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 2016

Question			Expected Answer(s)	Mark	Guidance
1	(a)		**Nylon -** polymer **Cast iron -** Ferrous metal / Alloy **Copper -** Non-ferrous metal **Bronze -** Non-ferrous metal / Alloy **High speed steel -** Ferrous metal / Alloy (5x1)	5	Repetition of materials acceptable
	(b)		Thermoplastics Thermosetting (plastics) (2x1)	2	Accept suitable alternatives if sufficiently descriptive
	(c)		**One** mark for a suitable example and **up to two** marks for an explanation of the term. Example: A composite material is one that combines two different materials (1) to make one with better / more suitable properties (1). Carbon fibre is an example of a composite material (1). 1 + (2x1)	3	Description without example 2 marks max.

Question			Expected Answer(s)	Mark	Guidance

2	(a)		**Product** **Suitable material** **Reason**
			
			 Bench vice jaw - cast iron / cast steel easy to cast into shape
			                                           very strong material
			
			 Lathe chuck guard polycarbonate clear / transparent
			                                           shatter resistant
			
			                                                    2 x (1+1)
				4	Not just 'steel'
					 Accept durable
					
					 Not 'Acrylic'
					
					 Ecf for relevant reason for choice if incorrect material given

	(b)		**One** mark for a suitable example and **up to two** marks for an explanation of use making reference to stimulus and response Examples: • A shape memory alloy can be bent into shape and then made to return to its original shape (1) by heating it or passing an electrical current through it (1). An example of the use of SMAs is in heating controls(1). • Thermochromic dyes can be used as temperature indicators (1) They are used in children's mugs (1) and change colour as the contents of the mug cool (1). 1 + (2x1)	**3**	Explanation without example 2 marks max. Not 'Memory foam'
	(c)		**One** mark for each of three relevant characteristics. Examples: • Relative cost • Availability • Ease of use • Safety in use • Form of supply • Sustainability (3x1)	**3**	1 mark max. for three 'properties'

Question			Expected Answer(s)		Mark	Guidance
3	(a)		**Process** **Hand tool used**			Stages to be in a workable order for max. marks
			Stage 2 saw down inside of lines to meet the holes hacksaw			

			Stage 3 remove section by chain drilling twist drill
			                     filing / abrafiling round file / abrafile
			                        chiselling cold chisel / hammer			

			Stage 4 file to lines to make required shape - (hand-flat) file			
				3 x (1+1)	**6**	

	(b)		Any **one** from:
			  • Plastic / powder coating
			  • Galvanising
			  • Oil blueing / blackening
			  • Electroplating /BZP
					1	Accept 'plating'
						
						Not polishing / linishing

Question			Guidance	Mark	Answer
3	(c)*		**Level 3 (5–6 marks)** Detailed discussion showing a clear understanding of the advantages and disadvantages of forging compared to machining. 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 forging compared to machining. 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 forging compared to machining. 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 advantages and disadvantages of forging compared to machining. Responses may include reference to: Shapes made in single blow Reduction in machining time Reduced overall cost of making part Improved strength through grain flow/compression Less waste of material Less swarf for disposal Doesn't need skilled workers in production Not suitable for making small quantities Need for special machinery Cost of having dies made

Question			Expected Answer(s)	Mark	Guidance
4	(a)	(i)	(Sand) casting Rapid prototyping processes - eg 3D printing; DMLS; stereolithography(SLA); SLS	1	
		(ii)	Permanent mould / Die casting; Investment (lost wax) casting Shell moulding; Box-less sand casting Forging (2x1)	2	
	(b)	(i)	**Up to two** marks for each of two adequate descriptions Examples; • Use a jig (1) that fits over the plate and has two holes to drill through (1), putting the holes in the correct position each time. • Make a fixture to hold the plate(1) and fix it onto a two spindle drilling machine (1) • On a CNC machine (1) from data produced on CAD (1) 2 x (2x1)	4	
		(ii)	**One** mark for each of three relevant safety precautions (including PPE). Examples: • Wear goggles to protect eyes • Wear overalls / apron • Make sure work is clamped firmly • Put guard in position around chuck • Remove chuck key before switching on • Keep work area clear of obstructions • Know where emergency stop is • Tie long hair back • Must be trained on use of machine • Machine set to correct speed / feed (3x1)	3	Accept other <u>relevant</u> precautions One-word responses – 1 mark max. in total

Question			Expected Answer(s)	Mark	Guidance
5	(a)		Up to **three** marks. Examples: • Machining centres / multi-axis machines • Water jet cutting machines / plasma cutting machines • Laser cutters / welders • Punching machines • Press-brake machines • Robots • 3D printers (3x1)	**3**	Accept other viable examples
	(b)		Up to **two** marks for each of two descriptions Examples: • CNC machines have faster production rates (1) as tool changes are done automatically (1) • More than one CNC machine (1) can be operated by one worker (1) • CNC machines produce more consistent results (1) as there is no human error involved (1) • Faster changeover (1) from production of one item to another(1) • 24/7 working (1) means increased production (1) 2 x (2x1)	**4**	
	(c)		**One** mark for each of **three** relevant effects. Examples: • Some workers may be made redundant • Working conditions should improve – less heavy / dirty work • Safer working environment as machines are fully enclosed when operating • Some staff may need re-training to use / programme the machines • Increased output / skills may result in higher pay for some • Changes to shift patterns (3x1)	**3**	Responses must relate directly to the workforce

Question			Expected Answer(s)	Mark	Guidance
6	(a)		Up to **two** marks for each of two justified descriptions. Examples: • Once the new technology has been paid for (1) the faster rate of production with automated machines makes the cost of manufacture less (1) • Fewer workers are needed (1) so the cost of making the products is reduced (1) • User computer controlled systems such as JIT (1) means that less stock has to be stored, leaving all factory space for production (1) • More consistent accuracy (1) so less waste produced (1) 2 x (2x1)	4	
6	(b)		Up to **three** marks for a relevant and detailed explanation Example: CAD can be used to generate design drawings which can then be shared with others electronically (1). 3D images and animation make it possible to see and evaluate the workings of the design(1) .Secure websites can be set up allowing customers/manufacturers to edit details and provide input into the development of the design(1) (3x1)	3	Response must relate to use of digital communications, not simply description of CAD process

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