

## **Cambridge National**

### **Science**

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

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

### **Mark Scheme for January 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.

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Question			Expected Answer(s)	Mark	Guidance
1	(a)	(i)	Mild steel Cast iron High carbon steel Stainless steel High speed steel  (2x1)	2	Do not accept Iron  Accept 'steel' for 1 mark
		(ii)	One mark for a suitable example (1) Explanation to include reference to a metallic mixture (1) not containing iron (1) (3x1)	3	Allow marks for explanation even if example is incorrect.
	(b)		One mark for each of three correctly named <i>Thermoplastic</i> materials e.g. ABS; Polypropylene; Nylon/polyamide; HIPS/polystyrene; PVC; PETE; Acrylic; HDPE/Polythene/Polyethylene (3x1)	3	Accept other <i>thermoplastics</i> .
	(c)		One mark for each of two suitable reasons e.g. So that the handles don't soften/melt with the heat. Thermosetting plastics are normally more rigid/strong than thermoplastics. They don't conduct heat (2x1)	2	Not simply 'stronger'
2	(a)		Copper is:- Conductive/conducts electricity Ductile Corrosion resistant Malleable  (2x1)	2	Accept reference to bending or 'bends easily'.
	(b)		Explanation could include reference to: Uninterrupted manufacture Reduced cost of materials Need for supply at short notice  Must be fully justified for both marks	2	

Question		Expected Answer(s)	Mark	Guidance	
	(c)	<p>One mark for each appropriate use of material e.g. cast iron – machine bases; garden benches</p> <p>ABS – home appliance casings; vacuum formed items; cycle helmets</p> <p>High speed steel – cutting tools/tool bits; drills</p> <p style="text-align: right;">(3x1)</p>	<b>3</b>	Accept as material used on 3D printers	
	(d)	<p>One mark for a suitable example, and up to two further marks for a reasoned explanation, which may include reference to the procedure and the suitability (e.g. x-rays to test for cracks in large castings / product is not damaged/destroyed in testing)</p> <p style="text-align: right;">(3x1)</p>	<b>3</b>		
<b>3</b>	(a)	(i)	<p>Mild steel is:- A relatively low-cost material; malleable/easy to form; easy to machine; widely available; a relatively strong metal</p> <p style="text-align: right;">(2x1)</p>	<b>2</b>	Two one word answers eg 'cheap' and 'strong' one mark only (as not qualified, i.e. <i>relatively</i> )
	(b)	(i)	<p><b>2</b> - Punch/centre drill hole position      Centre punch; centre drill; hammer <b>4</b> – Tap/thread hole                              M8 taper (&amp; plug) tap; tap wrench; vice</p> <p style="text-align: right;">(4x1)</p>	<b>4</b>	One tool only required for mark at each stage.
		(ii)	6.8mm	<b>1</b>	Only acceptable response
	(c)		<p>Up to three marks for a reasoned explanation, which must include reference to the hardness of the surface (1) and the toughness of the internal structure (1), and prevention of damage to end stop (1)</p> <p style="text-align: right;">(3x1)</p>	<b>3</b>	Accept other relevant points in explanation

Question			Expected Answer(s)	Mark	Guidance
4	(a)	(i)	A – cross slide B - tool holder/toolpost C - leadscrew/feedshaft D - tailstock  (4x1)	4	Allow 1 mark for 'tool' if no other correct response
		(ii)	Centre drilling	1	
		(iii)	One mark for each of three relevant safety precautions e.g. Make sure work/tool is firmly clamped; put all guards in position; remove chuck key after tightening work; know where emergency stop button is; keep work area clear of obstructions; have training/experience on the lathe; check machine is in safe working condition  (3x1)	3	No marks for reference to PPE BUT accept reference to long hair tied back / jewellery / loose clothing for one mark only
	(b)		One mark for each of two relevant factors e.g. material being machined; diameter of work being machined (or drill used); process being carried out (eg. slow for screwcutting); surface finish required  (2x1)	2	

Question		Expected Answer(s)	Mark	Guidance
5	(a)	Computer Numerical(Iy) Controlled	1	
	(b)	<p>Up to two marks for each of three <i>reasoned</i> advantages with justification.  e.g. A better surface finish will be produced; no secondary operations needed.  No tool changes needed during machining; production time will be quicker  No heavy clamping of workpiece required; no marks on surface  Less wastage of material/Multiple pieces can be placed closer together on material  Minimal radius in corners of square / rectangular holes; no secondary operations needed</p> <p style="text-align: right;">(3x2)</p>	6	<p>No marks for individual simplistic/one-word answers eg 'faster'</p> <p>Allow other justified advantages</p>
	(c)	<p>Up to three marks for a detailed description of a rapid prototyping process.</p> <p>Description should include reference to computer generated 3D image (1); slicing design into layers (1); building up of 3D prototype by selected process eg stereolithography/3D printing/laser sintering (1)</p> <p style="text-align: right;">(3x1)</p>	3	
6	(a)	<p>Up to two marks for each relevant/clear description</p> <ul style="list-style-type: none"> <li>• Use of barcoding</li> <li>• computerised stock control systems; can automatically order more stock when required.</li> <li>• Use of RFID, for stock control;</li> <li>• Use of online ordering; quicker</li> </ul> <p style="text-align: right;">(2x2)</p>	4	Justified response required for full mark

Question	Expected Answer(s)	Mark	Guidance
(b)*	<p><b>Level 3 (5–6 marks)</b> Detailed discussion showing a clear understanding of the impact of automation on the quality of engineered products with points for and against</p> <p>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 impact of automation on the quality of engineered products</p> <p>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 impact of automation on the quality of engineered products</p> <p>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 impact of automation on the quality of engineered products</p> <p>Responses may include reference to:</p> <ul style="list-style-type: none"> <li>• Reduction in the 'human error' effect</li> <li>• Use of 'constant monitoring' in quality control</li> <li>• Automatic adjustment to maintain accuracy on machines</li> <li>• Improved consistency of results from CNC machines</li> <li>• Developments in materials, processes and tooling producing better results/quality</li> <li>• High tech quality control techniques (eg use of lasers/3D scanners)</li> <li>• High cost of automation</li> <li>• Perceived reduction in quality of hand crafted products</li> <li>• Loss of individuality</li> </ul>
	<b>Total marks for paper</b>	<b>60</b>	

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