

Cambridge National

ENGINEERING MANUFACTURING

Level 1/2 CAMBRIDGE NATIONALS IN ENGINEERING MANUFACTURING

R109/01 Engineering materials, processes and production

Mark Scheme for Jan 2020

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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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Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The scoris **comments box** is used by your team leader to explain the Marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
If you have any questions or comments for your team leader, use the phone, the scoris messaging system, or e-mail.
9. For answers Marked by levels of response:
- To determine the level** – start at the highest level and work down until you reach the level that matches the answer
 - To determine the Mark within the level**, consider the following:

Descriptor	Award Mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of Marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of Marks available)
Consistently meets the criteria for this level	At top of level

10. 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

BOD	Benefit of doubt
X	Cross
DEV	Development
EG	Example/Reference
K	Knowledge
L1	Level 1
L2	Level 2
L3	Level 3

11. Here are the subject specific instructions for this question paper

Subject specific Marking instructions that apply across the whole question paper must appear here. These must be compatible with the OCR Marking Instructions above.

12. Here is the Mark scheme for this question paper.

MARK SCHEME

Question		Answer			Mark	Guidance
1	(a)	Item	Suitable material	Reason for selection	8	<p>One mark for each material</p> <p>One mark for any reason from the list only if it relates to a suitable material.</p> <p>ACCEPT any other relevant reasons</p> <p>IGNORE Does not oxidise</p> <p>IGNORE strong NOT Copper</p>
		Roof panel	Polycarbonate	Weather resistant Can be pressed to shape Is strong (in rippled / corrugated state) lightweight		
		Wheel rim	Aluminium alloy	It is lightweight Easily formed into a variety of shapes/styles Doesn't rust /corrode Good strength to weight ratio		
		Pipe fitting	PVC	Can be formed into various shapes It is lightweight Noncorrosive / durable Water resistant Recycled/ recyclable		
		Twist drill	High speed steel	Strong material can drill most metal Can cut at high speeds Can withstand high temperatures (without losing its temper)		

Question		Answer	Mark	Guidance												
1	(b)	<p>Explanation could include:</p> <p>Can machine hardened steels</p> <p>Retain the cutting edge longer (than high speed steel tools)</p> <p>Higher resistance to wear (than high speed steel tools)</p> <p>More cost effective than (high speed steel tools as they retain their cutting edge hardness)</p> <p>Can withstand high machining temperatures</p>	2	<p>ACCEPT any two answers from the list</p> <p>ACCEPT 'can cut / drill masonry'</p> <p>Award 2 marks for a fully justified single point</p>												
2	(a)	<table border="0"> <tr> <td><i>Brass</i></td> <td>Non-Ferrous metal</td> </tr> <tr> <td><i>Polypropylene</i></td> <td>Thermoplastic</td> </tr> <tr> <td><i>Carbon Steel</i></td> <td>Ferrous (metal)</td> </tr> <tr> <td><i>Epoxy Resin</i></td> <td>Thermosetting plastic</td> </tr> <tr> <td><i>Carbon Fibre</i></td> <td>Composite</td> </tr> <tr> <td><i>Glass</i></td> <td>Ceramic</td> </tr> </table>	<i>Brass</i>	Non-Ferrous metal	<i>Polypropylene</i>	Thermoplastic	<i>Carbon Steel</i>	Ferrous (metal)	<i>Epoxy Resin</i>	Thermosetting plastic	<i>Carbon Fibre</i>	Composite	<i>Glass</i>	Ceramic	5	1 Mark each correct material group
<i>Brass</i>	Non-Ferrous metal															
<i>Polypropylene</i>	Thermoplastic															
<i>Carbon Steel</i>	Ferrous (metal)															
<i>Epoxy Resin</i>	Thermosetting plastic															
<i>Carbon Fibre</i>	Composite															
<i>Glass</i>	Ceramic															
	(b)	(i)	<p>A material that remembers its shape / can be deformed when cold [1]</p> <p>and will return to its original shape when heated / appropriate stimulus applied [1]</p>	2												
		(ii)	<p>Dental wire for braces</p> <p>Fire alarm</p> <p>Glasses / Spectacles</p> <p>Electric door locks</p>	1	<p>Any one response – must be a use for the smart material</p> <p>ACCEPT other uses of shape memory alloys</p>											
		(iii)	<p>Thermochromic materials</p> <p>photochromic materials</p> <p>Shape memory plastics</p> <p>Quantum tunnelling compound / QTC</p>	2	<p>Any two responses</p> <p>ACCEPT: Polymorph ferrofluids</p>											

Question		Answer	Mark	Guidance						
3	(a)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">A</td> <td style="text-align: center;">C</td> <td style="text-align: center;">F</td> <td style="text-align: center;">E</td> <td style="text-align: center;">D</td> <td style="text-align: center;">B</td> </tr> </table>	A	C	F	E	D	B	3	One answer in correct position – 1 mark Two answers in correct order – 2 marks 3 or 4 answers in correct order – 3 marks
A	C	F	E	D	B					
	(b)	(i)	Urea-formaldehyde is a thermosetting plastic (and is not appropriate for blow moulding) / cannot be remoulded	1						
		(ii)	Injection moulding	1						
	(c)		Well ventilated area Awareness of location of fire extinguisher / blanket Mark items left to cool down as “hot” Use tongs or other appropriate equipment to handle hot material Have water nearby to quench items if necessary Complete appropriate training / ensure machinery is in good working order Check location of emergency stop Safe working environment / ensure no obstacles in surrounding area / no trip hazards / check for hazards Ensure items are cooled before touching them	2	Any two responses DO NOT ACCEPT PPE / tie hair back					
	(d)		Explanation may include: <ul style="list-style-type: none"> • Lightweight so it can easily be carried around • Does not break if dropped • Can be recycled / remoulded • Can be reused • Water resistant • Doesn't contaminate the contents • Relatively inexpensive material / cheap • Easy to mould into shape (and sizes) / mass produce • Thermal insulator • Transparent / range of colours (available) 	3	3 marks for three valid points in explanation Award 2 marks for a fully justified single point IGNORE reference to freshness					

Question		Answer	Mark	Guidance
4	(a)	<p>A - Eye shield</p> <p>B - Wheel</p> <p>C - Tool rest</p> <p>D - Wheel guard</p> <p>E - Water trough</p>	5	ACCEPT spark deflector
	(b)	<p>Shaping (tool bits)</p> <p>Sharpening (tools)</p> <p>Removing metal /material / trimming down</p> <p>Smoothing surfaces</p>	1	Any one response
	(c)	<p>Wear visor / goggles / face shield / face mask</p> <p>Boots</p> <p>Leather apron / overalls</p> <p>Hair tie/bobble/net</p>	2	<p>Any two responses</p> <p>DO NOT ACCEPT Tie hair back</p> <p>DO NOT ACCEPT gloves / gauntlet</p> <p>IGNORE bald apron</p>
	(d)	<p>Drilling</p> <p>Turning / tapering off</p> <p>Milling</p> <p>Sawing</p> <p>Filing</p> <p>Facing off</p>	2	<p>Any two responses</p> <p>IGNORE lathing</p> <p>IGNORE sanding</p> <p>IGNORE machining</p> <p>IGNORE Facing off if unqualified turning is used for other marking point</p>

Question		Answer	Mark	Guidance
5	(a)	<p>Explanation could include:</p> <ul style="list-style-type: none"> • Benefit no heat (from friction) produced in cutting area (1) • Justification: Variety of materials / thicknesses of materials – metals and plastics – can be cut (1) without melting, distortion or warping (1) • Benefit Clean/accurate/no human error process. (1) • Justification: Requires less further processing (1) • Benefit Clean/sharp cut and edge produced • Justification: Requires less further processing • Benefit: Can cut multiple shapes at same time (1) • Justify: reduces process times increases efficiency (1) • Benefit: Can be linked to CNC / automated process • Justification: repetition in manufacturing / reduced labour costs • Benefit: Water is recycled • Justification: environmental impact • Benefit: Can cut a variety of/intricate shapes • Justification: Higher value products can be manufactured / less wastage/ less 	3	<p>Justified response needed for full marks</p> <p>First two marking points can be any two benefits or justification Third marking point is for justification linked to</p> <p>IGNORE reference to time saving if unqualified or qualified with “by hand” but ALLOW reference to time qualified by named alternative manual machine.</p>
	(b)	<p>Milling Laser cutting Punching / pressing</p>	1	<p>Any one response</p> <p>IGNORE names of machines or tools</p>

Question		Answer	Mark	Guidance
	(c) (i)	Production in different parts of the world. (1) Can be either complete (products) or component parts to be assembled elsewhere. (1)	2	
	(ii)	Suitable benefits could be: <ul style="list-style-type: none"> • Reduced overall costs / labour costs • (Raw) Materials can be sourced locally / proximity to raw materials (and product will be more cost effective). • (Replacement) manufacturers can be found easily • Components are produced where resources are abundant for that item • Increased capability for high volume production • Greater capacity for varying the products produced • Increased access to overseas / new markets 	2	2 x 1 marks for suitable benefits
	(iii)	Video conferencing / phone conferencing Video calling / phone call Live chat Email/ Inter/Intranet / website / webinar / cloud storage Electronic communication of drawings / data / coding Messaging / SMS	2	Any two appropriate responses ACCEPT Named apps for both marks only if they are clearly different ways to communicate

Question			Answer	Mark	Guidance
6	(a)	(i)	Filing Sawing Drilling	2	Any two responses IGNORE responses that are clearly names of tools without justification (e.g. file vs file the material down)
		(ii)	Explanation: Once a die has been produced the same shape will be punched time after time [1] so quality of products produced will be the same time after time – no human error/ more accurate OR so less wastage , higher / faster output levels / no further processing required[1]	2	Justified response required for full marks

Question	Answer	Marks	Guidance / Indicative content
(b)*	<p>Level 3 (5–6 marks) Detailed discussion showing a clear understanding of the use of modern technology to design and manufacture products efficiently and giving consideration to costs.</p> <p><i>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.</i></p> <p>Level 2 (3–4 marks) A discussion showing an understanding of the use of modern technology to design and manufacture products efficiently and giving consideration to costs. <i>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.</i></p> <p>Level 1 (1–2 marks) Basic discussion showing limited understanding of the use of modern technology to design and manufacture products efficiently and giving consideration to costs.</p> <p><i>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.</i></p> <p>0 = no response worthy of credit</p>	6	<p>Up to six marks for a discussion or detailed explanation of the use of modern technology to design and manufacture products efficiently and giving consideration to costs.</p> <p>Reference to design and manufacturing elements including may include:</p> <p>IGNORE unqualified reference to modern technology, efficiency or cost.</p> <p>Specialist terminology such as CAD/CAM/CNC/CIM etc must be included to achieve full marks.</p> <ul style="list-style-type: none"> • Modern technology for designing CAD and manufacture CAM. <p>Efficiency:</p> <ul style="list-style-type: none"> • Automation of systems / can operate 24/7. • Reputation of the company can be enhanced (by the production of high-quality goods in less time). • Consistently produce the same high-quality product. • Lean manufacture with little waste material/rejects produced/ facilitates JIT manufacturing. • Products can be produced quicker and therefore can increase output to clients • Energy efficient. • Breakdowns can affect meeting production schedules and deadlines. <p>Cost:</p> <ul style="list-style-type: none"> • Set up costs and buying in computer and CNC equipment is normally very high. • Costs can be offset once production is fully underway.

Question	Answer	Marks	Guidance / Indicative content
			<ul style="list-style-type: none">• Labour costs can be reduced by automation.• Staff need to be trained to operate the systems.• Upskilling workforce – costs.• (Products can be produced faster so) quicker return on material purchasing costs• Reduced storage/inventory costs
	Total for paper	60	

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