Oxford Cambridge and RSA

Sample Assessment Material (SAM)

Cambridge Nationals in Engineering Manufacture
R014 Principles of engineering manufacture

MARK SCHEME
DRAFT

Duration: 1 hour 15 minutes

MAXIMUM MARK 70

Version: 2.0
Last updated: 12/07/21

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SAMPLE

This document consists of 9 pages

Crossed Out Responses
If a student has crossed out a response and written a clear alternative response, then the crossed out response is not marked. If no alternative is given, examiners will give students the benefit of the doubt and mark the crossed out response if it is legible.

Multiple Choice Question Responses
When a multiple choice question has only a single, correct response and a student gives two responses (even if one of these responses is correct), no mark will be awarded, as it is not possible to determine which was the first response selected.

Contradictory Responses
When a student provides contradictory responses, no mark will be awarded, even if one of the answers is correct.

Short Answer Questions (usually worth only **one mark per response**)
If a student needs to give a set number of short answer responses, but gives more, only the set number of responses will be marked. The response space will be marked from left to right on each line and then line by line until the required number of responses have been marked. The remaining responses will not be marked.

Short Answer Questions (worth **two or more marks**)
If a student is required to provide a description of, say, three items or factors and four items or factors are provided, then marking will be similar to the above example (but downwards).

Longer Answer Questions
If a student provides two (or more) responses to a medium or high tariff question which only needs a single (developed) response, and does not cross out the first response, the first response will be marked.

Levels of response marking

a. **To determine the level** – examiners will start at the highest level and work down until they reach the level that matches the answer
b. **To determine the mark within the level**, they will 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

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SECTION A

Question			Answer	Mark	Guidance
1			(d) Wasting	1	Correct answer only
2			(b) Elasticity	1	Correct answer only
3			(c) Injection moulding	1	Correct answer only
4			(c) MAG welding	1	Correct answer only
5			(d) Stainless steel	1	Correct answer only
6			(a) Ceramic	1	Correct answer only
7			(b) Hidden detail	1	Correct answer only
8			(a) Diameter	1	Correct answer only
9			(c) Putting in place procedures to make sure that products are made correctly and defect free	1	Correct answer only
10			(c) Material Requirements Planning	1	Correct answer only

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SECTION B

Question			Answer	Mark	Guidance
11	(a)		One mark for each of: A Chuck/spindle B Toolpost C Top slide/compound slide/compound rest D Tailstock	4	
11	(b)		Any **four** of: • Wear safety googles (1) to protect eyes from flying debris (1) • Use the machine guard (1) to protect against getting entangled in the rotating parts (1) • Remove the chuck key (1) so this is not thrown out of the lathe when the machine is turned on (1) • Wear safety shoes (1) to protect toes from any dropped parts (1) • Wear an apron (1) to prevent clothes being damaged by sharp edges of swarf (1) Award credit for any other appropriate response.	4	Award 1 mark each for stating up to two safety precautions and a second mark each for giving an appropriate reason why it is needed. The reasons given must be different. Do **not** accept wearing gloves.
11	(c)		Any **two** of: • In an alloy, the addition of atoms of a second metal to a pure metal can change the microstructure (1) or impede movement of atoms/slip planes within the material (1) • This can give better mechanical properties than a pure metal (1). Award credit for any other appropriate response.	2	

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Question			Answer	Mark	Guidance
12	(a)		Any **one** difference identified from: • Thermoplastic polymers can be reshaped/ thermosetting polymers cannot be reshaped (1) • Thermoplastic polymers soften when heated/ thermosetting polymers char when heated (1) • Thermoplastic polymers can be recycled/ thermosetting polymers cannot be recycled (1) With the following reason: • Thermoplastic polymers are not crosslinked/ thermosetting polymers are crosslinked (1) • Award credit for any other appropriate response.	2	
12	(b)		Any **two** from: • ABS • HIPS • PMMA/acrylic • polycarbonate Award credit for any other appropriate response.	2	
12	(c)		Any **six** from: • A mould is made • The polymer sheet is clamped to the vacuum former • The polymer sheet is heated until flexible • The mould/platen is raised • The vacuum is turned on/the air is sucked out from underneath the mould • Air pressure pushes the polymer against the mould • The mould is allowed to cool/removed from the polymer sheet • The excess material is cut away from the casing	6	Marks can only be awarded for process steps that are in the correct sequence

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Question			Answer	Mark	Guidance
13	(a)		Any **two** of: • It is a material that has a property that reacts to changes in its environment. • The change is reversible. Award credit for any other appropriate response.	2	
13	(b)		Any **two** of: • QTC conducts electricity when pressure is applied (1). It can be used in keypads (1). When pressure is applied to the key, electricity is allowed to flow through the QTC, completing the circuit (1). Any **two** of: • Thermochromic pigment changes colour with temperature (1). It can be used to make flexible thermometers (1), which could be stuck to the casing of a machine to indicate if it is overheating (1) by changing colour (1). Award credit for any other appropriate response.	4	Give one mark for application and one mark for each valid reason why it is used. Maximum of two marks for each material. Accept any valid example.
13	(c)		Any **four** of: • A mould is made (1) • The fibre is laid out in the mould (1) • The matrix material is painted onto the fibre/impregnated into the fibre (1) • The composite is allowed to dry/heated (1) to cure it (1) • Any excess material is cut away (1) Award credit for any other appropriate response.	4	Marks can only be awarded for process steps that are in the correct sequence. Credit up to the stated maximum can also be given for additional information on the process steps, such as orienting the fibre, vacuum bagging, use of an autoclave etc.

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Question			Answer	Mark	Guidance
14	(a)		Any **two** of: • CAM Milling machines/routers • Laser cutters • Presses • Injection moulding machines • Pressure die casting machines • 3D printers • Robotic welders • Robotic paint sprayers Award credit for any other appropriate response.	2	
14	(b)		Any **four** of: • Production speed would be quicker (1) as no breaks are needed (1)/tools are changed automatically (1) • Production output would be higher (1) as machines can operate 24/7 if required (1) • More consistent product (1) as human error is eliminated (1) • Machines can be automated with robotic loading and removal of components (1) reducing the need for human operators (1) Award credit for any other appropriate response.	4	Maximum of two marks just for stating reasons; the additional two marks must be explanation.
14	(c)		Any **two** of: • Reduced inventory (1) meaning that less money is tied up in inventory (1) • Quality defects can be detected quicker (1) due to less work in progress (1) Award credit for any other appropriate response.	2	Maximum of one mark just for stating reason; the additional mark must be explanation.
14	(d)		Any **two** of: • Late deliveries / Disruptions in supply of materials (1) could stop production (1) Award credit for any other appropriate response.	2	Maximum of one mark just for stating reason; the additional mark must be explanation.

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Question			Answer	Mark	Guidance
15	(a)		Any **six** of: • Reduced product cost (1) due to lower cost of labour (1) • Requirement for transportation to market (1) which would have an effect on the environment (1) • Reduced employment opportunities at existing sites (1) which may damage the company's reputation (1) • Possible differences in employment conditions (1) and local environmental legislation (1) could cause customers not to buy the product (1) due to ethical concerns (1) • Increased employment opportunities in the area of the new plant (1) which may bring economic prosperity to that area (1) • New workers may require training (1) to be able to achieve the international standards required by other countries (1) Award credit for any other appropriate response.	6	Award a maximum of three marks for just stating implications without explanation. Multiple marks can be given for a single implication where there are levels of detail in the explanation.
15	(b)		Any **four** of: • Early intercept of problems in production (1) reducing waste and scrap (1), which keeps costs down (1) • To achieve consistency of finished products (1), giving predictable product performance (1) • To conform to industry standards/regulations (1), reducing issues at customer and returns (1) Award credit for any other appropriate response.	4	Award a maximum of two marks for just stating reasons without explanation.

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Question			Answer	Mark	Guidance
16	(a)		Any **four** of: • Software divides the CAD model into a series of layers (1), which are exported to the 3D printer (1) • Printing head deposits the first layer (1) • The printing head raises one layer and deposits the second layer (1); this process is repeated until the shape is completed (1). • The product is removed from the base plate (1) • The product may be finished using abrasive paper to improve the surface quality (1) Award credit for any other appropriate response.	4	Marks can only be awarded for process steps that are in the correct sequence. Credit up to the stated maximum can also be given for additional information on the process steps, such as the use of PLA material, describing the etc.
16	(b)		**Level 3 (5–6 marks)** A **thorough** discussion including a **range** of advantages and disadvantages of casting compared to machining, showing **detailed** understanding of all the points stated. **Consistently** uses appropriate terminology. **Level 2 (3–4 marks)** An **adequate** discussion including **some** advantages and disadvantages of casting compared to machining, showing understanding of **some** of the points stated. **Some** use of appropriate terminology **Level 1 (1–2 marks)** A **brief** discussion including only either advantages or disadvantages of casting compared to machining, showing **limited** supporting understanding. **Little or no use** of appropriate terminology. 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 casting compared to machining. Responses may include reference to: • Shape made in single operation • Reduction in machining time, although dressing/finishing may still be needed • Reduced overall cost of making part • Less waste of material/less swarf for disposal • Less skilled workers needed to operate machines • Cost of mould manufacture • Risk of casting defects, such as porosity

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