OCR
Oxford Cambridge and RSA

Cambridge National

Engineering

Unit **R109:** Engineering materials, processes and production

Level 1/2 Cambridge National Award/Certificate in Engineering Manufacturing

Mark Scheme for January 2019

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

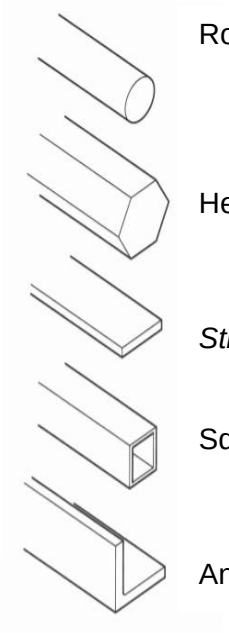
Mark schemes should be read in conjunction with the published question papers and the report on the examination.

These are the annotations, (including abbreviations), including those used in scoris, which are used when Marking

Annotation	Meaning of annotation
	Blank page
	Vague
	Tick
	Noted but no credit given
	Unclear
	Repeat
	Benefit of doubt
	Cross
	Development
	Example/Reference
	Knowledge
	Level 1
	Level 2
	Level 3

Question			Answer / Indicative Content	Mark	Guidance
1	(a)	(i)	Mild steel	1	Only correct answer.
		(ii)	• Malleability / Can be pressed into shape easily • Durability • Strength • Readily available • Takes a good finish • Relatively low cost compared with other metals • Easily welded	1	Accept any other appropriate property or characteristic Relevant one-word answers accepted ecf for correct reason if incorrect material in (i) – show as BOD
	(a)	(iii)	• (Cast/wrought) Iron • Carbon steels • Stainless steel • High Speed Steel	1	
	(b)	(i)	Composite	1	
	(b)	(ii)	• Can be formed to shape the boat hull • It is lightweight • Non-corrosive • Water resistant • Self-coloured/does not need a further finish • Easily repaired • Gives a smooth outer surface • UV resistant • Produces rigid forms	3	(3x1) Accept any three answers from list – 1 mark per response Accept ‘strong/strength’ but not ‘tough’ Do not accept ‘cheap’ Accept one-word answers if sufficiently descriptive
	(c)	(i)	Glass	1	Do not accept any plastic material – question states a ceramic material.
	(c)	(ii)	• Easily recycled • Can be re used (many times) • Does not contaminate contents • Contents are visible • Easy to clean • Easily moulded into shape • Corrosion resistant	2	(2x1) Accept any two answers from list – 1 mark per response ecf if relevant reasons for incorrect material in (i) – 1 mark only

Question			Answer / Indicative Content	Mark	Guidance
2	(a)		**Thermoplastic** • Nylon (1) • Use (1) e.g.: ○ toothbrush bristles, stockings, cord/rope, fabric, can be moulded to form car parts/electrical equipment, light-duty bearings; (lock)nuts; clothing. drone body • Polyvinyl Chloride (PVC) or PVC (1) • Use (1) e.g.: ○ roofing membranes, credit cards, children's toys, rainwater pipes, flooring, window frames, doors ○ **Thermosetting plastic** • Epoxy resin (1) • Use (1)e.g.: ○ Adhesive/glue, surface finishes, laminating resin • Phenol-formaldehyde (1) • Use (1)e.g.: Production of moulded products –billiard balls, electric switches, sockets, circuit boards, pan handles	**8**	(8x1) One mark for each of Nylon and Polyvinyl Chloride (PVC)/ PVC (the only Thermoplastic materials listed in the question) and one mark for each appropriate use stated. Accept other creditable answers for uses but do **not** accept repeated uses. Question specifically asks for different uses. ecf for appropriate use if material is in wrong cell. - show as BOD One mark for each of Epoxy resin and Phenol-formaldehyde (the only Thermosetting plastic materials listed in the question) and one mark for each appropriate use stated. Accept other creditable answers for uses but do **not** accept repeated uses. Question specifically asks for different uses. ecf for appropriate use if material is in wrong cell. - show as BOD
	(b)		• Injection moulding • Rotational moulding • Vacuum forming • Line bending • Press moulding • Extrusion	**2**	(2x1) Accept any two responses, one mark per response.

Question			Answer / Indicative Content	Mark	Guidance
3	(a)	(i)	A Round bar/rod B Hexagonal bar/rod C *Strip* D Square tube E Angle iron 	4	(4x1) Response must be 'form of supply'; no marks for simple reference to shapes – e.g. hexagonal No marks for simple use of bar, rod or tube Do **not** award strip – this one has been given in the question. Accept 'square box section' but not tube on its own Not just 'angle'
	(a)	(ii)	The material form suitable for the forged bracket is: • C / Strip	1	
	(b)		Stage 1 – ~~Cut metal to required length~~ Stage 2 – Drill holes in the bracket for wall fixing Stage 3 – Heat the metal in the forge Stage 4 – Place metal on the anvil Stage 5 – Hammer the metal to a right angle Stage 6 – ~~Allow metal to cool~~	3	One answer in correct order – 1 mark Two answers in correct order – 2 marks 3 or 4 answers in correct order – 3 marks Stage 1 and 6 given in the question.
	(c)		• Metal may fracture when cold bending • Easier to bend when hot • Hot forging avoids work hardening of the metal • It allows the metal to be bent more quickly • It allows a tighter bend to be made • Forging improves the strength of the bracket	2	(2x1) Any two appropriate responses – 1 mark each Do not accept one-word responses e.g. 'quicker'; 'easier'

Question			Answer / Indicative Content	Mark	Guidance
4	(a)		**A** – Head(stock) / motor (housing) **B** – Cutting tool e.g. - end mill / (slot) drill / cutter / reamer **C** – (Machine) vice / clamp **D** – (Work) table	**4**	(4x1)
	(b)		3 (X, Y and Z)	**1**	Do not accept 5 axis as this is not appropriate to Fig.6
	(c)		• End milling • Fly cutting / slab milling • Boring • Cutting a slot	**2**	(2x1) Any two appropriate answers – 1 mark each. Operations to be named, not described
	(d)		• Guards in place/closed • Machine set at correct speed • Correct cutter/tightened in position • Work piece securely held • Emergency stop checked • Cutter clear of work piece before starting machine • Check cooling fluid system is working	**3**	(3x1) Any three appropriate answers – 1 mark each Answer should be specific to machine checks and not PPE
5	**(a)**	**(i)**	• To join multiple pieces of metal • Suitable examples from medical components and • automotive industries • Complex welds that are difficult to do conventionally • Where accuracy of positioning is important	**1**	Any one appropriate response
	(a)	**(ii)**	Other types of welding e.g.: • Gas – Oxy/acetylene • Electric – Arc / MIG / TIG • Plasma Arc • Resistance/spot welding • Friction welding	**1**	Do **not** allow Laser welding – this is given in the question.

Question			Answer / Indicative Content	Mark	Guidance
	(a)	(iii)	• Welders helmet/welding goggles/face shield/ hand shield • Insulated gloves/gauntlets • Boots • Leather apron	2	(2x1) Not simply 'goggles' or 'visor'; must reference darkened glass Gloves and aprons must be heat resistant Answer must refer to PPE and not working area/process/training Do not accept reference to long hair, jewellery, loose ties or clothing
	(b)		• Part can be visualised on screen • Changes can be quickly made to design • Simulation - design can be rotated / revolved on screen to see different angles • Ability to share design details digitally • Animated 3D image can be produced (virtual model) • A prototype could be produced to check design	2	(2x1) Any two appropriate responses Do not accept one-word responses e.g. 'quicker'; 'easier'
	(c)		Design file created using CAD software Program converted onto 3D printer Computer controlled - material (liquid or powder) fused together Design built up in layers until required shape is achieved.	4	One mark for naming process Up to three further marks for a description of logical stages of the rapid prototyping process. Reference to computer control of process needed for full marks

Question			Answer	Marks	Guidance
6	(a)	(i)	Automation/Robots • Redundancies New machines/equipment • Re training • More specialist roles Better working environment • lighting/heating Safer working environment • less injuries e.g.: The workforce may reduce (1) as less people are needed when processes are automated. (1)	2	Up to two marks for a description impacting the workforce. Justified description (cause and effect) required for full marks
		(ii)	Better quality of products produced Consistency and precision of products Less wastage Higher production output / 24/7 production Final cost of products reduced e.g.: The product may be produced with higher consistency (1) as machines are less prone to human error. (1)	2	Up to two marks for a description impacting the product. Justified description (cause and effect) required for full marks

Question			Answer / Indicative Content	Mark	Guidance
6	(b)*		Up to six marks for a discussion of advantages and disadvantages of modern technology when compared with traditional processes. Positive responses may include reference to: • Quality of product produced. • Reduction of human error. • Repeat procedures 24/7. • Automatic adjustment to maintain accuracy on machines. • Better consistency of products from CNC machines. • Self-change tooling and more processes can be carried out by one machine (CNC Machine centre). Negative responses may include reference to: • Cost of replacing machines. • Loss of individuality. • Loss of workers skills. • Loss of traditional skills. • High automation costs. Upskilling work force – costs, reduction in employment opportunities.	6	**Levels of response** **Level 3 (5–6 marks)** Detailed discussion showing a clear understanding of the advantages and disadvantages of modern technology when compared with traditional processes Specialist terms will be used appropriately and correctly. The information will be presented in a structured format. The candidate can demonstrate the accurate use of spelling, punctuation and grammar. **Level 2 (3–4 marks)** Adequate discussion showing an understanding of the advantages and disadvantages of modern technology when compared with traditional processes. There will be some use of specialist terms, although these may not always be used appropriately. The information will be presented for the most part in a structured format. There may be occasional errors in spelling, punctuation and grammar. **Level 1 (1–2 marks)** Basic discussion showing limited understanding of the advantages and disadvantages of modern technology when compared with traditional processes There will be little or no use of specialist terms. Answers may be ambiguous or disorganised. Errors of spelling, punctuation and grammar may be intrusive. **Response must include reference to advantages *and* disadvantages to gain Level 3.** **Simple list of bullet points – Level 1 only**

Question			Answer / Indicative Content	Mark	Guidance
					0 = a response that is irrelevant and/or not worthy of a mark. Annotate with 'Seen' at end of response. Use only *K* and *DEV* annotations on script. Indicate Level at end or response.
			Total for paper	**60**	

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