



## **Cambridge National**

### **Engineering**

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

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

### **Mark Scheme for June 2018**

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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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These are the annotations, (including abbreviations), including those used in scoris, which are used when Marking

Annotation	Meaning of annotation
	Blank page
	Vague
	Tick
	Noted but no credit given
	Unclear
	Repeat
	Benefit of doubt
	Cross
	Development
	Example/Reference
	Knowledge
	Level 1
	Level 2
	Level 3

Question			Answer / Indicative Content	Mark	Guidance
1	(a)	(i)	One mark for each of three valid examples  Examples: Aluminium; brass; bronze; copper; duralumin; lead; tin; titanium; zinc  (3x1)	3	Accept other valid examples
		(ii)	Description must include reference to a mixture (1) of metals (1)  (2x1)		
	(b)	(i)	Thermoplastics can be softened by heat (1) but thermosetting cannot be changed once formed (1)  (2x1)	2	Accept 'easier to form' but do not accept reference to 'remoulding' thermoplastic products.  Reference to recycling – one mark only
		(ii)	One mark for each of three thermoplastics  Examples: ABS; polyamide/nylon; Acrylic/PMMA; Polystyrene; Polypropylene; PVC; PET(PETE); HDPE/LDPE; PTFE(Teflon); PLA (PolyLactic Acid); Polycarbonate; Acetal (3x1)		3
2	(a)		One mark for each of three relevant examples  Examples; Stainless steel - sinks; cutlery; food containers; urinals Carbon fibre - racing car bodies; bike frames; fishing rods; brake discs Cast iron - machine bases; decorative fire surrounds; saucepans; drain grids /covers; outside furniture  (3x1)	3	Accept other valid examples  Reference to 'parts' need to be specific Not Girders or beams; Accept 'bridges'

Question		Answer / Indicative Content	Mark	Guidance
	(b)	<p>Up to two marks for a clear and justified explanation            Example;            Sustainability is important because raw materials are being used up too quickly (1) and will run out completely if demand for them continues (1)</p> <p style="text-align: right;">(2x1)</p>	<b>2</b>	<p>Simplistic reference to raw materials or availability – 1 mark only</p>
	(c)	<p>Up to three marks for a clear and justified description of use.</p> <p>Examples:            SMA - Nitinol wire can be stretched and used in electric locks (1). When an electric current is passed through it, it heats up (1) and shrinks to pull the bolt open (1)            Thermochromic materials - Thermochromic dyes can be used in plastics (1) so that a child's mug (1) would change colour if the liquid inside was too hot (1)            QTC – QTC can be used in pressure pads for alarms (1)            When pressure is applied to the QTC it becomes conductive (1) and allows current to pass to the alarm output (1)</p> <p style="text-align: right;">(3x1)</p>	<b>3</b>	<p>Must relate to Shape Memory <u>Alloy</u>            Simplistic reference to 'returning to original shape' 1mark only</p> <p>Description of use in a specific product required for full marks</p>
	(d)	<p>Up to two marks for a clear description of a simple hardness test</p> <p>Example:            Place a hard point (1) against the metal and squeeze it in a vice / hit it with a large hammer; the size of the indentation shows how hard the metal is (1)</p> <p style="text-align: right;">(2x1)</p>	<b>2</b>	<p>Hit with hammer and see how big dent is - 1mark only</p> <p>Accept use of hardness testing equipment (eg Rockwell / Brinell / Vickers) for 1 mark only .</p>

Question		Answer / Indicative Content	Mark	Guidance
3	(a)	<p>Up to three marks for a clear description of the process</p> <p>Example; An aluminium alloy billet is heated (1) and placed into the extrusion machine. A hydraulic ram then forces the soft metal (1) through a specially shaped die (1) to produce the required shape</p> <p style="text-align: right;">(3x1)</p>	3	Three clear stages required for full marks
	(b)	<p>(i) One mark for each of two appropriate processes</p> <p>Examples: Die / sand casting; investment casting; shell moulding; forging; press forming; hydro-forming; spinning; rolling; bending/folding</p> <p style="text-align: right;">(2x1)</p>	2	Must be <u>metal</u> forming processes
		<p>(ii) Up to two marks for each clear description of a valid benefit</p> <p>Examples: Forming processes use less material (1) because less is cut away/less waste(1) Forming process are cheaper once the dies are made (1) because fewer machining operations are needed (1) Forming processes are quicker (1) because the item is made in one piece (1) Products generally stronger(1) due to improved grain structure(1) Complex shapes(1) can be made in one piece(1)</p> <p style="text-align: right;">2 x (1+1)</p>	4	Responses must be justified for full marks
	(c)	(CNC) milling; pressing, laser cutting; sawing	1	Accept other <i>appropriate</i> processes NOT 'Grinding' or 'cutting'

Question			Answer / Indicative Content	Mark	Guidance
4	(a)	(i)	<p>Process - Annealing</p> <p>The brass is heated to a (dull) red heat (1) and then left to cool naturally (1)</p> <p style="text-align: right;">1 + (2x1)</p>	3	<p>ecf for valid description but incorrectly named process</p> <p>Do not accept 'quenching' for cooling</p>
		(ii)	<p>Hardening Tempering Case hardening Normalising Nitriding</p> <p style="text-align: right;">(3x1)</p>	3	<p>Do not accept annealing – repeat from part (i)</p> <p>Not 'blackening/blueing' or 'quenching'</p>
		(iii)	<p>One mark for each of three <i>appropriate</i> precautions</p> <p>Examples: Eye protection; (leather) apron; fume extraction; fire extinguisher; strong footwear; (leather) gloves; use of tongs; clear workspace; no flammable substances nearby; tie hair back</p> <p style="text-align: right;">(3x1)</p>	3	<p>Not simply 'wear PPE' or reference to jewellery</p> <p>Accept other valid examples</p>
	(b)		<p>One mark for a finish <u>suitable</u> for brass</p> <p>Examples: (metal) polishing; brushing/buffing; lacquering; electroplating</p>	1	<p>Do not accept varnishing or painting</p>
5	(a)		<p>Up to two marks for each clear description of a valid benefit</p> <p>Examples: Water jet cutting can produce more intricate shapes (1) than conventional processes like milling (1) Water jet cutting can cut hard materials (1) that normal cutting tools would not cut (1) Water jet cutting gives a clean cut (1) and washes away the metal removed / re-circulates water to be used again(1)</p>		<p>Benefit must be specific to water jet cutting not simply use of CNC (eg no human error)</p>

Question	Answer / Indicative Content	Mark	Guidance
	Water jet cutting is safer(1) because no harmful gases are produced(1) <div style="text-align: right;">2 x (1+1)</div>	<b>4</b>	Justified responses required for full marks
<b>(b)</b>	One mark for each of two valid laser applications  Cutting; welding; hardening; etching/engraving; measurement /quality control; sintering (SLS); stereolithography(SLA) <div style="text-align: right;">(2x1)</div>	<b>2</b>	
<b>(c)</b>	Up to two marks for each clear description of a valid effect  Examples Some workers might be re-trained (1) to be able to do the more technical jobs / earn better salaries(1) Workers would be safer (1) because modern technologies do the dangerous / difficult / labour intensive jobs (1) The working environment is safer / cleaner (1) because air conditioning automatically removes fumes (1)  <div style="text-align: right;">2 x (2x1)</div>	<b>4</b>	Check for repetition of job loss from the stem of the question.  Accept other relevant effects.  Justified responses required for full marks



Question		Answer	Marks	Content	Guidance
					Levels of response
6	(a)*	Up to six marks for a discussion or detailed explanation of the impact of modern technologies on quality in engineering production		<p>Response might include reference to:</p> <p>Elimination of human error in manufacturing products. Modern technologies give consistent results. Modern processes, tooling and materials give higher quality finishes. CNC machines are self-monitoring and compensate automatically for any changes. Modern technologies stop production automatically to prevent production of waste. Modern technologies, like the use of lasers in quality control, ensure quality of production Improved quality helps companies reputation</p>	<p><b>Level 3 (5–6 marks)</b> Detailed discussion showing a clear understanding of the impact of modern technologies on quality in engineering production</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 modern technologies on quality in engineering production</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 modern technologies on quality in engineering production</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>Use 'knowledge' and 'development' annotations in the text. No ticks.</p>

Question			Answer	Marks	Content	Guidance
						<b>Levels of response</b>
				<b>6</b>		Indicate whether response is level 1, 2 or 3  0 = a response that is irrelevant and/or not worthy of a mark. Annotate with 'Seen' at end of response.

Question			Answer / Indicative Content	Mark	Guidance
<b>6</b>	<b>(b)</b>	<b>(i)</b>	One mark for each of two relevant examples  Examples: Video conferencing; Skype / facetime; digital transfer of technical data; SMS/texting; use of Internet websites; social media; messenger apps  (2x1)	<b>2</b>	Accept other <u>valid</u> examples  Do not accept telephones / phone calls
		<b>(ii)</b>	Up to two marks for a clear description  Example: Email could be used for a manufacturer to send orders instantly (1) for components/materials to a supplier (1)  (2x1)	<b>2</b>	Accept other valid examples  Justified description required for full marks
			<b>Total for paper</b>	<b>60</b>	

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