

Qualification title: Level 2 Technical Award in Engineering (1145-20)

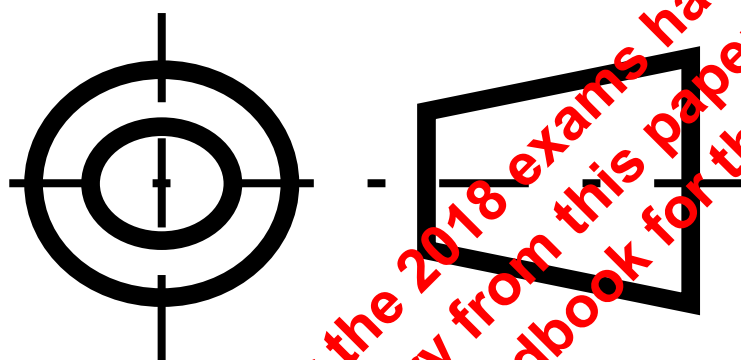
Test title: Externally set, externally marked

Version: Sample

Base mark: 80

1a

What does this symbol represent on an orthographic drawing?



Answer:

- Third angle projection.

Award 1 mark for correct response.

Test spec reference: 201101

Total marks: 1

1b

The following types of line are used on an orthographic drawing:



What letter represents the line for:

- i. Hidden detail
- ii. Centre line
- iii. Visible outline.

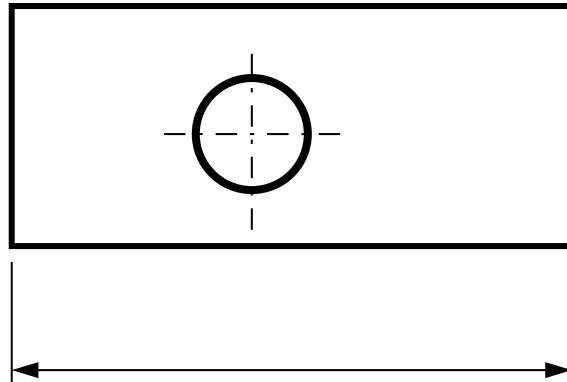
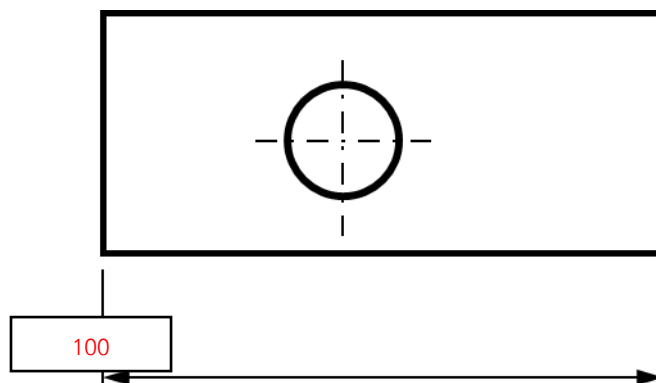
Answer:

- i. C
- ii. A
- iii. D

Award 1 mark for **each** correct response.

Test spec reference: 201.01**Total marks: 3****1c**

A component has a length of 100. Place the value in the correct location on the drawing.

**Answer:**

Award 2 marks for the correct location, as shown in the diagram above.

Award 1 mark if it is central, but below the dimension line

Award 1 mark if it is above the dimension line, but not central.

Test spec reference: 201.01

Total marks: 2

1d

Explain the purpose of:

- i. orthographic drawings
- ii. exploded views
- iii. isometric views.

Answer:

- i. Orthographic drawings communicate sizes (1) so that manufactures can accurately make the components (1).
- ii. Exploded views show how the parts fit together (1) so that products can be assembled correctly (1).
- iii. Isometric views show a 3D image of the product (1) to give a better visual representation of the final product (1).

For **each** response, award 1 mark for a basic explanation or 2 marks for a detailed explanation to a **maximum** of 6 marks.

Test spec reference: 201.01

Total marks: 6

1e

An engineering company manufactures tooling in small quantities for use by other companies. They are considering changing the way they create drawings of their products from manually produced to using CAD software.

Discuss the advantages and disadvantages of using CAD software instead of manually creating drawings of products.

Answer:

Indicative content:

Advantages:

- Increased accuracy
- Drawings can be changed quickly
- You can edit a previous drawing – you do not have to restart it from scratch
- Drawings can be shared electronically
- People in different parts of the world can work on the same drawing at different times of the day
- Electronic files can be sent directly to machines to make products
- Products can be tested virtually
- Different renders can be applied to see what the drawing looks like
- Libraries of standard parts can be used.

Disadvantages:

- Training may be required to use the software
- The CAD software can be quite expensive
- Any other appropriate response.

Band 1 1 – 4 marks

Descriptive response based on recall of knowledge, stating a few advantages or disadvantages in general terms.

Candidates at the top of this level may be characterised by showing some understanding of why one of these advantages is applicable specific to the stated context.

Band 2 5 – 8 marks

Mainly descriptive response showing knowledge recall, giving a range of advantages and disadvantages relative to the stated context.

Candidates at the top of this level may demonstrate understanding of some reasons for different advantages or disadvantages.

Band 3 9 – 12 marks

Detailed response showing both knowledge recall and understanding of a wide variety of advantages and disadvantages, all relevant to the stated context.

Candidates at the top of this level may be characterised by considering the relative impact of different advantages and disadvantages within the stated context.

Example answers:

Band 1

CAD drawings are more accurate. They can be changed more quickly as you don't have to restart a drawing when you want to change it. You can also email them to other people or CAM machines.

Band 2

Compared to manual drawings, CAD drawings may be more accurate, helping the people who are making the tooling to see exactly what is needed. Drawings can be easier to create or change as you can edit other drawings, for example if a customer wants slightly different tools. However, the CAD software might cost a lot and the designers would need training on how to use it.

Band 3

CAD drawings can be quicker to create than manual drawings, as you can edit previous versions rather than restarting from scratch. This means that the company will be able to respond to orders from customers quicker, whilst at the same time spending less on creating drawings. Although there is a cost for the CAD software and to train staff to use it, this can be less than the savings if lots of drawings are needed which is likely if tooling is being produced for lots of different customers.

The CAD drawings can also be shared more easily than manual drawings, as you can use email. Whilst there may be concerns about competitors getting hold of electronic drawings, email is very quick and would help the company to make things quicker if they are making the tools on a different site or in a different country. CAD would also allow direct transfer to CAM machines to make the tools, which could save time and therefore cost to make them.

Test spec reference: 201.02

Total marks: 12

2a

Define the following properties of materials.

- i. Tensile strength.
- ii. Hardness.

Answer:

Tensile strength – the ability to resist being broken due to a pulling force.
Hardness – the ability to resist abrasion and scratches.

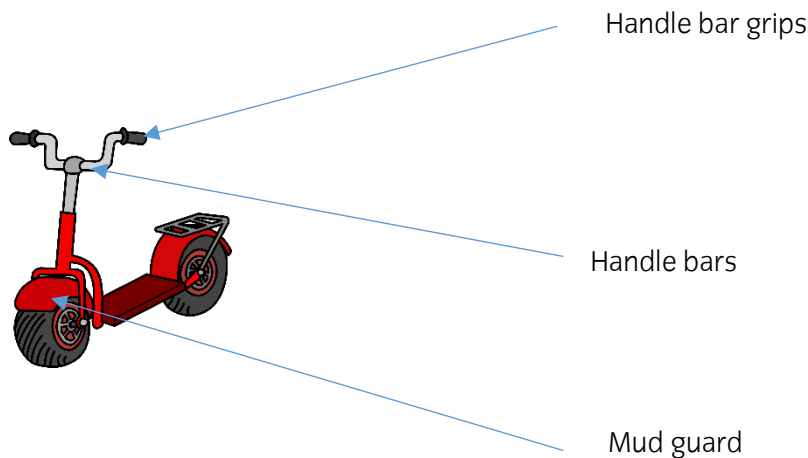
Award 1 mark for **each** correct response to a **maximum** 2 marks.

Test spec reference: 202.01

Total marks: 2

2b

The picture below shows a child's scooter.



For **each** part of the scooter identified, state a suitable material that it could be made from.
Explain why your choice is suitable.

- i. Handle bar grips.
- ii. Mud guard.
- iii. Handle bars.

Answer:

- i. Award 1 mark for rubber or a suitable named polymer material (1)

2 marks can be awarded for **two** separate reasons or **one** reason explained in detail.

Good grip (1), resistant to sweat or rain (1), can be formed by injection moulding so is cost effective (2).

- ii. Award 1 mark for any of a suitable named polymer, stainless steel, aluminium or painted mild steel.

2 marks can be awarded for **two** separate reasons or **one** reason explained in detail.

Rigidity (1), resistant to corrosion which is important as the scooter is likely to come into contact with water (2), formability (1).

- iii. Award 1 mark for stainless steel, aluminium or painted mild steel.

2 marks can be awarded for **two** separate reasons or **one** reason explained in detail.

Rigidity (1), strength (1), toughness so it doesn't break when dropped or hits something (2).

Test spec reference: 202.01

Total marks: 9

2c

It has been suggested that the scooter should have a lighting system. The design criteria for this system are:

- Weatherproof
- Shock proof
- Aesthetic
- Energy efficient
- Low cost
- Low maintenance.

The product will have:

- A light source
- A power source
- A case.

Suggest how the prototype should be developed to meet these requirements. Justify your suggestions.

Answer:

Indicative content:

- LEDs – low power consumption, long life, low cost, small size
- Batteries – lightweight, potentially rechargeable
- Use kinetic energy from the scooter
- Case – durability, size, weatherproof (non-corrosive), impact resistant
- On/off switch – weatherproof, small size
- Internal connections – PCB or stripboard, screwed connections

Band 1 1-3 marks

Responses focus on what should be in the final product rather than consideration of how it meets the design criteria.

Band 2 4-6 marks

Suggestions are made with some reasons for how they relate to the design criteria. Limited reference to prototyping.

Band 3 7-8 marks

All design criteria addressed with reasoned suggestions related to prototyping.

Example answers:

Band 1

There should be LED light as the light source. There should be a battery to power the light. These would be in a plastic case.

Band 2

Light source – use LEDs as they are energy efficient and will not require replacement.

Power source – battery which gives long life and is light and small so aesthetic.

Case – ABS case as it would be lightweight and readily available in different sizes as a modular kit it would be easy to put in a prototype.

Band 3

Light source – use LEDs as they are energy efficient and will not require replacement. They are small size so aesthetic and PCB mountable. It is also possible to select LEDs for specific applications so it is easy to try different ones to determine the best.

Power source – battery such as lithium which gives long life and is light and small so aesthetic. It is possible to calculate how long it would last as part of prototype testing.

Case – ABS case as it would be lightweight, weatherproof and shockproof. It is also low cost and readily available in different sizes as a modular kit it would be easy to put in a prototype. It also means that it doesn't have to be tested as it has already been proven and this will save time.

Test spec reference: 201.03, 202.01, 202.03, 202.04

Total marks: 8

3a

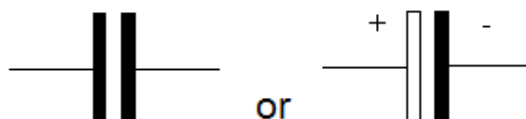
This picture shows a capacitor.



- i. What is the purpose of a capacitor?
- ii. State the unit in which capacitance is measured.
- iii. Draw the circuit symbol for a capacitor.

Answer:

- i. It stores electrical charge
- ii. Farads
- iii.



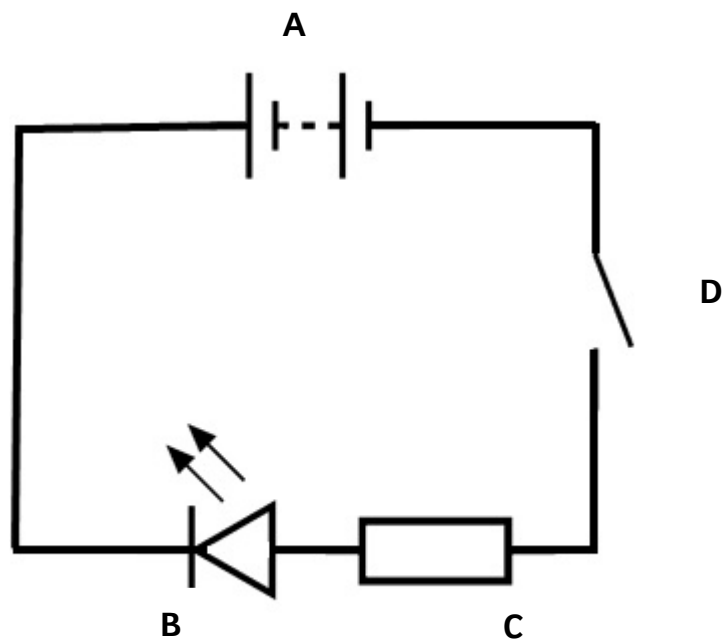
Award 1 mark for **each** correct response.

Test spec reference: 201.01, 201.03, 201.04

Total marks: 3

3b

i) The diagram below shows an electrical circuit.



Identify the labelled components shown in the circuit.

Answer:

- A Battery (accept cell).
- B Light emitting diode (accept LED).
- C Resistor.
- D Switch.

Award 1 mark for **each** correct response.

Test spec reference: 201.03

Total marks: 4

3b

ii) A designer is deciding how to make a prototype of the circuit.

Explain **two** advantages and **one** disadvantage of using a breadboard to prototype the circuit.

Answer:

Indicative content:

Advantages

- It uses the actual components
- Components can be reused
- Changes can be made quickly

Disadvantages

- Components can be loose
- Components can be damaged

Award up to 2 marks for **each** response. 1 mark **each** for a basic explanation, 2 marks for detailed explanation to a **maximum** 6 marks:

- It uses the actual components that will be used in the circuit (1)
- Components can be reused (1) which will mean a cost saving (1)
- Changes can be made very quickly (1)
- Components can be loose / fall out of the breadboard (1) which will slow down the process/so will not work as anticipated (1)
- Components can be damaged (1).

Test spec reference: 202.03

Total marks: 6

3c

Describe how an electrical component should be fixed to a printed circuit board using soldering.

Answer:

Indicative content:

- Place the component in the correct location on the PCB
- Tin the soldering iron
- Apply heat to the join / use the soldering iron
- Feed in the solder
- Any other appropriate response.

Award 1 mark for **each** relevant action up to a **maximum** 3 marks.

Test spec reference: 202.02

Total marks: 3

4a

A designer is thinking about making a product by vacuum forming.

- i. Describe the process of vacuum forming a product from start to finish.

Answer:

Indicative content:

- Place mould in the machine
- Clamp plastic over the mould
- Heat the plastic
- Raise the plattern / mould
- Turn on the vacuum / suck the air out
- Blow back some air.
- Lower the plattern / mould.
- Remove the mould.
- Cut of any excess material
- Any other appropriate response.

Award 1 mark for **each** relevant point in the process up to a **maximum** of 5 marks. Award 1 mark for correct sequence in a process where a **minimum** of **four** correct points in the process are given.

- ii. State a suitable material for vacuum forming.

Answer:

- Thermoplastic or any named thermoplastic

Award 1 mark for a correct response.

iii. Give **two** reasons why this material is suitable for vacuum forming.

Answer:

Award 1 mark **each** of any **two** of the following points:

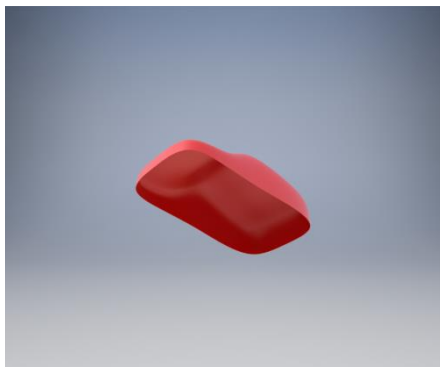
- When heated it changes shape
- When cooled it retains the new shape
- It can be reshaped
- Any other appropriate response.

Test spec reference: 202.02; 202.02

Total marks: 9

4b

A designer has created a plastic shell to be used as the body of a remote control car.



Evaluate the suitability of using the vacuum forming process to make a prototype of this product.

Answer:

Indicative content:

- Smooth surfaces
- Rounded edges
- No overhang
- Draft angle
- Will need holes cut out for wheels etc.
- Needs to be cut from main sheet
- Good for a prototype as quick
- Good if production is small scale
- Not suitable for mass production
- Requires a mould to build from.

Band 1 1 – 3 marks

Answers should be written in full sentences. Response shows a basic evaluation and relationship between design and production/prototyping.

Band 2 4 – 6 marks

There is some structure and logic in development of concepts and ideas with answers written in full sentences. Response shows a reasoned evaluation and relationships between design and production/prototyping.

Band 3 7 – 8 marks

There is well-structured and organised development of concepts and ideas. Answers are written in full sentences with effective use of technical language. Response shows a justified evaluation and clear relationship between design and production/prototyping.

Example answers

Band 1

It would be good as it has round edges and no overhang.

Band 2

The car has been designed to have smooth surfaces and rounded edges to come out of the mould easily. This is a good method of prototyping this product because it is cheap process and quick. If this were for mass production, it is not suitable as several moulds would be need to be produced and this would be time consuming and costly.

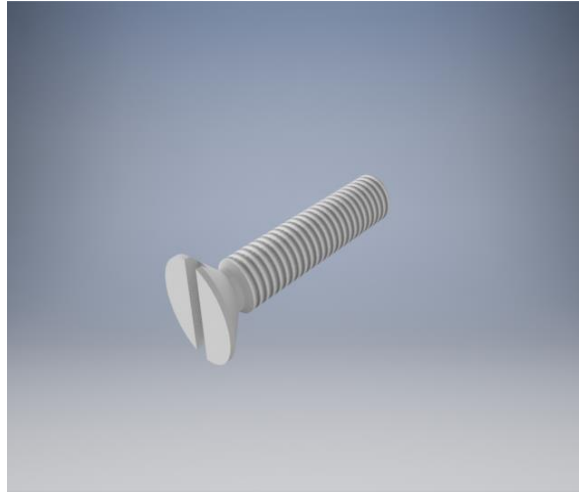
Band 3

The car has been designed to be aerodynamic and so the surfaces are smooth and edges rounded. Without this vacuum forming couldn't take place as sharp edges would fracture or not form. This is a good method of prototyping this product because it is a relatively cheap process and can be produced quickly. Modifications can be made quickly if testing shows that changes are needed. If this were for mass production, it is not suitable as several moulds would be need to be produced and this would be time consuming and costly. A process such as injection moulding would be more suitable. It is also quick but cheaper when producing large quantities. It is unclear whether this is to be mass produced, this would be shown in the design criteria.

Test spec reference: 202.02, 202.04**Total marks: 8**

5a

A designer has made a prototype of the product shown below from a solid block of aluminium that was in the workshop.



- i. Explain why the designer might choose to use a different form of aluminium for the final product.

Answer:

- i. Award 1 mark for any of the following, up to a **maximum** of 2 marks:
 - To reduce the amount of machining required (1), saving cost (1).
 - To reduce wastage (1) and environmental impact (1)
 - Any other appropriate response.
- ii. Other than a solid block, name a form of aluminium that would be **more** suitable for making this product.

Answer:

- iii. Bar. No other response is acceptable.

Award 1 mark for correct answer.

Test spec reference: 202.01

Total marks: 3

5b

The tolerance of a 10mm hole is ± 0.2 mm.

- i. What is the upper acceptable limit of the hole size?

Answer

- i. 10.2mm

1 mark for correct answer. The SI unit **must** be stated for the mark to be awarded.

- ii. Explain how the diameter of the hole would be accurately measured.

Answer:

Indicative content:

- Vernier callipers
- Plug gauge
- Use the reverse side of the callipers
- Open callipers until they touch the edge
- Insert a series of plug gauges until you find one of the correct size.

Band 1 1 – 2 marks

Responses are mainly descriptive.

Band 2 3 – 4 marks

Responses include some reasoning and focus mainly on the measuring device rather than how used.

Band 3 5 – 6 marks

Responses are reasoned and include reference to the type of measuring device and the process to be followed.

Example answers

Band 1

Vernier callipers should be used.

Band 2

Vernier callipers should be used because they are more accurate and can measure to an accuracy of 0.2mm.

Band 3

Vernier callipers should be used because they are more accurate and can measure to an accuracy of 0.2mm. To ensure repeatability the reverse side of the callipers would be used so that it touches the edges and this makes it more precise and accurate.

**Test spec reference: 201.01, 201.04;
201.04**

Total marks: 7