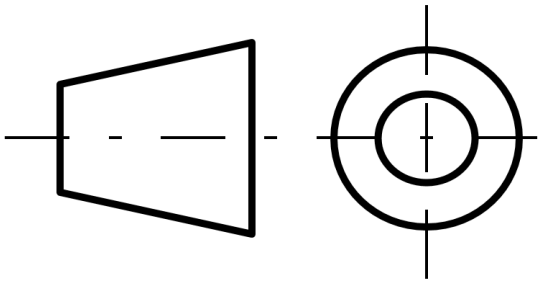
Qualification: 1145-20 Level 2 Technical Award in Engineering

1145-502 Level 2 Engineering – Theory exam (1) June 2018

Marking scheme

<table>
<tr><td>1a</td><td>What does the symbol in Figure 1 represent on an orthographic drawing?
 
Figure 1
<table>
<tr><th>Acceptable answer(s)</th><th>Guidance</th><th>Max mks</th></tr>
<tr><td>First angle projection.</td><td></td><td>(1 mark)</td></tr>
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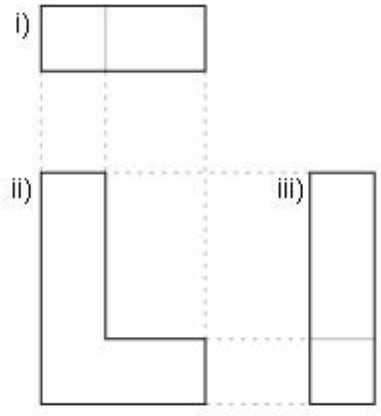
<tr><td>1b</td><td>An orthographic projection of an engineered product is shown in Figure 2. Label the three views shown.
 

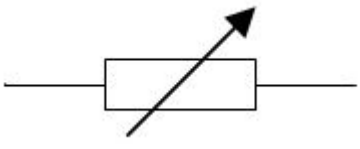
Figure 2</td></tr>
</table>

	Acceptable answer(s)	Guidance	Max mks
	i) Plan view. ii) Front view. iii) Side view.	1 mark for **each** correctly placed label.	(3 marks)
1c	State the meaning of **each** of the following abbreviations on an engineering drawing. i) CHAM. ii) CSK.		
	Acceptable answer(s)	**Guidance**	**Max mks**
	i) Chamfer. ii) Countersunk.	Award 1 mark for **each** correct response.	(2 marks)
2a	Define **each** of the following material properties. i) Thermal conductivity. ii) Hardness.		
	Acceptable answer(s)	**Guidance**	**Max mks**
	i) The ability of heat to pass through a material. ii) The ability of a material to resist abrasion and scratches.	Award 1 mark for **each** correct response.	(2 marks)
2b	i) A motor is a commonly used electrical component. What is the function of a motor? ii) State the unit in which the electrical power of a motor is measured.		
	Acceptable answer(s)	**Guidance**	**Max mks**
	i) To convert electrical energy into mechanical / rotational energy. ii) Watts (W).	(1 mark) (1 mark)	(2 marks)
2c	i) Which one of the following is the symbol for a thermistor?		

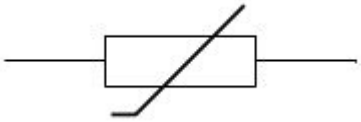
A

B

C



D



ii) Describe the function of a thermistor.
iii) Give **one** practical application of a thermistor and explain how it is used in this application.

	Acceptable answer(s)	**Guidance**	**Max mks**
	i) Correct answer is D. ii) A resistor whose resistance changes with temperature. iii) Award 1 mark for a suitable example, e.g. fire alarm, electronic thermometer, green house temperature monitor. 1 mark for either how it is used as a process block or for details of the circuitry involved. 1 mark for the resultant implications or for the output of the system.	Award 1 mark for correct response. (1 mark) (3 marks)	(5 marks)

3a Turning is used to remove material from a component. Give an example of an application where this might be used.

Acceptable answer(s)	**Guidance**	**Max mks**
• Manufacturing cylindrical components. • Producing a taper. • Producing a thread. • Facing a component. • Any other appropriate response.	Award 1 mark for a correct response.	(1 mark)

3b For **each** of the following types of materials, name **one** typical product that can be made from them.

i) Thermosetting polymer.
ii) Engineering ceramic.

Acceptable answer(s)	**Guidance**	**Max mks**
i) Glue. PCBs. Kitchen worktops. Yarn/thread for clothing. Electrical fittings. Handles. Or any other relevant response related to thermosetting polymer, e.g. polyester, epoxy resin, melamine. 1 mark	Award 1 mark for **each** correct response.	(2 marks)

	ii) Bullet-proof vest. Ball bearings. Gas turbine engines. Medical implants. Space shuttle tiles. Capacitors. Insulators. Or any other relevant response related to engineering ceramic, e.g. boron carbide, silicon nitride. 1 mark		
3c	Describe the properties of a thermochromic material and give **one** typical example of an application of this material.		
	Acceptable answer(s)	**Guidance**	**Max mks**
	A change of colour as temperature changes. (1) Award 1 mark for any **one** application: • Contact thermometers. • Battery testers. • Food packaging. • Mugs/cups with images that change colour when hot liquid is added. • Or any other relevant response.		(2 marks)
3d	Name **two** types of adhesives used by engineers.		
	Acceptable answer(s)	**Guidance**	**Max mks**
	Cyanoacrylates. Epoxy resin.	Award 1 mark for **each** correctly named adhesive.	(2 marks)
4a	Give **four** reasons why a designer would use a block model to create a prototype product.		
	Acceptable answer(s)	**Guidance**	**Max mks**
	Rapidly look at appearance (1), check its shape is right (1), cheaper than making a finished product (1), easy to change if it isn't the right size or shape (1). Any other valid point.	Award 1 mark for **each** valid point to a **maximum** of 4 marks.	(4 marks)

4b	Prototype models can be made from foam blocks. Describe **two** ways in which a model made from foam blocks can be rendered to give it a realistic appearance.		
	Acceptable answer(s)	**Guidance**	**Max mks**
	Create a smooth surface using Polyfilla/glue/water-based varnish. (1) Paint with acrylic or water-based paint. (1)		(2 marks)
5a	An engineering drawing is drawn to a scale of 1:100. A line is drawn 10 mm long. What length would this be at full scale?		
	Acceptable answer(s)	**Guidance**	**Max mks**
	1000 mm/100 cm/1 m.		(1 mark)
5b	CAD systems can be used to create 3D models of a product. Describe what **each** of the following tools does within a CAD model. i) Extrude. ii) Revolve.		
	Acceptable answer(s)	**Guidance**	**Max mks**
	i) Allows the creation of 3D object from a 2D section that is extended/pulled out (1) along a perpendicular path/plane (1). ii) Allows the creation of a circular/round 3D object from a 2D drawing (1) that is revolved around an axis (1).	Award **maximum** 2 marks for **each** correct description.	(4 marks)
5c	A designer has 3D CAD models of three separate components. Explain how they can be assembled together into a single product using the CAD software.		
	Acceptable answer(s)	**Guidance**	**Max mks**
	Award **maximum** 3 marks for describing tools such as align, mate. Creating a single drawing using the different models. Creating drawing constraints. Any other relevant point.		(3 marks)

6a	Name **four** pieces of information that would be shown within the title block of an engineering drawing.		
	Acceptable answer(s)	**Guidance**	**Max mks**
	• Title/Name of component/assembly. • Name of person who drew it. • Name of business/company. • Drawing number. • Projection type (first or 3rd). • Version number. • Date drawn. • Scale. • Units, e.g. mm • Sheet/page number, e.g. 1 of 3. • Material used for manufacture. • Surface finish/tolerances used throughout. • Any other suitable answer.	Award 1 mark for **each** correctly identified to a **maximum** of 4 marks.	(4 marks)
6b	Explain how a wiring diagram is different to a schematic diagram.		
	Acceptable answer(s)	**Guidance**	**Max mks**
	A schematic diagram shows plan and function for an electrical circuit (1). A wiring diagram shows how components are connected (1) and where located in device and physical connections (1).		(3 marks)
6c	Explain the purpose of **each** of the following types of drawing. i) Assembly. ii) Detail/component. iii) Block diagram.		
	Acceptable answer(s)	**Guidance**	**Max mks**
	i) An assembly drawing shows all the parts in their locations within the product (1) and is used by a fitter to assemble the parts into a product (1). ii) Shows all the dimensions of a product (1), to allow it to be manufactured (1). iii) Shows the parts of a functional system (1) and how they modify the signal that flows through the system (1).		(6 marks)

7a Figure 3 shows a disposable plastic coffee cup. Explain **two** benefits and **two** limitations of using plastic to make the cup, compared to other materials.

Figure 3

Acceptable answer(s)	**Guidance**	**Max mks**
Advantages e.g. Keeps coffee hot for a long time (1) as wall thickness thick/material properties of polystyrene means a good insulator (1). Can be manufactured in large quantities at low cost (1) as easy to form (1). Resistant to damage from the contents (1). Any other suitable responses. **Disadvantages** e.g. Cup requires thick walls to be effective insulator (1) which is uncomfortable on lips (1) or can affect taste experience (1). Flexibility of the plastic (1) may make it difficult to hold without spills (1). Damage to the environment (1) due to using plastic made from non-sustainable resources (1). Any other suitable responses.	Award 1 mark for **each** advantage up to a **maximum** of 2 and 1 mark for **each** disadvantage up to a **maximum** of 2; in addition, award 1 mark **each** for an explanation of why it is an advantage or disadvantage.	(8 marks)

7b Describe the process of injection moulding a plastic cup.

Acceptable answer(s)	**Guidance**	**Max mks**
• Granules/powdered polymer added to hopper of injection moulding machine. • Barrel of injection moulding machine (that contains rotating screw) is heated. • Rotating screw carries granules from the hopper. • Granules melted as carried along rotating screw. • Hydraulic ram pushes rotating screw forward and injects molten plastic into mould. • Plastic forms into a cup(s). • Cup cools in mould. • Cup is ejected from mould.	Award 1 mark for **each** relevant point in the process up to a **maximum** of 6 marks.	(6 marks)

7c	Explain why a manufacturer would choose to use injection moulding to make plastic cups.		
	Acceptable answer(s)	**Guidance**	**Max mks**
	Fast production rate/Mass production (1) so low cost of end product (1). Repeatable (1) so end product doesn't vary (1). Choice of plastics that can be used (1), increases design options (1). Colour additives can be used (1), so increasing design choices/attractiveness to customer (1). Low labour costs (1) as injection moulding machines are automatic (1). Any waste plastic can be reused again (1), so low costs of waste disposal (1).	Award marks as indicated, to a **maximum** of 5 marks.	(5 marks)

8 Figure 4 shows a fire extinguisher that is produced in large quantities for use in the home or small businesses.

Figure 4

Discuss how well this fire extinguisher meets **each** of following design criteria.

- Function.
- Cost.
- Suitable to be manufactured in large volumes.
- Resistance to impact.
- Ability to be easily moved.
- Sustainability.

	Acceptable answer(s)	Guidance	Max mks
	Note: Relative to Mar. 18 version this is a slightly more rigorous question and this may need to be considered during awarding/and marking. **Indicative content:** *Function* • Choice of material limited by manufacture of fire extinguisher fire safety regulations. • Withstand pressure of foam/retardant inside. • Flexibility of hose – required so as to direct at flame. • Corrosion/heat resistant as will be near flames. • Durability. *Cost* • Impact of material selection on the manufacturing process and cost, e.g. injection moulded to form complex shape of handle, press formed from metal sheet reduces cost. • Type of filling. *Suitable to be manufactured in large volumes* • Suitability to be extruded to form a cylinder with no seams or joins which would be a weak spot in a pressurised container. • Material choice allows for mass production in a standard form (tubing of set diameters). • Injection moulded to form complex shape of handle. • Press formed from metal sheet reduces cost. *Resistance to impact* • Toughness of material. • Integrity of the assembled product. *Ability to be easily moved* • Weight / density of materials, required wall thickness. *Sustainability* • Recyclability of materials. • Potential for reuse.	**Band descriptors** No answer worthy of credit, e.g. insufficient work submitted, answer not relevant to the question, answer is factually incorrect. **(0 marks)** **Band 1** – basic – largely descriptive response based on recall of knowledge, including direct comparison of a few design features. Consideration has been given to some of the design criteria. Candidates at the top of this level may be characterised by showing some understanding of the reasons for one or two design features relative to the design criteria. **(1-4 marks)** **Band 2** – clear – more detailed response, considering most of the specified design criteria. Shows recall of knowledge and understanding of the reasons for most of the design criteria and the interaction of the design criteria and the user. Candidates at the top of this level may be characterised by analysing the relative impact of the different materials or process options. **(5-8 marks)** **Band 3** – detailed – very detailed response, showing an understanding of the full range of the design criteria. A broad range of impacts are evaluated, with substantiation of which have the more significant effect and producing supporting conclusions. Candidates at the top of this level may be characterised by analysing and evaluating the positive and negative implications of the	(12 marks)

		design criteria in a broader context (such as, for example, on customers) and their application in design and manufacturing. **(9-12 marks)**	
		Total marks	**80**