

Qualification: 1145-532 Level 3 Engineering – Theory exam (2)

1145-31 Level 3 Advanced Technical Diploma in Engineering (540)

1145-32 Level 3 Advanced Technical Extended Diploma in Engineering (720)

Marking scheme

1a	<p>One of the issues a company has to deal with is health and safety in its UK premises. The main piece of legislation the company will have to comply with is the Health and Safety at Work Act 1974.</p> <p>Explain what is meant by '<i>as far as is reasonably practicable</i>'.</p>		
	Acceptable answer(s)	Guidance	Max mks
	<p>Award marks as indicated below up to a maximum of 4 marks:</p> <ul style="list-style-type: none"> • This means that the risk must be evaluated or judged (1), against the trouble (1), time (1) or money (1) to control it. • It means that the employer does not have to eliminate all risks (1), but only take appropriate actions to control them (1). • Any other appropriate response. 	<p>The bullet points are nominally split by topics; however, if they give any of the indicated points they get the mark.</p>	(4 marks)
1b	<p>One of the issues a company has to deal with is health and safety in its UK premises. The main piece of legislation the company will have to comply with is the Health and Safety at Work Act 1974.</p> <p>Explain how risk assessments can minimise the probability of injury in a working environment.</p>		
	Acceptable answer(s)	Guidance	Max mks
	<p>Award marks as indicated below up to a maximum 6 marks:</p> <ul style="list-style-type: none"> • They identify the potential hazards (1) which can increase awareness of them by people in the affected area (1) and have to be made available to workers (1). • They identify the risks associated with the hazards (1), which allows specific control measures to be put in place to reduce them (1). 	<p>The bullet points are nominally split by topics; however, if they give any of the indicated points they get the mark.</p>	(6 marks)

	<ul style="list-style-type: none"> • They evaluate the potential risks (1) allowing actions to be prioritised (1). • They are a legal requirement (1) so management have to respond to risk assessments or they may be prosecuted (1). • Marks can be also awarded for appropriate examples to illustrate other points. • Any other appropriate response. 								
2a	Explain why pre-tensioning may be needed when assembling mechanical components.								
	Acceptable answer(s)	Guidance	Max mks						
	<p>Award 1 mark each for any of the following points, up to a maximum of 2 marks.</p> <p>Any two of the following:</p> <ul style="list-style-type: none"> • Pre-tensioning is used for bolts and other mechanical fixings, typically elongating the component by applying a load. • When a load is applied to a joint containing a pre-tensioned bolt, the bolt does not sustain the full effect of the load, but usually only a small part of it. • It prevents mating parts from separating or sliding under normal loads. • Any other appropriate response. 		(2 marks)						
2b	<p>In the table below, state two common types of electrical cable. For each, state a typical use.</p> <table border="1"> <thead> <tr> <th>Type of cable</th> <th>Typical use</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> </tr> <tr> <td></td> <td></td> </tr> </tbody> </table>			Type of cable	Typical use				
Type of cable	Typical use								
	Acceptable answer(s)	Guidance	Max mks						
	<p>1 mark each for two types of cable and 1 mark each for a typical use.</p> <p>Any two of the following:</p>		(4 marks)						

	<ul style="list-style-type: none"> • Mains flex (1); transmit electricity in a home (1). • Armoured three-phase power supply cable (1); transmit power to a machine in a workshop (1). • Co-axial (1); transmit a radio or video signal from an aerial or camera to a screen (1). • Telephone cable (1); to link a telephone to a network or exchange (1). • Any other appropriate response. 		
3a	Explain the difference between market pull and technology push.		
	Acceptable answer(s)	Guidance	Max mks
	<p>1 mark for any of the following points, up to a maximum of 2 marks:</p> <p>Market pull is where consumer demand drives the development of a product (1) whereas technology push is when innovations in materials or technology drive innovation (1) – consumers may not be aware that they have a need for the innovation (1).</p>		(2 marks)
3b	An entrepreneur wants to invest in a business. Explain how entrepreneurs can be enablers for innovation.		
	Acceptable answer(s)	Guidance	Max mks
	<p>Award marks as indicated below, up to a maximum of 6 marks:</p> <ul style="list-style-type: none"> • By providing investment for development and manufacture. • Opportunism (1), through awareness of (changing) market needs (1) or developments in other areas, such as materials or processes (1). • By being able to make decisions faster than larger organisations (1) or by accepting greater risk in (financial) decisions than large organisations, which may tend to be risk averse (1). • Speculation (1): Traditionally, companies have developed products by market extension or product development, building on existing products and activities. Entrepreneurs may choose to support innovations that are unrelated to other activities (1). • By using links with other businesses or activities to support marketing or manufacture ('cross fertilisation'). • Any other appropriate response. 	<p>The bullet points are nominally split by topics; however, if they give any of the indicated points they get the mark.</p>	(6 marks)

3c	Some parts of a product need to be made as prototypes to see how they fit together. Describe how a prototype of a product can be made using 3D printing.		
	Acceptable answer(s)	Guidance	Max mks
	<p>1 mark for each of the steps in the description below, up to a maximum of 4 marks, for example:</p> <ul style="list-style-type: none"> • Produce a 3D model using CAD drawing software. • Supports may need to be included in the model for some complex geometries. • Process the model to create a stereolithography file (.stl), which splits the model into lots of very small layers. • The .stl file may be checked for manifold errors. • The head of the 3D printer moves in two dimensions to deposit each layer, starting at the base (1). It then moves up and deposits the next layer on top, repeating this process etc. (1). • The consumable material is a thin plastic wire that is melted by the printing head of the 3D printer. 	Note: this description is based on the common fused deposition modelling method – other appropriate methods should also be accepted.	(4 marks)
3d	Describe how market testing of a product would be carried out.		
	Acceptable answer(s)	Guidance	Max mks
	<p>1 mark each for the following points, up to a maximum of 4 marks:</p> <ul style="list-style-type: none"> • Interviews with potential customers (direct or online). • Use of focus groups. • Working trials by selected users/customers. • Use of trade shows or exhibitions. • Small scale/pilot launch. • Use of monadic, paired or discrete choice approaches to testing. • Use of feedback or results to refine the product. • Any other appropriate response. 		(4 marks)
4	A product is going to use a low carbon technology to generate energy. Explain how the use of low carbon technologies to convert waste into energy affects the environment.		
	Acceptable answer(s)	Guidance	Max mks
	Award marks as indicated below, up to a maximum 8 marks:		(8 marks)

	<ul style="list-style-type: none"> • Can reduce the consumption of non-renewable resources (1) such as fossil fuels (1). • Reduction in use of fossil fuels will affect the amount of pollution when obtaining (1) and transporting these resources (1). • The production of emissions such as carbon dioxide (1), which contribute to climate change (1). • May reduce both the need for landfill disposal (1) and incineration (1), which in turn may reduce pollution (1). • The impact on local ecology (1). • The specific impact of named low carbon technologies on the environment (1). • Any other relevant point. 		
5a	Explain the difference between virtual and augmented reality.		
	Acceptable answer(s)	Guidance	Max mks
	1 mark for each of the following, up to a maximum 2 marks: Virtual reality is a computer simulation of an image or environment with which a user can interact (1), whereas augmented reality superimposes a computer-generated image on a user's view of the real world, providing a composite view (1).		(2 marks)
5b	Virtual reality and augmented reality are finding an increasing number of domestic and industrial applications.		
	Acceptable answer(s)	Guidance	Max mks
	Award marks as indicated below, up to a maximum of 6 marks: <ul style="list-style-type: none"> • Affordable Virtual Reality (VR) headsets will allow the wearer to experience created environments and products (1), identifying any issues that need to be addressed (1) and potential opportunities for improvement (1). • Augmented reality (AR) headsets or viewers could provide overlays with instructions on how to carry out tasks (1), such as, for example, indicating where medical treatment is required on an injured person. • Immersive AR and VR environments such as holerooms (1) could allow innovative product designs to be tested without the expense of making physical prototypes (1), reducing development costs for innovative products (1). 	The bullet points are nominally split by topics; however, if they give any of the indicated points they get the mark.	(6 marks)

	<ul style="list-style-type: none"> • Customers could use VR to test products at the concept stage (1), facilitating integration of their ideas and feedback (1). • Marks can also be awarded for specific examples of the use of AR and VR to support the development of innovative products (such as, for example, the potential for completely virtual holidays or test drives, or the use of AR to instantly redecorate a room). • Any other suitable answer. 		
6	Discuss the influence that digital technologies have had on society.		
	Acceptable answer(s)	Guidance	Max mks
	<p>Band descriptors Award marks as follows:</p> <p>No answer worthy of credit – e.g. insufficient work submitted, answer not relevant to the question, answer is factually incorrect. (0 marks)</p> <p>Band 1 – basic – largely descriptive response based on recall of knowledge, stating the impact of one type of digital technology on society. Candidates at the top of this level may be characterised by showing some understanding of how a digital technology is affecting society, either positively or negatively. (1-4 marks)</p> <p>Band 2 – clear – more detailed response, covering a variety of different digital technologies and their effects on society. Shows recall of knowledge about the digital technologies and understanding of their advantages and disadvantages to society, compared to the alternatives that they have replaced. Candidates at the top of this level may be characterised by evidence of understanding that individual technologies have affected society in a number of different ways. (5-8 marks)</p> <p>Band 3 – detailed – fully detailed response showing awareness of a broad range of digital technologies, with analysis of the reasons for some of their potential impacts on society. The effects of a broad range of digital technologies are evaluated, with substantiation of which effects are deemed more important, making recommendations and producing supporting conclusions. Candidates at the top of this level may be characterised by analysing and evaluating the conflicting advantages and</p>	<p>Indicative content Examples of points that may be included in the answer are:</p> <ul style="list-style-type: none"> • Digital technologies enable very large amounts of information to be compressed on small storage devices. • This means books, libraries, film clips and music can be stored on very small devices or easily transmitted, for example by satellite systems, optical cables or through the internet. • The use of home computers to access the internet has greatly increased speed of access to news and information. This can mean that users can be more informed about current events, from a more diverse range of sources, but also more easily able to access data which may be adverse to the interests of society. • The use of computers for entertainment purposes has had a substantial impact on social interaction and the types of leisure activities undertaken. This can have secondary effects, for example, on health. 	(12 marks)

	<p>disadvantages of individual digital technologies from the perspective of different stakeholder groups within society. (9-12 marks)</p>	<ul style="list-style-type: none"> • Digital printing has facilitated a substantial increase in the ability to publish hard copies of documents at low cost in domestic or low-volume commercial environments. • Digital systems used in telecommunications give less distortion than analogue systems, although some people prefer the sound quality of analogue devices. • Microcontrollers are widely used in industrial and domestic control systems, giving increased flexibility of operation and allowing easy reprogramming. • Any other relevant point. <p><i>For no awardable content, award 0 marks.</i></p>	
		Total marks	60