

## **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**

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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.

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Question		Expected Answer(s)	Mark	Guidance
1	(a)	<p><b>Nylon</b> - polymer  <b>Cast iron</b> - Ferrous metal / Alloy  <b>Copper</b> - Non-ferrous metal  <b>Bronze</b> - Non-ferrous metal / Alloy  <b>High speed steel</b> - Ferrous metal / Alloy</p> <p>(5x1)</p>	<b>5</b>	Repetition of materials acceptable
	(b)	<p>Thermoplastics  Thermosetting (plastics)</p> <p>(2x1)</p>	<b>2</b>	Accept suitable alternatives if sufficiently descriptive
	(c)	<p><b>One</b> mark for a suitable example and <b>up to two</b> 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).</p> <p style="text-align: right;">1 +</p> <p>(2x1)</p>	<b>3</b>	Description without example 2 marks max.

Question		Expected Answer(s)			Mark	Guidance
2	(a)	<b>Product</b>	<b>Suitable material</b>	<b>Reason</b>	4	Not just 'steel' Accept durable  Not 'Acrylic'  Ecf for relevant reason for choice if incorrect material given
		<b>Bench vice jaw -</b>	cast iron / cast steel	easy to cast into shape very strong material		
		<b>Lathe chuck guard</b>	polycarbonate	clear / transparent shatter resistant	2 x (1+1)	
	(b)	<p><b>One</b> mark for a suitable example and <b>up to two</b> marks for an explanation of use making reference to stimulus and response</p> <p>Examples:</p> <ul style="list-style-type: none"> <li>• 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).</li> <li>• 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).</li> </ul>			3	Explanation without example 2 marks max.  Not 'Memory foam'
	(c)	<p><b>One</b> mark for each of three relevant characteristics.</p> <p>Examples:</p> <ul style="list-style-type: none"> <li>• Relative cost</li> <li>• Availability</li> <li>• Ease of use</li> <li>• Safety in use</li> <li>• Form of supply</li> <li>• Sustainability</li> </ul>			(3x1)	1 mark max. for three 'properties'

Question		Expected Answer(s)	Mark	Guidance
3	(a)	<p><b>Process</b></p> <p><b>Stage 2</b> saw down inside of lines to meet the holes</p> <p><b>Stage 3</b> remove section by chain drilling filing / abrafilng chiselling</p> <p><b>Stage 4</b> file to lines to make required shape - (hand-flat) file</p>	<p><b>Hand tool used</b></p> <p>hacksaw</p> <p>twist drill round file / abrafile cold chisel / hammer</p> <p>3 x (1+1)</p>	<p>6</p> <p>Stages to be in a workable order for max. marks</p>
	(b)	<p>Any <b>one</b> from:</p> <ul style="list-style-type: none"> <li>• Plastic / powder coating</li> <li>• Galvanising</li> <li>• Oil blueing / blackening</li> <li>• Electroplating /BZP</li> </ul>	<p>1</p>	

Question		Guidance	Mark	Answer
3	(c)*	<p><b>Level 3 (5–6 marks)</b> 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.</p> <p><b>Level 2 (3–4 marks)</b> 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.</p> <p><b>Level 1 (1–2 marks)</b> 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.</p> <p>0 = a response that is irrelevant and/or not worthy of a mark. Annotate with 'Seen' at end of response.</p>	6	<p>Up to six marks for a discussion or detailed explanation of the advantages and disadvantages of forging compared to machining.</p> <p>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</p> <p>Not suitable for making small quantities Need for special machinery Cost of having dies made</p>

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)	<b>Up to two</b> marks for each of two adequate descriptions  Examples; <ul style="list-style-type: none"> <li>• 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.</li> <li>• Make a fixture to hold the plate(1) and fix it onto a two spindle drilling machine (1)</li> <li>• On a CNC machine (1) from data produced on CAD (1)</li> </ul> <p style="text-align: right;">2 x</p> (2x1)	4	
		(ii)	<b>One</b> mark for each of three relevant safety precautions (including PPE).  Examples: <ul style="list-style-type: none"> <li>• Wear goggles to protect eyes</li> <li>• Wear overalls / apron</li> <li>• Make sure work is clamped firmly</li> <li>• Put guard in position around chuck</li> <li>• Remove chuck key before switching on</li> <li>• Keep work area clear of obstructions</li> <li>• Know where emergency stop is</li> <li>• Tie long hair back</li> <li>• Must be trained on use of machine</li> <li>• Machine set to correct speed / feed</li> </ul> (3x1)	3	Accept other <u>relevant</u> precautions  One-word responses – 1 mark max. in total

Question		Expected Answer(s)	Mark	Guidance
5	(a)	<p>Up to <b>three</b> marks.</p> <p>Examples:</p> <ul style="list-style-type: none"> <li>• Machining centres / multi-axis machines</li> <li>• Water jet cutting machines / plasma cutting machines</li> <li>• Laser cutters / welders</li> <li>• Punching machines</li> <li>• Press-brake machines</li> <li>• Robots</li> <li>• 3D printers</li> </ul> <p>(3x1)</p>	3	Accept other viable examples
	(b)	<p>Up to <b>two</b> marks for each of two descriptions</p> <p>Examples:</p> <ul style="list-style-type: none"> <li>• CNC machines have faster production rates (1) as tool changes are done automatically (1)</li> <li>• More than one CNC machine (1) can be operated by one worker (1)</li> <li>• CNC machines produce more consistent results (1) as there is no human error involved (1)</li> <li>• Faster changeover (1) from production of one item to another(1)</li> <li>• 24/7 working (1) means increased production (1)</li> </ul> <p>(2x1)</p>	2 x 4	
	(c)	<p><b>One</b> mark for each of <b>three</b> relevant effects.</p> <p>Examples:</p> <ul style="list-style-type: none"> <li>• Some workers may be made redundant</li> <li>• Working conditions should improve – less heavy / dirty work</li> <li>• Safer working environment as machines are fully enclosed when operating</li> <li>• Some staff may need re-training to use / programme the machines</li> <li>• Increased output / skills may result in higher pay for some</li> <li>• Changes to shift patterns</li> </ul> <p>(3x1)</p>	3	Responses must relate directly to the workforce

Question		Expected Answer(s)	Mark	Guidance
6	(a)	<p>Up to <b>two</b> marks for each of two justified descriptions.</p> <p>Examples:</p> <ul style="list-style-type: none"> <li>• Once the new technology has been paid for (1) the faster rate of production with automated machines makes the cost of manufacture less (1)</li> <li>• Fewer workers are needed (1) so the cost of making the products is reduced (1)</li> <li>• User computer controlled systems such as JIT (1) means that less stock has to be stored, leaving all factory space for production (1)</li> <li>• More consistent accuracy (1) so less waste produced (1)</li> </ul> <p style="text-align: right;">2 x</p> <p>(2x1)</p>	<b>4</b>	
6	(b)	<p>Up to <b>three</b> marks for a relevant and detailed explanation</p> <p>Example:</p> <p>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)</p> <p>(3x1)</p>	<b>3</b>	Response must relate to use of digital communications, not simply description of CAD process

**OCR (Oxford Cambridge and RSA Examinations)**  
1 Hills Road  
Cambridge  
CB1 2EU

**OCR Customer Contact Centre**

**Education and Learning**

Telephone: 01223 553998

Facsimile: 01223 552627

Email: [general.qualifications@ocr.org.uk](mailto:general.qualifications@ocr.org.uk)

[www.ocr.org.uk](http://www.ocr.org.uk)

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**OCR (Oxford Cambridge and RSA Examinations)**  
Head office  
Telephone: 01223 552552  
Facsimile: 01223 552553

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