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 2016

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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			Expected Answer(s)	Mark	Guidance
1	(a)		**Alloy -** Brass; Bronze; Cast iron ; Duralumin; Steel; stainless steel **Ferrous metal -** Iron; Cast iron; (carbon) Steel; Wrought iron; Stainless steel **Non-ferrous metal -** Aluminium; Copper; Brass; Bronze; Lead; Tin; Titanium; Zinc; (other appropriately named non-ferrous metal) **Polymer -** ABS; Acrylic; HIPs; Polyethylene; PVC; (other appropriately named Polymer) (8x1)	**8**	Not just 'Aluminium' Accept repetition of metals if correctly used. e.g. cast iron – Alloy *and* Ferrous metal Specific polymers needed, not 'Thermoplastic/thermoset'
	(b)		Up to two marks for an adequate description. Must include reference to 'mixture' (1) and 'metals' (and elements) (1) (1+1)	**2**	
2	**(a)**		Up to two marks for an adequate description. Must include reference to change of colour (1) with increase/decrease in temperature (1) (1+1)	**2**	
	(b)		One mark for each of three valid reasons. Examples: It is readily cast into complex shapes It is a relatively inexpensive material It is strong in compression It is easy to machine It can take a decorative/corrosion resistant finish It is a heavy material (3x1)	**3**	Three one word / simplistic responses – 1 mark only

Question			Expected Answer(s)	Mark	Guidance
	(c)		Plastics Metals Ceramics (2x1)	**2**	Accept specific examples of material types
	(d)		Up to three marks for a clear description of a specific process. One mark for named test and up to two further marks for description e.g. Tensile testing; compression testing; impact testing; fatigue testing; hardness testing Example: Tensile testing (1) is done to find the tensile strength of a metal. A special test piece of the metal is clamped in a machine and pulled until it stretches and breaks.(1) The force it takes to break it is used to work out the tensile strength (1) (3x1)	**3**	Detailed description required for full marks. Simplistic description with named test = 2 marks max.

Question			Expected Answer(s)	Mark	Guidance
3	(a)	(i)	Self-tapping screw; pan head screw; single slot screw	1	Reference to *type* of screw required
		(ii)	Up to three marks for a detailed explanation. Explanation must have reference to small pilot hole for screw in lower sheet of metal (1); clearance size hole in top sheet (1); screw is screwed into the hole and cuts its own thread (1) (3x1)	3	Description of use as a 'self-cutting' screw – 1 mark only
	(b)		Riveting; pop-riveting; soft soldering; nuts/spire nuts and bolts; spot/resistance welding; cyanoacrylate adhesive/superglue (2x1)	2	Not simple 'glue/adhesive'
	(c)		Up to two marks for each adequate description of a benefit. Examples: Forging can make shaped parts (1) more easily than machining (1) Forged parts are stronger (1) than machined parts where metal is cut away (1) Forging makes shaped parts in one blow (1) with little or no machining needed (1) There is less material wasted (1) as none/ not much has to be cut off (1) Forging shapes parts by moving the existing material(1) into a new shape(1) Increases metal strength (1) by squeezing grain/molecules together (1) 2 x (2x1	4	

Question			Expected Answer(s)	Mark	Guidance
4	(a)	(i)	**A -** Heaters / heating chamber **B -** Hopper **C -** Mould **D -** Injector / ram / feed screw (4x1)	**4**	Accept descriptive responses e.g. 'where the plastic is melted'
		(ii)	Vacuum forming; press moulding; blow moulding; extrusion; rotational moulding; compression moulding (3x1)	**3**	Not 'plastic coating'
	(b)		One mark for each of three valid reasons Examples: Plastics are more easily formed into complex shapes Plastics are heat and electrical insulators Plastic do not need finishing processes A wide range of different colours is available Products made from plastics can often be assembled more easily Less energy required in processing, therefore process costs less. Does not corrode Normally lighter than metals Lower cost per component when mass produced (3x1)	**3**	Reference to use in products accepted Three one word / simplistic responses – 1 mark only Not 'cheaper than metals' Not 'can be recycled'

Question			Expected Answer(s)	Mark	Guidance
5	(a)	(i)	Up to two marks for an adequate description of one benefit Examples: The water jet is very fine (1) so more complex shapes can be cut than by milling (1) Water jet cutting gives a cleaner cut (1) and 'swarf' is washed away by the jet (1) Reference to 'no-heat' (1) so no distortion of work (1) (2x1)	**2**	Justified response required for full marks Not 'more accurate than milling'
		(ii)	Up to three marks for a detailed explanation. Example: A multi-axis machining centre is a machine where the workpiece and/or cutting tools can be moved in many different ways (1) so that different operations such as turning, boring and milling can be carried out (1) without the need to change machines (1) (3x1)	**3**	
	(b)		Selective Laser Sintering (SLS) Stereolithography (SLA) Direct Metal Laser Sintering (DMLS) Fused Deposition Modelling (FDM) / 3D Printing Electron beam melting (2x1)	**2**	
	(c)		Up to three marks for a detailed explanation Example: CAD software used to design the product (1) and can be used to develop and change designs quickly (1) then rapid prototyping can produce examples of products for evaluation (1) (3x1)	**3**	Modern technologies used must be referenced in response for full marks Simple reference to CAD/CAM – 1 mark only

Question			Expected Answer(s)	Mark	Guidance
6	(a)	(i)	Up to two marks for an explanation of the term Global Manufacturing The explanation should include reference to large companies(1) having factories in different parts of the world / making different parts made in different countries(1) (2x1)	**2**	Justified response required for full marks Do not accept simple repetition of the question
		(ii)	One mark for each of two valid reasons. Examples: Lower cost of labour in developing countries Availability of necessary raw materials Proximity to lucrative markets for products Ease of sharing designs/ product information digitally anywhere in the world To get their products worldwide (wider market) / bigger target audience (2x1)	**2**	

Question			Expected Answer(s)	Mark	Guidance
	(b)*		**Level 3 (5–6 marks)** Detailed discussion showing a clear understanding of the effects on the workforce of introducing modern technologies into engineering manufacture. 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 effects on the workforce of introducing modern technologies into engineering manufacture. 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 effects on the workforce of introducing modern technologies into engineering manufacture. 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 effects on the workforce of introducing modern technologies into engineering manufacture. Responses may include reference to: Loss of manual jobs through automation of machines Staff may need extensive re-training to use new technologies Working conditions will improve as fewer heavy / dirty jobs will need doing Earnings of some staff may increase as skills levels rise / output increases
			Total marks for paper	**60**	

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