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 June 2015

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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.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Question			Answer/Indicative content	Mark	Guidance
1	(a)	(i)	ABS; HIPS; Polycarbonate; PVC (2x1)	2	
		(ii)	Concrete	1	
		(iii)	Brass; Copper; Tin; Zinc (2x1)	2	
		(iv)	Brass; Cast iron; High speed steel; Stainless steel	1	
	(b)		Up to two marks for a clear description making reference to the re-softening/ remoulding/reshaping/reprocessing (1) of the material by the application of heat(1) (2x1)	2	Reference to heat needed for second mark.
	(c)		Up to two marks for a clear explanation e.g. Mixing two or more metals together(1) can produce more useful properties(1) for use in a product. (2x1)	2	Justified response needed for full marks
2	(a)		Machinability Conductivity Corrosion resistance Wear resistance (2x1)	2	Accept Ductile
	(b)		One mark for each of two valid answers Examples: steel; stainless steel; brass; copper, aluminium alloys; ABS; HIPS; Tinplate; MDF; plywood; hardboard (2x1)	2	

Question			Answer/Indicative content	Mark	Guidance
	(c)		One mark for a suitable example and up to two further marks for a description of the application e.g. Shape memory alloy – shape memory alloy can be used in fire alarm systems. When the temperature rises to the alloy's transition temperature, the alloy returns to its original shape/length and completes a circuit to set off the alarm. Quantum tunnelling composite – QTC conducts electricity when pressure is applied. It can be used in sensor circuits for alarm systems. When a pressure pad is pressed two contacts are connected, completing the alarm circuit. 2 x (3x1)	**6**	Reference to external stimulus required for full marks
3	**(a)**	**(i)**	Forging or casting	**1**	
		(ii)	One mark for each of two relevant advantages e.g. shape is produced in one piece machining operations not usually required less material wastage forging produces stronger structure quicker to produce shape (2x1)	**2**	Accept 2 one word answers for 1 mark
	(b)		One mark for each of two suitable joining methods e.g. welding brazing rivetting cyanoacrylate adhesive(superglue) / epoxy resin (2x1)	**2**	Not simply 'adhesive'/'glue'
	(c)		One mark for each of two suitable finishes e.g. galvanising; painting; oil blackening(blueing); plastic/ powder coating; electroplating; (2x1)	**2**	

Question			Answer/Indicative content	Mark	Guidance
	(d)		Up to three marks for a clear explanation. Explanation may include reference to: Guaranteed quality; standard components simplify assembly; bulk manufacture cuts down cost; no need for staff/machinery to make components; all resources used for their own manufacturing (3x1)	**3**	Simplistic/one-word points – max 2 marks irrespective of number of points
4	**(a)**		One mark for correctly labelling vertical arrow alongside machine head	**1**	
	(b)		One mark for each of three relevant safety precautions e.g. work/tools must be securely clamped put all guards in position use correct speeds and feed rates know where emergency stop button is keep work area clear of obstructions have training/experience on the machine (3x1)	**3**	No marks for reference to PPE BUT accept reference to long hair tied back/jewellery/loose clothing for 1 mark only
	(c)		One mark for each of two relevant processes e.g. turning; boring; drilling; grinding; sawing; filing; threading (2x1)	**2**	Accept Laser cutting but not sanding
	(d)	**(i)**	**Stage 2** coat wax pattern in refractory slurry to build-up mould **Stage 3** heat mould to melt out wax **Stage 4** pour molten metal into mould and leave to cool/solidify (3x1)	**3**	Accept other relevant stages in a logical order for full marks.
		(ii)	Sand casting; shell moulding; die casting; centrifugal casting; continuous casting	**1**	

Question			Answer/Indicative content	Mark	Guidance
5	(a)	(i)	Up to three marks for a clear and relevant explanation Explanation may include reference to: Production would be quicker as no breaks are needed Machines can operate 24/7 if required More consistent accuracy as human error is eliminated Less skilled workers required to operate machines Machines can be automated with robotic loading and removal of components Process codes can be changed quickly for making other parts (3x1)	**3**	Fully justified response needed for full marks
		(ii)	Milling machine; router; laser cutter; water jet cutter; plasma cutter; machining centre; 3D printer; press brake (2x1)	**2**	Accept use of robots once only
	(b)		One mark for each of two relevant benefits relating to the workforce e.g. working conditions are cleaner/healthier safer working as machines are fully enclosed less heavy work to be done Developing new skills/higher paid jobs (2x1)	**2**	
	(c)		Up to three marks for a detailed description of an additive manufacturing process. Description should include reference to software used to slice the 3D design into layers(1); building up the layers of the required product(1) by selected additive manufacturing process(1) eg selective laser sintering(SLS); 3D printing (3x1)	**3**	No marks for simplistic / one-word responses
6	(a)		Up to two marks for each description e.g. the internet can be used to research materials and inform decisions for new products CAD packages can be used to present and modify designs more quickly Digital communications can be used to present and share design details Use of CAM for production of prototypes Use of smart materials to enhance performance of products 2x(1+1)	**4**	Justified response needed for full marks

Question			Answer/Indicative content	Mark	Guidance
	(b)	*	**Level 3 (5–6 marks)** Detailed discussion showing a clear understanding of the cost implications to a manufacturer of introducing modern technologies in production. 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 cost implications to a manufacturer of introducing modern technologies in production. 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 cost implications to a manufacturer of introducing modern technologies in production. 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. 0 = a response that is irrelevant and/or not worthy of a mark. Annotate with 'Seen' at end of response.	**6**	Up to six marks for a discussion or detailed explanation of the cost implications to a manufacturer of introducing modern technologies in production. Responses may include reference to: • High capital outlay for equipment • Cost of re-training staff for high tech roles • Cost of redundancy payments to staff no longer needed • Energy costs for new equipment • Cost of reorganising workplace to suit new technologies • Cost of lost production while equipment is installed
			Total marks for paper	**60**	

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