Routine Light Vehicle Maintenance	Assignment	www.cityandguilds.com
7270-102	Level 2	Competency in Removing and Replacing Light Vehicle Combustion Engine Units and Components	Assignment	www.cityandguilds.com
7270-103	Level 2	Competency in Removing and Replacing Light Vehicle Electrical Units and Components	Assignment	www.cityandguilds.com
7270-104	Level 2	Competency in Removing and Replacing Light Vehicle Chassis Units and Components	Assignment	www.cityandguilds.com
7270-105	Level 3	Competency in Inspecting Light Vehicles Using Prescribed Methods	Assignment	www.cityandguilds.com
7270-107	Level 3	Competency in Diagnosing and Rectifying Light Vehicle Combustion Engine Faults	Assignment	www.cityandguilds.com
7270-108	Level 3	Competency in Diagnosing and Rectifying Light Vehicle Chassis System Faults	Assignment	www.cityandguilds.com
7270-111	Level 3	Competency in Overhauling Light Vehicle Combustion Engine Mechanical Units	Assignment	www.cityandguilds.com
7270-112	Level 2	Competency in Removing and Replacing Light Vehicle Driveline Units and Components	Assignment	www.cityandguilds.com

Unit	Level	Unit title	Assessment method	Where to obtain assessment materials
7270-113	Level 3	Competency in Diagnosing and Rectifying Light Vehicle Transmission and Driveline Faults	Assignment	www.cityandguilds.com
7270-121	Level 2	Competency in Overhauling Light Vehicle Transmission Units	Assignment	www.cityandguilds.com
7270-131	Level 3	Competency in Overhauling Light Vehicle Steering and Suspension Units	Assignment	www.cityandguilds.com
7270-151	Level 2	Knowledge of Routine Light Vehicle Maintenance	Multiple choice test	Evolve
7270-152	Level 2	Knowledge of Light Vehicle Combustion Engine Mechanical, Lubrication and Cooling System Units and Components	Multiple choice test	Evolve
7270-153	Level 2	Knowledge of Removing and Replacing Light Vehicle Electrical Units and Components	Multiple choice test	Evolve
7270-154	Level 2	Knowledge of Removing and Replacing Light Vehicle Chassis Units and Components	Multiple choice test	Evolve
7270-155	Level 3	Knowledge of Inspecting Light Vehicles Using Prescribed Methods	Multiple choice test	Evolve
7270-157	Level 3	Knowledge of Diagnosis and Rectification of Light Vehicle Combustion Engine Faults	Multiple choice test	Evolve
7270-158	Level 3	Knowledge in Diagnosis and Rectification of Light Vehicle Chassis Faults	Multiple choice test	Evolve
7270-161	Level 3	Knowledge of Overhauling Light Vehicle Combustion Engine Mechanical Units	Multiple choice test	Evolve
7270-162	Level 2	Knowledge of Light Vehicle Transmission and Driveline Units and Components	Multiple choice test	Evolve
7270-163	Level 3	Knowledge of Diagnosis and Rectification of Light Vehicle Transmission and Driveline Faults	Multiple choice test	Evolve
7270-171	Level 3	Knowledge of Overhauling Light Vehicle Transmission Units	Multiple choice test	Evolve
7270-172	Level 2	Knowledge of Light Vehicle Fuel, Ignition, Air and Exhaust System Units and Components	Multiple choice test	Evolve
7270-181	Level 3	Knowledge of Overhauling Light Vehicle Steering and Suspension Units	Multiple choice test	Evolve
7270-218	Level 2	Competency in Removing and Fitting Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non-permanently Fixed Vehicle Body Panels	Assignment	www.cityandguilds.com
7270-268	Level 2	Knowledge of Removing and Fitting Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non-permanently Fixed Vehicle Body Panels	Multiple choice test	Evolve

Unit	Level	Unit title	Assessment method	Where to obtain assessment materials
7270-407	Level 3	Competency in the Diagnosing and Rectifying of Automotive Vehicle Auxiliary Electrical Faults	Assignment	www.cityandguilds.com
7270-457	Level 3	Knowledge of Diagnosis and Rectification of Vehicle Auxiliary Electrical Faults	Multiple choice test	Evolve
7270-601	Level 1	Knowledge of Carrying Out Non-High Voltage Operations On, Near or With an Electric Vehicle	Multiple choice test	Evolve
7270-602	Level 2	Knowledge of Isolating and Re-energising High Voltage Systems in an Electric Vehicle	Multiple choice test	Evolve
7270-603	Level 3	Knowledge of Removing and Replacing Components in an Electric Vehicle High Voltage Powertrain and Ancillary Systems	Multiple choice test	Evolve
7270-612	Level 2	Competency in Isolating and Re-energising High Voltage Systems in an electric vehicle	Assignment	www.cityandguilds.com
7270-613	Level 3	Competency in Removing and Replacing Components in an Electric Vehicle High Voltage Powertrain and Ancillary Systems	Assignment	www.cityandguilds.com
7270-830	Level 2	Knowledge of Diagnosing, Removing, Replacing and Recalibrating Motor Vehicle Advanced Driver Assistance System Components	Multiple choice test	Evolve
7270-831	Level 2	Competency in Diagnosing, Removing, Replacing and Recalibrating Motor Vehicle Advanced Driver Assistance System Components	Assignment	www.cityandguilds.com

5 Grading

Grading of individual assessments

Assignments will be graded as Pass only as detailed in the Assessment Pack.

Multiple choice tests will be graded as Pass/Merit/Distinction apart from the elective unit 7290-601 which is graded Pass only.

Grading of qualifications

The overall grading of both qualifications is Pass/Fail only.

All assessments, within the designated rules of combination must be achieved at a minimum of **Pass** for the qualification(s) to be awarded.

6 Units

Structure of the units

Each unit will follow the following format:

- City & Guilds reference number
- Title
- Level
- Guided learning hours (GLH)
- Relationship to NOS
- Assessment type
- Aim
- Learning outcomes, which are comprised of a number of assessment criteria
- Supporting information (unit range) where applicable

A unit describes what is expected of a competent person in particular aspects of his/her job.

Each **unit** is divided into **learning outcomes** which describe in further detail the skills and knowledge that a candidate should possess.

Each **learning outcome** has a set of **assessment criteria** which specify the desired criteria that have to be satisfied before an individual can be said to have performed to the agreed standard.

Supporting information define the breadth or scope of a learning outcome and its assessment criteria by setting out the various circumstances in which they are to be applied.

Unit 001 Competency in Health, Safety and Good Housekeeping in the Automotive Environment

Level:	Level 2
GLH:	60
Relationship to NOS:	This unit is linked to G1 Contribute to Housekeeping in Motor Vehicle Environment and G2 Reduce Risks to Health and Safety in the Motor Vehicle Environment.
Assessment type:	Assignment
Aim:	This unit enables the learner to develop the competency and skills to carry out day to day work area cleaning, clearing away, dealing with spillages and disposal of waste, used materials and debris and to identify hazards and risks in the automotive workplace and comply with relevant legislation and good practice.

Learning outcome	**The learner will:**
1. be able to use correct personal and vehicle protection within the automotive environment	
Assessment criteria	
The learner can: 1.1 select and use personal protective equipment throughout activities, to include appropriate protection of: a. eyes b. ears c. head d. skin e. feet f. hands g. lungs 1.2 select and use vehicle protective equipment throughout all activities.	

Learning outcome	The learner will:
2. be able to carry out effective housekeeping practices in the automotive environment	
Assessment criteria	
The learner can: 2.1 select and use cleaning equipment which is of the right type and suitable for the task 2.2 use utilities and appropriate consumables, avoiding waste 2.3 use materials and equipment to carry out cleaning and maintenance duties in allocated work areas, following automotive work environment policies, schedules and manufacturers' instructions 2.4 perform housekeeping activities safely and in a way which minimizes inconvenience to customers and staff 2.5 keep the work area clean and free from debris and waste materials 2.6 keep tools and equipment fit for purpose by regular cleaning and keeping tidy 2.7 dispose of used cleaning agents, waste materials and debris to comply with legal and workplace requirements.	

Learning outcome	The learner will:
3. be able to recognise and deal with dangers to work safely within the automotive workplace	
Assessment criteria	
The learner can: 3.1 name and locate the responsible persons for health and safety in their relevant workplace 3.2 identify and report working practices and hazards which could be harmful to themselves or others 3.3 carry out safe working practices whilst working with equipment, materials and products in the automotive environment 3.4 rectify health and safety risks encountered at work, within the scope and capability of their job role.	

Learning outcome	The learner will:
4. be able to conduct themselves responsibly	
Assessment criteria	
The learner can: 4.1 show personal conduct in the workplace which does not endanger the health and safety of themselves or others 4.2 display suitable personal presentation at work which ensures the health and safety of themselves and others at work.	

Unit 003 Competency in Supporting Job roles in the Automotive Work Environment

Level:	Level 3
GLH:	40
Relationship to NOS:	This unit is linked to G3 Maintain Working Relationships in the Motor Vehicle Environment
Assessment type:	Assignment
Aim:	This unit enables the learner to develop the competency and skills required to keep good working relationships with all colleagues and customers in the automotive work environment by using effective communication and support.

Learning outcome	**The learner will:**
1. be able to work effectively within the organisational structure of the automotive work environment	
Assessment criteria	
The learner can 1.1 respond promptly and willingly to requests for assistance from customers and colleagues 1.2 refer customers and colleagues to the correct person should requests fall outside their responsibility and capability.	

Learning outcome	**The learner will:**
2. be able to obtain and use information in order to support their job role within the automotive work environment	
Assessment criteria	
The learner can 2.1 select and use legal and technical information, in an automotive work environment.	

Learning outcome	The learner will:
3. be able to communicate with and support colleagues and customers effectively within the automotive work environment	
Assessment criteria	
The learner can 3.1 use methods of communication with customers and colleagues which meet their needs 3.2 give customers and colleagues accurate information 3.3 make requests for assistance from or to customers and colleagues clearly and courteously.	

Learning outcome	The learner will:
4. be able to develop and keep good working relationships in the automotive work environment	
Assessment criteria	
The learner can 4.1 contribute to teamwork by initiating ideas and co-operating with customers and colleagues 4.2 treat customers and colleagues in a way which shows respect for their views and opinions 4.3 make and keep achievable commitments to customers and colleagues 4.4 inform colleagues promptly of anything likely to affect their own work.	

Unit 004 Competency in Materials, Fabrication, Tools and Measuring Devices in the Automotive Environment

Level:	Level 2
GLH:	60
Relationship to NOS:	This unit is linked to G4 Use of hand tools and equipment in motor vehicle engineering
Assessment type:	Assignment
Aim:	This unit enables the learner to develop the competency and skills required to correctly select, care and use key hand tools and measuring devices for modification, fabrication and repair in the automotive environment. To correctly prepare and use common work environment equipment and the correct selection and fabrication of materials used when modifying and repairing. Including the correct application of automotive engineering fabrication and fitting principles.

Learning outcome	**The learner will:**
1. be able to select, maintain and use hand tools and measuring devices in the automotive environment	
Assessment criteria	
The learner can: 1.1 select, maintain and use suitable hand tools safely when fabricating and fitting in the automotive workplace 1.2 select, maintain and use suitable measuring devices safely when fabricating and fitting in the automotive environment 1.3 select, maintain and use suitable PPE for fabrication, repair and fitting in the automotive environment 1.4 select, maintain and use suitable electrical measuring tools safely when repairing vehicles and components.	

Learning outcome	The learner will:
2. be able to prepare and use common workshop equipment	
Assessment criteria	
The learner can: 2.1 use suitably maintained workshop equipment safely 2.2 use correct interpretation of 'safe working load' on lifting and supporting equipment 2.3 report any faulty or damaged tools and equipment to the relevant persons clearly and promptly 2.4 store work tools and equipment in a safe manner which permits ease of access and identification for use.	

Learning outcome	The learner will:
3. be able to select materials when fabricating, modifying and repairing vehicles and fitting components	
Assessment criteria	
The learner can: 3.1 select and use appropriate materials whilst constructing, fitting, modifying or repairing vehicles and components.	

Learning outcome	The learner will:
4. be able to apply automotive engineering, fabrication and fitting principles when modifying and repairing vehicles and components	
Assessment criteria	
The learner can: 4.1 use correct procedures when: a. filing b. tapping threads c. cutting plastics and metals d. drilling plastics and metals e. fitting 4.2 use appropriate techniques when fabricating, repairing and modifying vehicles and components 4.3 select and use: a. gaskets b. seals c. sealants d. fittings and fasteners 4.4 apply modification and repair techniques to automotive electrical circuits 4.5 select and use locking, fixing and fastening devices.	

Unit 008 Competency to Identify and Agree Motor Vehicle Customer Service Needs

Level:	Level 3
GLH:	40
Relationship to NOS:	This unit is linked to G8 Identify and agree the motor vehicle customer needs.
Assessment type:	Assignment
Aim:	This unit enables the learner to develop the competency and skills to gain information from customers on their perceived needs; give advice and information and agree a course of action; contract for the agreed work and complete all necessary records and instructions.

Learning outcome	**The learner will:**
1. be able to obtain relevant information from the customer	
Assessment criteria	
The learner can: 1.1 obtain and interpret sufficient, relevant information, from the customer to make an assessment of their needs 1.2 clarify customer and vehicle needs by referring to vehicle data and operating procedures.	

Learning outcome	**The learner will:**
2. be able to provide relevant information to the customer	
Assessment criteria	
The learner can: 2.1 provide customers with accurate, current and relevant advice and information, in a form that the customer will understand 2.2 demonstrate techniques which encourage customers to ask questions and seek clarification during conversation.	

Learning outcome	**The learner will:**
3. be able to agree work undertaken with the customer	
Assessment criteria	
The learner can: 3.1 summarise and record work agreed with the customer, before accepting the vehicle 3.2 implement confirmation of the agreement by ensuring customer understanding.	

Learning outcome	The learner will:
4. be able to ensure recording systems are implemented correctly	
Assessment criteria	
The learner can: 4.1 use recording systems which are accurate and complete, in the required format and signed by the customer where necessary 4.2 perform the next stage in the process by passing on completed records to the correct person promptly 4.3 demonstrate correct procedures for customer approval where the contracted agreement is likely to be exceeded.	

Unit 051 Knowledge of Health, Safety and Good Housekeeping in the Automotive Environment

Level:	Level 2
GLH:	30
Relationship to NOS:	This unit is linked to G1 Contribute to Housekeeping in Motor Vehicle Environment and G2 Reduce Risks to Health and Safety in the Motor Vehicle Environment.
Assessment type:	Assignment
Aim:	This unit enables the learner to develop the understanding in routine maintenance and cleaning of the automotive environment and using resources economically. It will also provide skills in Health and Safety legislation and an appreciation of significant risks in the automotive environment and how to identify and deal with them. Once completed the learner will be able to identify hazards and evaluate and reduce risk.

Learning outcome	**The learner will:**
1. understand the correct personal and vehicle protective equipment to be used within the automotive environment	
Assessment criteria	
The learner can: 1.1 explain the importance of wearing the types of PPE required for a range automotive repair activities 1.2 identify vehicle protective equipment for a range of repair activities 1.3 describe vehicle and personal safety considerations when working at the roadside.	

Learning outcome	**The learner will:**
2. understand effective housekeeping practices in the automotive environment	
Assessment criteria	
The learner can: 2.1 describe why the automotive environment should be properly cleaned and maintained 2.2 describe requirements and systems which may be put in place to ensure a clean automotive environment 2.3 describe how to minimise waste when using utilities and consumables 2.4 state the procedures and precautions necessary when cleaning and maintaining an automotive environment 2.5 describe the selection and use of cleaning equipment when dealing with general cleaning, spillages and leaks in the automotive environment. 2.6 describe procedures for correct disposal of waste materials from an automotive environment	

2.7 describe procedures for starting and ending the working day which ensure effective housekeeping practices are followed.

Learning outcome	**The learner will:**
3. understand key health and safety requirements relevant to the automotive environment	
Assessment criteria	
The learner can: 3.1 list the main legislation relating to automotive environment health and safety 3.2 describe the general legal duties of employers and employees required by current health and safety legislation 3.3 describe key, current health and safety requirements relating to the automotive environment 3.4 describe why workplace policies and procedures relating to health and safety are important.	

Learning outcome	**The learner will:**
4. understand about hazards and potential risks relevant to the automotive environment	
Assessment criteria	
The learner can: 4.1 identify key hazards and risks in an automotive environment 4.2 describe policies and procedures for reporting hazards, risks, health and safety matters in the automotive environment. 4.3 state precautions and procedures which need to be taken when working with vehicles, associated materials, tools and equipment. 4.4 identify fire extinguishers in common use and which types of fire they should be used on 4.5 identify key warning signs and their characteristics that are found in the vehicle repair environment. 4.6 state the meaning of common product warning labels used in an automotive environment.	

Learning outcome	**The learner will:**
5. understand personal responsibilities	
Assessment criteria	
The learner can: 5.1 explain the importance of personal conduct in maintaining the health and safety of the individual and others 5.2 explain the importance of personal presentation in maintaining health safety and welfare.	

Unit 008 Competency to Identify and Agree Motor Vehicle Customer Service Needs

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.

Economic use of Resources

a. Consumable materials e.g., grease, oils, split pins, locking and fastening devices etc.

Requirement to maintain work area effectively

a. Cleaning tools and equipment to maximise workplace efficiency.
b. Requirement to carry out the housekeeping activities safely and in a way that minimises inconvenience to customers and staff.
c. Risks involved when using solvents and detergents.
d. Advantages of good housekeeping.

Spillages, leaks and waste materials

a. Relevance of safe systems of work to the storage and disposal of waste materials.
b. Requirement to store and dispose of waste, used materials and debris correctly.
c. Safe disposal of special / hazardous waste materials.
d. Advantages of recycling waste materials.
e. Dealing with spillages and leaks.

Basic legislative requirements

a. Provision and Use of Work Equipment Regulations 1992
b. Power Presses Regulations 1992
c. Pressure Systems and Transportable Gas Containers Regulations 1989
d. Electricity at Work Regulations 1989
e. Noise at Work Regulations 1989
f. Manual Handling Operations Regulations 1992
g. Health and Safety (Display Screen Equipment) Regulations 1992
h. Abrasive Wheel Regulations
i. Safe Working Loads
j. Working at Height Regulations.

Routine maintenance of the workplace

a. Trainees' personal responsibilities and limits of their authority with regard to work equipment.
b. Risk assessment of the workplace activities and work equipment.

c. Workplace person responsible for training and maintenance of workplace equipment.
d. When and why safety equipment must be used.
e. Location of safety equipment.
f. Particular hazards associated with their work area and equipment.
g. Prohibited areas.
h. Plant and machinery that trainees must not use or operate.
i. Why and how faults on unsafe equipment should be reported.
j. Storing tools, equipment and products safely and appropriately.
k. Using the correct PPE.
l. Following manufacturers' recommendations.
m. Location of routine maintenance information e.g., electrical safety check log.

Legislation relevant to Health and Safety

a. HASAWA
b. COSHH
c. EPA
d. Manual Handling Operations Regulations 1992
e. PPE Regulations 1992.

General regulations to include an awareness of:

a. Health and Safety (Display Screen Equipment) Regulations 1992
b. Health and Safety (First Aid) Regulations 1981
c. Health and Safety (Safety Signs and Signals) Regulations 1996
d. Health and Safety (Consultation with Employees) Regulations 1996
e. Employers Liability (Compulsory Insurance) Act 1969 and Regulations 1998
f. Confined Spaces Regulations 1997
g. Noise at Work Regulations 1989
h. Electricity at Work Regulations 1989
i. Electricity (Safety) Regulations 1994
j. Fire Precautions Act 1971
k. Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1985
l. Pressure Systems Safety Regulations 2000
m. Waste Management 1991
n. Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002
o. Control of Asbestos at Work Regulations 2002.

Legislative duties

a. The purpose of a Health and Safety Policy.
b. The relevance of the Health and Safety Executive.
c. The relevance of an initial induction to Health and Safety requirements at your workplace.
d. General employee responsibilities under the HASAWA and the consequences of non-compliance.
e. General employer responsibilities under the HASAWA and the consequences of non-compliance.
f. The limits of authority with regard to Health and Safety within a personal job role.
g. Workplace procedure to be followed to report Health and Safety matters.

Precautions to be taken when working with vehicles, workshop materials, tools and equipment including electrical safety, pneumatics and hydraulics

a. Accessing and interpreting safety information.
b. Seeking advice when needed.
c. Seeking assistance when required.
d. Reporting of unsafe equipment.
e. Storing tools, equipment and products safely and appropriately.
f. Using the correct PPE.
g. Following manufacturers' recommendations.
h. Following application procedures e.g., hazardous substances.
i. The correct selection and use of extraction equipment.

PPE to include:

a. typical maintenance procedures for PPE equipment to include:
b. typical maintenance log
c. cleaning procedures
d. filter maintenance
e. variation in glove types
f. air quality checks.
g. choice and fitting procedures for masks and air breathing equipment.
h. typical workplace processes which would require the use of PPE to include:
i. welding
j. sanding and grinding
k. filling
l. panel removal and replacement
m. drilling
n. cutting
o. chiselling
p. removal of broken glass
q. removal of rubber seals from fire damaged vehicles
r. removal of hypodermic needles
s. servicing activities
t. roadside recovery.
u. unserviceable PPE.
v. PPE required for a range automotive repair activities. To include appropriate protection of:
    i. eyes
    ii. ears
    iii. head
    iv. skin
    v. feet
    vi. hands
    vii. lungs.

Fire and extinguishers

a. Classification of fire types.
b. Using a fire extinguisher effectively.
c. Types of extinguishers:
    i. foam

ii. dry powder
iii. CO_2
iv. water
v. fire blanket.

Action to be taken in the event of a fire to include:

a. the procedure as:
b. raise the alarm
c. fight fire only if appropriate
d. evacuate building
e. call for assistance.

Product warning labels to include:

a. reasons for placing warning labels on containers.
b. warning labels in common use
    i. toxic
    ii. corrosive
    iii. poisonous
    iv. harmful
    v. irritant
    vi. flammable
    vii. explosive.

Warning signs and notices

a. Colours used for warning signs:
    i. red
    ii. blue
    iii. green.
    iv. shapes and meaning of warning signs:
    v. round
    vi. triangular
    vii. square.
    viii. The meaning of prohibitive warning signs in common use.
    ix. The meaning of mandatory warning signs in common use.
    x. The meaning of warning notices in common use.
    xi. General design of safe place warning signs.

Hazards and risks to include:

a. the difference between a risk and a hazard.
b. potential risks resulting from:
    i. the use and maintenance of machinery or equipment
    ii. the use of materials or substances
    iii. accidental breakages and spillages
    iv. unsafe behaviour
    v. working practices that do not conform to laid down policies
    vi. environmental factors
    vii. personal presentation
    viii. unauthorised personal, customers, contractors etc entering your work premises
    ix. working by the roadside

x. vehicle recovery.

c. the employee's responsibilities in identifying and reporting risks within their working environment.
d. the method of reporting risks that is outside your limits of authority.
e. potential causes of:
f. fire
g. explosion
h. noise
i. harmful fumes
j. slips
k. trips
l. falling objects
m. accidents whilst dealing with broken down vehicles.

Personal responsibilities

a. The purpose of workplace policies and procedures on:
b. the use of safe working methods and equipment
c. the safe use of hazardous substances
d. smoking, eating, drinking and drugs
e. emergency procedures
f. personal appearance.
g. The importance of personal appearance in the control of health and safety.

Action to be taken in the event of colleagues suffering accidents

a. The typical sequence of events following the discovery of an accident such as:
   i. make the area safe
   ii. remove hazards if appropriate i.e., switch off power
   iii. administer minor first aid
   iv. take appropriate action to re-assure the injured party
   v. raise the alarm
   vi. get help
   vii. report on the accident.
b. Typical examples of first aid which can be administered by persons at the scene of an accident:
   i. check for consciousness
   ii. stem bleeding
   iii. keep the injured person's airways free
   iv. place in the recovery position if injured person is unconscious
   v. issue plasters for minor cuts
   vi. action to prevent shock i.e., keep the injured party warm
   vii. administer water for minor burns or chemical injuries
   viii. wash eyes with water to remove dust or ingress of chemicals (battery acid)
   ix. need to seek professional help for serious injuries.
c. Examples of bad practice which may result in further injury such as:
   i. moving the injured party
   ii. removing foreign objects from wounds or eyes
   iii. inducing vomiting
   iv. straightening deformed limbs.

Unit 053 Knowledge of Support for Job Roles in the Automotive Work Environment

Level:	Level 3
GLH:	20
Relationship to NOS:	This unit is linked to G3 Maintain Working Relationships in the Motor Vehicle Environment.
Assessment type:	Assignment
Aim:	This unit enables the learner to develop an understanding of how to keep good working relationships with all colleagues in the automotive work environment by using effective communication and support skills.

Learning outcome	**The learner will:**
1. understand key organisational structures, functions and roles within the automotive work environment	
Assessment criteria	
The learner can: 1.1 identify the purpose of the different sections of a typical automotive work environment 1.2 explain organisational structures and lines of communication within the automotive work environment 1.3 explain levels of responsibility within specific job roles in an automotive workplace. To include: a. trainee b. skilled technician c. supervisor d. manager.	

Learning outcome	**The learner will:**
2. understand the importance of obtaining, interpreting and using information in order to support their job role within the automotive work environment	
Assessment criteria	
The learner can: 2.1 explain the importance of different sources of information in an automotive work environment 2.2 explain how to find, interpret and use relevant sources of information 2.3 describe the main legal requirements relating to the vehicle, including road safety requirements 2.4 explain the importance of working to recognised procedures and processes 2.5 explain when replacement units and components must meet the manufacturers' original equipment specification 2.6 explain the purpose of how to use identification codes.	

Learning outcome	The learner will:
3. understand the importance of different types of communication within the automotive work environment	
Assessment criteria	
The learner can: 3.1 explain where different methods of communication would be used within the automotive environment 3.2 explain the factors which can determine their choice of communication 3.3 explain how the communication of information can change with the target audience to include informed and uninformed people.	

Learning outcome	The learner will:
4. understand communication requirements when carrying out vehicle repairs in the automotive work environment	
Assessment criteria	
The learner can: 4.1 explain how to report using written and verbal communication 4.2 explain the importance of documenting information relating to work carried out in the automotive environment 4.3 explain the importance of working to agreed timescales.	

Learning outcome	The learner will:
5. understand how to develop good working relationships with colleagues and customers in the automotive workplace	
Assessment criteria	
The learner can: 5.1 describe how to develop positive working relationships with colleagues and customers 5.2 explain the importance of developing positive working relationships 5.3 explain the importance of accepting other peoples' views and opinions 5.4 explain the importance of making and honouring realistic commitments to colleagues and customers.	

Unit 053 Knowledge of Support for Job Roles in the Automotive Work Environment

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.

The structure of a typical vehicle repair business

a. How these areas relate to each other within the business:
   i. body shop
   ii. vehicle repair workshop
   iii. paint shop
   iv. valeting
   v. vehicle parts store
   vi. main office
   vii. vehicle sales
   viii. reception.

Sources of information

a. Other staff.
b. Manuals.
c. Parts lists.
d. Computer software and the internet.
e. Manufacturer.
f. Diagnostic equipment.

Communication requirements when carrying out vehicle repairs

a. Locating and using correct documentation and information for:
   i. recording vehicle maintenance and repairs
   ii. vehicle specifications
   iii. component specifications
   iv. oil and fluid specifications
   v. equipment and tools
   vi. identification codes.
b. Procedures for:
   i. referral of problems
   ii. reporting delays
   iii. additional work identified during repair or maintenance
   iv. keeping others informed of progress.

Methods of communication:

a. verbal
b. signs and notices
c. memos
d. telephone
e. electronic mail
f. vehicle job card
g. notice boards
h. SMS text messaging
i. letters.
j. Organisational and customer requirements:
    i. importance of time scales to customer and organization
    ii. relationship between time and costs
    iii. meaning of profit.
k. Choice of communication
    a. distance
    b. location
    c. job responsibility.
l. Importance of maintaining positive working relationships:
    i. morale
    ii. productivity
    iii. company image
    iv. customer relationships
    v. colleagues.

Unit 054 Knowledge of Materials, Fabrication, Tools and Measuring Devices in the Automotive Environment

Level:	Level 2
GLH:	40
Relationship to NOS:	This unit is linked to G4 Use of hand tools and equipment in Motor Vehicle Engineering.
Assessment type:	Assignment
Aim:	This unit enables the learner to develop the understanding required to correctly select, care and use key hand tools and measuring devices for modification, fabrication and repair in the automotive environment. To correctly prepare and use common work environment equipment and the correct selection and fabrication of materials used when modifying and repairing. Including the correct application of automotive engineering fabrication and fitting principles.

Learning outcome	**The learner will:**
1. understand how to select, use and care for hand tools and measuring devices in the automotive environment	
Assessment criteria	
The learner can: 1.1 identify and explain the use of common types of hand tools used for fabricating and fitting in the automotive environment 1.2 identify and explain the use of common measuring devices used for fabrication and fitting in the automotive environment 1.3 describe, within the scope of their responsibilities, how to select, prepare and maintain hand tools, measuring devices and PPE used for fabrication, repair and fitting in the automotive environment 1.4 state the limitations of common hand tools and measuring devices used for fabricating, repair and fitting in the automotive workplace 1.5 explain how common hand tools and measuring devices used for fabricating, repair and fitting in the automotive environment should be stored and maintained 1.6 identify common electrical measuring tools used in the repair of vehicles and components 1.7 explain the preparation and safe and correct use of common electrical tools when measuring voltage, current and resistance.	

Learning outcome	**The learner will:**
2. understand how to prepare and use common workshop equipment	
Assessment criteria	
The learner can:	

2.1	describe the preparation and safe use of workshop equipment
2.2	explain the term: safe working load.

Learning outcome	**The learner will:**
3. understand how to select materials when fabricating, modifying and repairing vehicles and fitting components	
Assessment criteria	
The learner can:	
3.1	describe the properties, application and limitations of ferrous and non-ferrous metals, including their safe use
3.2	describe the properties, application and limitations of common non-metallic materials, including their safe use
3.3	define common terms relating to the properties of materials.

Learning outcome	**The learner will:**
4. understand how to apply automotive engineering, fabrication and fitting principles when modifying and repairing vehicles and components	
Assessment criteria	
The learner can:	
4.1	describe how to tap threads, file, cut and drill plastics and metals when modifying or repairing vehicles
4.2	describe how to measure, mark out, shape and join materials when fabricating
4.3	describe the selection and fitting procedures of the following: a. gaskets and seals b. sealants and adhesives c. fittings and fasteners d. electrical circuit components
4.4	identify locking, fastening and fixing devices
4.5	state the importance of current operating specifications for limits, fits and tolerances in the automotive environment.

Unit 054 Knowledge of Materials, Fabrication, Tools and Measuring Devices in the Automotive Environment

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.

Common types of hand tools used for fabricating and fitting in the automotive workplace to include:

a. files
b. hacksaws and snips
c. hammers
d. screwdrivers
e. pliers
f. spanners
g. sockets
h. punches
i. types of drill and drill bits
j. taps and dies
k. stud removers
l. marking out tools.

Common measuring devices used for fabrication and fitting in the automotive environment.

To include:

a. rule or tape
b. callipers
c. feeler gauge
d. volume measures
e. micrometer
f. dial gauges
g. torque wrenches
h. depth gauges.

Common electrical measuring tools used in the repair of vehicles and components.

To include:

a. ammeter
b. voltmeter
c. ohmmeter
d. multi-meter.

Common electrical terms when measuring:

a. voltage
b. current
c. resistance.

Workshop equipment (including appropriate PPE) to include:

a. hydraulic jacks
b. axle stands
c. pillar drills
d. air tools
e. vehicle lifts
f. cranes
g. hoists
h. electrical power tools.

The properties, application and limitations to include safe use of ferrous and non-ferrous metals used when constructing, modifying and repairing vehicles and components.

Materials to include:

a. carbon steels
b. alloy steels
c. cast iron
d. aluminium alloys
e. brass
f. copper
g. lead.

The properties, application and limitations to include safe use of non-metallic materials used when constructing, modifying and repairing vehicles and components.

Materials to include:

a. glass
b. plastics
c. kevlar
d. rubber.

Terms relating to the properties of materials to include:

a. hardness
b. toughness
c. ductility
d. elasticity
e. tenacity
f. malleability
g. plasticity.

Unit 058 Knowledge of How To Identify and Agree Motor Vehicle Customer Service Needs

Level:	Level 3
GLH:	45
Relationship to NOS:	This unit is linked to G8 Identify and Agree the Motor Vehicle Customer Needs.
Assessment type:	Assignment
Aim:	This unit enables the learner to develop an understanding of how to gain: information from customers on their perceived needs; give advice and information and agree a course of action; contract for the agreed work and complete all necessary records and instructions.

Learning outcome	**The learner will:**
1. understand legislative and organisational requirements and procedures	
Assessment criteria	
The learner can: 1.1 describe the fundamental legal requirements of current consumer legislation and the consequences of their own actions in respect of this legislation 1.2 describe the content and limitations of company and product warranties for the vehicles dealt with by their company 1.3 explain the limits of their own authority for accepting vehicles 1.4 explain the importance of keeping customers informed of progress 1.5 describe their workplace requirements for the completion of records 1.6 explain how to complete and process all the necessary documentation.	

Learning outcome	**The learner will:**
2. understand how to communicate and care for customers	
Assessment criteria	
The learner can: 2.1 explain how to communicate effectively with customers 2.2 describe how to adapt their language when explaining technical matters to non-technical customers 2.3 explain how to use effective questioning techniques 2.4 describe how to care for customers and achieve customer satisfaction.	

Learning outcome	The learner will:
3. understand company products and services	
Assessment criteria	
The learner can: 3.1 describe the range of options available to resolve vehicle problems 3.2 describe the range and type of services offered by their company 3.3 explain the effect of resource availability upon the receipt of customer vehicles and the completion work 3.4 explain how to access costing and work completion time information.	

Unit 058 Knowledge of Wow To Identify and Agree Motor Vehicle Customer Service Needs

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.

Organisational requirements

a. Explain the organisation's terms and conditions applicable to the acceptance of customer vehicles.
b. Explain the content and limitations of vehicle and component warranties for the vehicles dealt with by your organisation.
c. Detail what, if any, limits there are to the authority for accepting vehicles.
d. Detail why it is important to keep customers advised of progress and how this is achieved within the organisation.
e. Detail the organisation's procedures for the completion and processing of documentation and records, including payment methods and obtaining customer signatures as applicable.

Principles of customer communication and care

a. First Impressions.
b. Listening skills – 80:20 ratio.
c. Eye contact and smiling.
d. Showing interest and concern.
e. Questioning techniques and customer qualification.
f. Giving clear non-technical explanations.
g. Confirming understanding (statement/question technique, reflective summary).
h. Written communication – purpose, content, presentation and style.
i. Providing a high quality service – fulfilling (ideally exceeding) customer expectations within agreed time frames.
j. Obtaining customer feedback and corrective actions when dissatisfaction expressed.
k. Dealing with complaints.

Company products and services

a. Service standards
    i. national
    ii. manufacturer
    iii. organisational.
b. The range and type of services offered by the organisation.

i. diagnostic
ii. servicing
iii. repair
iv. warranty
v. MOT testing
vi. fitment of accessories/enhancements
vii. internal.

c. The courses of action available to resolve customer problems:
   i. the extent and nature of the work to be undertaken
   ii. the terms and conditions of acceptance
   iii. the cost
   iv. the timescale
   v. required payment methods.
d. The effect of resource availability upon the receipt of customer vehicles and the completion of work:
   i. levels and availability of equipment
   ii. levels and availability of technicians
   iii. workshop loading systems.
e. How to access costing and work completion time information:
   i. manuals
   ii. computer based.

Vehicle information systems, servicing and repair requirements

a. Accessing technical data including diagnostics.
b. Servicing to manufacturer requirements/standards.
c. Repair/operating procedures.
d. MOT standards/requirements.
e. Quality controls – interim and final.
f. Requirements for cleanliness of vehicle on return to customer.
g. Handover procedures.

Consumer legislation to include:

a. consumer protection
b. sale of goods
c. data protection
d. product liability
e. health and safety
f. discrimination.

Unit 101 Competency in Routine Light Vehicle Maintenance

Level:	Level 2
GLH:	60
Relationship to NOS:	This unit is linked to LV01 Carry out Routine Light Vehicle Maintenance.
Assessment type:	Assignment
Aim:	This unit allows the learner to develop the competency and skills required to carry out routine maintenance, adjustments and replacement activities as part of the periodic servicing of light vehicles.

Learning outcome	**The learner will:**
1. be able to work safely when carrying out light vehicle routine maintenance	
Assessment criteria	
The learner can: 1.1 use suitable personal and vehicle protective equipment throughout all light vehicle routine maintenance activities 1.2 work in a way which minimises the risk of damage to the vehicle and its systems and the surrounding area. 1.3 prepare the vehicle systems and work area for safe working procedures, as appropriate to the vehicle.	

Learning outcome	**The learner will:**
2. be able to use suitable sources of technical information to support all vehicle maintenance activities	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support light vehicle routine maintenance activities including: a. vehicle technical data b. maintenance procedures c. legal requirements 2.2 use technical information to support light vehicle inspection activities.	

Learning outcome	**The learner will:**
3. be able to use appropriate tools and equipment	
Assessment criteria	
The learner can: 3.1 select, prepare and check the appropriate tools and equipment required following manufacturers' instructions for carrying out routine maintenance	

3.2	ensure that equipment has been calibrated to meet manufacturers and legal requirements
3.3	use the correct tools and equipment in the way specified by manufacturers' when carrying out routine maintenance.

Learning outcome	**The learner will:**
4. be able to carry out light vehicle routine maintenance	
Assessment criteria	
The learner can:	
4.1	carry out light vehicle maintenance using prescribed methods, adhering to the correct specifications and tolerances for the vehicle and following: a. manufacturer's approved inspection methods b. manufacturer's maintenance recognised repair methods c. health, safety and environmental requirements d. working methods and procedures
4.2	carry out adjustments, replacement of vehicle components and replenishment of consumable materials following the manufacturer's current specification
4.3	ensure the examination methods identify accurately any vehicle system and or component problems falling outside the maintenance schedule are specified.
4.4	ensure any comparison of the vehicle against specification accurately identifies any: a. differences from the vehicle specification b. vehicle appearance and condition faults c. variation from legal requirements
4.5	use the manufacturer's approved methods to evaluate the performance of all replaced and adjusted components and systems accurately complete all vehicle maintenance activities within the agreed timescale.

Learning outcome	**The learner will:**
5. be able to record information and make suitable recommendations	
Assessment criteria	
5.1	ensure records are accurate, complete and passed to the relevant person(s) within the agreed timescale and in the format required
5.2	report any problems or issues relating to the vehicle's condition or conformity to the relevant person(s) promptly
5.3	take appropriate action which complies with the customer's instructions and make suitable and justifiable recommendations for cost effective repair where system adjustments cannot be made within the manufacturer's specification
5.4	identify and report any expected delays in completion to the relevant person(s) promptly in the format required record and report any additional faults noticed during the course of their work promptly in the format required.

Unit 102 Competency in Removing and Replacing Light Vehicle Engine Units and Components

Level:	Level 2
GLH:	90
Relationship to NOS:	This unit is linked to LV02 Remove and Replace Motor Engine Units and Components.
Assessment type:	Assignment
Aim:	This unit enables the learner to develop the competency and skills required to remove and replace light vehicle combustion engine system components. It also covers the evaluation of performance of the replaced units and systems.

Learning outcome	**The learner will:**
1. be able to work safely when carrying out removal and replacement activities	
Assessment criteria	
The learner can: 1.1 use suitable personal and vehicle protective equipment when working on light vehicle engine systems and components 1.2 work in a way which minimises the risk of damage to the vehicle and its systems and the surrounding area, including: a. damage to other vehicle systems b. damage to other vehicle components and units c. contact with leakage d. contact with hazardous substances 1.3 prepare the vehicle systems and work area for safe working procedures, as appropriate to the vehicle.	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support light vehicle engine unit and component removal and replacement activities including: a. vehicle technical data b. removal and replacement procedures c. legal requirements 2.2 use technical information to support light vehicle engine unit and component removal and replacement activities.	

Learning outcome	The learner will:
3. be able to use appropriate tools and equipment	
Assessment criteria	
The learner can: 3.1 select, prepare and check the appropriate tools and equipment required following manufacturers' instructions for removal and replacement of motor vehicle engine system components 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the correct tools and equipment in the way specified by manufacturers to remove and replace motor vehicle engine systems.	

Learning outcome	The learner will:
4. be able to carry out removal and replacement of light vehicle engine mechanical, lubrication and cooling units and components.	
Assessment criteria	
The learner can: 4.1 remove and replace the light vehicle's engine systems and components, adhering to the correct specifications and tolerances for the vehicle and following: a. the manufacturer's approved removal and replacement methods b. recognised workplace procedures c. health and safety and environmental requirements 4.2 ensure that reassembled/replaced light vehicle engine units and components conform to the vehicle operating specification and any legal requirements 4.3 use suitable testing methods to evaluate the performance of the reassembled system 4.4 complete all system remove and refit activities within the agreed timescale.	

Learning outcome	The learner will:
5. be able to record information and make suitable recommendations	
Assessment criteria	
The learner can: 5.1 ensure your records are accurate, complete and passed to the relevant person(s) within the agreed timescale and in the format required 5.2 make suitable and justifiable recommendations for cost effective repairs 5.3 identify and report any unexpected delays in completion to the relevant person(s) promptly 5.4 record and report any additional faults noticed during the course of their work promptly in the format required.	

Unit 103 Competency in Removing and Replacing Light Vehicle Electrical Units and Components

Level:	Level 2
GLH:	90
Relationship to NOS:	This unit is linked to LV03 Remove and Replace Motor Electrical Units and Components.
Assessment type:	Assignment
Aim:	This unit enables the learner to develop the competency and skills required to remove and replace light vehicle engine system components. It also covers the evaluation of performance of the replaced units and systems.

Learning outcome	**The learner will:**
1. be able to work safely when carrying out removal and replacement activities	
Assessment criteria	
The learner can: 1.1 use suitable personal and vehicle protective equipment when working on light vehicle electrical systems and components 1.2 work in a way which minimises the risk of damage to the vehicle and its systems and the surrounding area 1.3 prepare the vehicle systems and work area for safe working procedures, as appropriate to the vehicle.	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support light vehicle electrical unit and component removal and replacement activities including: a. vehicle technical data b. removal and replacement procedures c. legal requirements 2.2 use technical information to support light vehicle electrical unit and component removal and replacement activities.	

Learning outcome	**The learner will:**
3. be able to use appropriate tools and equipment	
Assessment criteria	

The learner can: 3.1 select, prepare and check the appropriate tools and equipment required following manufacturers' instructions for removal and replacement of motor vehicle electrical system components 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the correct tools and equipment in the way specified by manufacturers to remove and replace motor vehicle electrical auxiliary systems.

Learning outcome	**The learner will:**
4. be able to carry out removal and replacement of light vehicle electrical units and components.	
Assessment criteria	
The learner can: 4.1 remove and replace the motor vehicle's electrical systems and components, adhering to the specifications and tolerances for the vehicle and following: a. the manufacturer's approved removal and replacement methods b. recognised researched repair methods c. health and safety and environmental requirements. 4.2 ensure that replacement electrical auxiliary units and components conform to the vehicle operating specification and any legal requirements 4.3 use suitable testing methods to evaluate the performance of the reassembled system 4.4 complete all the system remove and refit activities within the agreed timescale.	

Learning outcome	**The learner will:**
5. be able to record information and make suitable recommendations	
Assessment criteria	
The learner can: 5.1 ensure your records are accurate, complete and passed to the relevant person(s) within the agreed timescale and in the format required 5.2 make suitable and justifiable recommendations for cost effective repairs 5.3 identify and report any expected delays in completion to the relevant person(s) promptly 5.4 record and report any additional faults noticed during the course of their work promptly in the format required.	

Unit 104 Competency in Removing and Replacing Light Vehicle Chassis Units and Components

Level:	Level 2
GLH:	90
Relationship to NOS:	This unit is linked to LV04 Remove and Replace Motor Vehicle Chassis Units and Components.
Assessment type:	Assignment
Aim:	This unit allows the learner to develop the competency and skills required to remove and replace light vehicle steering, suspension and braking units (including wheels and tyres). It also covers the evaluation of performance of the replaced units and systems.

Learning outcome	**The learner will:**
1. be able to work safely when carrying out removal and replacement activities	
Assessment criteria	
The learner can: 1.1 use suitable personal and vehicle protective equipment throughout all light vehicle chassis unit and component removal and replacement activities 1.2 work in a way which minimises the risk of damage to the vehicle and its systems and the surrounding area 1.3 prepare the vehicle systems and work area for safe working procedures, as appropriate to the vehicle.	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support light vehicle chassis unit and component removal and replacement activities including: a. vehicle technical data b. removal and replacement procedures c. legal requirements 2.2 use technical information to support light vehicle chassis unit and component removal and replacement activities.	

Learning outcome	**The learner will:**
3. be able to use appropriate tools and equipment	
Assessment criteria	

The learner can:

3.1 select, prepare and check the appropriate tools and equipment required following manufacturers' instructions for removal and replacement of light vehicle chassis systems including:
   a. steering
   b. suspension
   c. braking
   d. wheels and tyres

3.2 ensure that equipment has been calibrated to meet manufacturers and legal requirements

3.3 use the correct tools and equipment in the way specified by manufacturers to remove and replace light vehicle chassis systems.

Learning outcome	**The learner will:**
4. be able to carry out removal and replacement of light vehicle chassis units and components	
Assessment criteria	

The learner can:

4.1 remove and replace the light vehicle's chassis systems and components, adhering to the correct specifications and tolerances for the vehicle and following:
   a. the manufacturer's approved removal and replacement methods
   b. recognised researched repair methods
   c. health and safety and environmental requirements

4.2 ensure that replacement light vehicle chassis units and components conform to the vehicle operating specification and any legal requirements

4.3 use suitable testing methods to evaluate the performance of the reassembled system

4.4 ensure that the reassembled light vehicle chassis system performs to the vehicle operating specification and meets any legal requirements

4.5 complete all system diagnostic activities within the agreed timescale.

Learning outcome	**The learner will:**
5. be able to record information and make suitable recommendations	
Assessment criteria	

The learner can:

5.1 ensure your records are accurate, complete and passed to the relevant person(s) in the agreed timescale and in the format required

5.2 make suitable and justifiable recommendations for cost effective repairs

5.3 identify and report any expected delays in completion to the relevant person(s) promptly in the format required

5.4 record and report any additional faults noticed during the course of their work promptly in the format required.

Unit 105 Competency in Inspecting Light Vehicles Using Prescribed Methods

Level:	Level 2
GLH:	80
Relationship to NOS:	This unit is linked to LV05 Inspect Motor Vehicles Using Prescribed Methods.
Assessment type:	Assignment
Aim:	This unit enables the learner to develop the competency and skills to carry out a range of light vehicle inspections on vehicles using a variety of prescribed testing and inspection methods.

Learning outcome	**The learner will:**
1. be able to work safely when carrying out light vehicle inspections using prescribed methods	
Assessment criteria	
The learner can: 1.1 use suitable personal and vehicle protective equipment throughout all light vehicle inspection activities 1.2 work in a way which minimises the risk of damage to the vehicle and its systems and the surrounding area, including: a. damage to other vehicle systems b. damage to other vehicle components and units c. contact with leakage d. contact with hazardous substances 1.3 prepare the vehicle systems and work area for safe working procedures, as appropriate to the vehicle.	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support vehicle inspection activities including: a. vehicle technical data b. inspection procedures c. legal requirements 2.2 use technical information to support light vehicle inspection activities.	

Learning outcome	The learner will:
3. be able to use appropriate tools and equipment	
Assessment criteria	
The learner can: 3.1 select, prepare and check the appropriate tools and equipment required following manufacturers' instructions for carrying out a range of inspections on light vehicle systems 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the correct tools and equipment in the way specified by manufacturers when carrying out a range of inspections on light vehicle systems.	

Learning outcome	The learner will:
4. be able to carry out systematic light vehicle inspections using prescribed methods	
Assessment criteria	
The learner can: 4.1 carry out systematic light vehicle inspections using prescribed methods, adhering to the correct specifications and tolerances for the vehicle and following a. the manufacturer's approved inspection methods b. recognised workplace procedures c. health, safety and environmental requirements 4.2 ensure that inspected light vehicle conforms to the vehicle operating specification and any legal requirements 4.3 ensure any comparison of the vehicle against specification accurately identifies any: a. differences from the vehicle specification b. vehicle appearance and condition faults c. variation from legal requirements 4.4 use suitable testing methods to evaluate the performance of the inspected systems 4.5 complete all inspection activities within the agreed timescale.	

Learning outcome	The learner will:
5. be able to record information and make suitable recommendations	
Assessment criteria	
The learner can: 5.1 ensure your records are accurate, complete and passed to the relevant person(s) within the agreed timescale and in the format required 5.2 make suitable and justifiable recommendations for cost effective repairs based upon the results of your tests and inspections 5.3 identify and report any unexpected delays in completion to the relevant person(s) promptly 5.4 record and report any additional faults noticed during the course of their work promptly in the format required.	

Unit 107 Competency in Diagnosing and Rectifying Light Vehicle Combustion Engine and Component Faults

Level:	Level 3
GLH:	90
Relationship to NOS:	This unit is linked to LV07 Diagnose and Rectify Light Vehicles Engine and Component Faults.
Assessment type:	Assignment
Aim:	This unit enables the learner to demonstrate the competency and skills required to diagnose and rectify light vehicle combustion engine mechanical, electrical, hydraulic and fluid systems faults. It also covers the evaluation of performance of the replaced or repaired units and systems. This includes SI, CI, Hybrid and alternative fuel vehicles.

Learning outcome	**The learner will:**
1. be able to work safely when carrying out light vehicle engine diagnostic and rectification activities	
Assessment criteria	
The learner can: 1.1 use suitable personal protective equipment and vehicle protective equipment when using light vehicle diagnostic methods and carrying out rectification activities 1.2 work in a way which minimises the risk of damage to the vehicle and its systems and the surrounding area including: a. damage to other vehicle systems b. damage to other vehicle components and units c. contact with leakage 1.3 contact with hazardous substances 1.4 prepare the vehicle systems and work area for safe working procedures, as appropriate to the vehicle.	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support light vehicle diagnostic and rectification activities including: a. vehicle technical data b. diagnostic test procedures 2.2 use sufficient diagnostic information in a logical and systematic way to enable an accurate diagnosis of light vehicle engine system faults.	

Learning outcome	The learner will:
3. be able to use appropriate tools and equipment	
Assessment criteria	
The learner can: 3.1 select, prepare and check the appropriate tools and equipment required following manufacturers' instructions necessary for diagnostic and rectification activities 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the correct tools and equipment in the way specified by manufacturers throughout all light vehicle combustion engine diagnostic and rectification activities.	

Learning outcome	The learner will:
4. be able to carry out light vehicle engine diagnosis, rectification and test activities	
Assessment criteria	
The learner can: 4.1 use diagnostic methods that are relevant to the symptoms presented 4.2 evaluate their assessment of dismantled sub-assemblies and identify their condition and suitability for repair or replacement accurately 4.3 carry out all diagnostic and rectification activities following: a. workplace procedures and manufacturers' instructions b. recognised researched diagnostic and rectification methods c. health and safety and environmental requirements 4.4 collect sufficient diagnostic information in a logical way to enable an accurate diagnosis of engine system faults 4.5 identify and record any system deviation from acceptable limits accurately 4.6 work in a way to ensure damage does not occur to components, other vehicle systems and units 4.7 ensure all repaired or replacement components and units conform to the vehicle operating specification and any legal requirements 4.8 Correctly adjust components and units correctly to ensure that they operate to meet system requirements 4.9 use testing methods that are suitable for assessing the performance of the system rectified 4.10 ensure the rectified light vehicle engine system performs to the vehicle operating specification and any legal requirements, prior to return to the customer.	

Learning outcome	The learner will:
5. be able to record information and make suitable recommendations	
Assessment criteria	
The learner can: 5.1 complete all system diagnostic activities within the agreed timescale 5.2 identify and report any anticipated delays in completion to the relevant person(s) promptly in the format required 5.3 record and report any additional faults noticed during the course of their work promptly in the format required 5.4 make suitable and justifiable recommendations for cost effective repairs 5.5 inform the relevant person(s) promptly where repairs are uneconomic or unsatisfactory to perform	

5.6	ensure your records are accurate, complete and passed to the relevant person(s) within the agreed timescale in the format required.

Unit 108 Competency in Diagnosing and Rectifying Light Vehicle Chassis System Faults

Level:	Level 3
GLH:	90
Relationship to NOS:	This unit is linked to LV08 Diagnose and Rectify Light Vehicle Chassis System Faults.
Assessment type:	Assignment
Aim:	This unit enables the learner to demonstrate competency and skills required to diagnose and rectify light vehicle combustion engine mechanical, electrical, hydraulic and fluid systems faults. It also covers the evaluation of performance of the replaced or repaired units and systems. This includes SI, CI, Hybrid and alternative fuel vehicles

Learning outcome	**The learner will:**
1. be able to work safely when carrying out light vehicle chassis diagnostic and rectification activities	
Assessment criteria	
The learner can: 1.1 use suitable personal protective and vehicle protective equipment when using light vehicle diagnostic methods and carrying out rectification activities 1.2 work in a way which minimises the risk of damage to the vehicle and its systems and the surrounding area, including: a. damage to other vehicle systems b. damage to other vehicle components and units c. contact with leakage d. contact with hazardous substances 1.3 prepare the vehicle systems and work area for safe working procedures, as appropriate to the vehicle.	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support light vehicle diagnostic and rectification activities including: a. vehicle technical data b. diagnostic test procedures 2.2 use sufficient diagnostic information in a logical and systematic way to enable an accurate diagnosis of light vehicle chassis system faults.	

Learning outcome	The learner will:
3. be able to use appropriate tools and equipment	
Assessment criteria	
The learner can: 3.1 select, prepare and check the appropriate tools and equipment required following manufacturers' instructions for diagnostic and rectification activities 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the correct tools and equipment in the way specified by manufacturers throughout all light vehicle chassis diagnostic and rectification activities.	

Learning outcome	The learner will:
4. be able to carry out light vehicle chassis diagnosis, rectification and test activities	
Assessment criteria	
The learner can: 4.1 use diagnostic methods that are relevant to the symptoms presented 4.2 evaluate their assessment of dismantled sub-assemblies and identify their condition and suitability for repair or replacement accurately 4.3 carry out all diagnostic and rectification activities following: a. workplace procedures and manufacturers' instructions b. recognised researched diagnostic and rectification methods c. health and safety and environmental requirements 4.4 collect sufficient diagnostic information in a logical way to enable an accurate diagnosis of chassis system faults 4.1 identify and record any system deviation from acceptable limits accurately 4.2 work in a way to ensure damage does not occur to components, other vehicle systems and units 4.7 ensure all repaired or replacement components and units conform to the vehicle operating specification and any legal requirements 4.8 adjust components and units correctly to ensure that they operate to meet system requirements 4.9 use testing methods that are suitable for assessing the performance of the system rectified 4.10 ensure the rectified light vehicle chassis system performs to the vehicle operating specification and any legal requirements prior to return to the customer.	

Learning outcome	The learner will:
5. be able to record information and make suitable recommendations	
Assessment criteria	
The learner can: 5.1 complete all system diagnostic activities within the agreed timescale 5.2 identify and report any anticipated delays in completion to the relevant person(s) promptly in the format required. 5.3 record and report any additional faults noticed during the course of their work promptly in the format required. 5.4 make suitable and justifiable recommendations for cost effective repairs 5.5 inform the relevant person(s) promptly where repairs are uneconomic or unsatisfactory to perform	

5.6	ensure your records are accurate, complete and passed to the relevant person(s) within the agreed timescale in the format required.

Unit 111 Competency in Overhauling Light Vehicle Combustion Engine Mechanical Units

Level:	Level 3
GLH:	20
Relationship to NOS:	This unit is linked to LV11 Overhaul Light Vehicle Mechanical Units.
Assessment type:	Assignment
Aim:	This unit enables the learner to demonstrate the competency and skills required in overhauling combustion engines. It also covers the evaluation of performance of the overhauled units and systems.

Learning outcome	**The learner will:**
1 be able to work safely when overhauling light vehicle combustion engine mechanical units	
Assessment criteria	
The learner can: 1.1 use suitable personal and vehicle protective equipment when working on light vehicle engine systems and components 1.2 work in a way which minimises the risk of damage to the vehicle and its systems and the surrounding area including: a. damage to other vehicle systems b. damage to other vehicle components and units c. contact with leakage d. contact with hazardous substances 1.3 prepare the vehicle systems and work area for safe working procedures, as appropriate to the vehicle.	

Learning outcome	**The learner will:**
2 be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support the overhauling of light vehicle engine units including: a. vehicle technical data b. overhauling procedures c. legal requirements 2.2 use technical information to support the overhauling of light vehicle engine units.	

Learning outcome	**The learner will:**
3 be able to use appropriate tools and equipment	
Assessment criteria	

The learner can: 3.1 select, prepare and check the appropriate tools and equipment required following manufacturers' instructions for overhauling light vehicle engine units 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the correct tools and equipment in the way specified by manufacturers to overhaul light vehicle engine units.

Learning outcome	**The learner will:**
4 be able to carry out the overhauling of light vehicle engine mechanical units	
Assessment criteria	
The learner can: 4.1 carry out all overhauling of light vehicle engine mechanical units, adhering to the specifications and tolerances for the vehicle and following: a. the manufacturer's approved overhauling methods b. recognised researched overhauling methods c. health and safety and environmental requirements 4.2 ensure the assessment of the dismantled unit identifies accurately its condition and suitability for overhaul 4.3 inform the relevant person(s) promptly where an overhaul is uneconomic or unsatisfactory to perform 4.4 use testing methods that comply with the manufacturer's requirements 4.5 adjust the unit's components correctly where necessary to ensure that they operate to meet the vehicle operating requirements. 4.6 ensure the overhauled units and assemblies conform to the vehicle operating specification and any legal requirements prior to return to customer.	

Learning outcome	**The learner will:**
5 be able to record information and make suitable recommendations	
Assessment criteria	
The learner can: 5.1 ensure your records are accurate, complete and passed to the relevant person(s) within the agreed timescale and in the format required 5.2 make suitable and justifiable recommendations for cost effective repairs 5.3 identify and report any unexpected delays in completion to the relevant person(s) promptly in the format required 5.4 record and report any additional faults noticed during the course of their work promptly in the format required.	

Unit 112 Competency in Removing and Replacing Light Vehicle Driveline Units and Components

Level:	Level 2
GLH:	90
Relationship to NOS:	This unit is linked to LV12 Remove and Replace Light Vehicle Driveline Units and Components.
Assessment type:	Assignment
Aim:	This unit allows the learner to develop the competency and skills required in removing and replacing light vehicle transmission and driveline units. It also covers the evaluation of performance of the replaced units and systems.

Learning outcome	**The learner will:**
1 be able to work safely when carrying out removal and replacement activities	
Assessment criteria	
The learner can 1.1 use suitable personal and vehicle protective equipment when working on light vehicle transmission and driveline unit and component removal and replacement activities 1.2 work in a way which minimises the risk of damage to the vehicle and its systems and the surrounding area, including: a. damage to other vehicle systems b. damage to other vehicle components and units c. contact with leakage d. contact with hazardous substances 1.3 prepare the vehicle systems and work area for safe working procedures, as appropriate to the vehicle,	

Learning outcome	**The learner will:**
2 be able to use relevant information to carry out the task	
Assessment criteria	
The learner can 2.1 select suitable sources of technical information to support light vehicle transmission and driveline unit and component removal and replacement activities including: a. vehicle technical data b. removal and replacement procedures c. legal requirements 2.2 use technical information to support light vehicle transmission and driveline unit and component removal and replacement activities.	

Learning outcome	The learner will:
3 be able to use appropriate tools and equipment	
Assessment criteria	
The learner can 3.1 select, prepare and check the appropriate tools and equipment required following manufacturers' instructions for removal and replacement of light vehicle transmission and driveline systems 3.2 ensure that equipment has been calibrated to meet manufacturers and legal requirements 3.3 use the correct tools and equipment in the way specified by manufacturers to remove and replace light vehicle transmission and driveline systems.	

Learning outcome	The learner will:
4 be able to carry out removal and replacement of light vehicle transmission and driveline units and components	
Assessment criteria	
The learner can 4.1 remove and replace the light vehicle's transmission and driveline systems and components, adhering to the correct specifications and tolerances for the vehicle and following: a. the manufacturer's approved removal and replacement methods b. recognised workplace procedures c. health and safety and environmental requirements 4.2 ensure that replacement/reassembled light vehicle transmission and driveline units and components conform to the vehicle operating specification and any legal requirements 4.3 use suitable testing methods to evaluate the performance of the reassembled system 4.4 complete all the system remove and refit activities within the agreed timescale.	

Learning outcome	The learner will:
5 be able to record information and make suitable recommendations	
Assessment criteria	
The learner can 5.1 ensure your records are accurate, complete and passed to the relevant person(s) within the agreed timescale and in the format required 5.2 make suitable and justifiable recommendations for cost effective repairs 5.3 identify and report any unexpected delays in completion to the relevant person(s) promptly 5.4 record and report any additional faults noticed during the course of their work promptly in the format required.	

Unit 113 Competency in Diagnosing and Rectifying Light Vehicle Transmission and Driveline Faults

Level:	Level 3
GLH:	90
Relationship to NOS:	This unit is linked to LV13 Diagnose and Rectify Light Vehicle Transmission and Driveline System Faults.
Assessment type:	Assignment
Aim:	This unit enables the learner to demonstrate they can diagnose and rectify light vehicle gearboxes, hubs and bearings, driveline shafts, clutches, differentials and final drive unit faults. It also covers the evaluation of performance of the replaced or repaired units and systems. This includes SI, CI, Hybrid and alternative fuel vehicles.

Learning outcome	**The learner will:**
1. be able to work safely when carrying out light vehicle transmission and driveline diagnostic and rectification activities	
Assessment criteria	
The learner can: 1.1 use suitable personal protective and vehicle protective equipment when using light vehicle diagnostic methods and carrying out rectification activities 1.2 work in a way which minimises the risk of damage to the vehicle and its systems and the surrounding area, including: a. damage to other vehicle systems b. damage to other vehicle components and units c. contact with leakage d. contact with hazardous substances 1.3 prepare the vehicle systems and work area for safe working procedures, as appropriate to the vehicle.	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support light vehicle diagnostic and rectification activities including: a. vehicle technical data b. diagnostic test procedures 2.2 use sufficient diagnostic information in a logical and systematic way to enable an accurate diagnosis of light vehicle transmission and driveline system faults.	

Learning outcome	The learner will:
3. be able to use appropriate tools and equipment	
Assessment criteria	
The learner can: 3.1 select, prepare and check the appropriate tools and equipment required following manufacturers' instructions for diagnostic and rectification activities 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the correct tools and equipment in the way specified by manufacturers' throughout all light vehicle transmission and driveline diagnostic and rectification activities.	

Learning outcome	The learner will:
4. be able to carry out light vehicle transmission and driveline diagnosis, rectification and test activities	
Assessment criteria	
The learner can: 4.1 use diagnostic methods that are relevant to the symptoms presented 4.2 evaluate their assessment of dismantled sub-assemblies and identify their condition and suitability for repair or replacement accurately 4.3 carry out all diagnostic and rectification activities following: a. workplace procedures and manufacturers' instructions b. recognised researched diagnostic and rectification methods c. health and safety and environmental requirements 4.4 collect sufficient diagnostic information in a logical way to enable an accurate diagnosis of transmission and driveline system faults 4.5 identify and record any system deviation from acceptable limits accurately 4.6 work in a way to ensure damage does not occur to components, other vehicle systems and units 4.7 ensure all repaired or replacement components and units conform to the vehicle operating specification and any legal requirements 4.8 correctly adjust components and units when necessary to ensure that they operate to meet system requirements 4.9 use testing methods that are suitable for assessing the performance of the system rectified 4.10 ensure the light vehicle transmission and driveline system rectified performs to the vehicle operating specification and any legal requirements prior to return to customer.	

Learning outcome	The learner will:
5. be able to record information and make suitable recommendations	
Assessment criteria	
The learner can: 5.1 complete all system diagnostic activities within the agreed timescale 5.2 identify and report any anticipated delays in completion to the relevant person(s) promptly in the format required 5.3 record and report any additional faults noticed during the course of their work promptly in the format required. 5.4 make suitable and justifiable recommendations for cost effective repairs	

5.5 inform the relevant person(s) promptly where repairs are uneconomic or unsatisfactory to perform 5.6 ensure your records are accurate, complete and passed to the relevant person(s) within the agreed timescale in the format required.

Unit 121 Competency in Overhauling Light Vehicle Transmission Units

Level:	Level 3
GLH:	20
Relationship to NOS:	This unit is linked to LV11 Overhaul Light Vehicle Mechanical Units.
Assessment type:	Assignment
Aim:	This unit allows the learner to demonstrate the competency and skills required in overhauling gearboxes and final drive assemblies. It also covers the evaluation of performance of the overhauled units and systems.

Learning outcome	**The learner will:**
1 be able to work safely when overhauling light vehicle transmission units	
Assessment criteria	
The learner can: 1.1 use suitable personal and vehicle protective equipment when overhauling light vehicle transmission units 1.2 work in a way which minimises the risk of damage to the vehicle and its systems and the surrounding area including: a. damage to other vehicle systems b. damage to other vehicle components and units c. contact with leakage d. contact with hazardous substances 1.3 prepare the vehicle systems and work area for safe working procedures, as appropriate to the vehicle.	

Learning outcome	**The learner will:**
2 be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support the overhauling of light vehicle transmission units including: a. vehicle technical data b. overhauling procedures c. legal requirements 2.2 use technical information to support the overhauling of light vehicle transmission units.	

Learning outcome	**The learner will:**
3 be able to use appropriate tools and equipment	
Assessment criteria	

The learner can: 3.1 select, prepare and check the appropriate tools and equipment required following manufacturer's instructions for overhauling of light vehicle transmission systems 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the correct tools and equipment in the way specified by manufacturers to overhaul light vehicle transmission units.

Learning outcome	**The learner will:**
4 be able to carry out the overhauling of light vehicle transmission units	
Assessment criteria	
The learner can: 4.1 carry out all overhauling of light vehicle transmission units, adhering to the specifications and tolerances for the vehicle and following: a. the manufacturer's approved overhauling methods b. recognised researched overhauling methods c. health and safety and environmental requirements 4.2 ensure the assessment of the dismantled unit identifies accurately its condition and suitability for overhaul 4.3 inform the relevant person(s) promptly where an overhaul is uneconomic or unsatisfactory to perform 4.4 use testing methods that comply with the manufacturer's requirements 4.5 adjust the unit's components correctly where necessary to ensure that they operate to meet the vehicle operating requirements 4.6 ensure the overhauled units and assemblies conform to the vehicle operating specification and any legal requirements prior to return to customer.	

Learning outcome	**The learner will:**
5 be able to record information and make suitable recommendations	
Assessment criteria	
The learner can: 5.1 ensure your records are accurate, complete and passed to the relevant person(s) within the agreed timescale and in the format required 5.2 make suitable and justifiable recommendations for cost effective repairs 5.3 identify and report any unexpected delays in completion to the relevant person(s) promptly in the format required 5.3 record and report any additional faults noticed during the course of their work promptly in the format required.	

Unit 131 Competency in Overhauling Light Vehicle Steering and Suspension Units

Level:	Level 3
GLH:	20
Relationship to NOS:	This unit is linked to LV11 Overhaul Light Vehicle Mechanical Units.
Assessment type:	Assignment
Aim:	This unit allows the learner to demonstrate the competency and skills required in overhauling steering and suspension units. It also covers the evaluation of performance of the overhauled units and systems.

Learning outcome	**The learner will:**
1 be able to work safely when overhauling light vehicle steering and suspension units	
Assessment criteria	
The learner can: 1.1 use suitable personal and vehicle protective equipment when overhauling light vehicle steering and suspension units 1.2 work in a way which minimises the risk of damage to the vehicle and its systems and the surrounding area, including: a. damage to other vehicle systems b. damage to other vehicle components and units c. contact with leakage d. contact with hazardous substances 1.3 prepare the vehicle systems and work area for safe working procedures, as appropriate to the vehicle.	

Learning outcome	**The learner will:**
2 be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support the overhauling of light vehicle steering and suspension units including: a. vehicle technical data b. overhauling procedures c. legal requirements 2.2 use technical information to support the overhauling of light vehicle steering and suspension units.	

Learning outcome	The learner will:
3 be able to use appropriate tools and equipment	
Assessment criteria	
The learner can: 3.1 select, prepare and check the appropriate tools and equipment required following manufacturers' instructions for overhauling light vehicle steering and suspension units 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the correct tools and equipment in the way specified by manufacturers to overhaul light vehicle steering and suspension units.	

Learning outcome	The learner will:
4 be able to carry out the overhauling of light vehicle steering and suspension units	
Assessment criteria	
The learner can: 4.1 carry out all overhauling of light vehicle steering and suspension units, adhering to the specifications and tolerances for the vehicle and following: a. the manufacturer's approved overhauling methods b. recognised researched overhauling methods c. health and safety and environmental requirements. 4.2 ensure the assessment of the dismantled unit identifies accurately its condition and suitability for overhaul 4.3 inform the relevant person(s) promptly where an overhaul is uneconomic or unsatisfactory to perform 4.4 use testing methods that comply with the manufacturer's requirements 4.5 adjust the unit's components correctly where necessary to ensure that they operate to meet the vehicle operating requirements 4.6 ensure the overhauled units and assemblies conform to the vehicle operating specification and any legal requirements.	

Learning outcome	The learner will:
5 be able to record information and make suitable recommendations	
Assessment criteria	
The learner can: 5.1 ensure your records are accurate, complete and passed to the relevant person(s) within the agreed timescale and in the format required 5.2 make suitable and justifiable recommendations for cost effective repairs 5.3 identify and report any unexpected delays in completion to the relevant person(s) promptly in the format required 5.4 record and report any additional faults noticed during the course of their work promptly in the format required.	

Unit 151 Knowledge of Routine Light Vehicle Maintenance

Level:	Level 2
GLH:	20
Relationship to NOS:	This unit is linked to LV01 Carry Out Routine Light Vehicle Maintenance.
Assessment type:	Multiple choice test
Aim:	This unit enables the learner to develop an understanding of conducting routine maintenance, adjustment and replacement activities as part of the periodic servicing of light vehicles.

Learning outcome	**The learner will:**
1 Understand how to carry out routine light vehicle maintenance	
Assessment criteria	
The learner can: 1.1 describe how to work safely when carrying out routine maintenance, including: a. avoiding injury to self/others b. damage to vehicle systems, components, and units c. contact with leakage and hazardous substances d. waste disposal (including environmental impact) e. when working on hybrid/electric and alternative fuel vehicles. 1.2 explain how to conduct scheduled, routine light vehicle maintenance activities against vehicle specifications to identify component, a. damage b. corrosion c. inadequate fluid levels d. leaks e. wear f. security problems and general condition and serviceability 1.3 identify the assessment methods used to check for conformity 1.4 Identify the different systems to be inspected while carrying out light vehicle routine maintenance, including: a. engine b. chassis c. wheels and tyres d. transmission and driveline e. electrical and electronic f. exterior vehicle body g. vehicle interior h. on board vehicle displays 1.5 identify and interpret sources of technical information for scheduled maintenance activities	

1.6 describe the importance of using the correct sources of technical information
1.7 state the purpose of and how to use identification codes
1.8 explain how to conduct routine vehicle maintenance on light vehicles (Hybrid, electric and alternative fuel vehicles) for the following:
   a. power units
   b. transmission systems
   c. chassis systems
   d. advanced driver assistance systems
1.9 explain how to check and make adjustments to clearances, settings, alignment, pressures, tension, speeds and levels relevant to the engine area, transmission area, chassis area, electrical area and body
1.10 describe the procedures used for checking the condition and serviceability of light vehicle units and components
1.11 describe the procedures for checking, replenishing and replacing fluid levels required for routine service vehicle components
1.12 describe the procedures for checking and replacing lubricants and fluids, including identification of the recommended grade
1.13 state the consequence(s) of using incorrect lubricants, fluids and components
1.14 identify adjustments that need to be carried out on a light vehicle routine maintenance
1.15 explain the procedure for recognising and reporting cosmetic damage to vehicle components and units outside normal service items
1.16 state the procedure for reporting delays and the referral of problems
1.17 identify the operating specifications and tolerances for the systems being checked while carrying out light vehicle routine maintenance (including, Hybrid/electric and alternative fuel vehicles).

Learning outcome	**The learner will:**
2 Understand the importance of carrying out light vehicle maintenance	
Assessment criteria	
The learner can: 2.1 describe the legal requirements relating to the vehicle maintenance activities for vehicle systems and components 2.2 describe the importance of work-based policies for the following: a. vehicle maintenance information b. working to agreed timescales and keeping others informed of progress c. the relationship between time and costs d. reporting anticipated delays to the relevant person(s) promptly e. signing workplace documentation and vehicle records 2.3 describe the importance of manufacturers' and warranty requirements relating to routine maintenance for vehicle systems and components.	

Unit 151 Knowledge of Routine Light Vehicle Maintenance

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.

Knowledge to include conducting scheduled maintenance, adjustments, replacements and replenishment of components and systems in accordance with manufacturer's instructions for the period and/or mileage interval.

a. Vehicle maintenance, inspection and adjustment and record findings, including Hybrid/electrical and alternative fuel vehicles.

b. Vehicle inspection techniques used in routine maintenance including:
   i. aural
   ii. visual and functional assessments of components and units
   iii. measurements
   iv. engine systems
   v. chassis systems
   vi. wheels and tyres
   vii. transmission system
   viii. electrical and electronic systems
   ix. exterior vehicle body
   x. vehicle interior including comfort and convenient systems

c. The procedures used for inspecting the condition and serviceability of the following:
   i. filters
   ii. drive belts
   iii. wiper blades
   iv. brake linings
   v. pads
   vi. tyres
   vii. lights.
   viii. lubricants and fluids

d. Preparation and appropriate use of equipment to include:
   i. test instruments and equipment
   ii. emission equipment
   iii. wheel alignment
   iv. headlight beam setting equipment
   v. diagnostic and fault code readers.

e. Procedures for checking and replenishing fluid levels:
   i. oil
   ii. coolant

iii. washer fluid
iv. hydraulic fluids
v. exhaust emissions treatment

f. Procedures for checking and replacement of lubricants:
   i. replace oil filters
   ii. check levels
   iii. types of oil
   iv. cleanliness
   v. disposal of old oil and filters

g. Procedures for carrying out adjustments on vehicle systems or components:
   i. clearances
   ii. settings
   iii. alignment
   iv. pressures
   v. tensions
   vi. operational performance

h. Procedures for checking electrical systems:
   i. operation
   ii. security
   iii. performance

i. Importance and process of detailed inspection procedures:
   i. following inspection checklists
   ii. checking conformity to manufacturer's specifications
   iii. necessity for adjustment(s) and calibration(s)
   iv. UK and European legal requirements.to the vehicle maintenance activities for vehicle systems and components

j. Importance and process of completing all relevant documentation relating to routine maintenance:
   i. inspection records
   ii. job cards
   iii. vehicle repair records
   iv. vehicle service history
   v. reset electronic service history (if applicable)

k. The need to use vehicle protective equipment prior to repair. Requirements and methods used for protecting:
   i. vehicle body panels
   ii. paint surfaces
   iii. seats
   iv. carpets and floor mats

l. The need to check the vehicle following routine maintenance.

m. The need to inspect the vehicle following routine maintenance:
   i. professional presentation of vehicle
   ii. customer perceptions

n. The checks of vehicle following routine maintenance:
   i. removal of oil and grease marks
   ii. body panels
   iii. paint surfaces

iv. seats
v. carpets and floor mats
vi. re-instatement of components.

o. The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction, including:
   i. cleanliness of vehicle interior and exterior
   ii. security of components and fittings
   iii. re-instatement of components and fittings
   iv. testing and programming components for correct operation (as necessary)
   v. documentation completed prior to handover to customer (electronic/written)
   vi. explanation to customer of work completed (if applicable).

Unit 152 Knowledge of Light Vehicle Engine Mechanical, Lubrication and Cooling System Units and Components

Level:	Level 2
GLH:	20
Relationship to NOS:	This unit is linked to LV02 Remove and Replace Light Vehicle Engine Units and Components.
Assessment type:	Multiple choice test
Aim:	This unit enables the learner to develop an understanding of light vehicle combustion engine, mechanical, lubrication and cooling system units and components when conducting routine maintenance, adjustment and replacement activities.

Learning outcome	**The learner will:**
1 understand how the main light vehicle engine mechanical systems operate	
Assessment criteria	
The learner can 1.1 describe how to work safely when carrying out removal and replacement activities, including: a. avoiding injury to self/others b. damage to vehicle systems, components and units c. contact with leakage and hazardous substances d. waste disposal (including environmental impact) e. when working on hybrid/electric and alternative fuel vehicles 1.2 describe how combustion engine systems and their related units and components operate 1.3 identify light vehicle engine mechanical system components 1.4 describe the construction and operation of light vehicle engine mechanical systems a. four stroke b. spark ignition c. compression ignition d. rotary 1.5 identify the key engineering principles that are related to light vehicle engine mechanical systems a. compression ratios b. cylinder capacity c. power d. torque 1.6 state common terms used in light vehicle engine mechanical system design a. tdc b. bdc c. stroke	

d. bore.

Learning outcome	The learner will:
2 understand how light vehicle engine lubrication systems operate	
Assessment criteria	
The learner can 2.1 identify light vehicle engine lubrication system components 2.2 describe the construction and operation of light vehicle engine lubrication components and systems, including: a. full flow b. bypass c. wet sump d. dry sump 2.3 compare key light vehicle engine lubrication system components and assemblies to identify differences in construction and operation 2.4 identify the key engineering principles that are related to light vehicle engine lubrication systems a. classification of lubricants b. properties of lubricants c. methods of reducing friction 2.5 state common terms used in light vehicle engine lubrication system design.	

Learning outcome	The learner will:
3 understand how light vehicle engine cooling, heating and ventilation systems operate	
Assessment criteria	
The learner can 3.1 identify light vehicle engine cooling, heating and ventilation system components 3.2 describe the construction and operation of light vehicle engine cooling, heating and ventilation systems 3.3 compare key light vehicle engine cooling, heating and ventilation system components and assemblies against alternatives to identify differences in construction and operation 3.4 identify the key engineering principles that are related to light vehicle engine cooling, heating and ventilation systems a. heat transfer b. linear and cubical expansion c. specific heat capacity d. boiling point of liquids 3.5 state common terms used in key light vehicle engine cooling, heating and ventilation system design.	

Learning outcome	The learner will:
4 understand how to check, replace and test light vehicle engine mechanical, lubrication and cooling systems system units and components	
Assessment criteria	

The learner can

4.1 describe how to prepare, check and use all the removal and replacement equipment required

4.2 describe how to remove and replace engine system mechanical and electrical unit and components

4.3 describe how combustion engine systems and their related units and components are constructed, dismantled and reassembled

4.4 identify the properties of jointing materials and when and where they should be used including gaskets, sealants, fittings and fasteners

4.5 explain the relationship between testing methods and the engine units and components being replaced

4.6 describe common types of testing methods used to check the operation of engine mechanical, lubrication and cooling systems and their purpose

4.7 describe how to test and evaluate the performance of replacement engine units and components and the reassembled system against vehicle operating specifications and any legal requirements

4.8 identify common faults found in light vehicle engine mechanical, lubrication and cooling systems and their causes.

4.9 identify manufacturers' specifications for the type and quality of engine units and components to be used.

Unit 152 Knowledge of Light Vehicle Engine Mechanical, Lubrication and Cooling System Units and Components

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.

Engines

Knowledge to include, inspection, adjustment and recording of findings, including for Hybrid and alternative fuel vehicles and components.

a. Engine types and configurations:
   i. inline
   ii. flat
   iii. vee
   iv. rotary
   v. four-stroke cycle and two-stroke cycle for spark ignition and compression ignition engines
   vi. naturally aspirated and forced induction engines
   vii. hybrid/alternative fuel engines.
b. Relative advantages and disadvantages of different engine types and configurations.
c. Engine components and layouts:
   i. single (OHC) and multi camshaft (DOHC)
   ii. single and multi-cylinder (2, 4, 6, 8-cylinder types).
d. Cylinder head layout and design, combustion chamber and piston design including:
   i. tdc
   ii. bdc
   iii. bore
   iv. stroke
e. Calculate compression ratios and cylinder volume for given data.
f. The procedures used when inspecting engines.
g. The procedures to assess:
   i. serviceability
   ii. wear
   iii. condition
   iv. clearances
   v. settings
   vi. linkages
   vii. joints

viii. fluid systems
ix. adjustments
x. operation and functionality
xi. security.

h. Symptoms and faults associated with mechanical engine operation:
i. poor performance
ii. abnormal or excessive mechanical noise
iii. erratic running
iv. low power
v. exhaust emissions
vi. abnormal exhaust smoke
vii. unable to start
viii. exhaust gas leaks to cooling system
ix. exhaust gas leaks.

Lubrication

a. The advantages and disadvantages of wet and dry systems.
b. Engine lubrication system:
i. splash and pressurised systems
ii. full flow systems
iii. pumps
iv. pressure relief valve
v. bypass valve
vi. filters
vii. oil galleries
viii. oil coolers.
c. Terms associated with lubrication and engine oil:
i. full flow
ii. hydrodynamic
iii. boundary
iv. viscosity
v. natural and synthetic oil
vi. viscosity index
vii. multi-grade.
d. The requirements and features of engine oil:
i. operating temperatures
ii. pressures
iii. lubricant grades
iv. viscosity
v. multi-grade oil
vi. additives
vii. detergents
viii. dispersants
ix. antioxidants inhibitors
x. anti-foaming agents
xi. anti-wear
xii. synthetic oils
xiii. organic oils
xiv. mineral oils.

e. Symptoms and faults associated with lubrication systems:
   i. excessive oil consumption
   ii. oil leaks
   iii. oil in water
   iv. low or excessive pressure
   v. oil contamination.
f. The procedures used when inspecting lubrication system operation.

Cooling, Heating and Ventilation

a. The components, operating principles, and functions of engine cooling systems.
b. Procedures used to remove, replace and adjust cooling system components:
   i. cooling fans and control devices
   ii. header tanks, radiators and pressure caps
   iii. heater matrix and temperature control systems
   iv. expansion tanks hoses, clips and pipes
   v. thermostats water pumps and coolant
   vi. ventilation systems.
c. The preparation and method of use of appropriate specialist equipment used to evaluate system performance following component replacement.
   i. system pressure testers
   ii. pressure cap testers
   iii. hydrometer, or anti-freeze testing equipment
   iv. chemical tests for the detection of combustion gas.
d. The layout and construction of internal heater systems.
e. The controls and connections within internal heater system.
f. Symptoms and faults associated with cooling systems:
   i. coolant leaks
   ii. coolant in oil
   iii. internal heating system: efficiency, operation, leaks, controls, air filtration, air leaks and contamination
   iv. excessively low or high coolant temperature.
g. The procedures used when inspecting:
   i. internal heating system
   ii. cooling system.

General

a. The preparation, testing and use of tools and equipment used for:
i. dismantling and refitting
ii. removal and replacement of engine units and components including electrical equipment.
b. Appropriate safety precautions:
   i. personal protective equipment (PPE)
   ii. vehicle protective equipment (VPE)
   iii. removal and replacing engine units and components.
c. The importance of logical and systematic processes.
d. The inspection and testing of engine units and components.
e. The preparation of replacement units for re-fitting or replacement.
f. The reasons why replacement components and units must meet the original specifications - Original Equipment manufacturer (OEM) – warranty requirements, to maintain performance and safety requirements.

g. Refitting procedures.
h. The inspection and testing of units and system to ensure compliance with manufacturer's, legal and performance requirements.
i. Manufacturer's recommended work times, job times set by your company, or a job time agreed with a specific customer.
j. The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction:
    i. cleanliness of vehicle interior and exterior
    ii. security of components and fittings
    iii. re-instatement of components and fittings
    iv. testing and programming components for correct operation (as necessary)
    v. cancelling of any fault codes and warning lights.
    vi. documentation completed prior to handover to customer (electronic/written)
    vii. explanation to customer of work completed (if applicable).

Unit 153 Knowledge of Removing and Replacing Light Vehicle Electrical Units and Components

Level:	Level 2
GLH:	45
Relationship to NOS:	This unit is linked to LV03 Remove and Replace Light Vehicle Electrical Units and Components.
Assessment type:	Multiple choice test
Aim:	This unit enables the learner to develop an understanding of the principles, construction and operation and testing methods of common electrical and electronic systems and components. It also covers the procedures involved in the removal and replacement of system components and the evaluation of their performance.

Learning outcome	**The learner will:**
1 understand light vehicle electrical and electronic principles	
Assessment criteria	
1.1 describe how to work safely when working on light vehicle electrical units and components, including: a. avoiding injury to self/others b. damage to vehicle systems, components and units c. contact with leakage and hazardous substances d. waste disposal (including environmental impact) 1.2 identify electrical symbols and units found in light vehicle circuits 1.3 interpret simple light vehicle wiring diagrams 1.4 describe the types and operation of light vehicle circuit protection devices and why these are necessary 1.5 describe earthing principles and earthing methods 1.6 identify the use of different cables and connectors used in light vehicle circuits 1.7 describe the operation and application of o electrical and electronic sensors and actuators 1.8 identify the key electrical and electronic control principles that are related to light vehicle electrical circuits 1.9 state common terms used in light vehicle electrical circuits 1.10 identify the hazards associated with working on or near Hybrid/electric and alternative fuel vehicles and components.	

Learning outcome	**The learner will:**
2 understand how light vehicle batteries, starting, charging, warning systems and components operate	

Assessment criteria
The learner can 2.1 identify light vehicle batteries, starting, charging, warning systems and components 2.2 describe the construction and operation of light vehicle batteries, starting, charging, warning systems and components 2.3 describe how to remove and replace batteries, starting, charging, warning systems and components 2.4 compare light vehicle batteries, starting, charging, warning systems and components and assemblies against alternatives to identify differences in construction and operation 2.5 state common terms used in conjunction with light vehicle batteries, starting, charging, warning systems and components.

Learning outcome	The learner will:
3 understand how light vehicle auxiliary electrical systems operate	
Assessment criteria	
The learner can 3.1 identify light vehicle auxiliary system components 3.2 describe the construction and operation of light vehicle auxiliary systems, including: a. lighting b. wiper c. security and alarm d. comfort and convenience (including refrigerant legal requirements) e. information and entertainment f. telephone and communication g. electric window h. monitoring and instrumentation 3.3 compare key light vehicle auxiliary system components and assemblies against alternatives to identify differences in construction and operation 3.4 state common terms used in light vehicle auxiliary system design.	

Learning outcome	The learner will:
4 understand how to check, replace and test light vehicle electrical systems and components	
Assessment criteria	
The learner can 4.1 describe how to remove and replace light vehicle electrical system units and components 4.2 describe the hazards associated with working on or near Hybrid/electric and alternative fuel vehicles and components 4.3 describe common and appropriate types of testing methods used to check the operation of light vehicle electrical systems and components and their purpose 4.4 explain how to test evaluate the performance of replacement electrical units and components and the reassembled system against vehicle operating specifications and legal requirements 4.5 identify common faults found in light vehicle electrical systems and components.	

Unit 153 Knowledge of Removing and Replacing Light Vehicle Electrical Units and Components

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.

Knowledge to include Hybrid/electrical and alternative fuel vehicles.

Electrical/electronic principles

a. The requirements for an electrical circuit:
   i. battery
   ii. cables
   iii. switch
   iv. current consuming device
   v. continuity.
b. Electrical units:
   i. volt (electrical pressure)
   ii. ampere (electrical current)
   iii. ohm (electrical resistance)
   iv. watt (power).
c. The direction of current flow and electron flow.
d. Series and parallel circuits to include:
   i. current flow
   ii. voltage of components
   iii. volt drop
   iv. resistance.
   v. the effect on circuit operation of open circuit component(s).
e. Earth and insulated return systems.
f. Cable sizes and colour codes.
g. Different types of connectors, terminals, and circuit protection devices.
h. Common electrical and electronic symbols.
i. Methods of electronic communication systems (including multiplexing)
j. The meaning of:
   i. short circuit
   ii. open/complete circuit
   iii. bad earth
   iv. high resistance
   v. earth return circuits

k. The principles of vehicle electronic systems and components.
l. Interpret vehicle wiring diagrams to include:
    i. vehicle lighting
    ii. auxiliary circuits
    iii. warning circuits
    iv. comfort and convenience systems
    v. starting and charging systems.
m. Function and construction of electrical components including:
    i. circuit relays
    ii. bulb types
    iii. fan and heater
    iv. circuit protection.
n. The safety precautions when working on electrical and electronic systems to include:
    i. disconnection and connection of battery
    ii. avoidance of short circuits
    iii. power surges
    iv. prevention of electric shock (high voltage systems)
    v. protection of electrical and electronic components
    vi. protection of circuits from overload or damage.
o. The set-up and use of:
    i. digital multi-meters
    ii. voltmeter
    iii. ammeter/amp clamp
    iv. ohmmeter
    v. oscilloscope
    vi. manufacturer's dedicated test equipment.
p. Electrical and electronic checks for electrical and electronic systems to include:
    i. connections
    ii. security
    iii. functionality
    iv. performance to specifications
    v. continuity, open circuit
    vi. short circuit
    vii. high resistance
    viii. volt drop
    ix. current consumption
    x. output patterns (oscilloscope).
q. Symptoms and faults associated with electrical and electronic systems to include:
    i. high resistance
    ii. loose and corroded connections
    iii. short circuit
    iv. excessive current consumption
    v. open circuit
    vi. malfunction
    vii. poor performance
    viii. battery faults to include flat battery
    ix. failure to hold charge
    x. low state of charge
    xi. overheating

xii. poor starting.

Battery and charging

a. The construction and operation of vehicle batteries including:
   i. different types of automotive batteries
   ii. cells
   iii. separators
   iv. plates
   v. electrolyte.
b. The operation of the vehicle charging system:
   i. alternator
   ii. rotor
   iii. stator
   iv. slip ring
   v. brush assembly
   vi. three phase output
   vii. diode rectification pack
   viii. voltage regulation
   ix. phased winding connections
   x. cooling fan
   xi. alternator drive system.

Starting

a. The layout, construction and operation of engine starting systems, gear reduction and pre-engaged principles.
b. The function and operation of the following components:
   i. gear reduction and pre-engaged starter motor
   ii. starter ring gear
   iii. pinion
   iv. starter solenoid
   v. ignition/starter switch
   vi. starter relay (if appropriate)
   vii. one-way clutch (pre-engaged starter motor).

Lighting

a. Function and construction of electrical components including:
   i. front and tail lamps
   ii. main and dip beam headlamps
   iii. fog and spot lamps
   iv. lighting and dip switch
   v. directional indicators.
   vi. daytime running lights
b. The circuit diagram and operation of components for:
   i. side and tail lamps
   ii. headlamps
   iii. interior lamps
   iv. fog and spot lamps
   v. direction indicators.
   vi. daytime running lights

c. The statutory requirements for vehicle lighting when using a vehicle on the road.
d. Headlamp adjustment and beam setting.

Auxiliary systems

a. Auxiliary
    i. function and operation of electrical components including:
    ii. satellite navigation
    iii. blue tooth systems
    iv. cruise control including adaptive
    v. speed limiter
    vi. electric folding roof
    vii. immobiliser
    viii. keyless entry
    ix. self-parking
    x. parking sensors
    xi. reverse camera
    xii. steering wheel controls
    xiii. airbags
    xiv. supplementary restraint systems
    xv. Tyre Pressure Monitoring Systems (TPMS)
    xvi. digital dashboard
    xvii. smart phone integration
    xviii. tracking and vehicle shut down devices
    xix. active window displays
    xx. automatic high beam control
    xxi. vehicle to vehicle communication
    xxii. automatic tailgate/boot opening
    xxiii. lane departure warning
    xxiv. lane assist
    xxv. blind spot alert
    xxvi. collision warning
    xxvii. wi-fi connectivity
    xxviii. voice recognition
    xxix. Hybrid and electric charging systems
    xxx. heated seats
    xxxi. electrically adjusted seats
    xxxii. heated screens
    xxxiii. electric mirrors
    xxxiv. climate control
    xxxv. air conditioning
    xxxvi. any other current/state of art safety/comfort/convenience features

General

a. How to prepare, check and use removal and replacement:
    i. tools and equipment
    ii. electrical testing equipment and equipment used for dismantling
    iii. removal and replacement of electrical and electronic systems and components.
b. Appropriate safety precautions:
    i. PPE

ii. vehicle protection when dismantling
iii. removal of and replacing electrical and electronic components and systems
iv. the hazards associated with working on or near hybrid/electric and alternative fuel vehicles and components

c. The importance of logical and systematic processes.
d. Preparation of replacement units for re-fitting or replacement electrical and electronic components and systems.
e. The reasons why replacement components and units must meet the original specifications (OES) – warranty requirements, to maintain performance, safety requirements.
f. Refitting procedures.
g. The inspection and testing of units and systems to ensure compliance with manufacturer's, legal and performance requirements.
h. The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction:
   i. cleanliness of vehicle interior and exterior
   ii. security of components and fittings
   iii. re-instatement of components and fittings
   iv. testing and programming components for correct operation (as necessary)
   v. cancelling of any fault codes and warning lights
   vi. documentation completed prior to handover to customer (electronic/written)
   vii. explanation to customer of work completed (if applicable).

Unit 154 Knowledge in Removing and Replacing Light Vehicle Chassis Units and Components

Level:	Level 2
GLH:	45
Relationship to NOS:	This unit is linked to LV04 Remove and Replace Light Vehicle Chassis Units and Components
Assessment type:	Multiple choice test
Aim:	This unit enables the learner to develop an understanding of the construction and operation of common steering, suspension and braking systems (including wheels and tyres). It also covers the procedures involved in the removal and replacement of system components and the evaluation of their performance.

Learning outcome	**The learner will:**
1 understand how light vehicle steering and suspension systems operate	
Assessment criteria	
The learner can 1.1 describe how to work safely when working on chassis units and components, including: a. avoiding injury to self/others b. damage to vehicle systems, components and units c. contact with leakage and hazardous substances d. waste disposal (including environmental impact) e. when working on hybrid/electric and alternative fuel vehicles. 1.2 identify light vehicle steering and suspension system components 1.3 describe the construction and operation of light vehicle steering and suspension systems 1.4 compare key light vehicle steering and suspension system components and assemblies against alternatives to identify differences in construction and operation 1.5 identify the key engineering principles that are related to light vehicle steering and suspension systems, including: a. steering angles b. hydraulic forces c. stress and strain 1.6 state common terms used in light vehicle steering and suspension system design.	

Learning outcome	**The learner will:**
2 understand how light vehicle braking systems operate	
Assessment criteria	
The learner can	

2.1 identify light vehicle braking system components
2.2 describe the construction and operation of light vehicle braking systems
2.3 compare key light vehicle braking system components and assemblies against alternatives to identify differences in construction and operation
2.4 identify the key engineering principles that are related to light vehicle braking systems, including:
a. laws of friction
b. hydraulics
c. pneumatics
d. properties of fluids
e. properties of air
f. braking efficiency
2.5 state common terms used in light vehicle braking system design.

Learning outcome	**The learner will:**
3 understand how light vehicle wheel and tyre systems operate	
Assessment criteria	
The learner can 3.1 identify light vehicle wheel and tyre components 3.2 describe the construction and operation of light vehicle wheels and tyres 3.3 compare key light vehicle wheel and tyre components and assemblies against alternatives to identify differences in construction and operation 3.4 identify the key engineering principles that are related to light vehicle wheel and tyre systems, including: a. friction b. un-sprung weight c. dynamic and static balance 3.5 state common terms used in light vehicle wheel and tyre design.	

Learning outcome	**The learner will:**
4 understand how to check, replace and test light vehicle chassis units and components	
Assessment criteria	
The learner can 4.1 describe how to remove and replace chassis units and components 4.2 describe the hazards associated with working on or near Hybrid/electric and alternative fuel vehicles and components 4.3 describe the common and appropriate types of testing methods used to check the operation of chassis units and components and their purpose 4.4 explain how to test and evaluate the performance of replacement chassis system units and components and the reassembled system against vehicle operating specifications and legal requirements 4.5 identify common faults found in light vehicle chassis units and components.	

Unit 154 Knowledge in Removing and Replacing Light Vehicle Chassis Units and Components

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.

Knowledge to include Hybrid/electrical and alternative fuel vehicles.

Steering

a. The action and purpose of steering geometry:
   i. castor angle
   ii. camber angle
   iii. kingpin or swivel pin inclination
   iv. wheel/rim offset
   v. wheel alignment (tracking) (toe in and toe out)
   vi. toe out on turns
   vii. four-wheel alignment
b. The following terms associated with steering:
   i. Ackerman principle
   ii. slip angles
   iii. self-aligning torque oversteer and understeer
   iv. neutral steer.
c. The components and layout of hydraulic power steering systems:
   i. piston and power cylinders
   ii. drive belts and pumps
   iii. hydraulic valve (rotary, spool and flapper type)
   iv. hydraulic fluid.
d. The advantages of power assisted steering.
e. The operation of hydraulic power steering.
f. The principles of electric power steering systems.
g. The procedures used for inspecting the serviceability and condition of:
   i. manual steering
   ii. power assisted steering.
h. Steering system defects to include:
   i. uneven tyre wear
   ii. wear on outer edge of tyre
   iii. wear on inner edge of tyre
   iv. flats on tread
   v. steering vibrations
   vi. wear in linkage

vii. damage linkage
viii. incorrect wheel alignment
ix. incorrect steering geometry.

Suspension

a. The layout and components of suspension systems:
   i. non-independent suspensions
   ii. independent front suspension (IFS)
   iii. independent rear suspension (IRS)
   iv. hydraulic
   v. pneumatic
   vi. rigid axle types.
b. The operation of suspension systems and components:
   i. leaf and coil springs
   ii. torsion bar
   iii. rubber springs
   iv. Macpherson strut system
   v. hydraulic
   vi. pneumatic
   vii. hydraulic dampers
   viii. trailing arms
   ix. wish bones
   x. ball joints
   xi. track control arms
   xii. bump stops
   xiii. anti-roll bars
   xiv. stabiliser bars
   xv. swinging arms
   xvi. parallel link
   xvii. swinging half-axles
   xviii. transverse link
   xix. semi-swinging arms.
c. The advantages of different systems including:
   i. non-independent
   ii. independent suspension (IFS)
   iii. independent suspension (IRS)
   iv. hydraulic
   v. hydro-pneumatic
   vi. rigid axle.
d. The principles of electronic suspensions systems.
e. The forces acting on suspension systems during braking, driving and cornering.
f. The methods of locating the road wheels against braking, driving and cornering forces.
g. The methods of controlling cornering forces by fitting anti-roll torsion members.
h. Suspension terms:
   i. rebound
   ii. bump
   iii. float
   iv. dive
   v. pitch

vi. roll
vii. compliance.

i. The procedures used for inspecting the serviceability and condition of the suspension system

j. Suspension system defects:
   i. ride height (unequal and low)
   ii. wear
   iii. noises under operation
   iv. fluid leakage
   v. excessive travel
   vi. excessive tyre wear
   vii. bounce
   viii. poor vehicle handling
   ix. worn dampers
   x. worn joints
   xi. damaged linkages.

Brakes

a. The construction and operation of drum brakes:
   i. leading and trailing shoe construction
   ii. self-servo action
   iii. automatic adjusters
   iv. backing plates
   v. parking brake system.

b. The construction and operation of disc brakes:
   i. disc pads
   ii. caliper
   iii. brake disc
   iv. ventilated disc
   v. disc pad retraction
   vi. parking brake system
   vii. electrical and electronic components
   viii. wear indicators and warning lamps.

c. The construction and operation of the hydraulic braking system:
   i. dual line layout
   ii. master cylinders
   iii. wheel cylinders
   iv. disc brake caliper and pistons
   v. brake pipe
   vi. brake servo
   vii. warning lights
   viii. parking brakes
   ix. load sensing valve/brake proportioning valve.

d. The principles and components of electronic ABS systems, electrical and electronic components.

e. The requirements and hazards of brake fluid:
   i. boiling point
   ii. hygroscopic action
   iii. manufacturer’s change periods

iv. fluid classification and rating
v. potential to damage paint surfaces.

f. Terms associated with mechanical and hydraulic braking systems:
i. braking efficiency
ii. brake fade
iii. brake imbalance
iv. ABS.

g. The procedures used for inspecting the serviceability and condition of the braking system.

h. Braking system defects:
i. worn shoes or pads
ii. worn or scored brake surfaces
iii. abnormal brake noises
iv. brake judder
v. fluid contamination of brake surfaces
vi. fluid leaks
vii. pulling to one side
viii. poor braking efficiency
ix. lack of servo assistance
x. brake drag
xi. brake grab
xii. brake fade.

Wheel and tyres

a. The construction of different types of tyre:
i. radial
ii. cross ply
iii. bias belted
iv. tread patterns
v. tyre mixing regulations
vi. tyre applications.

b. Tyre markings:
i. tyre and wheel size markings
ii. speed rating
iii. direction of rotation
iv. profile
v. load rating
vi. ply rating
vii. tread-wear indicators.

c. Wheel construction:
i. light alloy
ii. pressed steel and wire wheels
iii. well based wheel rims.

d. Types of bearing used for wheel bearing arrangements:
i. roller
ii. taper roller
iii. needle
iv. ball and plain

e. The procedures used for inspecting the serviceability and condition of:
i. tyres & wheels

ii. bearings.

f. The defects associated with tyres and wheels:
   i. abnormal tyre wear
   ii. cuts
   iii. puncture and puncture repair
   iv. side wall damage
   v. wheel vibrations
   vi. tyre noise (squeal during cornering)
   vii. tyre over heating (low pressure)
   viii. tread separation
   ix. tyre pressure monitoring systems (TPMS) including valves.

General

a. The procedures for dismantling, removal and replacement of chassis system components Including the preparation of:
   i. testing and use of tools and equipment
   ii. electrical meters
   iii. removing and replacing chassis systems and components.

b. Appropriate safety precautions:
   i. personal protective equipment (PPE)
   ii. vehicle protective equipment (VPE)
   iii. removing and replacing chassis systems and components.

c. The importance of logical and systematic processes.

d. The inspection and testing of chassis systems and components.

e. The preparation of replacement units for re-fitting or replacement of chassis systems or components.

f. Identify the reasons why replacement components and units must meet the original specifications, including original equipment manufacturer (OEM):
   i. warranty requirements
   ii. to maintain performance
   iii. safety requirements.

g. Refitting procedures

h. The inspection and testing of units and systems to ensure compliance with manufacturer's, legal and performance requirements.

i. The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction:
   i. cleanliness of vehicle interior and exterior
   ii. security of components and fittings
   iii. re-instatement of components and fittings
   iv. testing and programming components for correct operation (as necessary)
   v. cancelling of any fault codes and warning lights.
   vi. documentation completed prior to handover to customer (electronic/written)
   vii. explanation to customer of work completed (if applicable).

Unit 155 Knowledge of Inspecting Light Vehicles Using Prescribed Methods

Level:	Level 2
GLH:	40
Relationship to NOS:	This unit is linked to LV05 Inspect Light Vehicles using Prescribed Inspection Methods and LV06 Inspect Light Vehicles.
Assessment type:	Multiple choice test
Aim:	This unit enables the learner to develop an understanding of how to carry out a range of inspections on light vehicles using a variety of prescribed testing and inspection methods.

Learning outcome	**The learner will:**
1 understand how to carry out inspections on light vehicles using prescribed methods	
Assessment criteria	
The learner can: 1.1 describe how to work safely when inspecting light vehicles using prescribed methods, including: a. avoiding injury to self/others b. damage to vehicle systems, components and units c. contact with leakage and hazardous substances d. waste disposal (including environmental impact) e. when working on hybrid/electric and alternative fuel vehicles. 1.2 explain the difference between the various prescribed light vehicle inspection methods including: a. pre-work b. post-work c. pre-delivery d. maintenance e. pre-MOT f. safety inspection 1.3 explain how to find interpret and use sources of technical information for scheduled maintenance activities 1.4 describe the importance of using the correct sources of technical information, including identification codes 1.5 identify how vehicle systems operate and the operational tolerances for the vehicle(s) on which you are working, including: a. engine area b. transmission area c. chassis / frame area d. electrical area	

1.6 identify the procedures involved in carrying out a logical and systematic inspection using prescribed inspection methods

1.7 identify the conformity of vehicle systems on light vehicles inspections

1.8 compare test and inspection results against light vehicle specification and legal requirements

1.9 describe the importance of making accurate records of the results of tests and inspections and interpreting them correctly

1.10 explain how to record and complete inspection and test results in the format required

1.11 identify how to make recommendations based upon the results of your inspections

1.12 explain the implications of failing to carry out light vehicle inspections activities correctly

1.13 describe the importance of work-based policies for the following:

a. vehicle inspection activities
b. working to agreed timescales and keeping others informed of progress
c. the relationship between time and costs and productivity
d. reporting anticipated delays to the relevant person(s) promptly

1.14 explain the implications of signing workplace documentation and vehicle records

Including use of different types of formats in which records may be stored

1.15 explain the procedure for recognising and reporting cosmetic damage to light vehicle components and units outside normal inspection items.

Unit 155 Knowledge of Inspecting Light Vehicles Using Prescribed Methods

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.

Knowledge to include pre and post work vehicle inspections and record findings to include Hybrid/electrical and alternative fuel vehicles.

a. Personal protective equipment (PPE)
b. Vehicle protective equipment (VPE) relating to:
    i. vehicle body panels
    ii. paint surfaces
    iii. seats
    iv. carpets and floor mats prior to conduction vehicle inspections.
c. Prepare and use appropriate inspection equipment and tools.
d. Inspection procedures following inspection checklists.
e. Pre and post work vehicle inspection procedures.
    Aural, visual and functional assessments on:
        i. engine systems
        ii. chassis systems
        iii. wheels and tyres
        iv. transmission system
        v. electrical and electronic systems
        vi. exterior vehicle body
        vii. vehicle interior.
f. The methods for carrying out inspections for: damage, corrosion, fluid leaks, wear, security and condition to include:
    i. engine systems
    ii. chassis systems
    iii. transmission systems
    iv. brakes
    v. steering
    vi. suspension
    vii. wheels
    viii. tyres
    ix. body panels and vehicle exterior
    x. electrical and electronic systems and components
    xi. vehicle seating and vehicle interior
    xii. vehicle instrumentation
    xiii. driver controls.
g. Check conformity to manufacturer’s specifications and legal requirements.
h. Comply with manufacturer's recommended work times, job times set by your company or a job time agreed with a specific customer.

i. Completion of documentation to include:
    i. inspection records
    ii. job cards
    iii. vehicle records.
j. Make recommendations based on results of vehicle inspections.
k. The checks necessary to ensure customer satisfaction for:
    i. cleanliness of vehicle interior and exterior
    ii. documentation completed prior to handover to customer (electronic/written)
    iii. explanation to customer of additional work required on completion (if applicable).

Unit 157 Knowledge of Diagnosis and Rectification of Light Vehicle Combustion Engine Faults

Level:	Level 3
GLH:	45
Relationship to NOS:	This unit is linked to LV07 Diagnose and Rectify Light Vehicles Engine and Component Faults.
Assessment type:	Multiple choice test
Aim:	This unit enables the learner to develop an understanding of diagnosis and rectification of combustion engine mechanical, electrical, hydraulic and fluid systems. It also covers light vehicle engine systems and the evaluation of their performance.

Learning outcome	**The learner will:**
1. understand how light vehicle engine systems operate	
Assessment criteria	
The learner can: 1.1 describe how to work safely when diagnosing and rectifying light vehicle chassis system faults, including: a. avoiding injury to self/others b. damage to vehicle systems, components and units c. contact with leakage and hazardous substances d. waste disposal (including environmental impact) e. when working on hybrid/electric and alternative fuel vehicles. 1.2 explain the construction and operation of light vehicle engine systems to include: a. SI fuel systems b. CI fuel systems c. ignition systems d. engine management e. valve mechanisms f. pressure charged induction systems g. exhaust emission reduction systems h. heating, ventilation and cooling i. hydraulic/pneumatic j. electrical/electronic k. engine mechanical 1.3 describe how light vehicle combustion engine systems interact and are dismantled, reassembled, measured and adjusted to manufacturers' specifications 1.4 identify the types and causes of combustion engine, mechanical, electrical, electronic, hydraulic/pneumatic and fluid system, component and unit faults and failures	

1.5 identify vehicle operating specifications for limits, fits and tolerances relating to combustion engine, mechanical, electrical, electronic, hydraulic/pneumatic and fluid systems

1.6 explain how to assess the condition within the combustion engine, mechanical, electrical, electronic, hydraulic/pneumatic and fluid components and units

1.7 identify combustion engine, mechanical, electrical, hydraulic/pneumatic and fluid component and unit replacement procedures, the circumstances which will necessitate replacement and other possible courses of action

1.8 explain how combustion engine systems interlink and interact, including communication networks and multiplexing

1.9 compare light vehicle engine system components and assemblies against alternatives to identify differences in construction and operation

1.10 identify the engineering principles that are related to light vehicle engine systems:

a. volumetric efficiency
b. flame travel, pre ignition and detonation
c. fuel properties
d. composition of carbon fuels
e. combustion process
f. legal requirements for exhaust emissions.

1.11 describe the electrical and electronic principles associated with engine systems, including types of sensors and actuators, their application and operation.

Learning outcome	**The learner will:**
2. understand how to diagnose and rectify faults in light vehicle engine systems	
Assessment criteria	

The learner can:

2.1 describe how to analyse symptoms and causes of faults found in light vehicle engine systems

2.2 explain systematic diagnostic techniques and testing of engine mechanical, electrical, electronic, hydraulic/pneumatic and fluid systems using prescribed processes or formats

2.3 describe how engine mechanical, electrical, electronic, hydraulic/pneumatic and fluid systems are dismantled, reassembled, measured and adjusted to manufacturers' specifications when rectifying faults

2.4 explain how to examine, measure and make suitable adjustments to the components

2.5 explain how to select, prepare and use diagnostic and rectification equipment and interpret test results

2.6 explain activities to identify and rectify the faults in the engine systems, mechanical, electrical, electronic and fluid systems

2.7 explain how to source, interpret, evaluate and use information for diagnostic test results, including manufacturers tolerances and legal requirements

2.8 explain how to evaluate the operation of components and systems following diagnosis and repair to confirm system performance.

2.9 describe the importance of work-based policies for the following:

a. information for diagnostic and rectification activities
b. working to agreed timescales and keeping others informed of progress
c. the relationship between time and costs and productivity
d. reporting anticipated delays to the relevant person(s) promptly.

Unit 157 Knowledge of Diagnosis and Rectification of Light Vehicle Combustion Engine Faults

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit. The following information is included to support centres in terms of teaching and delivery.

Knowledge of diagnostic and rectification to include Hybrid and alternative fuel vehicles and components.

Single and multi-point and gasoline direct injection (GDI) petrol injection systems

a. The operation and construction of single and multi-point injection systems including:
    i. fuel supply system
    ii. fuel pump
    iii. filter
    iv. fuel regulator
    v. injectors
    vi. sequential injection
    vii. continuous injection
    viii. grouped
    ix. electronic control unit (ECU)
    x. injector pulse width
    xi. sensors/actuators.
b. The operation of each system under various operating conditions including:
    i. cold starting
    ii. warm up
    iii. hot starting
    iv. acceleration
    v. deceleration
    vi. cruising
    vii. full load.
c. Engine speed limiting and knock sensing.

Engine management

a. The function and purpose of engine management systems.
b. The difference between analogue, digital, programmable and non-programmable systems.
c. Open loop and closed loop control, types of input and output devices.
d. The function and operation of digital components and systems.
e. The operation of engine management systems under various conditions

Valve mechanisms

a. The reasons for variable valve timing and multi-valve arrangements and the effect on performance.
b. Layout of multi-valve arrangements, components, operation and drive arrangements.
c. Construction features and operation of variable valve timing engines and electronic control.

Pressure charged induction systems

a. The meaning of volumetric efficiency; explain the effect of volumetric efficiency on engine performance, torque and power.
b. The methods used to improve volumetric efficiency:
    i. variable valve timing
    ii. turbo-charging
    iii. supercharging
    iv. intercoolers.
c. The operation of turbo-chargers and the purpose of:
    i. turbo-charging
    ii. supercharging
    iii. intercoolers
    iv. waste gates
    v. exhaust gas recirculation.
d. Advantages and disadvantages of pressure charging induction systems.

Terms associated with combustion

a. Flame travel, pre-ignition and detonation.
b. Fuel properties:
    i. octane rating
    ii. cetane rating
    iii. phases of combustion (diesel)
    iv. volatility
    v. composition of petrol and diesel fuels
    vi. hydro-carbon content.
c. Composition of carbon fuels (petrol and diesel):
    i. % hydrogen and carbon (hydrocarbons – HC)
    ii. composition of air
    iii. % oxygen
    iv. % nitrogen
d. Combustion process for spark ignition and compression ignition engines:
    i. air fuel ratio
    ii. lambda ratio
    iii. stoichiometric ratio.
e. The by-products of combustion for different engine conditions and fuel mixtures:
    i. CO
    ii. CO2
    iii. O
    iv. N
    v. H2O

vi. NOx.
vii. particulate matter (PM)

f. Describe the legal requirements for exhaust emissions:
   i. MOT requirements
   ii. Current UK and European exhaust emissions

Assessment, repair and restoration of mechanical engine components

a. How engine mechanical components are assessed and measured for wear and serviceability:
   i. cylinder bores
   ii. cylinder heads
   iii. crankshaft journals
   iv. valve faces
   v. valve guides
   vi. valve seats
   vii. camshafts
b. The methods used for the diagnosing, repairing and restoration of engine components.
   i. compression testing (dry and wet)
   ii. performance testing
   iii. cylinder leakage test
   iv. road testing where relevant.

Cooling, heating and ventilation

a. The components, operating principles, and functions of engine cooling systems.
b. Procedures used to remove, replace and adjust cooling system components:
   i. cooling fans and control devices
   ii. header tanks, radiators and pressure caps
   iii. heater matrix and temperature control systems
   iv. expansion tanks hoses, clips and pipes
   v. thermostats water pump and coolant
   vi. ventilation systems.
c. The preparation and method of use of appropriate specialist equipment used to evaluate system performance following component replacement:
   i. system pressure testers
   ii. pressure cap testers
   iii. hydrometer, or anti-freeze testing equipment
   iv. chemical tests for the detection of combustion gas.
d. The layout and construction of internal heater systems.
e. The controls and connections within internal heater system.
f. Symptoms and faults associated with cooling systems:
   i. coolant leaks
   ii. coolant in oil
   iii. internal heating system: efficiency, operation, leaks, controls, air filtration, air leaks and contamination
   iv. excessively low or high coolant temperature.
g. The procedures used when inspecting
   i. internal heating system
   ii. cooling system.

Air conditioning systems and legal requirements

a. The operation of air conditioning components including:
    i. compressors/drive mechanism
    ii. condensers
    iii. receivers
    iv. dryers
    v. connections
    vi. expansion valves
    vii. hoses
    viii. evaporator
    ix. refrigerants.
b. The layout and operation of air conditioning systems.

Climate control systems

a. Identify components used in climate control systems including:
    i. sensors
    ii. speed controls
    iii. control systems
    iv. servomotors
    v. electronic components.
b. The layout of climate control systems.
c. The operation of climate control system.

Symptoms and faults in engine mechanical systems and components

a. Symptoms and faults related to:
    i. worn cylinders
    ii. cylinder liners
    iii. pistons
    iv. piston rings
    v. crankshaft
    vi. camshaft
    vii. bearings
    viii. cylinder head and gasket
    ix. valves
    x. valve seats and valve guides
    xi. timing belts/chains
    xii. lubrication system and components
    xiii. oil pump
    xiv. relief valve
    xv. filter

Diagnosis of faults in engine mechanical systems and components

a. Interpret information for:
    i. diagnostic tests
    ii. manufacturer's vehicle and equipment specifications
    iii. use of equipment
    iv. testing procedures

v. test plans
vi. legal requirements.

b. The preparation of tools and equipment for use in diagnostic testing and assessment.

c. Systematic assessment, testing and inspection of engine components and systems including:
   i. mechanical system & component condition
   ii. engine balance
   iii. power balance
   iv. performance and operation
   v. wear
   vi. run out
   vii. alignment.

d. Use of appropriate tools and equipment including:
   i. compression tester
   ii. leakage testers
   iii. cylinder balance tester
   iv. straight edge and feeler blades
   v. measuring equipment
   vi. coolant pressure tester
   vii. combustion leak tester kit

e. Evaluate and interpret test results from diagnostic testing.

f. Compare test result and values with vehicle manufacturer's specifications and settings.

g. The procedures for dismantling, components and systems and the use of appropriate equipment and procedures.

h. Assess, examine and measure components including:
   i. settings
   ii. values
   iii. condition
   iv. wear and performance of components and systems.

i. Probable faults:
   i. malfunctions
   ii. incorrect settings
   iii. wear.

j. Rectification or replacement procedures.

k. Evaluate operation of components and systems following diagnosis and repair to confirm system performance.

Faults and symptoms in ignition systems

a. Ignition system failure or malfunctions including:
   i. no spark
   ii. misfiring
   iii. backfiring
   iv. cold or hot starting problems
   v. poor performance
   vi. pre-ignition
   vii. exhaust emission levels
   viii. fuel consumption
   ix. low power
   x. unstable idle speed.

Faults and symptoms in electronic petrol and diesel injection systems

a. Petrol and diesel injection system failures or malfunctions including:

i. cold or hot starting problems
ii. poor performance
iii. exhaust emissions
iv. high fuel consumption
v. erratic running
vi. low power
vii. unstable idle speed.

Faults and symptoms in engine management systems

a. Engine management system failure or malfunctions including:

i. misfiring
ii. backfiring
iii. cold or hot starting problems
iv. poor performance
v. pre-ignition
vi. air-leak
vii. exhaust emission levels
viii. fuel consumption
ix. low power
x. unstable idle speed.

Diagnosis of faults in electronic ignition, petrol and diesel injection and engine management systems

a. Locate and interpret information for:

i. diagnostic tests
ii. manufacturer's vehicle and equipment specifications
iii. use of equipment
iv. testing procedures
v. test plans
vi. fault codes
vii. legal requirements.

b. The preparation of tools and equipment for use in diagnostic testing and assessment.

c. Conduct systematic assessment, testing of engine systems including:

i. component condition and performance
ii. component settings
iii. component values
iv. electrical and electronic values
v. system performance and operation
vi. use of appropriate tools and equipment including gauges
vii. multi-meter
viii. oscilloscope
ix. diagnostic tester
x. manufacturer's dedicated equipment
xi. exhaust gas analyser
xii. fuel pressure tester

xiii. vacuum and pressure tester

d. Evaluate and interpret test results from diagnostic testing.

e. Compare test result, values and fault codes with vehicle manufacturer's specifications and settings.

f. The procedures for dismantling, components and systems using appropriate equipment.

g. Assess, examine and measure components including:

i. settings
ii. voltages
iii. current consumption
iv. resistance
v. output patterns with oscilloscope
vi. condition
vii. wear and performance of components and systems
viii. electrical safety procedure
ix. hazards (Hybrid and alternative fuel vehicles and components)
x. input and output values
xi. electrical symbols

h. Identify probable faults and indications of:

i. faults
ii. malfunctions
iii. incorrect settings
iv. wear
v. values
vi. inputs and outputs
vii. fault codes.

i. Rectification or replacement procedures.

j. Evaluation and the operation of components and systems following diagnosis and repair to confirm system performance.

Faults and symptoms in vehicle comfort systems

a. System failure, malfunction or ineffectiveness of internal heating system, air conditioning system or climatic control system including:

i. leaks
ii. abnormal noise
iii. failure to operate
iv. control faults
v. inadequate operation.

b. Evaluate and interpret test results from diagnostic testing.

c. Compare test result, values and fault codes with vehicle manufacturer's specifications and settings.

d. How to dismantle, components and systems using appropriate equipment and procedures.

e. How to assess, examine and measure components including: settings, input and output values, voltages, current consumption, resistance, pressures, condition, wear and performance of components and systems.

f. Identification of probable faults and indications of faults, malfunctions, incorrect settings, wear, values, inputs and outputs, fault codes, pressures and leaks.

g. Rectification or replacement procedures.

h. Evaluation and operation of components and systems following diagnosis and repair to confirm system performance.

i. The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction:

i. cleanliness of vehicle interior and exterior
ii. security of components and fittings
iii. re-instatement of components and fittings
iv. testing and programming components for correct operation (as necessary)
v. cancelling of any fault codes and warning lights
vi. documentation completed prior to handover to customer (electronic/written)
vii. explanation to customer of work completed (if applicable).

Unit 158 Knowledge in Diagnosis and Rectification of Light Vehicle Chassis Faults

Level:	Level 3
GLH:	45
Relationship to NOS:	This unit is linked to LV08 Diagnose and Rectify Light Vehicle Chassis System Faults.
Assessment type:	Multiple choice test
Aim:	This unit enables the learner to develop an understanding of diagnosis and rectification of braking steering and suspension systems. It also covers light vehicle chassis systems and the evaluation of their performance

Learning outcome	**The learner will:**
1 understand how the light vehicle chassis systems operate	
Assessment criteria	
The learner can: 1.1 describe how to work safely when diagnosing and rectifying light vehicle chassis system faults, including: a. avoiding injury to self/others b. damage to vehicle systems, components and units c. contact with leakage and hazardous substances d. waste disposal (including environmental impact) e. when working on hybrid/electric and alternative fuel vehicles. 1.2 explain the construction and operation of light vehicle chassis systems, including: a. electronic braking b. front and rear wheel geometry c. four-wheel steer d. hydraulic power steering e. electronic power steering f. self levelling suspension g. ride control system 1.3 describe how chassis systems interact and are dismantled, reassembled, measured and adjusted to manufacturers' specifications 1.4 identify the types and causes of chassis mechanical, electrical, electronic, hydraulic/pneumatic and fluid system, component and unit faults and failures 1.5 Identify vehicle operating specifications for limits, fits and tolerances relating to chassis mechanical, electrical, electronic, hydraulic/pneumatic and fluid systems 1.6 explain how to assess the condition of the chassis mechanical, electrical, electronic, hydraulic/pneumatic and fluid components and units 1.7 Identify chassis mechanical, electrical, hydraulic/pneumatic and fluid component and unit replacement procedures, the circumstances which will necessitate replacement and other possible courses of action	

1.8 explain how light vehicle chassis electrical systems interlink and interact, including communication networks and multiplexing systems

1.9 compare light vehicle chassis system components and assemblies against alternatives to identify differences in construction and operation

1.10 identify the engineering principles that are related to light vehicle chassis systems, including:

a. inertia force, mass and acceleration
b. laws of friction
c. statics (springs and torsion bars)
d. hydraulic machines.

1.11 describe the electrical and electronic principles associated with chassis systems, including types of sensors and actuators, their application and operation.

Learning outcome	**The learner will:**
2 understand how to diagnose and rectify faults in light vehicle chassis systems	
Assessment criteria	
The learner can: 2.1 explain how to analyse symptoms and causes of faults found in light vehicle chassis systems 2.2 explain systematic diagnostic techniques and testing of chassis systems, mechanical electrical, electronic, hydraulic/pneumatic and fluid systems using prescribed processes 2.3 explain how chassis systems, mechanical, electrical, electronic, hydraulic/pneumatic and fluid systems are dismantled, reassembled, measured and adjusted to manufacturers' specifications 2.4 explain how to examine, measure and make suitable adjustments to the components 2.5 explain how to select, prepare and use diagnostic and rectification equipment and interpret test results 2.6 explain activities to identify and rectify the faults in the chassis mechanical, electrical, electronic, hydraulic/pneumatic and fluid systems. 2.7 explain how to source, interpret, evaluate and use information for diagnostic test results, including manufacturers tolerances, identification codes and legal requirements 2.8 explain how to evaluate the operation of components and systems following diagnosis and repair to confirm system performance. 2.9 explain the importance of work-based policies for the following: a. information for diagnostic and rectification activities b. working to agreed timescales and keeping others informed of progress c. the relationship between time and costs and productivity d. reporting anticipated delays to the relevant person(s) promptly.	

Unit 158 Knowledge in Diagnosis and Rectification of Light Vehicle Chassis Faults

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit. The following information is included to support centres in terms of teaching and delivery.

Knowledge to include diagnostic and rectification for include Hybrid/electrical and alternative fuel vehicles.

Electrical and electronic principles of light vehicle chassis systems

a. The operation of electrical and electronic systems and components related to light vehicle chassis systems including:
    i. Electronic control unit (ECU)
    ii. sensors and actuators
    iii. electrical inputs
    iv. voltages
    v. oscilloscope patterns
    vi. electronic communication systems
b. The interaction between the electrical/electronic system and mechanical components of chassis systems.
c. Electronic and electrical safety procedures.

Operation of electronic ABS and EBD braking systems

a. Layout of:
    i. anti-lock braking systems (ABS)
    ii. warning systems including type pressure monitoring systems (TPMS).
b. Operation of:
    i. hydraulic and electronic control units
    ii. wheel speed sensors
    iii. load sensors and proportioning valves
    iv. hoses/brake pipes
    v. cables and connectors.
c. Advantage of ABS and EBD braking systems.
d. The relationship and interaction of ABS braking with associated systems.

Steering geometry for light vehicle applications

a. Non-steered wheel geometry settings.
b. Front/rear wheel geometry:
    i. castor
    ii. camber
    iii. kingpin or swivel pin inclination
    iv. negative offset
    v. toe in and toe out
    vi. toe out on turns

vii. Ackerman principle
viii. slip angles
ix. self-aligning torque
x. oversteer and understeer
xi. torque steer
xii. neutral steer.

c. The operation and layout of rear and four-wheel steering.
d. The construction and operation of power assisted steering systems:
   i. hydraulic system
   ii. power cylinders
   iii. drive belts and pumps
   iv. hydraulic valve (rotary, spool and flapper type).
e. The operation of:
   i. electronic power steering systems (EPS)
   ii. electrical and electronic components.

Components and operation of self-levelling suspension

a. The components, construction and operation of a self-levelling suspension system.
b. The operation of self-levelling suspension system under various conditions:
   i. self-energising
   ii. pump operated self-levelling suspension.

Operation of fitting ride-controlled systems

a. The reasons for fitting ride height-controlled systems.
b. The operation of driver controlled and ride-controlled systems.

Symptoms and faults in braking systems

a. Symptoms and faults associated with braking systems:
   i. mechanical
   ii. hydraulic
   iii. electrical and electronic systems
   iv. fluid leaks
   v. warning light operation
   vi. poor brake efficiency
   vii. wheel locking under braking.

Diagnosis and faults in braking systems

a. Locate and interpret information for:
   i. diagnostic tests
   ii. vehicle and equipment specifications
   iii. use of equipment
   iv. testing procedures
   v. test plans
   vi. fault codes
   vii. legal requirements.
b. Prepare equipment for use in diagnostic testing.
c. Conduct systematic testing and inspection of:
   i. braking system
   ii. ABS braking with and associated systems
   iii. mechanical
   iv. hydraulic
   v. electrical and electronic systems.
d. Using appropriate tools and equipment including:
   i. multi-meters

ii. oscilloscope
iii. measuring equipment
iv. brake roller tester

e. Evaluate and interpret test results from diagnostic testing.
f. Compare test result and values with vehicle manufacturer's specifications and settings.
g. How to dismantle, components and systems using appropriate equipment and procedures.
h. Assess, examine and evaluate the operation, settings, values, condition and performance of components and systems.
i. Probable faults, malfunctions, incorrect settings.
j. Rectification or replacement procedures.
k. Operation of systems following diagnosis and repair to confirm operation and performance.

Symptoms and faults associated with steering systems

a. Symptoms and faults associated with steering systems:
   i. mechanical
   ii. hydraulic
   iii. electrical and electronic
   iv. steering boxes (worm and re-circulating ball)
   v. rack and pinion
   vi. steering arms and linkages
   vii. steering joints and bushes
   viii. idler gears
   ix. bearings
   x. steering columns (collapsible and absorbing)
   xi. power steering system.

Diagnosis and faults in steering systems

a. Locate and interpret information for:
   i. diagnostic tests
   ii. vehicle and equipment specifications
   iii. use of equipment
   iv. testing procedures
   v. test plans
   vi. fault codes
   vii. legal requirements.

b. How to prepare equipment for use in diagnostic testing.
c. Conduct systematic testing and inspection of:
   i. steering systems
   ii. mechanical
   iii. hydraulic
   iv. electrical and electronic systems
   v. power assisted steering system.

e.2 Using appropriate tools and equipment including:
   i. multi-meters
   ii. oscilloscope
   iii. pressure gauges
   iv. wheel alignment equipment
   v. steering geometry equipment.

d. Evaluate and interpret test results from diagnostic testing.
e. Compare test result and values with vehicle manufacturer's specifications and settings.
f. How to dismantle, components and systems using appropriate equipment and procedures.
j. Assess, examine and evaluate the:
   i. operation
   ii. settings

iii. values
iv. condition and performance of components and systems.

k. Probable faults, malfunctions, and incorrect settings.
l. Rectification or replacement procedures.
m. Operation of systems following diagnosis and repair to confirm operation and performance.

Symptoms and faults associated with suspension systems

a. Symptoms and faults associated with suspension systems:
   i. mechanical
   ii. hydraulic
   iii. electrical and electronic
   iv. conventional
   v. self-levelling and ride-controlled suspension systems
   vi. ride height (unequal and low)
   vii. wear
   viii. noises under operation
   ix. fluid leakage
   x. excessive travel
   xi. excessive tyre wear.

Diagnosis and faults in suspension systems

a. Locate and interpret information for:
   i. diagnostic tests
   ii. vehicle and equipment specifications
   iii. use of equipment
   iv. testing procedures
   v. test plans
   vi. fault codes
   vii. legal requirements.
b. How to prepare equipment for use in diagnostic testing.
c. How to conduct systematic testing and inspection of:
   i. suspension systems (including adaptive/active)
   ii. mechanical
   iii. hydraulic
   iv. pneumatic
   v. electrical and electronic systems
   vi. conventional
   vii. self-levelling and ride-controlled suspension systems.
   viii. magneto rheological
d. Using appropriate tools and equipment including:
   i. multi-meters
   ii. oscilloscope
   iii. pressure gauges/measuring equipment
   iv. alignment equipment
   v. geometry equipment.

e. Evaluate and interpret test results from diagnostic testing.
f. Compare test result and values with vehicle manufacturer's specifications and settings.
g. How to dismantle, components and systems using appropriate equipment and procedures.
h. Assess, examine and evaluate the operation, settings, values, condition and performance of components and systems.
i. Probable faults, malfunctions and incorrect settings and rectification or replacement procedures.
j. Operation of systems following diagnosis and repair to confirm operation and performance.

Measurements on components

a. To include**:**

i. settings
ii. voltages
iii. current consumption
iv. resistance
v. output patterns with oscilloscope
vi. condition
vii. wear and performance of components and systems
viii. electrical safety procedure
ix. hazards (Hybrid and alternative fuel vehicles and components)
x. input and output values
xi. electrical symbols

The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction:

a. To include:

i. cleanliness of vehicle interior and exterior
ii. security of components and fittings
iii. re-instatement of components and fittings
iv. testing and programming components for correct operation (as necessary)
v. cancelling of any fault codes and warning lights
vi. documentation completed prior to handover to customer (electronic/written)
vii. explanation to customer of work completed (if applicable).

Unit 161 Knowledge of Overhauling Light Vehicle Combustion Engine Mechanical Units

Level:	Level 3
GLH:	20
Relationship to NOS:	This unit is linked to LV11 Overhaul Light Vehicle Mechanical Units.
Assessment type:	Multiple choice test
Aim:	This unit enables the learner to develop an understanding of the construction, operation and overhauling light vehicle combustion engine units and components.

Learning outcome	**The learner will:**
1 understand how to overhaul light vehicle engine units	
Assessment criteria	
The learner can: 1.1 describe how to work safely when overhauling light vehicle combustion engine units and components, including: a. avoiding injury to self/others b. damage to vehicle systems, components and units c. contact with leakage and hazardous substances d. waste disposal (including environmental impact) e. when working on hybrid/electric and alternative fuel vehicles. 1.2 identify light vehicle engine unit components 1.3 describe the construction and operation of light vehicle engine units 1.4 describe the common and appropriate types of testing methods used to check the operation of combustion engine units and components and their purpose 1.5 explain how to prepare, use and assess of all overhauling and testing equipment 1.6 explain common symptoms, causes and faults found in light vehicle engine units 1.7 explain methods used to identify engine unit faults 1.8 explain how to evaluate and interpret test results found in diagnosing light vehicle engine unit faults and compare with manufacturers' specifications and settings 1.9 explain how to examine, measure and make suitable adjustments to light vehicle engine components 1.10 explain how light vehicle engine units are dismantled, overhauled and reassembled 1.11 explain how to evaluate the operation and performance of replacement engine system units and components and the reassembled system against vehicle operating specifications and legal requirements.	

Unit 161 Knowledge of Overhauling Light Vehicle Combustion Engine Units

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit. The following information is included to support centres in terms of teaching and delivery.

Knowledge to include, Hybrid and alternative fuel vehicles and components where applicable.

Vehicle mechanical units

a. Identify unit components.
b. Understand unit construction.
c. Describe unit operation.

How units are dismantled and reassembled

a. The dismantling procedure.
b. Tools and equipment used for stripping and rebuilding units and assemblies.
c. Methods of safe storage for removed components during overhaul activities.
d. The process for assessing the condition of sub-assemblies including:
   i. fit
   ii. tolerances
   iii. permitted limits.
e. The rebuild procedure for units and assemblies.
f. Adjustment procedures during re-assembly.

Unit and assembly testing and evaluation procedures

a. Appropriate testing and evaluation procedures prior to dismantling units.
b. Appropriate testing and evaluation procedures of components after dismantling units.
c. How to use overhauling and test equipment for the task.
d. The cost-benefit relationship between reconditioning, repair and replacement of components within units.
e. How to test and evaluate the performance of the overhauled units against the operating specification.
f. How to interpret test results.
g. Adjustment procedures during final evaluation.

Faults associated with units and assemblies being overhauled

a. Describe the causes of faults and failures associated within units and assemblies.
b. How to make adjustments to meet final specification after testing and evaluation of assembled units and assemblies.

The procedures for dismantling, removal and replacement of units and components

a. The preparation, testing and use of:
   i. tools and equipment

b. Appropriate safety precautions:
   i. Personal protective equipment (PPE)
   ii. Vehicle protective equipment (VPE)
   iii. Removal and replacing electrical and electronic components and systems.
c. The importance of logical and systematic processes.
d. The reasons why replacement components and units must meet the original specifications original equipment manufacturer (OEM)_ – warranty requirements, to maintain performance, safety requirements.
e. Refitting procedures.
f. The inspection and testing of units and systems to ensure compliance with manufacturer's, legal and performance requirements.
g. The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction:
   i. cleanliness of vehicle interior and exterior
   ii. security of components and fittings
   iii. re-instatement of components and fittings
   iv. testing and programming components for correct operation (as necessary)
   v. cancelling of any fault codes and warning lights
   vi. documentation completed prior to handover to customer (electronic/written)
   vii. explanation to customer of work completed (if applicable).

Unit 162 Knowledge of Light Vehicle Transmission and Driveline Units and Components

Level:	Level 2
GLH:	45
Relationship to NOS:	This unit is linked to LV12 Remove and Replace Light Vehicle Driveline Units and Components.
Assessment type:	Multiple choice test
Aim:	This unit enables the learner to develop an understanding of the construction and operation of common transmission and driveline systems. It also covers the procedures involved in the removal and replacement of system components and the evaluation of their performance.

Learning outcome	**The learner will:**
1 understand how light vehicle clutch systems operate	
Assessment criteria	
The learner can 1.1 describe how to work safely when working on light vehicle transmission and driveline units and components, including: a. avoiding injury to self/others b. damage to vehicle systems, components and units c. contact with leakage and hazardous substances d. waste disposal (including environmental impact) e. when working on hybrid/electric and alternative fuel vehicles. 1.2 identify light vehicle clutch system components 1.3 describe the construction and operation of light vehicle clutch systems 1.4 compare key light vehicle clutch system components and assemblies against alternatives to identify differences in construction and operation 1.5 identify the key engineering principles that are related to light vehicle clutch systems to include: a. principles of friction b. principle of levers c. torque transmission 1.6 state common terms used in light vehicle clutch system design.	

Learning outcome	The learner will:
2 understand how light vehicle manual gearbox systems operate	
Assessment criteria	
The learner can 2.1 identify light vehicle manual gearbox system components 2.2 describe the construction and operation of light vehicle manual gearbox systems. 2.3 compare key light vehicle manual gearbox system components and assemblies against alternatives to identify differences in construction and operation 2.4 identify the key engineering principles that are related to light vehicle manual gearbox systems a. gear ratios b. torque multiplication 2.5 state common terms used in light vehicle manual gearbox system design.	

Learning outcome	The learner will:
3 understand how light vehicle driveline systems operate	
Assessment criteria	
The learner can 3.1 explain how to find, interpret and use sources of information applicable to units and component removal and replacement within transmission and driveline systems 3.2 describe the importance of using the correct sources of technical information, including identification codes 3.3 identify light vehicle driveline components 3.4 describe the construction and operation of light vehicle driveline systems 3.5 compare key light vehicle driveline components and assemblies against alternatives to identify differences in construction and operation 3.6 identify the key engineering principles that are related to light vehicle driveline systems a. final drive and overall gear ratios b. simple stresses 3.7 state common terms used in light vehicle driveline design. 3.8 explain the electrical and electronic principles associated with transmission and driveline systems including: a. vehicle earthing principles and earthing methods b. types of circuit protection c. electrical safety procedures d. electric symbols e. units and terms f. electronic control system principles 3.9 describe the importance of work-based policies for the following: a. removal and refitting activities b. working to agreed timescales and keeping others informed of progress c. the relationship between time, costs and productivity.	

Learning outcome	The learner will:
4 understand how to check, replace and test transmission and driveline units and components	
Assessment criteria	
The learner can	

4.1 describe how transmission and driveline systems operate and how their related units and components are constructed, removed and replaced

4.2 describe how to remove and replace transmission and driveline system mechanical, electrical and hydraulic/pneumatic units and components

4.3 identify the properties of jointing materials and when and where they should be used including gaskets, sealants, fittings and fasteners

4.4 describe common types of testing methods used to check the operation of transmission and driveline systems and their purpose

4.5 explain how to evaluate the performance of replacement units against vehicle specification

4.6 identify common faults found in light vehicle transmission and driveline systems and their causes.

4.7 explain how to test and evaluate the performance of replacement transmission and driveline system units and components and the reassembled system against the vehicle operating specifications and any legal requirements

4.8 explain how to select the appropriate testing method for transmission and driveline systems following replacement of components

4.9 explain why replacement units and components must meet the original equipment manufacturer (OEM) for warranty or other requirements.

Unit 162 Knowledge of Light Vehicle Transmission and Driveline Units and Components

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit. The following information is included to support centres in terms of teaching and delivery.

Knowledge to include Hybrid/electric and alternative fuel vehicles and components.

The operation of clutch operating systems

a. Clutch operating mechanisms
   i. clutch fork and pedal assembly
   ii. hydraulic operated
   iii. mechanical
   iv. cable operated
   v. hydraulic components
   vi. pneumatic
   vii. master cylinder
   viii. slave cylinder
   ix. hydraulic pipes
   x. electrical and electronic components (fluid level indicators).

The operation of friction clutches

a. The reasons for fitting a clutch.
b. The construction and operation of:
   i. hydraulically and cable operated clutches
   ii. coil spring clutches
   iii. diaphragm spring clutches
   iv. single plate clutches
   v. multi plate clutches.

The operation of gearboxes

a. The reasons for fitting gearboxes, to provide neutral, reverse, torque multiplication.
b. An awareness of different gearbox types:
   i. transverse
   ii. inline
   iii. manual and semi-automated
   iv. automatic
   v. constantly variable transmission (CVT)
   vi. direct shift gearbox (DSG)
   vii. new technologies for transmission systems
c. The layout and construction of gears and shafts for different gear box designs, sliding mesh, constant mesh and synchromesh gearboxes reverse gear.
d. The construction and operation of:
   i. gear selection linkages

ii. selector forks and rods
iii. detents and interlock mechanisms

e. The construction and operation of synchromesh devices.
f. The arrangements for gearbox bearings:
i. bushes
ii. oil seals
iii. gaskets and gearbox lubrication
iv. speedometer drive
g. The electrical and electronic components including reverse lamp switch
h. Calculate gear ratios and driving torque for typical gearbox specifications.

The operation of driveline components

a. The layout and construction of prop shafts and drive shafts used in front wheel, rear wheel and four-wheel drive systems.
b. The reasons for using flexible couplings and sliding joints in transmissions systems.
c. The reason for using constant velocity joints in drive shafts incorporating steering mechanisms.
d. The construction and operation of:
i. universal joints
ii. sliding couplings
iii. constant velocity joints
e. The simple stresses applied to shafts: torsional, axial, bending and shear.
f. The construction and operation of:
i. final drive units
ii. crown wheel & pinion
iii. bevel
iv. hypoid and helical gears
v. differential gears
vi. sun & planet gears
vii. epicyclic gears
viii. lubricants
ix. lubrication bearings and seals
x. limited slip differential.
g. The reasons for fitting a differential.
h. Calculate final drive gear ratios.
i. Calculate the overall gear ratio from given data (gearbox ratio x final drive ratio).

The testing and inspection techniques used for light vehicle transmission systems

a. The techniques and procedures used for inspecting and testing clutches and clutch mechanisms including:
i. clearances
ii. pedal and lever settings
iii. cables & linkages
iv. hydraulic system
v. leaks
vi. adjustments
vii. travel.
b. The techniques and procedures used for inspecting and testing gearboxes including:
i. leaks
ii. gear selection
iii. synchromesh operation
iv. abnormal noise.
c. The techniques and procedures used for inspecting and testing drive line systems (prop & drive shafts, couplings) including:
i. security

ii. serviceability of rubber boots
iii. leaks
iv. alignment
v. balance weights (where applicable).

d. The techniques used when inspecting and testing final drive systems including:
i. fluid levels
ii. leaks
iii. noise.

The faults and symptoms associated with vehicle transmissions systems

a. The faults and symptoms associated with transmission systems:
i. clutch faults
ii. gearbox faults
iii. drive line faults (prop-shaft, drive shaft, universal and constant velocity joints)
iv. universal joint alignment
v. final drive faults.

b. Faults and symptoms to include mechanical, electrical and hydraulic systems.

The procedures for dismantling, removal and replacement of transmission units and components

a. The preparation, testing and use of tools and equipment, electrical meters and equipment used for dismantling removing and replacing transmission systems and components.
b. appropriate safety precautions:
i. Personal protective equipment (PPE)
ii. vehicle protective equipment (VPE)
iii. removing and replacing transmission systems and components
c. The importance of logical and systematic processes.
d. The inspection and testing of transmission systems and components
e. The preparation of replacement units for re-fitting or replacement of transmission systems or components.
f. The reasons why replacement components and units must meet the original specifications (Original Equipment Manufacturer (OEM):
i. warranty requirements
ii. to maintain performance
iii. safety requirements.
g. The inspection and testing of units and system to ensure compliance with manufacturer's, legal and performance requirements.
h. The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction:
i. cleanliness of vehicle interior and exterior
ii. security of components and fittings
iii. re-instatement of components and fittings
iv. testing and programming components for correct operation (as necessary)
v. documentation completed prior to handover to customer (electronic/written)
vi. explanation to customer of work completed (if applicable).

Types of wheel bearing arrangements:

i. fully floating
ii. three quarter floating
iii. semi floating axles.

Unit 163 Knowledge of Diagnosis and Rectification of Light Vehicle Transmission and Driveline Faults

Level:	Level 3
GLH:	45
Relationship to NOS:	This unit is linked to LV13 Diagnose and Rectify Light Vehicle Transmission and Driveline System Faults.
Assessment type:	Multiple choice test
Aim:	This unit enables the learner to develop an understanding of diagnosis and rectification of light vehicle gearboxes, hubs and bearings, driveline shafts, clutches, differentials and final drive units. It also covers the evaluation of performance of the systems.

Learning outcome	**The learner will:**
1 understand how the light vehicle transmission and driveline systems operate	
Assessment criteria	
The learner can: 1.1 describe how to work safely when diagnosing and rectifying light vehicle transmission and driveline system faults, including: a. avoiding injury to self/others b. damage to vehicle systems, components and units c. contact with leakage and hazardous substances d. waste disposal (including environmental impact) e. when working on hybrid/electric and alternative fuel vehicles. 1.2 explain the construction and operation of transmission and driveline mechanical, electrical, electronic, hydraulic/pneumatic and fluid systems 1.3 describe how transmission and driveline mechanical, electrical, electronic, hydraulic/pneumatic and fluid systems are dismantled, reassembled and adjusted 1.4 identify the types and causes of transmission and driveline mechanical, electrical, electronic, hydraulic/pneumatic and fluid system, component and unit faults and failures 1.5 identify vehicle operating specifications for limits, fits and tolerances relating to transmission and driveline, mechanical, electrical, electronic, hydraulic/pneumatic and fluid systems for the vehicle(s) on which you work 1.6 explain how to assess the condition within the transmission and driveline, mechanical, electrical, electronic, hydraulic/pneumatic and fluid components and units 1.7 identify transmission and driveline. mechanical, electrical, hydraulic/pneumatic and fluid component and unit replacement procedures, the circumstances which will necessitate replacement and other possible courses of action 1.8 explain the interaction between electrical, electronic and mechanical components including communication networks and multiplexing	

1.9 compare light vehicle transmission and driveline system components and assemblies against alternatives to identify differences in construction and operation

1.10 identify electrical and engineering principles that are related to light vehicle transmission and driveline systems including:

a. friction
b. torque transmission
c. materials
d. fluids and energy
e. potential and kinetic energy
f. electric symbols, units and terms

1.11 describe the electrical and electronic principles associated with transmission and driveline systems, including types of sensors and actuators, their application and operation.

Learning outcome	**The learner will:**
2 understand how to diagnose and rectify faults in light vehicle transmission and driveline systems	
Assessment criteria	

The learner can:

2.1 explain how to analyse symptoms and causes of faults found in transmission and driveline systems

2.2 explain systematic diagnostic techniques and testing of transmission and driveline, mechanical, electrical, electronic, hydraulic/pneumatic and fluid systems using prescribed processes

2.3 describe how transmission, mechanical, electrical, electronic, hydraulic/pneumatic and fluid systems are dismantled, reassembled, measured and adjusted to manufacturers' specifications following repair

2.4 explain how to find, interpret and use sources of information applicable to units and component removal and replacement within transmission and driveline systems

2.5 explain how to examine, measure and make suitable adjustments to components

2.6 explain how to select, prepare, check and use diagnostic testing equipment and rectification equipment for light vehicle transmission and driveline systems

2,7 explain activities to identify and rectify the faults in the transmission, driveline mechanical, electrical, electronic, hydraulic/pneumatic and fluid systems.

2.8 explain how to source, interpret, evaluate and use information for diagnostic test results, including manufacturers tolerances, identification codes and legal requirements

2.9 explain how to evaluate the operation of components and systems following diagnosis and repair to confirm system performance

2.10 describe the importance of work-based policies for the following:

a. information for diagnostic and rectification activities
b. working to agreed timescales and keeping others informed of progress
c. the relationship between time and costs and productivity
d. reporting anticipated delays to the relevant person(s) promptly.

Unit 163 Knowledge of Diagnosis and Rectification of Light Vehicle Transmission and Driveline Faults

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit. The following information is included to support centres in terms of teaching and delivery.

Knowledge to include Hybrid/electric and alternative fuel vehicles and components.

Electrical and electronic principles related to light vehicle transmission systems

a. The operation of electrical and electronic systems and components related to light vehicle transmission systems including:
   i. ECU
   ii. sensors and actuators
   iii. electrical inputs and outputs
   iv. voltages
   v. oscilloscope patterns
   vi. electronic communication systems.
b. The interaction between the electrical/electronic system, hydraulic system and mechanical components of the transmission systems.
c. Electronic and electrical safety procedures.

The operation of light vehicle clutches and fluid couplings

a. The construction and operation of friction clutches (coil spring, diaphragm) including single and multi-plate clutch designs.
b. The construction and operation of fluid couplings including:
   i. fluid flywheel
   ii. torque converter (torque multiplication, efficiency)
   iii. benefits of fluid couplings
   iv. benefits of torque converter over fluid flywheel.

The operation of light vehicle transmissions and driveline systems

c. The construction and operation of manual gearboxes:
   i. different gear box designs
   ii. gear arrangements
   iii. shaft and bearing arrangements
   iv. synchromesh devices
   v. interlock mechanisms
   vi. linkages
   vii. overdrive
   viii. lubrication.
d. The construction and operation of automatic gearboxes including hydraulic and electronic control systems: operations of epicyclic gears (sun, planet, annulus and carrier), method

for achieving different gear ratios using epicyclic gearing; hydraulic control systems, components and operation; electronic control system, components and operation.
The construction, operation and the benefits of:
viii. manual and semi-automated
ix. automatic
x. constantly variable transmission (CVT)
xi. direct shift gearbox (DSG)
xii. new technologies for transmission systems

e. The construction and operation of final drive systems including:
   i. conventional crown wheel and pinion
   ii. differential gears
   iii. limited slip differential
   iv. new technologies for driveline systems.
f. The construction and operation of light vehicle 4-wheel drive systems including third differential and differential locks.
g. The operation of light vehicle traction control systems and launch control.
h. The construction and operation of light vehicle hub arrangements.
i. The construction and operation of:
   i. drive shafts
   ii. prop shafts including flexible joints and couplings
   iii. universal joints
   iv. constant velocity joints
   v. sliding joints.

Symptoms and faults in light vehicle transmissions and drive-line systems

a. Clutch and coupling faults:
   i. abnormal noises
   ii. vibrations
   iii. fluid leaks
   iv. slip
   v. judder
   vi. grab
   vii. failure to operate correctly
b. Gearbox faults:
   i. abnormal noises
   ii. vibrations
   iii. loss of drive
   iv. difficulty engaging or disengaging gears
   v. automatic gear box types
   vi. abnormal noises
   vii. vibrations
   viii. loss of drive
   ix. failure to engage gear
   x. failure to disengage gear
   xi. leaks
   xii. failure to operate
   xiii. incorrect shift patterns
   xiv. electrical and electronic faults.
c. Final drive faults:
   i. abnormal noises
   ii. vibrations
   iii. loss of drive
   iv. oil leaks
   v. failure to operate
   vi. electrical and electronic faults.

d. Drivelines and couplings:
    i. abnormal noises
    ii. vibrations
    iii. loss of drive.

Faults in light vehicle transmission systems

a. Interpret information for diagnostic tests, vehicle and equipment specifications, use of equipment, testing procedures, test plans, fault codes and legal requirements.
b. How to prepare equipment for use in diagnostic testing.
c. How to conduct systematic testing and inspection of transmission system, mechanical, hydraulic, electrical and electronic systems using appropriate tools and equipment including, multi- meters, oscilloscope and pressure gauges.
d. How to carry out workshop based and road testing of vehicle and transmission system.
e. Evaluate and interpret test results from diagnostic and/or road testing.
f. Compare test result and values with vehicle manufacturer's specifications and settings.
g. How to dismantle, components and systems using appropriate equipment and procedures.
h. Assess, examine and evaluate the operation, settings, values, condition and performance of components and systems.
i. Probable faults, malfunctions and incorrect settings.
j. Rectification or replacement procedures.

Operation of systems following diagnosis and repair to confirm operation and performance

a. Measurements on components to include:
    i. settings
    ii. input and output values
    iii. voltages
    iv. current consumption
    v. resistance
    vi. output patterns with oscilloscope
    vii. pressures
    viii. condition
    ix. wear and performance.

The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction:

a. including:
    i. cleanliness of vehicle interior and exterior
    ii. security of components and fittings
    iii. re-instatement of components and fittings
    iv. testing and programming components for correct operation (as necessary)
    v. cancelling of any fault codes and warning lights
    vi. documentation completed prior to handover to customer (electronic/written)
    vii. explanation to customer of work completed (if applicable).

Unit 171 Knowledge of Overhauling Light Vehicle Transmission Units

Level:	Level 3
GLH:	20
Relationship to NOS:	This unit is linked to LV11 Overhaul Light Vehicle Mechanical Units.
Assessment type:	Multiple choice test
Aim:	This unit enables the learner to develop an understanding of the construction, operation and overhauling light vehicle gearboxes and final drive assemblies.

Learning outcome	**The learner will:**
1 understand how to overhaul light vehicle gearbox and final drive units	
Assessment criteria	
The learner can: 1.1 describe how to work safely when overhauling light vehicle gearboxes and final drive assemblies, including: a. avoiding injury to self/others b. damage to vehicle systems, components and units c. contact with leakage and hazardous substances d. waste disposal (including environmental impact) e. when working on hybrid/electric and alternative fuel vehicles 1.2 identify light vehicle gearbox and final dive unit components 1.3 describe the construction and operation of light vehicle gearbox and final drive units 1.4 describe common and appropriate types of testing methods used to check the operation of transmission and driveline units and components and their purpose 1.5 explain how to prepare and check the accuracy and operation of all overhauling and testing equipment 1.6 explain common symptoms, causes and faults found in light vehicle gearbox and final drive units 1.7 explain methods used to identify gearbox and final drive unit faults 1.8 explain how to evaluate and interpret test results found in diagnosing light vehicle gearbox and final drive unit faults and compare with manufacturers' specifications and settings 1.9 explain how to examine, measure and make suitable adjustments to light vehicle gearbox and final drive components 1.10 explain how light vehicle gearbox and final drive units are dismantled, overhauled and reassembled. 1.11 explain how to evaluate the operation and performance of replacement transmission and driveline units and components and the reassembled system against vehicle operating specifications and legal requirements.	

Unit 171 Knowledge of Overhauling Light Vehicle Transmission Units

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit. The following information has been provided to support centres in terms of teaching and delivery.

Knowledge to include, Hybrid/electric and alternative fuel vehicles and components where applicable.

Vehicle transmission units

a. Identify unit components.
b. Understand unit construction.
c. Describe unit operation.

How units are dismantled and reassembled

a. The dismantling procedure.
b. Tools and equipment used for stripping and rebuilding units and assemblies.
c. Methods of safe storage for removed components during overhaul activities.
d. The process for assessing the condition of sub-assemblies including:
    i. fit
    ii. tolerances
    iii. permitted limits.
e. The rebuild procedure for units and assemblies.
f. Adjustment procedures during re-assembly.

Unit and assembly testing and evaluation procedures

a. Appropriate testing and evaluation procedures prior to dismantling units.
b. Appropriate testing and evaluation procedures of components after dismantling units.
c. How to use overhauling and test equipment for the task.
d. The cost-benefit relationship between reconditioning, repair and replacement of components within units.
e. How to test and evaluate the performance of the overhauled units against the operating specification.
f. How to interpret test results.
g. Adjustment procedures during final evaluation.

Faults associated with units and assemblies being overhauled

a. Causes of faults and failures within units and assemblies.
b. The faults associated with units and assemblies.
c. How to make adjustments to meet final specification after testing and evaluation of assembled units and assemblies.

The procedures for dismantling, removal and replacement of units and components

a. The preparation, testing and use of:
    i. tools and equipment
    ii. removal and replacement of electrical and electronic systems and components.
b. Appropriate safety precautions:
    i. Personal protective equipment (PPE)
    ii. Vehicle protective equipment (VPE)
    iii. Relevant and current legislation
    iv. removal and replacing electrical and electronic components and systems.
c. The importance of logical and systematic processes.
d. Preparation of replacement units for re-fitting or replacement electrical and electronic components and systems.
e. The reasons why replacement components and units must meet the original specifications original equipment manufacturer (OEM) – warranty requirements, to maintain performance, safety requirements.
f. Refitting procedures.
g. The inspection and testing of units and systems to ensure compliance with manufacturer's, legal and performance requirements.

The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction:

a. Including:
    i. cleanliness of vehicle interior and exterior
    ii. security of components and fittings
    iii. re-instatement of components and fittings
    iv. testing and programming components for correct operation (as necessary)
    v. cancelling of any fault codes and warning lights
    vi. documentation completed prior to handover to customer (electronic/written)
    vii. explanation to customer of work completed (if applicable).

Unit 172 Knowledge of Light Vehicle Fuel, ignition, Air and Exhaust System Units and Components

Level:	Level 2
GLH:	20
Relationship to NOS:	This unit is linked to LV02 Remove and Replace Light Vehicle Engine Units and Components.
Assessment type:	Multiple choice test
Aim:	This unit enables the learner to develop an understanding of the construction, removal, replacement and operation of common fuel, ignition, air and exhaust systems. It also covers the procedures involved in the removal and replacement of system components and the evaluation of their performance.

Learning outcome	**The learner will:**
1 understand how light vehicle engine fuel systems operate	
Assessment criteria	
The learner can 1.1 describe how to work safely when carrying out removal and replacement activities, including: a. avoiding injury to self/others b. damage to vehicle systems, components and units c. contact with leakage and hazardous substances d. waste disposal (including environmental impact) e. when working on hybrid/electric and alternative fuel vehicles. 1.2 describe how combustion engine systems and their related units and components operate 1.3 identify light vehicle engine fuel system components 1.4 describe the construction and operation of light vehicle engine fuel systems a. multi point injection b. single point injection c. gasoline direct injection (GDI) 1.5 compare key light vehicle engine fuel system components and assemblies against alternatives to identify differences in construction and operation 1.6 identify the key principles that are related to light vehicle engine fuel systems a. properties of fuels b. combustion processes c. exhaust gas constituents 1.7 state common terms used in light vehicle engine fuel system design.	

Learning outcome	**The learner will:**

2 understand how light vehicle engine ignition systems operate
Assessment criteria
The learner can 2.1 identify light vehicle engine ignition system components 2.2 describe the construction and operation of light vehicle engine ignition systems 2.3 compare key light vehicle engine ignition system components and assemblies against alternatives to identify differences in construction and operation 2.4 identify the key principles that are related to light vehicle engine ignition systems a. flame travel b. ignition timing 2.5 state common terms used in key light vehicle engine ignition system design.

Learning outcome	**The learner will:**
3 understand how light vehicle engine air supply and exhaust systems operate	
Assessment criteria	
The learner can 3.1 identify light vehicle engine air supply and exhaust system components 3.2 describe the construction and operation of light vehicle engine air supply and exhaust systems a. supercharging b. turbocharging c. exhaust gas recirculation (egr) d. diesel particulate filters (dpf) e. catalytic converters f. exhaust emission additive systems 3.3 compare key light vehicle engine air supply and exhaust system components and assemblies against alternatives to identify differences in construction and operation 3.4 identify the key principles that are related to light vehicle engine air supply and exhaust systems a. sound absorption b. reduction of harmful emissions 3.5 state common terms used in key light vehicle engine air supply and exhaust system design.	

Learning outcome	**The learner will:**
4 understand how to check, replace and test light vehicle engine fuel system units and components	
Assessment criteria	
The learner can 4.1 describe how to remove and replace fuel, ignition, air and exhaust systems unts and components 4.2 explain how combustion engine systems and their related units and components are constructed, dismantled and reassembled 4.3 identify the properties of jointing materials and when and where they should be used including gaskets, sealants, fittings and fasteners 4.4 describe common types of testing methods used to check the operation of engine fuel, air supply and exhaust systems and their purpose	

4.5 describe how to evaluate the performance of replacement units against vehicle specification

4.6 explain common faults found in light vehicle fuel, air supply and exhaust systems and their causes

4.7 identify the manufacturer's specification for the type and quality of engine units and components to be used.

Unit 172 Knowledge of Light Vehicle Fuel, ignition, Air and Exhaust System Units and Components

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit. The following information is included to support centres in terms of teaching and delivery.

Knowledge to include Hybrid and alternative fuel vehicles and components.

Fuel - Petrol

a. The function and layout of petrol injection systems:
   i. single and multi-point systems
   ii. injection components
   iii. fuel pump
   iv. injector(s)
   v. air flow sensor
   vi. throttle potentiometer
   vii. idle speed control valve
   viii. coolant sensor
   ix. MAP and air temperature sensors
   x. mechanical control devices
   xi. electronic control units
   xii. fuel pressure regulators
   xiii. fuel pump relays
   xiv. lambda exhaust sensors
   xv. flywheel and camshaft sensors
   xvi. air flow sensors (air flow meter and air mass meter)
   xvii. EGR valve.
   xviii. additional manufacturers specific sensors/actuators

b. The operation of single, multi-point and Gasoline Direct Injection (GDI) petrol injection systems and components:
   i. fuel pump
   ii. single and multi-point systems
   iii. injection components
   iv. injector(s)
   v. air flow sensor
   vi. throttle potentiometer
   vii. mechanical control devices
   viii. idle speed control valve

ix. coolant sensor
x. MAP and air temperature sensors
xi. electronic control units
xii. fuel pressure regulators
xiii. fuel pump relays
xiv. lambda exhaust sensors
xv. flywheel and camshaft sensors
xvi. air flow sensors (air flow meter and air mass meter)
xvii. EGR valve
xviii. additional manufacturers specific sensors/actuators

c. The procedures used when inspecting petrol system.

Fuel – Diesel

a. The layout and construction of inline, rotary, common rail and unit injection type diesel systems.
b. The principles and requirements of compression ignition engines:
   i. combustion chambers (direct and indirect injection).
c. The function and operation of diesel fuel injection components:
   ii. fuel filters
   iii. sedimenters
   iv. injectors
   v. injector types (direct and indirect injection)
   vi. multi-hole and pintle nozzle designs
   vii. governors
   viii. fuel pipes
   ix. glow plugs (heater plugs)
   x. fuel cut-off devices
   xi. electronic control systems and components
d. The construction, purpose and operation of:
   i. turbochargers
   ii. use of inter-coolers.
e. Explain the procedures for injection pump timing
f. The safety procedures used when inspecting and bleeding diesel system.

Fuel

a. The meaning of terms related to:
   i. hydro-carbon fuels
   ii. volatility
   iii. calorific value
   iv. flash point
   v. octane value
   vi. cetane value.
b. The composition of hydro-carbon fuels:
   i. % Hydrogen and carbon in petrol and diesel fuels.
c. The composition of air (% nitrogen, oxygen), % of oxygen.
d. The chemically correct air/fuel ratio for petrol engines as 14.7:1 (lambda 1, stoichiometric ratio).
e. Weak and rich air/fuel ratios for petrol engines.
f. Exhaust composition and by-products for chemically correct, rich and weak air/fuel ratios of petrol engines:

i. water vapour (H_2O)
ii. nitrogen (N)
iii. carbon monoxide (CO)
iv. carbon dioxide (CO2)
v. carbon (C)
vi. hydrocarbon (HC)
vii. oxides of nitrogen (NOx, NO2, NO) and particulates, particulate matter (PM).

g. The relative advantages and disadvantages of diesel and petrol engines.
h. Symptoms and faults associated with fuel systems
   i. diesel fuel system: air in fuel system, water in fuel, filter blockage, leaks, difficult starting, erratic running, excessive smoke (black, blue, white), engine knock, turbocharger faults
   ii. petrol injection system: leaks, erratic running, excessive smoke, poor starting, poor performance, poor fuel economy, failure to start, exhaust emissions, running-on, excessive fuel consumption and surging.

Ignition

a. The layout of electronic ignition systems.
b. Electronic ignition circuits and components:
   i. LT Circuit
   ii. battery
   iii. ignition switch
   iv. electronic trigger sensors
   v. HT Circuit
   vi. spark plugs (reach, heat range, electrode features and electrode polarity)
   vii. ignition coil
   viii. electronic ignition timing system
c. The operation electronic system components:
   i. amplifiers
   ii. triggering systems
   iii. inductive pick-ups
   iv. hall generators
   v. optical pulse generators
   vi. control units.
d. The operation of amplifier units.
e. Ignition terminology:
   i. electronic ignition control systems
   ii. advance and retard of ignition timing
f. The operation of electronic ignition systems under various conditions and loads to include:
   i. engine idling
   ii. during acceleration
   iii. under full load
   iv. cruising
   v. overrun
   vi. cold starting.
g. The principles of engine management systems:
   i. closed loop system
   ii. integrated ignition
   iii. injection systems

iv. sensors.

h. The procedures used when inspecting:
   i. ignition system
   ii. engine management
   iii. sensors.

i. Symptoms and faults associated with ignition system operation:
   i. Failure to start hot or cold,
   ii. erratic running
   iii. poor performance
   iv. misfire
   v. exhaust emissions irregularities
   vi. ignition noise (pinking).

Air supply and exhaust systems

a, The construction, operation and purpose of air filtration systems.

b. The construction, operation and purpose of the exhaust systems.

c. Exhaust system design to include silencers, Diesel Particulate Filters (DPF) and catalytic converters.

d. The procedures used when inspecting induction, air filtration and exhaust systems.

e. Exhaust emission additive systems

f. Positive Crankcase Ventilation (PCV) valve

g. EVAP systems

h. Symptoms and faults associated with air and exhaust systems:
   i. exhaust gas leaks
   ii. air leaks.

General

a.The preparation, testing and use of tools and equipment used for:
   i. dismantling and reassembling
   ii. removal and replacement of engine units and components.

b. Appropriate safety precautions:
   i. Personal Protective Equipment (PPE)
   ii. vehicle protective equipment (VPE)
   iii. removal and replacing engine units and components.

c. The importance of logical and systematic processes.

d. The inspection and testing of engine units and components.

e. The preparation of replacement units for re-fitting or replacement.

f. The reasons why replacement components and units must meet the original specifications Original Equipment Manufacturers (OEM) – warranty requirements, to maintain performance and safety requirements.

g. The inspection and testing of units and system to ensure compliance with manufacturer's, legal and performance requirements.

h. The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction:
   i. cleanliness of vehicle interior and exterior
   ii. security of components and fittings
   iii. re-instatement of components and fittings
   iv. testing and programming components for correct operation (as necessary)
   v. cancelling of any fault codes and warning lights
   vi. documentation completed prior to handover to customer (electronic/written)
   vii. explanation to customer of work completed (if applicable).

Unit 181 Knowledge of Overhauling Light Vehicle Steering and Suspension Units

Level:	Level 3
GLH:	20
Relationship to NOS:	This unit is linked to LV11 Overhaul Light Vehicle Mechanical Units.
Assessment type:	Multiple choice test
Aim:	This unit enables the learner to develop an understanding of the construction and operation and overhauling of steering and suspension units.

Learning outcome	**The learner will:**
1 understand how to overhaul light vehicle steering and suspension units	
Assessment criteria	
The learner can 1.1 describe how to work safely when overhauling light vehicle steering and suspension units, including: a. avoiding injury to self/others b. damage to vehicle systems, components and units c. contact with leakage and hazardous substances d. waste disposal (including environmental impact) e. when working on hybrid/electric and alternative fuel vehicles 1.2 identify light vehicle steering and suspension unit component 1.3 describe the construction and operation of light vehicle steering and suspension units 1.4 describe the common and appropriate types of testing methods used to check the operation of steering and suspension units and components and their purpose 1.5 explain how to prepare and check the accuracy and operation of all the overhauling and testing equipment required 1.6 explain common symptoms, causes and faults found in light vehicle steering and suspension units 1.7 explain methods used to identify steering and suspension unit faults 1.8 explain how to evaluate and interpret test results found in diagnosing light vehicle steering and suspension unit faults and compare with manufacturers' specifications and settings 1.9 explain how to examine, measure and make suitable adjustments to light vehicle steering and suspension components 1.10 explain how light vehicle steering and suspension units are dismantled, overhauled and reassembled 1.11 explain how to evaluate the operation and performance of replacement steering and suspension units and components and the reassembled system against vehicle operating specifications and legal requirements.	

Unit 181 Knowledge of Overhauling Light Vehicle Steering and Suspension Units

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit. The following is included to support centres in terms of teaching and delivery.

Knowledge to include, Hybrid/electric and alternative fuel vehicles and components where applicable.

Vehicle steering and suspension units

a. Identify unit components.
b. Understand unit construction.
c. Describe unit operation.

How units are dismantled and reassembled

a. The dismantling procedure.
b. Tools and equipment used for stripping and rebuilding units and assemblies.
c. Methods of safe storage for removed components during overhaul activities.
d. The process for assessing the condition of sub-assemblies including:
    i. fit
    ii. tolerances
    iii. permitted limits.
e. The rebuild procedure for units and assemblies.
f. Adjustment procedures during re-assembly.

Unit and assembly testing and evaluation procedures

a. Appropriate testing and evaluation procedures prior to dismantling units.
b. Appropriate testing and evaluation procedures of components after dismantling units.
c. How to use overhauling and test equipment for the task.
d. The cost-benefit relationship between reconditioning, repair and replacement of components within units.
e. How to test and evaluate the performance of the overhauled units against the operating specification.
f. How to interpret test results.
g. Adjustment procedures during final evaluation.

Faults associated with units and assemblies being overhauled

a. Causes of faults and failures within units and assemblies.
b. The faults associated with units and assemblies.
c. How to make adjustments to meet final specification after testing and evaluation of assembled units and assemblies.

The procedures for dismantling, removal and replacement of electrical and electronic units and components

a. The preparation, testing and use of:
    i. tools and equipment
    ii. removal and replacement of electrical and electronic systems and components.
b. Appropriate safety precautions:
    i. Personal protective equipment (PPE)
    ii. Vehicle protective equipment (VPE)
    iii. removal and replacing electrical and electronic components and systems.
c. The importance of logical and systematic processes.
d. Preparation of replacement units for re-fitting or replacement electrical and electronic components and systems.
e. The reasons why replacement components and units must meet the original specifications (original equipment manufacturer (OEM – warranty requirements, to maintain performance, safety requirements.
f. Refitting procedures.
g. The inspection and testing of units and systems to ensure compliance with manufacturer's, legal and performance requirements.

The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction:

cleanliness of vehicle interior and exterior

i. security of components and fittings
ii. re-instatement of components and fittings
iii. testing and programming components for correct operation (as necessary)
iv. cancelling of any fault codes and warning lights
v. documentation completed prior to handover to customer (electronic/written)
vi. explanation to customer of work completed (if applicable).

Unit 218 Competency in Removing and Fitting of Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non-Permanently Fixed Vehicle Body Panels

Level:	Level 2
GLH:	40
Relationship to NOS:	This unit is linked to BP18 Remove and Fit Basic Motor Mechanical, Electrical and Trim (MET) Components and Non Permanently Fixed Motor Vehicle Body Panels.
Assessment type:	Assignment
Aim:	This unit enables the learner to demonstrate they can carry out a range of removal and fitting of basic mechanical, electrical and trim (MET) components and non-permanently fixed light vehicle body panels. It also covers the evaluation of the operation of the components when fitted.

Learning outcome	**The learner will:**
1. be able to work safely when carrying out removal and fitting of basic MET components and non-permanently fixed light vehicle body panels	
Assessment criteria	
The learner can 1.1 use suitable personal protective equipment and vehicle coverings throughout all light vehicle removal and fitting of basic MET components and non-permanently fixed light vehicle body panels 1.2 work in a way which minimises the risk of damage or injury to the vehicle, people and the environment.	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can 2.1 select suitable sources of technical information to support light vehicle removal and fitting activities including: a. vehicle technical data b. removal and fitting procedures c. legal requirements 2.2 use technical information to support light vehicle removal and fitting activities.	

Learning outcome	**The learner will:**
3. be able to use appropriate tools and equipment	
Assessment criteria	

3.1 select the appropriate tools and equipment necessary for carrying out removal and fitting of basic MET components and non-permanently fixed light vehicle body panels 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the correct tools and equipment in the way specified by manufacturers when carrying removal and fitting of basic MET components and non-permanently fixed light vehicle body panels.

Learning outcome	**The learner will:**
4. be able to carry out removal and fitting of basic MET components and non-permanently fixed light vehicle body panels	
Assessment criteria	
The learner can 4.1 remove and fit basic MET components and non-permanently fixed light vehicle body panels 4.2 ensure that the removal and fitting of basic MET components and non-permanently fixed light vehicle body panels conforms to the vehicle operating specification and any legal requirements 4.3 ensure no damage occurs to other components when carrying out removal and fitting of basic MET components and non-permanently fixed light vehicle body panels 4.4 ensure all components and panels are stored safely and in the correct location.	

Learning outcome	**The learner will:**
5. be able to record information and make suitable recommendations	
Assessment criteria	
The learner can 5.1 produce work records that are accurate, complete and passed to the relevant person(s) promptly in the format required 5.2 make suitable and justifiable recommendations for cost effective repairs 5.3 record and report any additional faults noticed during the course of their work promptly in the format required.	

Unit 268 Knowledge of Removing and Fitting of Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non-Permanently Fixed Vehicle Body Panels

Level:	Level 2
GLH:	20
Relationship to NOS:	This unit is linked to BP18 Remove and Fit Basic Motor Mechanical, Electrical and Trim (MET) Components and Non Permanently Fixed Motor Vehicle Body Panels.
Assessment type:	Multiple choice test
Aim:	This unit enables the learner to develop an understanding of carrying out a range of removal and fitting of basic mechanical, electrical and trim (MET) components and non-permanently fixed light vehicle body panels. It also covers the evaluation of the operation of the components when fitted.

Learning outcome	**The learner will:**
1. understand how to carry out removal and fitting of basic light vehicle mechanical electrical and trim (MET) components	
Assessment criteria	
The learner can 1.1 identify the procedures involved in carrying out the systematic removal and fitting of basic light vehicle MET components to the standard required including: a. bumpers b. headlamp units c. road wheels d. batteries e. bonnet and boot trim f. interior trim components g. exterior trim components 1.2 identify the procedures involved in working with supplementary safety systems when fitting basic light vehicle MET components 1.3 identify the procedures involved in working with gas discharge headlamp systems when fitting basic light vehicle MET components 1.4 explain the methods and procedures for storing removed light vehicle MET components 1.5 identify the different types of fastenings and fixings used when removing and fitting light vehicle MET components 1.6 explain the reasons for the use of different types of fastenings and fixings used in light vehicle MET components 1.7 explain the procedures, methods and reasons for ensuring correct alignment of light vehicle MET components 1.8 identify the quality checks that can be used to ensure correct alignment and operation of light vehicle MET components	

1.9 identify correct conformity of vehicle systems against light vehicle specification and legal requirements on completion 1.10 explain the procedure for reporting cosmetic damage to light vehicle MET components and units.

Learning outcome	**The learner will:**
2. understand how to carry out removal and fitting of basic light vehicle non permanently fixed vehicle body panels	
Assessment criteria	
The learner can 2.1 identify the procedures involved in carrying out the systematic removal and fitting of basic light vehicle non-welded, non-structural body panels to the standard required including: a. wings b. doors c. bonnets d. boot lids and tailgates e. bumper bars, covers and components 2.2 identify the procedures involved in working with supplementary safety systems when fitting basic light vehicle non-welded, non-structural body panels 2.3 explain the methods and procedures for storing removed light vehicle non-welded, non-structural body panels 2.4 identify the different types of fastenings and fixings used when removing and fitting light vehicle non-welded, non-structural body panels 2.5 explain the reasons for the use of different types of fastenings and fixings used in light vehicle non-welded, non-structural body panels 2.6 explain the procedures, methods and reasons for ensuring correct alignment of light vehicle non-welded, non-structural body panels 2.7 identify the quality checks that can be used to ensure correct alignment and operation of light vehicle non-welded, non-structural body panels 2.8 identify correct conformity of vehicle systems against light vehicle specification and legal requirements on completion 2.9 explain the procedure for reporting cosmetic damage to light vehicle non-welded, non-structural body panels.	

Unit 268 Knowledge of Removing and Fitting of Basic Light Vehicle Mechanical, Electrical and Trim (MET) Components and Non-Permanently Fixed Vehicle Body Panels

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit. The following is included to support centres in terms of teaching and delivery.

Describe procedures to prevent damage to the vehicle, components and contents when removing, storing and refitting basic MET components

a. The methods that can be used to protect undamaged items to ensure they are removed and refitted without causing unnecessary damage:
    i. bumpers
    ii. headlamp units
    iii. road wheels
    iv. batteries
    v. bonnet and boot trim
    vi. interior trim components
    vii. exterior trim components.
b. The procedures for the correct storage of vehicle contents.
c. The process for the reporting of extra damage and items that may have broken when removed or refitted.

The processes involved when handling batteries

a. The procedure for the removal, storage and refitting of lead acid batteries.
b. The procedure for the disposal of lead acid batteries.
c. Battery checks:
    i. electrolyte
    ii. discharge
    iii. specific gravity.
d. The charging process and procedures:
    i. trickle charge
    ii. normal charge
    iii. boost/start.
e. The health and safety issues involved when charging (explosive gasses).

Types of clips and fixings

a. The following types of clips and identify reasons and limitations for their use:
    i. speed
    ii. ‘c’
    iii. ‘d’
    iv. ‘j’ type captive nut
    v. ‘r’
    vi. ‘u’ type captive nut
    vii. cable clip
    viii. trim clips.
b. The following types of fixings and identify reasons and limitations for their use:
    i. pop rivet
    ii. plastic rivet
    iii. plastic capture nut
    iv. nut and bolt
    v. shoulder bolt
    vi. ‘Nyloc’ type nuts
    vii. washers
    viii. ‘Spring’ type washers
    ix. self-tapping screws and bolts
    x. quick release plastic trim fastenings
    xi. trim tapes
    xii. adhesives and sealers.

The processes involved when carrying out quality checks

a. Items that may have been ‘workshop’ soiled and describe processes for rectifying:
    i. door cards
    ii. seats
    iii. carpets
    iv. boot and bonnet trims.
b. Methods for checking gaps.
c. The process for checking and aligning headlamps:
    i. address handling procedures for halogen bulbs
    ii. address handling and health and safety issues relating to xenon bulbs and systems.
d. Operational checks and rectification methods to include:
    i. lights
    ii. washers and wipers
    iii. SRS systems (checking not rectification)
    iv. charging system (checking not rectification)
    v. horn
    vi. fluid levels
    vii. interior switches
    viii. operation of door lock mechanisms.

Removing and fitting non-structural body panels

a. Find, interpret and use sources of information applicable to the removal and fitting of basic non welded non-structural body panels.
b. Select check and use all the tools and equipment required to remove and fit basic non welded non-structural body panels including:

i. hinge pin removers
ii. spanners
iii. screwdrivers.

c. The different types of mechanical fixings for non-welded non-structural body panels and when and why they should be used including:
   i. bolts
   ii. self-tapping bolts
   iii. speed nuts
   iv. washers.
d. The correct procedures and processes for removing and fitting of non-welded non-structural body panels.
e. The need for correct alignment of panels and methods to achieve this:
   i. aperture gaps
   ii. alignment of panel features
   iii. best fit of components to panels
   iv. vehicle geometry
   v. operation of openings such as doors, tailgates, bonnets etc.
f. The types of quality control checks that can be used to ensure correct alignment and contour of panels and operation of components to manufacturer's specification.
g. The method of storing removed panels and the importance of storing them correctly.

Unit 407 Competency in Diagnosing and Rectifying Vehicle Auxiliary Electrical Faults

Level:	Level 3
GLH:	90
Relationship to NOS:	This unit is linked to AE06 Diagnose and Rectify Vehicle Electrical Units and Component Faults.
Assessment type:	Assignment
Aim:	This unit enables the learner to demonstrate they can diagnose and rectify automotive vehicle auxiliary electrical system faults. It also covers the evaluation of performance of the replaced or repaired units and systems. This includes SI, CI, Hybrid and alternative fuel vehicles.

Learning outcome	**The learner will:**
1. be able to work safely when carrying out automotive vehicle auxiliary electrical diagnostic and rectification activities	
Assessment criteria	
The learner can: 1.1 use suitable personal and vehicle protective equipment when carrying out auxiliary electrical diagnostic and rectification activities 1.2 work in a way which minimises the risk of damage to the vehicle and its systems and the surrounding area including: a. damage to other vehicle systems b. damage to other vehicle components and units c. contact with leakage d. contact with hazardous substances 1.3 prepare the vehicle systems and work area for safe working procedures, as appropriate to the vehicle.	

Learning outcome	**The learner will:**
2. be able to use relevant information to carry out the task	
Assessment criteria	
The learner can: 2.1 select suitable sources of technical information to support automotive vehicle diagnostic and rectification activities including: a. vehicle technical data b. diagnostic test procedures 2.2 use sufficient diagnostic information in a logical and systematic way to enable an accurate diagnosis of automotive auxiliary electrical system faults.	

Learning outcome	The learner will:
3. be able to use appropriate tools and equipment	
Assessment criteria	
The learner can: 3.1 select, prepare and check the appropriate tools and equipment required following manufacturers' instructions for diagnostic and rectification activities 3.2 ensure that equipment has been calibrated to meet manufacturers' and legal requirements 3.3 use the correct tools and equipment required in the way specified throughout all automotive auxiliary electrical diagnostic and rectification activities.	

Learning outcome	The learner will:
4. be able to carry out automotive vehicle auxiliary electrical diagnosis, rectification and test activities	
Assessment criteria	
The learner can: 4.1 use diagnostic methods that are relevant to the symptoms presented 4.2 evaluate their assessment of dismantled sub-assemblies and identify their condition and suitability for repair or replacement accurately 4.3 carry out all diagnostic and rectification activities following: a. workplace procedures and manufacturers' instructions b. recognised researched diagnostic and rectification methods c. health and safety and environmental requirements 4.4 collect sufficient diagnostic information in a logical way to enable an accurate diagnosis of auxiliary electrical system faults 4.5 identify and record any system deviation from acceptable limits accurately 4.6 work in a way to ensure damage does not occur to components, other vehicle systems and units 4.7 ensure all repaired or replacement components and units conform to the vehicle operating specification and any legal requirements 4.8 adjust components and units correctly to ensure that they operate to meet system requirements 4.9 use testing methods that are suitable for assessing the performance of the system rectified 4.10 ensure the rectified automotive auxiliary electrical system performs to the vehicle operating specification and any legal requirements prior to return to the customer.	

Learning outcome	The learner will:
5. be able to record information and make suitable recommendations	
Assessment criteria	
The learner can: 5.1 complete all system diagnostic activities within the agreed timescale 5.2 identify and report any anticipated delays in completion to the relevant person(s) promptly in the format required. 5.3 record and report any additional faults noticed during the course of their work promptly in the format required. 5.4 make suitable and justifiable recommendations for cost effective repairs	

5.5	inform the relevant person(s) promptly where repairs are uneconomic or unsatisfactory to perform
5.6	ensure your records are accurate, complete and passed to the relevant person(s) within the agreed timescale in the format required.

Unit 457 Knowledge of Diagnosis and Rectification of Vehicle Auxiliary Electrical Faults

Level:	Level 3
GLH:	45
Relationship to NOS:	This unit is linked to AE06 Diagnose and Rectify Vehicle Electrical Units and Component Faults.
Assessment type:	Multiple choice test
Aim:	This unit enables the learner to develop an understanding of diagnosis and rectification of vehicle auxiliary electrical systems and their units. It also covers the evaluation of performance of the systems. This includes SI, CI, Hybrid and alternative fuel vehicles.

Learning outcome	**The learner will:**
1. understand vehicle electrical and electronic principles	
Assessment criteria	
The learner can: 1.2 explain the principles of electrical inputs, outputs. voltages and oscilloscope patterns, digital and electronic communication systems 1.3 explain the principles of sensor inputs, computer processing and actuator outputs 1.4 identify sensor types (passive and active) 1.5 identify the electrical principles that are related to light vehicle electrical circuits.	

Learning outcome	**The learner will:**
2. understand how light vehicle auxiliary electrical systems operate	
Assessment criteria	
The learner can: 2.1 describe how to work safely when diagnosing and rectifying auxiliary electrical system faults, including: a. avoiding injury to self/others b. damage to vehicle systems, components and units c. contact with leakage and hazardous substances d. waste disposal (including environmental impact) e. when working on hybrid/electric alternative fuel vehicles. 2.2 explain the construction and operation of advanced automotive auxiliary electrical systems including regenerative braking systems 2.3 describe how auxiliary electrical systems interact and are dismantled, reassembled, measured and adjusted to manufacturers' specifications 2.4 identify the types and causes of auxiliary electrical system, components, faults and failures	

2.5 identify vehicle operating specifications for limits and tolerances relating to auxiliary electrical systems

2.6 explain how to assess the condition within auxiliary electrical system, components and units

2.7 identify auxiliary electrical systems, component and unit replacement procedures, the circumstances which will necessitate replacement and other possible courses of action

2.8 explain how auxiliary electrical systems interlink and interact, including communication networks and multiplexing

2.9 compare auxiliary electrical system, components and assemblies against alternatives to identify differences in construction and operation

2.10 identify the electrical principles that are related to auxiliary electrical systems

2.11 describe the electrical and electronic principles associated with auxiliary electrical systems, including types of sensors and actuators, their application and operation.

Learning outcome	**The learner will:**
3. understand how to diagnose and rectify faults in auxiliary electrical systems	
Assessment criteria	
The learner can: 3.1 describe how to analyse symptoms and faults found in auxiliary electrical systems 3.2 explain systematic diagnostic techniques and testing of auxiliary electrical systems, using prescribed processes or formats 3.3 explain how to examine, measure and make suitable adjustments to components 3.4 explain how to select, prepare and use diagnostic and rectification equipment for auxiliary electrical systems 3.5 explain activities to rectify the faults in auxiliary electrical systems 3.6 explain how to source, interpret, evaluate and use information for diagnostic test results, including manufacturers tolerances, identification codes and legal requirements 3.7 explain how to evaluate the operation of components and systems following diagnosis and repair to confirm system performance. 3.8 describe the importance of work-based policies for the following: a. information for diagnostic and rectification activities b. working to agreed timescales and keeping others informed of progress c. the relationship between time and costs and productivity d. reporting anticipated delays to the relevant person(s) promptly.	

Unit 457 Knowledge of Diagnosis and Rectification of Vehicle Auxiliary Electrical Faults

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit. The following information is included to support centres in terms of teaching and delivery.

Knowledge to include diagnostic and rectification including Hybrid/electrical and alternative fuel vehicles.

The electrical principles that are related to light vehicle electrical circuits:

a. Ohms law
b. Voltage
c. Power
d. Current (AC and DC)
e. Resistance
f. Magnetism
g. Electromagnetism and electromagnetic induction
h. Digital and electronic communication systems
i. Electrical units and symbols
j. Electrical and electronic terminology including smart charging
k. Relevant electrical safety.

Battery and charging

a. The construction and operation of vehicle batteries including:
    i. different types of automotive batteries
    ii. cells
    iii. separators
    iv. plates
    v. electrolyte.
b. The diagnoses and rectification of the vehicle charging system:
    i. alternator
    ii. rotor
    iii. stator
    iv. slip ring
    v. brush assembly
    vi. three phase output
    vii. diode rectification pack
    viii. voltage regulation
    ix. phased winding connections
    x. cooling fan

xi. alternator drive system.

Starting

a. The layout, construction and operation of engine starting systems: gear reduction and pre-engaged principles.
b. The function and operation of the following components:
    i. gear reduction and pre-engaged starter motor
    ii. starter ring gear
    iii. pinion
    iv. starter solenoid
    v. ignition/starter switch
    vi. starter relay (if appropriate)
    vii. one-way clutch (pre-engaged starter motor).

Lighting systems and technology

c. Lighting systems should include:
    i. Xenon lighting
    ii. gas discharge lighting
    iii. ballast system
    iv. LED
    v. intelligent front lighting
    vi. complex reflectors
    vii. fibre optic
    viii. optical patterning
    ix. manufacturers specific lighting technology

Lighting circuits and the relationship between each circuit

d. Circuits must include:
    i. sidelights including number plate lights and marker lights
    ii. LED
    iii. dipped beam
    iv. main beam
    v. dim/dip
    vi. daytime running lights
    vii. indicators and hazard lights
    viii. high intensity and fog light.

Common faults and testing methods associated with external lighting system

e. Fault diagnosis for:
    i. lighting systems failing to operate correctly
    ii. switches
    iii. relays
    iv. bulbs failing to operate.

The operating principles of external lighting systems and multiplexing systems

f. To include all external lighting systems and a good knowledge of multiplexing systems.

The different types of electric windows and mirror systems and components

g. Components should include:
    i. window
    ii. mirror motors

iii. multi-functional switches
iv. relays
v. total closure modules.

The function of component parts in the electric window and mirror systems

h. Components must include:
   i. motors
   ii. relays
   iii. interfaces
   iv. modules
   v. switches.

The operating principles of electric windows and mirror systems

i. Operating principles of the following:
   i. motors
   ii. interfaces
   iii. switches
   iv. modules.

Common faults and testing methods associated with electric windows and mirror systems

j. Fault diagnosis for:
   i. electric windows failing to open or close
   ii. electric mirrors fail to adjust
   iii. slow operation on both systems.

The different types of screen heating systems and components

k. Systems must include:
   i. heated front screens
   ii. heated rear screens
   iii. heated mirrors.

The function and operating principles of components for heated screen and mirror systems

l. Components must include:
   i. front and rear screen elements
   ii. mirror elements
   iii. time control relays
   iv. multifunction relays and switches.

Common faults and testing methods associated with heated screen and mirror systems

a. Faults must include:
   i. screen elements not operating
   ii. timer relays not operating and staying on permanently.

The different types of I.C.E. systems and components (in car entertainment)

a. Systems and components must include:
   i. radio CD
   ii. DVD players
   iii. USB ports
   iv. MP3 players
   v. speakers
   vi. aerial systems

vii. amplifiers
viii. V.D.U. screens
ix. Satellite Navigation
x. communication units.

The function of components in I.C.E. systems

a. Systems include:
   i. radios
   ii. CD players
   iii.
   iv. DVD players
   v. USB ports
   vi. aerial systems
   vii. speakers
   viii. amplifiers
   ix. VDU screens
   x. mobile communication units.

The operating principles of I.C.E. systems

a. Operation of entertainment systems speaker and aerial systems.

Common faults and testing methods associated with I.C.E. systems

a. Faults to include:
   i. entertainment and navigation units not operating
   ii. speaker, aerial and amplifier systems not functioning correctly
   iii. excessive radio interference (suppression)
   iv. use of diagnostic computers and systems.

The different types of integrated security/warning systems and components

a. Components to include:
   i. control units
   ii. alarm modules
   iii. audible warning units
   iv. immobiliser units
   v. sensing units
   vi. horn
   vii. audible warning speakers
   viii. tracking devices

The function of component parts in integrated security and warning systems

a. Components to include
   i. control units
   ii. alarm modules
   iii. audible warning units
   iv. interior sensing systems
   v. immobiliser units
   vi. relays
   vii. LEDs
   viii. horns
   ix. tracking devices.

The operating principles of integrated security and warning systems

a. Operation of alarm systems and audible warning units.

The relevant legislation relevant to security and warning systems

m. Find and apply all relevant legislation for the fitment and use of security and warning systems.

Common faults and testing methods associated with security and warning systems

a. Components to include:
    i. control units
    ii. audible warning units
    iii. immobiliser units
    iv. horns
    v. relays
    vi. LEDs
    vii. wiring
    viii. connections and protection devices
    ix. removal and refitting procedures
    x. using computer diagnostics to identify faults
    xi. use of manufacturer's diagnostic equipment.

The different wiper system components

a. Components must include:
    i. wiper motors
    ii. washer motors
    iii. washer level sensor
    iv. automatic wipers and intermittent control
    v. wiper linkage
    vi. multifunction relays
    vii. headlamp wash/wipe.

The function of component wiper and washer components

a. Components and systems must include:
    i. wiper motors
    ii. automatic wipers and intermittent control
    iii. intermittent wash wipe relays
    iv. parking systems .

The operating principles, faults and testing methods of wiper and washer systems

a. Principles, fault diagnosis and testing for:
    i. wiper motors failing
    ii. damaged linkages
    iii. incorrect operation of intermittent and parking systems
    iv. earth faults
    v. control unit failure .

The different heating, cooling system components and air conditioning/climate control.

a. Components include:
    i. heater motors
    ii. speed control systems
    iii. switches
    iv. valves
    v. radiator cooling fan motors

vi. relays
vii. air conditioning units.

The function of component heating, cooling parts and air conditioning/climate control

a. Components include:
   i. heater motors
   ii. speed control systems
   ii. valves
   iii. switches
   iv. relays
   v. cooling fan motors
   vi. air conditioning units
   vii. thermostatic switches.

The operating principles and regulations of heating, cooling systems, and air conditioning/climate control

a. Principles to include:
   i. conduction
   ii. convection
   iii. radiation
   iv. circulation
   v. boiling points
   vi. states of matter (gas, liquid, solid)
   vii. temperature control
   viii. heat transfer.

Common faults and testing methods associated with heating, cooling systems and air conditioning/climate control

a. Fault diagnosis for:
   i. heater motor failing to operate on all/one speed
   ii. radiator cooling fan not operating
   iii. valves
   iv. relays
   v. switches not operating
   vi. electrical related faults on the air conditioning system.

The different types of locking system components

a. **Including:**
   i. door locking actuators
   ii. solenoids
   iii. deadlocking actuators
   iv. anti-theft modules
   v. boot release solenoids
   vi. remote central locking
   vii. keyless entry
   viii. specific integrated manufacturer systems

The operation and function of locking system and components

a. Solenoids, actuators multifunctional relays, anti-theft modules and release systems.

Common faults and testing methods associated with locking systems

a. Door locking actuators, solenoids, connections, wiring, relays, and protection devices/fuses.

The different types of Supplementary Restraint and Airbag systems

a. Components include:
   i. control units
   ii. sensors
   iii. seat belt pretensioners
   iv. airbag assemblies
   v. wiring systems
   vi. warning systems.

The function of component parts in the Supplementary Restraint and Airbag systems

a. Components include:
   i. control units
   ii. interfaces
   iii. sensors
   iv. airbag units
   v. pretensioners.

The operating principles of Supplementary Restraint and Airbag systems

a. including:
   i. Operation of the sensors.
   ii. Operation of the airbag unit.
   iii. Operation of the various types of pretensioner.
   iv. Safe handling procedures and regulations.

Common faults and testing methods associated Supplementary Restraint and Airbag systems

a. Fault diagnosis for Airbag and SRS faults:
   i. fault code identification
   ii. wiring faults
   iii. component failure
   iv. earth problems
   v. sensor faults.

How to select, prepare and use diagnostic and rectification equipment for automotive auxiliary electrical systems

a. including:
   i. Voltmeters
   ii. Ammeters /amp clamp
   iii. Ohmmeters
   iv. Multi-meters
   v. Battery testing equipment
   vi. Dedicated and computer based diagnostic equipment
   vii. Oscilloscopes.

How to examine, measure and make suitable adjustments to components for automotive auxiliary electrical systems

a. including:
   i. Settings
   ii. Input and output values
   iii. Voltages
   iv. Current consumption

v. Resistance
vi. Input and output patterns with oscilloscope (including frequency and duty cycle
vii. measurements
viii. Condition
ix. Wear and performance

The inspection and re-instatement of the vehicle following repair to ensure customer satisfaction

a. including:
   i. cleanliness of vehicle interior and exterior
   ii. security of components and fittings
   iii. re-instatement of components and fittings
   iv. testing and programming components for correct operation (as necessary)
   v. cancelling of any fault codes and warning lights
   vi. documentation completed prior to handover to customer (electronic/written)
   vii. explanation to customer of work completed (if applicable).

Unit 601 Knowledge of Carrying Out Non-High Voltage Operations On, Near or With an Electric Vehicle

Level:	Level 1
GLH:	8
Relationship to NOS:	EV01: carry out non high voltage operations on, near or with an electric vehicle.
Assessment type:	Multiple choice test
Aim:	To be able to identify and name the types of electric vehicles and the high voltage components fitted, and to be able to state the legislation and understand the hazards associated with working around high voltage vehicles. Know how to identify the different types of charging systems, and how to safely charge on electric vehicles. This unit is for people who work on, near or with electric vehicles but do not work on the vehicle's high voltage system.

Learning outcome	**The learner will:**
1. understand the operational differences between electric and non-electric vehicles, and know how to identify the different types of electric vehicles	
Assessment criteria	
The learner must know: 1.1 the differences between an electric vehicle and a non-electric vehicle 1.2 how to identify electric vehicles and their type 1.3 how to identify and locate high voltage electrical components in an electric vehicle 1.4 the function of high voltage components 1.5 how to identify the types of charging systems associated with electric vehicles 1.6 the methods of sourcing information related to electric vehicles 1.7 how to use and interpret technical information on electric vehicles.	

Learning outcome	**The learner will:**
2. understand the importance of adhering to health and safety legislation, regulations, guidelines and workplace procedures and know how to work safely around electric vehicles	
Assessment criteria	
The learner must know: 2.1 current health and safety legislation, industry codes of practice or guidelines relevant to working on, near or with electric vehicles 2.2 the personal protective equipment required when working on or around electric vehicles 2.3 the importance of ensuring a safe working environment 2.4 the workplace procedures for working safely around electric vehicles	

2.5	how to safely operate an electric vehicle
2.6	how to safely work around high voltage components
2.7	the precautionary measures necessary when using plug-in charging equipment and how to use charging systems safely
2.8	workplace procedures that must be followed in the event of emergencies.

Learning outcome	**The learner will:**
3. understand the hazards associated with working on or around electric vehicles	
Assessment criteria	
The learner must know:	
3.1	the hazards associated with high voltage components
3.2	the hazards associated with electric vehicles when exposed to extreme temperatures, vehicle impact and other adverse conditions
3.3	the health implications of strong magnetic fields and electrical conductivity through the human body.

Unit 601 Knowledge of Carrying Out Non-High Voltage Operations On, Near or With an Electric Vehicle

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.

Learning outcome 1
Range

1.1 **Differences** between

a. Internal combustion engines
b. Starting systems
c. Charging systems
d. Regenerative braking
e. Layouts
f. Badging / logos
g. Components

1.1-1.5 **Electric vehicle(s)**

a. Pure (PEV) / battery electric vehicle (BEV)
b. Extended range (ER-EV)
c. Range extended (RE-EV)
d. Fuel cell (FCEV)
e. Hybrid (HEV)
f. Plug-in hybrid (PHEV)
g. Mild hybrid

1.3-1.4 **Components**

a. High voltage batteries
b. Low voltage batteries
c. Invertor
d. High voltage cables
e. DC to DC convertor
f. Fuel cell
k. Charging equipment and cables
l. Motor/generators

1.4 **Types of charging systems**

a. Plugs/ sockets (AC to DC)
b. Trickle charging (3 pin socket)
c. AC charging
d. DC charging (charging station)
e. Combined charging systems
f. Hybrid self-charging systems

1.6 **Sources of information**

a. Manufacturer or vehicle technical information
b. Job cards
c. Equipment manufacturer's websites

1.7 **Technical information** on

a. Charging socket type and location
b. Location of high voltage components
c. Location of low voltage batteries
d. Connecting an auxiliary power source
e. Battery range/capacity
f. Dashboard symbols

Learning outcome 2
Range

2.1 **Health and safety legislation, industry codes of practice, guidelines**

a. Health and safety at work act (HASWA)
b. Electrical equipment regulations
c. Electricity at work regulations
d. Regulation No 100 of the Economic Commission for Europe of the United Nations (UNECE) – 'High Voltage means the classification of an electric component or circuit, if it's working voltage is > 60 V and ≤ 1500 V DC or > 30 V and ≤ 1000 V AC
e. HSE guidelines

The latest relevant legislation should be referred to.

2.1-2.2
2.4-2.5 **Electric vehicle(s)**

a. Pure (PEV) / battery electric vehicle (BEV)
b. Extended range (ER-EV)
c. Range extended (RE-EV)
d. Fuel cell (FCEV)
e. Hybrid (HEV)
f. Plug-in hybrid (PHEV)
g. Mild hybrid

2.2 **Personal protective equipment**

a. Overalls
b. Foot protection
c. Gloves (correctly rated)
d. Eye protection

2.3 **Safe working environment**

a. Signage
b. Barriers
c. Cordoning
d. Secure key box
e. Spill kit
f. Warning labels

2.4 **Workplace procedures** for

a. Ensuring that the vehicle has been made safe as appropriate to the work you are carrying out
b. Referring/reporting problems when working with electric vehicles
c. Recording and reporting work carried out on electric vehicles

2.5 **Safely operate** procedures include
a. Ensure vehicle is in ready mode
b. Check for warning symbols on dashboard
c. Check for system displays and messages
d. Check surroundings before moving off
e. Awareness that an engine may start at any time on a hybrid vehicle

2.6 **High voltage components**
a. Batteries
b. Capacitors
c. Invertor
d. DC to DC convertor
e. Motors(AC/traction)
f. Cabling
g. Air conditioning compressor

2.8 **Emergencies**
a. Electric shock
b. Fire
c. Flood
d. Chemical leakage

Learning outcome 3
Range

3.1, 3.2 **Hazards**
a. Fire / thermal runaway
b. Explosion
c. Arc flash
d. Gases/fumes
e. Chemicals
f. Electric shock
h. Dangerous voltage retention in components even when vehicle is switched off

3.1 **High voltage components**
a. Batteries
b. Capacitors
c. Invertor
d. DC to DC convertor
e. Motors (AC/traction)
f. Cabling
g. Air conditioning compressor

3.2 **Electric vehicle(s)**
a. Pure (PEV) / battery electric vehicle (BEV)
b. Extended range (ER-EV)
c. Range extended (RE-EV)

d. Fuel cell (FCEV)
e. Hybrid (HEV)
f. Plug-in hybrid (PHEV)
g. Mild hybrid

3.3 **Implications**

a. Cardiac arrest
b. Muscle, nerve and tissue damage
c. Thermal burns
d. Medical equipment damage including pacemakers

Unit 602 Knowledge of Isolating and Re-energising High Voltage Systems in an Electric Vehicle

Level:	Level 2
GLH:	14
Relationship to NOS:	EV04: isolate and re-energise high voltage systems in an electric vehicle
Assessment type:	Multiple choice test
Aim:	This unit enables the learner to identify and describe the types of electric vehicles, their associated components and the terminology used. To understand the importance of legislation and to understand the hazards associated with working on high voltage vehicles. To be able to follow workplace procedures and prepare an electric vehicle for isolation and understand how to correctly and safely isolate and re-energise an electric vehicle using the correct tools/equipment following manufacturers procedures.

Learning outcome	**The learner will:**
1. understand the differences between the different types of electric vehicles and their electrical systems	
Assessment criteria	
The learner must know: 1.1 the different types of electric vehicles and their electrical systems 1.2 the terminology used within electric vehicle systems 1.3 how and where to access technical information on the specific electric vehicle systems 1.4 how to identify high voltage components including their location and the routing of high voltage cabling 1.5 the features of high voltage safety systems relevant to their work.	

Learning outcome	**The learner will:**
2. understand the legislative and workplace procedures that should be adhered to when isolating and re-energising high voltage systems in an electric vehicle	
Assessment criteria	
The learner must know: 2.1 the current health and safety legislation, industry codes of practice or guidelines relevant to working on electric vehicles 2.2 specific vehicle manufacturer's repair and safety procedures 2.3 the importance of manufacturer's guidance and the precautions necessary to take when: a. charging	

b. connecting an auxiliary power source to an electric vehicle
c. towing/lifting an electric vehicle

2.4 how to select and use the appropriate personal
a. personal protective equipment
b. signage

2.5 the importance of working in a way which minimises the risk of:
a. injury to themselves and others
b. damage to their working environment
c. damage to other vehicle systems, components and units

2.6 workplace requirements and procedures for:
a. reporting/referral of problems
b. making others aware that work is being carried out a vehicle

2.7 workplace procedures that must be followed in the event of emergencies.

Learning outcome	**The learner will:**
3. understand the hazards associated with working on or around electric vehicles	
Assessment criteria	
The learner must know: 3.1 how to identify hazards associated with working with electric vehicles 3.2 the hazards associated with electric vehicles when exposed to extreme temperatures, vehicle impact and other adverse conditions 3.3 the implications of electrical conductivity and strong magnetic fields through the human body.	

Learning outcome	**The learner will:**
4. understand how to isolate and re-energise electric vehicle high voltage systems	
Assessment criteria	
The learner must know: 4.1 methods of sourcing information for isolating and re-energising an electric vehicle's high voltage systems 4.2 how to use and interpret technical information for isolating and re-energising an electric vehicle's high voltage systems 4.3 how to select and use the correct electrical testing equipment 4.4 how to calibrate and test multimeters, diagnostic equipment and specific vehicle testing equipment, prior to use 4.5 the procedure for isolating and re-energising an electric vehicle's high voltage system following manufacturer's instructions 4.6 how to accurately test that the residual voltage is below manufacturer's specification following the isolation process 4.7 how to test and evaluate the performance of the high voltage system against manufacturer's operating specifications and legal requirements 4.8 how to interpret test results and make recommendations based on test results 4.9 the importance of ensuring all high voltage vehicle systems are functioning correctly and safely before the vehicle is released to the customer.	

Unit 602 Knowledge of Isolating and Re-energising High Voltage Systems in an Electric Vehicle

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.

Learning outcome 1
Range

1.1-1.3 **Electric vehicle(s)**

a. Pure (PEV) / battery electric vehicle (BEV)
b. Extended range (ER-EV)
c. Range extended (RE-EV)
d. Fuel cell (FCEV)
e. Hybrid (HEV)
f. Plug-in hybrid (PHEV)
g. Mild hybrid
h. Micro hybrid

1.4 **Identify** from:

a. Labelling
b. Colour
c. Materials
d. Insulation
e. Cross-sectional area

1.4 **Components** include:

a. High voltage batteries (to include Nickel Metal Hydride (Ni-Mh), Lithium (Li-ion))
b. Invertor
c. High voltage cables
d. DC to DC convertor
e. Fuel cell
f. Cooling components
g. PTC heaters
h. Heat pumps
i. High voltage air conditioning compressors
j. Charging equipment and cables
k. AC three phase motor/generators
l. Power/battery management system

Learning outcome 2
Range

2.1 **Health and safety legislation, industry codes of practice, guidelines**

a. Health and safety at work act
b. Electrical equipment regulations
c. Electricity at work regulations
d. Regulation No 100 of the Economic Commission for Europe of the United Nations (UNECE) – 'High Voltage means the classification of an electric component or circuit, if it's working voltage is > 60 V and ≤ 1500 V DC or > 30 V and ≤ 1000 V AC root mean square (ms)
e. HSE guidelines
f. End of Life Vehicle regulations
g. COSHH

The latest relevant legislation should be referred to.

2.3 **Towing precautions** to include

a. Speed limitations
b. Distance limitations
c. Potential energising of components / systems

2.4 **Personal protective equipment** to include

a. Overalls
b. Foot protection
c. Gloves (correctly rated)
d. Eye protection
e. Rubber mats
f. Insulated tools

2.5 **Components** include:

High voltage batteries (to include Nickel Metal Hydride (Ni-Mh), Lithium (Li-ion))
b. Invertor
c. High voltage cables
d. DC to DC convertor
e. Fuel cell
f. Cooling components
g. PTC heaters
h. Heat pumps
i. High voltage air conditioning compressors
j. Charging equipment and cables
k. AC three phase motor/generators
l. Power/battery management system

2.7 **Emergencies**

a. Electric shock
b. Fire
c. Flood

Learning outcome 3
Range

3.1, 3.2 **Hazards**

a. Fire / thermal runaway
b. Explosion

c. Arc flash
d. Gases/fumes
e. Chemicals
f. Electric shock
g. Damage to cables
h. Dangerous voltage retention in components even when vehicle is switched off

3.1-3.2 **Electric vehicle(s)**

a. Pure (PEV) / battery electric vehicle (BEV)
b. Extended range (ER-EV)
c. Range extended (RE-EV)
d. Fuel cell (FCEV)
e. Hybrid (HEV)
f. Plug-in hybrid (PHEV)
g. Mild hybrid

3.3 **Implications**

a. Cardiac arrest
b. Muscle, nerve and tissue damage
c. Thermal burns
d. Medical equipment damage e.g. pacemakers

Learning outcome 4
Range

4.1 **Sourcing information** from

a. Manufacturer or vehicle technical information
b. Job cards
c. Equipment manufacturer's websites
d. Internet / web-based systems
e. Mobile phone applications
f. Manufacturer's support – obtain technical support on roadside
g. Manufacturer's recovery information – to include location of high voltage components and safe handling instructions (first responder)

4.2 **Technical information** on:

a. High voltage systems
b. Low voltage systems
c. Operating voltage ranges

4.1, 4.2, 4.5 **Electric vehicle(s)**

a. Pure (PEV) / battery electric vehicle (BEV)
b. Extended range (ER-EV)
c. Range extended (RE-EV)
d. Fuel cell (FCEV)
e. Hybrid (HEV)
f. Plug-in hybrid (PHEV)
g. Mild hybrid
h. Micro hybrid

4.4 **Procedure** to include:

a. Following manufacturers set procedure / instructions
b. Identification and location of:
   i. isolation switches/plugs
   ii. service

iii. isolation connector

c. Risk assessment

4.8 **Interpret**:

a. Live data
b. Test results
c. Manufacturer's specifications
d. Tolerances

Unit 603 Knowledge of Removing and replacing Components in an Electric Vehicle High Voltage Powertrain and Ancillary Systems

Level:	Level 3
GLH:	28
Relationship to NOS:	EV03: remove and replace components in an electric vehicle high voltage powertrain and ancillary systems
Assessment type:	Multiple choice test
Aim:	To be able to identify and describe the function and operation of different types of electric and hybrid systems and components including charging. To understand the importance of legislation, and to understand the hazards associated with working on electric vehicles. To safely carry out the removal and replacement of components in isolated high voltage systems in an electric vehicle, and the effect that high voltage component technology has on other vehicle systems. High voltage systems include the powertrain and ancillary systems.

Learning outcome	**The learner will:**
1. understand the operation of electric vehicle systems	
Assessment criteria	
The learner must know: 1.1 the operational and constructional differences between an electric vehicle and a non-electric vehicle 1.2 the different types of electric vehicles and their electrical systems 1.3 the advantages and disadvantages of different types of charging systems associated with electric vehicles.	

Learning outcome	**The learner will:**
2. understand the features, function and construction of electric vehicle components and alternative fuel systems	
Assessment criteria	
The learner must know: 2.1 how to identify the components that make up the high voltage electrical system 2.2 how to locate high voltage electrical cables and components in an electric vehicle 2.3 the voltages of high voltage components fitted to different types of electric vehicles 2.4 the function and construction of high voltage components 2.5 methods of sourcing information applicable to component: a. construction b. removal	

c. replacement within an electric vehicle's high voltage systems

2.6 how to use and interpret technical information applicable to component:
   a. construction
   b. removal
   c. replacement within an electric vehicle's high voltage systems

2.7 the purpose and advantages of alternative fuel components and systems on electric vehicles

2.8 the benefits of different types of energy storage systems.

Learning outcome	**The learner will:**
3. understand the electrical and electronic principles relating to low and high voltage systems and components	
Assessment criteria	
The learner must know: 3.1 the principles of chassis and insulated earth return systems as appropriate to electric vehicles 3.2 electrical and electronic theories including electrical terminology, symbols and units 3.3 electrical and electronic principals associated with ancillary systems, sensors and actuators, their application and operation 3.4 the operating principles of electric vehicle components 3.5 how interaction occurs between components within electric vehicle systems 3.6 how electric vehicle systems interact and communicate.	

Learning outcome	**The learner will:**
4. understand the importance of adhering to health and safety legislation, regulations, guidelines and workplace procedures and know how to work safely around electric vehicles	
Assessment criteria	
The learner must know: 4.1 current health and safety legislation, industry codes of practice or guidelines relevant to working on electric vehicles 4.2 the importance of manufacturers guidance and the precautions necessary to take when: a. charging b. connecting an auxiliary power source to an electric vehicle c. towing or lifting an electric vehicle 4.3 how to select, check and use the appropriate personal protective equipment and vehicle protective equipment 4.4 how to ensure a safe working environment 4.5 how to store, dispose of, recycle and return any removed high voltage components in line with legislative, environmental and organisational requirements 4.6 manufacturer's and workplace requirements and procedures for: a. reporting/referring problems b. making others aware that work is being carried out on an electric vehicle 4.7 workplace and safety procedures that must be followed in the event of electric shock 4.8 how to safely operate an electric vehicle 4.9 how to safely use charging systems and plug in charging equipment 4.10 how to safely mobilise an electric vehicle	

4.11 how to work safely avoiding damage to other vehicle systems, components and units and contact with leakage and hazardous substances.

Learning outcome	**The learner will:**
5. understand the hazards associated with working on electric vehicles and how to minimise risk to yourself and others when removing and replacing components in an electric vehicle	
Assessment criteria	
The learner must know: 5.1 the hazards associated with high voltage components 5.2 how to reduce the risk of high voltage hazards when working on and around electric vehicles 5.3 the impact of hazards associated with electric vehicles when exposed to extreme temperatures, vehicle impact and other adverse conditions 5.4 the health implications of strong magnetic fields and electrical conductivity through the human body 5.5 the hazards associated with alternative fuel systems, including hydrogen fuel cells 5.6 the hazards associated with interrupting a circuit with high current flow and the need for high voltage circuit protection 5.7 how to carry out a risk assessment on damaged or broken-down electric vehicles.	

Learning outcome	**The learner will:**
6. understand how to test, remove and replace components in an electric vehicle	
Assessment criteria	
The learner must know: 6.1 how to identify faults and damage using testing methods in high voltage electrical systems and components 6.2 how to select and use the correct testing equipment 6.3 how to select, prepare, check and use repair and replacement equipment 6.4 how to conduct tests on isolated high voltage systems following safety and workplace procedures 6.5 how to conduct a test on energy sources and systems 6.6 how to determine the serviceability of a component in a high voltage system 6.7 the manufacturer's specification on the type and quality of components to be used for replacement 6.8 how to remove and replace a component on an electric vehicle system following manufacturer's instructions 6.9 the importance of testing and evaluating the performance of replacement components and the reassembled system against manufacturer's operating specifications and legal requirements and make a recommendation based on test results 6.10 the importance of ensuring all vehicle systems and components are functioning correctly and safely before the vehicle is released to the customer.	

Unit 603 Knowledge of Removing and Replacing Components in an Electric Vehicle High Voltage Powertrain and Ancillary Systems

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.

Learning outcome 1
Range

1.1 **Differences between**

a. Traction motor/Internal combustion engines
b. Emissions
c. Starting systems
d. Shutting down (powering off)
e. Charging systems and power sources
f. Battery range
g. Braking systems
h. Layouts
i. Badging
j. Components

1.1-1.3 **Electric vehicle(s)**

a. Pure (PEV) / battery electric vehicle (BEV)
b. Extended range (ER-EV)
c. Range extended (RE-EV)
d. Fuel cell (FCEV)
e. Hybrid (HEV)
f. Plug-in hybrid (PHEV)
g. Mild hybrid
h. Micro hybrid

1.3 **Types of charging systems**

a. Plugs/ sockets (AC/DC)
b. Trickle charging (3 pin socket)
c. AC charging
d. DC charging (charging station)
e. Combined charging systems
f. Hybrid self-charging systems

Learning outcome 2
Range

2.1 **Identify** from:

a. Labelling
b. Colour
c. Materials
d. Insulation
e. Cross-sectional area

2.1 **Component** types:

a. Electrical
b. Electronic
c. Magnetic
d. Chemical
e. Mechanical

2.1-2.4 **Components/ High voltage components**

a. High voltage batteries (to include Nickel Metal Hydride (Ni-Mh), Lithium (Li-ion))
b. Invertor
c. High voltage cables
d. DC to DC convertor
e. Fuel cell
f. Cooling components
g. PTC heaters
h. Heat pumps
i. High voltage air conditioning compressors
j. Charging equipment and cables
k. AC three phase motor/generators
l. Power/battery management system
m. Auxiliary systems
n. Chassis and insulated earth return systems

2.2, 2.3, 2.5-2.7 **Electric vehicle(s)**

a. Pure (PEV) / battery electric vehicle (BEV)
b. Extended range (ER-EV)
c. Range extended (RE-EV)
d. Fuel cell (FCEV)
e. Hybrid (HEV)
f. Plug-in hybrid (PHEV)
g. Mild hybrid
h. Micro hybrid

2.5 **Sourcing information** from

a. Manufacturer or vehicle technical information
b. Job cards
c. Equipment manufacturer's websites
d. Internet / web-based systems
e. Mobile phone applications

2.6 **Technical information** on

a. Location of high voltage components
b. Location of low voltage batteries
c. Isolating and re-energising procedures
d. Component replacement

2.7 **Alternative fuel components**

a. Alternative fuels including hydrogen and liquefied petroleum gas
b. Fuel Tanks
c. Fuel lines
d. Fuel cell stack
e. Batteries (high / low voltage)
f. Motor / Generators
g. Power and battery management control units
h. DC / DC convertor
i. Cooling components

2.8 **Energy storage systems**

a. Fully electric vehicle batteries
b. Hybrid batteries
c. Auxiliary battery
d. Fuel cells
e. Capacitors

Learning outcome 3
Range

3.2 **Electrical and electronic theories**

a. Ohms law
b. Watts law
c. Voltage
d. Power
e. Current (ac/dc)
f. Resistance
g. Magnetism
h. Electromagnetism
i. Electromagnetic induction

3.3 **Sensors**

a. Voltage
b. Current
c. Temperature
d. Position

3.3 **Actuators**

a. Idle speed control
b. Swirl flaps
c. Exhaust Gas recirculation
d. Purge Solenoid Valve Control
e. Turbocharger
f. Heating and air conditioning

3.4-3.6 **Electric vehicle(s)**

a. Pure (PEV) / battery electric vehicle (BEV)
b. Extended range (ER-EV)
c. Range extended (RE-EV)
d. Fuel cell (FCEV)
e. Hybrid (HEV)
f. Plug-in hybrid (PHEV)

g. Mild hybrid
h. Micro hybrid

3.5 **Component** types

a. Electrical
b. Electronic
c. Magnetic
d. Chemical
e. Mechanical

3.5 **Components**

a. High voltage batteries
b. Invertor
c. DC to DC convertor
d. Cooling / heating components,
e. High voltage air conditioning compressors
f. Charging equipment and cables
g. AC three phase motor/generators
h. Power/battery management system
i. Auxiliary batter

3.5-3.6 **Interaction**

a. Between electric motor and engine
b. Controller Area Network (CAN)
c. Local Interconnected Network (LIN)
d. Media Oriented Systems Transport (MOST)
e. FlexRay
f. SRS (Supplementary restraint systems)
g. Braking systems including (ABS)
h. Steering-By-Wire (SBW)

Learning outcome 4
Range

4.1 **Health and safety legislation, industry codes of practice, guidelines**

a. Health and safety at work act
b. Electrical equipment regulations
c. Regulation No 100 of the Economic Commission for Europe of the United Nations (UNECE) – 'High Voltage means the classification of an electric component or circuit, if it's working voltage is > 60 V and ≤ 1500 V DC or > 30 V and ≤ 1000 V AC root mean square (ms)
d. Electricity at Work Regulations
e. HSE guidelines
f. Manufacturer technical repair information
g. End of Life Vehicle regulations
h. COSHH

4.1, 4.2
4.8, 4.9, 4.11 **Electric vehicle(s)**

a. Pure (PEV) / battery electric vehicle (BEV)
b. Extended range (ER-EV)
c. Range extended (RE-EV)
d. Fuel cell (FCEV)
e. Hybrid (HEV)
f. Plug-in hybrid (PHEV)

g. Mild hybrid
h. Micro hybrid

4.2 **Towing precautions** to include
a. Speed limitations
b. Distance limitations
c. Potential energising of components / systems

4.3 **Personal protective equipment** to include
d. Overalls
e. Feet protection
f. Gloves (correctly rated)
h. Eye protection
i. Rubber mats
j. Insulated tools

4.3 **Vehicle protective equipment** to include
a. Seat covers
b. Floor mats
c. Steering wheel covers
d. Wing protectors

4.4 **Safe working environment** to include
a. Signage
b. Barriers
c. Cordoning
d. Secure key box
e. Spill kit
f. Warning labels

4.8 **Safely operate** procedures include
a. Ensure vehicle is in ready mode
b. Check for warning symbols on dashboard
c. Check for system displays and messages
d. Check surroundings before moving off
e. Awareness that an engine may start at any time on a hybrid vehicle

4.9 **Safe use of charging systems** procedures include
a. Precautions when charging in the presence of water – e.g., rain, valeting bay
b. Correct use of extension leads when charging
c. Check suitability of power supply used when charging
d. Signage
e. Cabling and connections
f. Risks to personal health and safety

Learning outcome 5
Range

5.1-5.3, 5.5, 5.6 **Hazards to include**

a. Fire / thermal runaway
   i. Exothermic reaction
   ii. Endothermic reaction
b. Explosion
c. Arc flash
d. Gases/fumes
e. Chemicals
f. Electric shock
g. Damage to cables
h. Dangerous voltage retention in components even when vehicle is switched off

5.1 **High voltage components**

a. High voltage batteries (to include Nickel Metal Hydride (Ni-Mh), Lithium (Li-ion))
b. Invertor
c. High voltage cables
d. DC to DC convertor
e. Fuel cell
f. Cooling components
g. PTC heaters
h. Heat pumps
i. High voltage air conditioning compressors
j. Charging equipment and cables
k. AC three phase motor/generators
l. Power/battery management system
m. Auxiliary systems

5.2, 5.3, 5.6 **Electric vehicle(s)**

a. Pure (PEV) / battery electric vehicle (BEV)
b. Extended range (ER-EV)
c. Range extended (RE-EV)
d. Fuel cell (FCEV)
e. Hybrid (HEV)
f. Plug-in hybrid (PHEV)
g. Mild hybrid
h. Micro hybrid

5.4 **Implications**

a. Cardiac arrest
b. Muscle, nerve and tissue damage
c. Thermal burns
d. Medical equipment damage e.g. pacemakers

5.7 **Risk assessment** procedures include

a. Risk assessment documentation and responsible persons
b. Taking action to eliminate or reduce risk
c. Observing, assessing, analysing an environment while working, to identify and remove risk
d. Monitoring situation
e. Reviewing situation

Learning outcome 6
Range

6.1 **Testing methods**

a. Sensory (visual, sound, smell, touch for temperature or vibration)
b. Functional
c. Measurement (including fault code identification)

6.1, 6.6-6.8, 6.10 **Components**

a. High voltage batteries
b. Low voltage batteries
c. AC three phase motors/generators
d. Cabling and wiring (wiring colour, size and cross-sectional area)
e. Relays and contactors
f. Electronic control units
g. On-board charger and charging port
h. DC to DC convertor
i. Isolators
j. Inverters/rectifiers
k. Battery management units
l. Vehicle start/stop control
m. Driver instrumentation
n. Multi-battery systems
o. Drive trains (layout)
p. Power sources, (engine / motor)
q. Sensors (voltage, current, temperature, position, resolver)
r. Ancillary components
s. Air conditioning compressor
t. Heating components

6.2/6.3 **Equipment**

a. Electrical multimeters / voltmeter rated to a minimum 1000V (CAT. III) or 600V (CAT.IV) including leads and probes
b. Other safe and appropriate electrical testing equipment
c. Hand tools
d. Code readers
e. Special tools (manufacturer specific equipment/diagnostic equipment and software)
f. Relevant safety equipment

6.9 **Testing** by

a. Checking fault codes
b. Checking voltage/current
c. Checking wiring and cable routing
d. Conducting road tests

6.9 **Evaluating** by

a. Checking warning lights
b. Checking on board displays
c. Using diagnostic equipment
d. Conducting a road test

Unit 612 Skills in Isolating and re-energising High Voltage Systems in an Electric Vehicle

Level:	Level 2
GLH:	3
Relationship to NOS:	EV04: Isolate and re-energise high voltage systems in an electric vehicle
Assessment type:	Assignment
Aim:	To be able to demonstrate how to isolate and re-energise an electric vehicle correctly and safely to manufacturer's instructions.

Learning outcome	**The learner will:**
1. be able to work safely when isolating and re-energising a high-voltage system in an electric vehicle, adhering to legislation, workplace and manufacturer's requirements	
Assessment criteria	
The learner must know: 1.1 identify the type of electric vehicle being worked on 1.2 locate and record relevant information about the vehicle 1.3 notify relevant colleagues of their intention to work on a high voltage vehicle 1.4 ensure the work area is clearly identified and made safe using signs and barriers as appropriate 1.5 work in a way that minimises risk of: a. injury to themselves b. damage to their working environment c. damage to other vehicle systems, components and units 1.6 select and use the appropriate personal protective equipment (PPE) and vehicle protective equipment (VPE) when isolating and re-energising high voltage systems in electric vehicles 1.7 conduct a dynamic risk assessment on the electric vehicle and the working area to determine any potential hazards 1.8 assess the hazards presented by the electric vehicle 1.9 follow manufacturers' and workplace procedures for: a. reporting/referring problems b. recording and reporting work carries out on an electric vehicle 1.10 follow current regulatory requirements and legislation relevant to working on electric vehicles.	

Learning outcome	**The learner will:**
2. be able to safely isolate and re-energise an electric vehicle high voltage system and evaluate the performance of the re-energised system	
Assessment criteria	
The learner must know: 2.1 prepare, check and use appropriate test equipment following manufacturer's instructions 2.2 identify high voltage components and cabling	

2.3	follow the manufacturer's procedures to isolate and re-energise the high voltage system within their level of authority
2.4	follow the manufacturer's recommendations to ensure residual voltage is within manufacturer's specification when isolating the high voltage system
2.5	evaluate the performance of the re-energised high voltage system accurately using suitable testing methods
2.6	ensure the high voltage system performs to the manufacturer’s operating specifications and legal requirements
2.7	record and report accurately to the relevant person(s) the work activities they have carried out on or near the vehicle.

Unit 612 Skills in Isolating and re-energising High Voltage Systems in an Electric Vehicle

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.

Learning outcome 1

Range

1.1, 1.8-1.9 **Electric vehicle(s)**

a. Pure (PEV) / battery electric vehicle (BEV)
b. Extended range (ER-EV)
c. Range extended (RE-EV)
d. Fuel cell (FCEV)
e. Hybrid (HEV)
f. Plug-in hybrid (PHEV)
g. Mild hybrid
h. Micro hybrid

1.7 **Dynamic risk assessment** procedures include

a. Risk assessment documentation and responsible persons
b. Taking action to eliminate or reduce risk
c. Monitoring situation
d. Reviewing situation

Unit 613 Skills in Removing and Replacing Components in an Electric Vehicle High Voltage Powertrain and Ancillary Systems

Level:	Level 3
GLH:	5
Relationship to NOS:	EV03: Remove and replace components in an electric vehicle high voltage powertrain and ancillary systems
Assessment type:	Assignment
Aim:	To be able to demonstrate how to safely remove, test, evaluate and replace a component from an electric vehicle following manufacturers procedures.

Learning outcome	**The learner will:**
1. be able to work safely when removing and replacing components in a high voltage electric vehicle system, adhering to legislation, workplace and manufacturer requirements	
Assessment criteria	
The learner must know: 1.1 identify the type of electric vehicle being worked on 1.2 locate and record relevant information about the vehicle 1.3 ensure the work area is clearly identified using signs and barriers as appropriate, following environmental standards and regulations at all times 1.4 perform the correct procedures to make the vehicle safe prior to starting any work activities 1.5 ensure work cannot be started without their knowledge and agreement 1.6 support work activities by adhering to: a. system manufacturer's vehicle technical data b. removal and replacement procedures c. legal requirements 1.7 select and use the recommended personal protective equipment (PPE) and vehicle protective equipment (VPE) appropriate to removing and replacing components in a high voltage electric vehicle system 1.8 work in a way which minimises risk of: a. injury to themselves b. damage to their working environment c. damage to other vehicle systems, components and units 1.9 conduct a dynamic risk assessment on the vehicle and the work area to determine any potential hazards	

Learning outcome	**The learner will:**
2. be able to safely remove, select and replace components in high voltage system and accurately evaluate the performance of the rectified system	
Assessment criteria	

The learner must know:

2.1 prepare, check and use appropriate equipment following manufacturer's instructions

2.2 select replacement components which meet the manufacturers' recommendations or conform to operating specification

2.3 carry out component removal and replacement activities following:

a. manufacturers' instructions
b. industry recognised repair methods
c. health, safety and environmental requirements

2.4 record and report any faults or relevant issues noticed during inspection or repair work

2.5 evaluate the performance of the rectified high voltage system accurately using suitable testing methods

2.6 ensure the high voltage system performs to the manufacturer's operating specifications and legal requirements prior to returning to customer

2.7 record and report accurately to the relevant person(s) the work activities they have carried out on or near the vehicle.

Unit 613 Skills in Removing and Replacing Components in an Electric Vehicle High Voltage Powertrain and Ancillary Systems

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.

Learning outcome 1
Range

1.1 **Electric vehicle(s)**

a. Pure (PEV) / battery electric vehicle (BEV)
b. Extended range (ER-EV)
c. Range extended (RE-EV)
d. Fuel cell (FCEV)
e. Hybrid (HEV)
f. Plug-in hybrid (PHEV)
g. Mild hybrid
h. Micro hybrid

1.10 **Dynamic risk assessment** procedures include

a. Risk assessment documentation and responsible persons
b. Taking action to eliminate or reduce risk
c. Observing, assessing, analysing an environment while working, to identify and remove risk
d. Monitoring situation
e. Reviewing situation

Learning outcome 2
Range

2.1 **Equipment**

a. Electrical multimeters / voltmeter rated to a minimum 1000V (CAT. III) or 600V (CAT.IV) including leads and probes
b. Other safe and appropriate electrical testing equipment
c. Hand tools
d. Code readers
e. Special tools (manufacturer specific equipment and software)
f. Relevant safety equipment

2.2-2.3 **Components**

a. High voltage batteries
b. Low voltage batteries
c. Motors/generators
d. Cabling and wiring (wiring colour, size and cross-sectional area)
e. Relays and contactors
f. Electronic control units
g. On-board charger and charging port
h. DC / DC convertor
i. Isolators
j. Inverters/rectifiers
k. Battery management units
l. Vehicle start/stop control
m. Driver instrumentation
n. Multi-battery systems
o. Drive trains (layout)
p. Power sources (engine / motor)
q. Sensors
r. Ancillary components

Unit 830 Knowledge of Diagnosing, Removing, Replacing and Recalibrating Motor Vehicle Advanced Driver Assistance System Components

Level:	Level 3
GLH:	20
Relationship to NOS:	LV19: Diagnose, remove, replace and recalibrate motor vehicle Advanced System components
Assessment type:	Multiple choice test
Aim:	To be able to identify and describe the function and operation of different types of advanced driver assistance systems (ADAS) and components. To understand the importance of good customer service and adhering to legislation/workplace procedures. To safely remove, test and replace components using the correct tools and equipment and following the manufacture's procedures.

Learning outcome	**The learner will:**
1. understand the health and safety and legislative procedures required to be followed, when working on advanced driver assistance systems	
Assessment criteria	
The learner must know: 1.1 current health and safety legislation that must be followed when working on advanced driver assistance systems 1.2 current legal requirements relating to advanced driver assistance systems and components 1.3 the legal requirements of dynamic calibration activity on the road 1.4 the risks and potential legal implications of returning an uncalibrated vehicle to the customer 1.5 specific vehicle manufacturer's repair and safety procedures 1.6 the impact of industry regulations on autonomous vehicle capability levels.	

Learning outcome	**The learner will:**
2. understand the importance of adhering to workplace procedures, and the value of providing a positive customer experience and keeping up to date with technology	
Assessment criteria	
The learner must know: 2.1 workplace procedures for: a. recording fault location and correction activities	

b. reporting the results of tests carried out
c. completing and storing documentation relating to ADAS verifiable calibration
d. reporting/referring problems
e. reporting delays to the completion of work to managers and customers
f. the calibration environment as identified by the manufacturers' instructions
g. the use of customer questioning
h. the use of diagnostic testing methods

2.2 the importance of maintaining accurate documentation on diagnostic and rectification activities
2.3 the importance of working to agreed timescales and keeping others informed of progress
2.4 the importance of customer interaction when diagnosing faults and calibrating
2.5 the value of providing the customer with evidence of successful calibration
2.6 the importance of reporting anticipated delays to the relevant person(s) promptly
2.7 the relationship between time, costs and productivity
2.8 the benefits of keeping up to date with emerging ADAS technology.

Learning outcome	**The learner will:**
3. understand advanced driver assistance system components, operation, failures and calibration	
Assessment criteria	
The learner must know: 3.1 the types of ADAS sensors and their function 3.2 the purpose and operation of advanced driver assistance systems 3.3 methods of sourcing information on ADAS operating specifications 3.4 how to use and interpret technical information on ADAS operating specifications 3.5 the types and causes of ADAS failures 3.6 the different types of vehicle calibration.	

Learning outcome	**The learner will:**
4. understand the electrical and electronic principles relating to advanced driver assistance systems	
Assessment criteria	
The learner must know: 4.1 electrical and electronic theories including electrical terminology, symbols and units 4.2 electrical safety procedures when working on advanced driver assistance systems 4.3 how electrical and electronic units and components are constructed 4.4 how electrical and electronic units and components are dismantled and reassembled 4.5 how electrical and electronic units and components operate 4.6 the interaction between electrical, electronic and mechanical components within advanced driver assistance systems 4.7 how electrical systems interlink and interact.	

Learning outcome	**The learner will:**
5. understand how to test, remove, replace and recalibrate components related to advanced driver assistance systems	
Assessment criteria	
The learner must know:	

5.1 how to carry out systematic diagnostic testing of ADAS components using electrical and electronic testing techniques

5.2 how to identify the most appropriate diagnostic testing method for the symptoms presented

5.3 the types of ADAS diagnostic equipment and their function

5.4 how to prepare and check the accuracy of diagnostic testing equipment

5.5 how to use electrical and electronic testing equipment to correctly and safely diagnose ADAS faults

5.6 how to interpret vehicle data and tests results in order to identify the location and cause of ADAS faults

5.7 the circumstances which will necessitate replacement and recalibration of ADAS components and other possible courses of action

5.8 the importance of working to recognised diagnostic procedures

5.9 methods of sourcing correct information applicable to:

a. diagnostic test procedures
b. component removal procedures
c. component replacement procedures
d. system/component recalibration procedures

5.10 how to use and interpret technical information to aid:

a. diagnostic activities
b. component removal
c. component replacement
d. system/component recalibration

5.11 how to remove, replace and recalibrate vehicle or ADAS components, in the proximity of sensors

5.12 how to make cost effective recommendations for rectification.

Unit 830 Knowledge of Diagnosing, Removing, Replacing and Recalibrating Motor Vehicle Advanced Driver Assistance System Components

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.

Learning outcome 1
Range

1.1 **Health and safety legislation**

a. Health and Safety at Work Act
b. Electricity at Work Regulations
c. General Safety Regulation
d. Health and Safety Executive
e. Highway Code
f. Provision and Use of Work Equipment Regulations

1.2 **Legal Requirements**

a. Returning vehicles to their original specification
b. Confirming components are calibrated and functioning within the manufacturers' technical specifications.
c. Technician competency proof
d. Customer contract
e. Duty of care

1.3 **Legal Requirements**

a. Driving license category
b. Insurance cover
c. Highway Code
d. Road Traffic Act
e. Vehicle roadworthy

f. Road tax
g. MOT

1.4 **Risks**

a. Unexpected systems trigger
b. Potential accidents/collisions

1.4 **Implications**

a. Liability of the workshop
b. Evidence of negligence
c. Fines
d. Prosecution
e. Imprisonment

1.5 **Repair and Safety Procedures**

a. Risk assessment
b. Specific manufacturer repair methods
c. Equipment software updates
d. Calibration and maintenance of equipment
e. Use of appropriate environment

1.6 **Impact**

a. Set boundaries for levels of automation
b. Volume of automation on public roads
c. Updated raining of operators/drivers/technicians on new and evolving technology
d. Cyber security risks

1.6 **Industry regulations**

a. Insurance Industry Requirements (IIR) for the safe repair of ADAS-equipped vehicles
b. Type approval regulations
c. Automated and Electric Vehicles Act
d. General Safety Regulation
e. Pedestrian Safety Regulation

1.6 **Autonomous vehicle capability levels**

a. SAE Levels of Driving Automation

Learning outcome 2
Range

2.1a/b/c/e **Recording/reporting/storing** ensuring

a. Accurate records
b. Auditable records
c. Compliance with data protection

2.1c, 2.2 **Documentation** information to include

a. Customer details
b. Vehicle data
c. Third party contracted repairer information
d. Technician proof of competency
e. Equipment used to test/diagnose/calibrate
f. Date of activities
g. The work carried out

2.1f **Calibration environment**

a. Layout
b. Floor surface/level
c. Space available
d. Lighting
e. Equipment available
   i. Target / radar boards
   ii. Computer software devices
   iii. Laser guided tools
   iv. Wheel clamps
   v. Scales
   vi. Mirrors
   vii. Alignment / positioning aids for radar sensors

2.1h **Methods**

a. Following manufacturer's instructions
b. Planning a logical sequence
c. Visual inspection
d. Vehicle scans
e. Using diagnostic software
f. Conducting electrical tests
g. Interpreting fault codes
h. Calibration procedures/checks
i. Road testing

2.3, 2.5-2.6 **Value/importance**

a. Customer satisfaction
b. Business productivity
c. Business reputation
d. Repeat business
e. Reduces risk of liability accusations

2.3 **Agreed timescales**

a. Manufacturers' recommended work times
b. Job times set by the company
c. Job time agreed with the customer

2.4 **Customer interaction**

a. Using technical and non-technical language as appropriate
b. Use of documentation for clarification
c. Confirming customer understanding

2.7 **Relationship**

a. How extended labour times can affect costs and productivity
b. The consequences of mistakes and rework and its effect on time, cost and productivity
c. The effects of uneconomical use of resources, materials / consumables
d. Methods of increasing efficiency through planning, organisation of the workspace and maintaining tools and equipment
e. How training and personal development can be advantageous to saving time, costs and being more productive

Learning outcome 3
Range

3.1 **Sensors**

a. Optical / cameras
b. Radar
c. Lidar
d. Ultrasonic

3.2 **Advanced driver assistance systems** to include

a. Steering
b. Braking, emergency brake assist (autonomous and ABS)
c. Lane departure / lane support systems
d. Driver assistance
e. Parking assistance
f. Collision avoidance
g. Adaptive lighting / Night vision
h. Adaptive cruise control
i. Rear-cross traffic alert
j. Intelligent speed adaption
k. Seat belt reminders
l. In-vehicle data recorders

m. Intelligent speed adaption
n. Electronic stability control
o. E-call systems

3.5 **ADAS failures**

a. Network faults
b. Calibration faults
c. Collision damage
d. Component failure
e. Water ingress
f. Poor connections
g. Electrical faults
h. Damage caused by incorrect testing methods
i. Damages caused by incorrect removal

3.6 **Types of calibration**

a. Static
b. Dynamic
c. Self-calibrating

Learning outcome 4
Range

4.1 **Electrical and Electronic Theories**

a. Ohms law
b. Watts law
c. Voltage
d. Power
e. Current (AC/DC)
f. Resistance
g. Magnetism
h. Electromagnetism
i. Electromagnetic induction
j. Digital and fibre optics principles
k. Radio waves
l. Time of Flight and doppler shifts (doppler shifts - the change in frequency of a wave)

4.3-4.5 **Units and components**

a. Circuit boards
b. Processors
c. Image sensors
d. Radar receivers
e. Radar transmitters
f. Laser Diode

g. Photodiode
h. Semiconductor devices
i. Electronic chips
j. Transistors
k. Resistors
l. Transducers
m. Variable resistors
n. Micro-processors
o. Capacitors
p. Electrical inputs
q. Electrical outputs

4.5 **Operation** of ADAS components

a. Component bandwidths/frequencies
b. Signal processing
c. Field of view
d. Road sign/pedestrian/object recognition
e. Distances/ranges/angle measurements
f. Monitoring of speeds and direction of motion
g. Production of high-resolution maps and images
h. Systems anticipating driver intentions and late reactions
i. Internal components operation

4.7 **Interlink and Interact**

a. Multiplexing
b. Communication networks

Learning outcome 5
Range

5.1-5.2/5.8 **Diagnostic testing procedures**

a. Recording relevant vehicle information
b. Accessing current technical information
c. Performing a full module scan
d. Locating components
e. Evaluating the evidence / test results
f. Verifying the fault
g. Carrying out further tests / additional diagnostic testing in a logical sequence
h. Rectifying the problem
i. Checking all systems

5.1 **Testing techniques** include

a. Visual inspection

b. Voltage, resistance and current measuring
c. Frequency measuring
d. Dedicated and computer-based testing
e. Oscilloscope waveforms / checking for noise
f. Vehicle scans
g. Disconnecting components to check if fault codes are erased
h. Splicing / back probing

5.3-5.5 **Testing and diagnostic equipment**

a. Voltmeters
b. Ammeters
c. Ohmmeters
d. Dedicated and computer-based equipment
e. Fault-code readers
f. Auxiliary battery supply/charger
g. Battery testing equipment
h. Scan tools
i. Multimeters
j. Oscilloscopes
k. Calibration equipment
l. Wheel alignment equipment
m. Breakout box
n. Hand tools
o. Special purpose tools
p. General workshop equipment

5.4 **Checks** to include

a. Capability
b. Limitations
c. Software subscriptions
d. Software versions/updates
e. Equipment calibrating procedures
f. Maintenance and service contracts

5.7, 5.11 **Components**

a. Mechanical
b. Electrical
c. Electrical Control Unit (ECU's)
d. Trim
e. Sensors
f. Cameras

5.7 **Other Courses of Action** to include:

a. Action if calibration fails
b. Wheel alignment checks and adjustments
c. Steering angle reset
d. Road test

5.11 **Sensors**

a. Optical / cameras
b. Radar
c. Lidar
d. Ultrasonic

Unit 831 Skills in Diagnosing, removing, replacing and Recalibrating Motor Vehicle Advanced Driver Assistance System Components

Level:	Level 3
GLH:	7
Relationship to NOS:	LV19: Diagnose, remove, replace and recalibrate motor vehicle Advanced System components
Assessment type:	Assignment
Aim:	To be able to demonstrate how to safely test, diagnose, repair and recalibrate Advanced Driver Assist Systems. .

Learning outcome	**The learner will:**
1. be able to demonstrate safe and appropriate working methods when carrying out diagnostic and rectification activities of advanced driver assistance systems and components	
Assessment criteria	
The learner must know: 1.1 select and use the recommended personal protective equipment (PPE) when carrying out testing, diagnosis and rectification activities 1.2 select and use the appropriate vehicle protective equipment (VPE) when carrying out testing, diagnosis and rectification activities 1.3 ensure the work area is clearly identified using signs and barriers as appropriate, following environmental standards and regulations at all times 1.4 work in a way which minimises risk of: a. injury to themselves b. damage to other vehicle systems, components and units c. contact with leakages d. contact with hazardous substances 1.5 follow relevant up-to-date industry codes of practice at all times 1.6 prepare and check the required testing and diagnostic equipment following legislative and manufacturer's instructions, prior to use. 1.7 carry out a risk assessment on vehicle and work area, prior to use.	

Learning outcome	**The learner will:**
2. be able to diagnose advanced driver assistance system faults, in a safe, methodical and efficient manner	
Assessment criteria	
The learner must know: 2.1 confirm and record presence and type of advanced driver assistance systems and sensors	

2.2 support the identification of advanced driver assistance system faults by sourcing and interpreting vehicle technical information/data
2.3 select and use the required diagnostic and rectification tools and equipment correctly and safely
2.4 use testing techniques which are relevant to the symptoms presented and advanced driver assistance system type
2.5 collect and record sufficient diagnostic information in a logical and systematic way to enable an accurate diagnosis of advanced driver assistance system faults
2.6 identify and record accurately any system deviation from acceptable limits as per manufacturer's specifications or industry standards
2.7 assess components and units to establish their condition and suitability for repair or replacement
2.8 carry out diagnostic testing procedures and all diagnostic activities following:
a. manufacturers' instructions
b. health, safety and environmental requirements
c. workplace procedures
2.9 analyse the diagnostic information to produce a cost effective, accurate recommendation for rectification.

Learning outcome	**The learner will:**
3. be able to effectively communicate with colleagues, supervisors, and customers throughout the diagnostic and rectification process	
Assessment criteria	
The learner must know: 3.1 produce records that are accurate, complete, and passed to the relevant person(s) within the agreed timescale in the format required 3.2 report any anticipated delays in completion of diagnosis and rectification work to the relevant person(s) promptly and effectively 3.3 complete all diagnostic and rectification activities within the agreed timescale.	

Learning outcome	**The learner will:**
4. be able to remove, replace and recalibrate advanced driver assistance system components	
Assessment criteria	
The learner must know: 4.1 carry out component removal and replacement activities following: a. manufacturers' instructions b. industry recognised replacement methods c. health, safety and environmental requirements 4.2 carry out rectification activities following: a. manufacturers' instructions b. industry recognised replacement methods c. health, safety and environmental requirements 4.3 ensure the calibration environment is as identified by the manufacturer's instructions 4.4 ensure all replacement components and parts in the proximity of sensors conform to the vehicle manufacturer's specification and any legal requirements 4.5 recalibrate advanced driver assistance system sensors correctly to ensure that they operate to meet vehicle system requirements and function to the vehicle manufacturer's specified tolerances	

4.6 record that recalibration has been successfully completed and meets vehicle manufacturer's specified tolerances.

Unit 831 Skills in Diagnosing, Removing, Replacing and Recalibrating Motor Vehicle Advanced Driver Assistance System components

Supporting information

Candidates will be assessed on the assessment criteria as specified within the unit and the following supporting information is included to support centres in terms of teaching and delivery.

Learning outcome 1
Range

1.5 **Industry Codes of Practice** to include

a. UK Insurance Industry Requirements (IIR) for the safe repair of ADAS-equipped vehicles
b. Type approval regulations
c. Automated and Electric Vehicles Act
d. General Safety Regulation
e. Pedestrian Safety Regulation

1.6 **Testing and diagnostic equipment**

a. Voltmeters
b. Ammeters
c. Ohmmeters
d. Dedicated and computer-based equipment
e. Fault-code readers
f. Auxiliary battery supply/charger
g. Battery testing equipment
h. Scan tools
i. Multimeters
j. Oscilloscopes
k. Calibration equipment
l. Wheel alignment equipment
m. Breakout box
n. Hand tools
o. Special purpose tools
p. General workshop equipment (including target boards, radar boards, measurement equipment)

1.7 **Risk assessment** procedures include

a. Risk assessment documentation and responsible persons
b. Taking action to eliminate or reduce risk
c. Observing, assessing, analysing an environment while working, to identify and remove risk
d. Monitoring situation
e. Reviewing situation

Learning outcome 2
Range

2.1 **Sensors**

a. Optical / cameras
b. Radar
c. Lidar
d. Ultrasonic

2.2, 2.5 **Faults** that occur within

a. Driver safety systems
b. Pedestrian safety systems
c. Motion/stability systems
d. Collision avoidance systems

2.3 **Tools and equipment**

a. Voltmeters
b. Ammeters
c. Ohmmeters
d. Dedicated and computer-based equipment
e. Fault-code readers
f. Auxiliary battery supply/charger
g. Battery testing equipment
h. Scan tools
i. Multimeters
j. Oscilloscopes
k. Calibration equipment
l. Wheel alignment equipment
m. Breakout box
n. Hand tools
o. Special purpose tools
p. General workshop equipment (including target boards, radar boards, measurement equipment)

2.4 **Testing techniques** include

a. Visual inspection
b. Voltage, resistance and current measuring
c. Frequency measuring
d. Dedicated and computer-based testing
e. Oscilloscope waveforms / checking for noise
f. Vehicle scans
g. Disconnecting components to check if fault codes are erased
h. Splicing / back probing

2.8 **Diagnostic testing procedures**

a. Recording relevant vehicle information
b. Accessing current technical information
c. Performing a full module scan
d. Locating components
e. Evaluating the evidence / test results
f. Verifying the fault
g. Carrying out further tests / additional diagnostic testing in a logical sequence
h. Rectifying the problem
i. Checking all systems

Learning outcome 3
Range

3.1 **Records** to include

a. Customer details
b. Vehicle data
c. Third party contracted repairer information
d. Technician proof of competency
e. Equipment used to test/diagnose/calibrate
f. Date of activities
g. The work carried out

Learning outcome 4
Range

4.1 **Component** types

a. Mechanical
b. Electrical
c. Electrical Control Unit (ECU's)
d. Trim
e. Sensors

f. Cameras

4.2 **Calibration environment**

a. Layout
b. Floor surface/level
c. Space available
d. Lighting
e. Equipment available
    i. Target / radar boards
    ii. Computer software devices
    iii. Laser guided tools
    iv. Wheel clamps
    v. Scales
    vi. Mirrors
    vii. Alignment / positioning aids for radar sensors

4.3 **Sensors**

a. Optical / cameras
b. Radar
c. Lidar
d. Ultra-sonic

4.3 **Recalibrate**

a. Static systems
b. Dynamic systems
c. Self-calibrating systems

Appendix 1 Sources of general information

The following documents contain essential information for centres delivering City & Guilds qualifications. They should be referred to in conjunction with this handbook. To download the documents and to find other useful documents, go to the **Centres and Training Providers homepage** on **www.cityandguilds.com**.

City & Guilds / ILM Quality Assurance Standards: Centre Handbook

This document contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve 'approved centre' status, or to offer a particular qualification, as well as updates and good practice exemplars for City & Guilds assessment and policy issues. Specifically, the document includes sections on:

- The centre and qualification approval process
- Assessment, internal quality assurance and examination roles at the centre
- Registration and certification of candidates
- Reasonable adjustments and special considerations
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Management systems
- Maintaining records
- Assessment
- Internal quality assurance
- External quality assurance.

City & Guilds / ILM Quality Assurance Standards: Centre Approval Process

This document explains the requirements for the delivery, assessment and awarding of our qualifications. All centres working with City & Guilds must adopt and implement these requirements across all of their qualification provision. Specifically, this document:

- specifies the quality assurance and control requirements that apply to all centres
- sets out the basis for securing high standards, for all our qualifications and/or assessments
- details the impact on centres of non-compliance

Our Quality Assurance Requirements document encompasses the relevant regulatory requirements of the following documents, which apply to centres working with City & Guilds:

- Ofqual's General Conditions of Recognition

The **centre homepage** section of the City & Guilds website also contains useful information on such things as:

- **Walled Garden**: how to register and certificate candidates online
- **Events**: dates and information on the latest Centre events
- **Online assessment**: how to register for e-assessments.

Useful contacts

UK learners General qualification information	**E: learnersupport@cityandguilds.com**
International learners General qualification information	**E: intcg@cityandguilds.com**
Centres Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results	**E: centresupport@cityandguilds.com**
Single subject qualifications Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change	**E: singlesubjects@cityandguilds.com**
International awards Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports	**E: intops@cityandguilds.com**
Walled Garden Re-issue of password or username, technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems	**E: walledgarden@cityandguilds.com**
Employer Employer solutions including, Employer Recognition: Endorsement, Accreditation and Quality Mark, Consultancy, Mapping and Specialist Training Delivery	**E: business@cityandguilds.com**

If you have a complaint, or any suggestions for improvement about any of the services that we provide, email: **feedbackandcomplaints@cityandguilds.com**

About City & Guilds

As the UK's leading vocational education organisation, City & Guilds is leading the talent revolution by inspiring people to unlock their potential and develop their skills. We offer over 500 qualifications across 28 industries through 8500 centres worldwide and award around two million certificates every year. City & Guilds is recognised and respected by employers across the world as a sign of quality and exceptional training.

City & Guilds Group

Our vision is for a world in which everyone has the skills and opportunities to succeed. We support over 4 million people each year to develop skills that help them into a job, develop on that job and to prepare for their next job. As a charity, we're proud that everything we do is focused on achieving this purpose. Whether that's through delivering work-based learning programmes that build competency, providing flexible pathways that support lifelong employability or through the City & Guilds Foundation funding initiatives that help remove barriers to work and learning.

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