



Oxford Cambridge and RSA

Cambridge National

Engineering

R109/01: Engineering Manufacture: Engineering materials, processes and production

Level 1/2 Cambridge National Certificate/Award

Mark Scheme for June 2022

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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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MARKING INSTRUCTIONS

PREPARATION FOR MARKING ON-SCREEN

1. Make sure that you have accessed and completed the relevant and training packages for on-screen Marking: *RM Assessor assessor Online Training* and the *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the Instructions for On-Screen Marking and the Mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal <http://www.rm.com/support/ca>
3. Log-in to RM Assessor and Mark the **required number** of practice responses and the **required number** of standardisation responses.

YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING INSTRUCTIONS – FOR MARKING ON-SCREEN AND FOR PAPER BASED MARKING

1. Mark strictly to the Mark scheme.
2. Marks awarded must relate directly to the Marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the Mark scheme, consult your Team Leader by telephone or the RM Assessor messaging system, or by email.
5. **Crossed Out Responses**
Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Rubric Error Responses – Optional Questions

Where candidates have a choice of questions across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM

assessor, which will select the highest mark from those awarded. (The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)

Multiple Choice Question Responses

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate). When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. (The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)

Short Answer Questions (requiring a more developed response, worth **two or more marks**)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.
7. There is a NR (No Response) option. Award NR (No Response)
 - there is nothing written in the answer space

Award Zero '0' if:




- anything is written in the answer space and is not worthy of credit (this includes text and symbols).

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 RM Assessor **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 RM Assessor 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 RM Assessor, which are used when Marking

Annotation	Meaning of annotation
	Blank page
	Vague
	Tick

SEEN	Noted but no credit given
?	Unclear
REP	Repeat
BOD	Benefit of doubt
ECF	Error carried forward
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 / Indicative Content	Mark	Guidance
1	(a)	(i)	Food can – Steel (1) Glasses – Titanium (1) Sports bottle - Polypropylene (1) Trumpet – Brass (1)	4	
		(ii)	Food can – Ferrous (1) Glasses - Non ferrous (1) Sports bottle – Thermoplastic (1) Trumpet – Non-ferrous (1)	4	ecf material type must match the material in 1(a)(i) even if the material is incorrect.
	(b)	(i)	Thermosetting / polymer / plastic / thermosett	1	
		(ii)	As an adhesive / glue / coating Filling cracks	1	ALLOW references to joining or coating components ALLOW mould a named item IGNORE unqualified reference to an item IGNORE unqualified manufacture a named item DO NOT ALLOW superglue

			Total	[10]	
2	(a)	(i)	(Pop) rivet / nut and bolt / adhesive / machine screw / glue	1	DO NOT ALLOW any joining process that requires heat DO NOT ALLOW screws
		(ii)	The sheet metal used is thin / heating for the time required / amount of heat (for continuous weld) (1) Would cause melting / distortion / deformation (1).	2	IGNORE affect the shape
		(iii)	Polycarbonate Polypropylene Nylon Aluminium HDPE Wood ABS Carbon fibre	2	Any two from the list IGNORE titanium / stainless steel / copper (sheet) / unqualified plastic DO NOT ALLOW steel / mild steel
		(iv)	ALLOW appropriate properties from the list below that match the materials in 2(iii) <ul style="list-style-type: none"> • Does not rust / corrode / does not require painting or other surface finishes. • Density • Hard wearing / tough / durable / weather resistant /hard / machineable • Strong / rigid / stiff • Conductivity 	2	DO NOT ALLOW non-corrosive DO NOT ALLOW characteristics ALLOW it can be moulded if this is consistent with their answer to (iii) ALLOW lightweight ALLOW not brittle ecf ALLOW two appropriate properties for one correct material even if the other material is incorrect. No marks if both materials incorrect

	(b)	<ul style="list-style-type: none"> • Speeds up production / quicker / more efficient (1) • Allows for automation /robotic process (1) • Allows different thicknesses to be joined together (1) • Avoids heat distortion (1) • Allows for easier repair / replacement / removal of automotive panels(1) • Safer (method to use than gas welding) (1) • Cheaper / less cost (1) 	1	Any valid point
	(c)	<p>Ductility – the ability to be drawn/ stretched/pulled into wire (without losing strength/breaking) (1)</p> <p>Conductivity – the ease with which an electric charge/ electricity or heat can pass through a metal (1)</p>	2	IGNORE conduct
		Total	[10]	

3	(a)	<p><i>Alloy wheel – powder coating</i> (1) <i>Chrome mixer tap – electroplating</i> (1) <i>Copper bracelet – polishing</i> (1) <i>Garden incinerator – galvanising</i> (1)</p>	4		
	(b)	<p>To remove (excess) material (1) using an abrasive moving belt or disc (1)</p>	2	DO NOT ALLOW polishing	
	(c)	<ul style="list-style-type: none"> • To improve the flatness of a surface / obtain smooth finish (1) • To remove joints and seams from metal that has been welded or fused together. (1) • Can be used to create a distinctive brushed/matt finish especially on aluminium. (1) 	1	Any point listed	
	(d)	(i)	<p><i>Quantum Tunnelling Composite (QTC)</i> Uses e.g.</p> <ul style="list-style-type: none"> • Pressure pad / alarm sensor / plates • Touch / keypads / buttons on (mobile) phones / touch screens • Sensory applications • Flexible switches 	1	ALLOW any other appropriate use.
		(ii)	<p><i>Thermochromic material</i> Uses e.g.</p> <ul style="list-style-type: none"> • Thermometer • Temperature indicator • Colour changing hot drinks cup/mug – design/colour changes with heat • Battery test strip. • Colour changing spoons • Colour changing clothing • Thermochromic inks / paints / dyes / pigments 	1	ALLOW any other appropriate use.

		(iii) <i>Shape memory plastic</i> Uses e.g.- <ul style="list-style-type: none"> • Medical devices (eg stents, catheters) • Car (plastic) bumper if dented can return to its original shape through applying a heat stimulus. • (Dental) braces • Garden tunnels for plant growing • TPU Thermoplastic polyurethane (TPU) 	1	ALLOW any other appropriate use. e.g., fibres for comfort wear clothing.
		Total	[10]	

4	(a)	(i)	(Centre) lathe	1	ALLOW multi axis machine
		(ii)	Brazing	1	
		(iii)	<ul style="list-style-type: none"> The screwdriver blade is cleaned (with emery cloth). heated / (placed on the brazing hearth) To the correct / required temperature 290°C / (dark) blue colour. (It is picked up with tongs and) quenched in water / allowed to cool in air 	4	One mark per point from the list up maximum of 4 marks. ALLOW temperature values in range 280-300°C
	(b)		<p>Explanation of advantages of JIT e.g.</p> <ul style="list-style-type: none"> Only amount of materials needed is ordered (1) Materials used (on production line) straight away / bought when needed (1) Saves/ reduces storage space/land (1) Reduces stock holding (1) Reduces waste. (1) Reduced financial outlay for materials (1) Reduces production/ storage cost (1) Improves cash flow. (1) Quicker to adapt to customer demand. / continuous quality improvement (1) 	4	<p>Allow similar explanations</p> <p>IGNORE can be delivered quickly</p> <p>ALLOW less risk of damage while in storage</p> <p>ALLOW saves storing materials</p>
			Total	[10]	

5	(a)	<p>Explanation of benefits of using CNC machinery e.g.</p> <p>Any two from:</p> <ul style="list-style-type: none"> • Increased production (1) • Computer controlled / fewer human operatives (1) • Lower production costs / increased profitability (1) <p>Up to four from:</p> <ul style="list-style-type: none"> • Products manufactured faster / in less time (1) • consistent quality / less chance of human error(1) • good for high scale production (1). • Less waste / fewer rejects (1) • 24/7 production / does not require breaks (1) • Higher tolerances than manual manufacture (1) • Safer for operator (1) 	4	<p>ALLOW similar explanations ORA</p> <p>ALLOW decreased energy cost</p> <p>ALLOW more accurate</p>
	(b)	<ul style="list-style-type: none"> • Lathe • Milling machine • Router • Drilling • Punching machine • Press brake machine • Multi axis (machining) centre • Laser cutter • plasma cutter • water jet cutter • 3D printer /SLS /SDLS • Pick and place • Grinding • Welding 	2	Any two from list

	(c)	<ul style="list-style-type: none"> • Increased / high cost (to purchase / train staff/ repair) • Staff need to be retrained/ programming skills required/ • Cost of downtime while new technology is installed. • Installation space /time • Energy usage may increase • Requires specialist maintenance 	2	IGNORE reference to reduced work force
	(d)	<ul style="list-style-type: none"> • Safer (for work force due to guards and fitted safety devices etc). • Upskilling of workforce / better salaries. • Better working environment / less manual requirement 	2	
		Total	[10]	

6	(a)	Computer Aided Design	1	
	(b)	<p>Explanation of how CAD benefits product development e.g.</p> <ul style="list-style-type: none"> • Designs can be produced (on computer) (1) • Changes / development can be made quickly / without wasting resources (1) • (3D) Design ideas can be simulated / modelled to check that they work (1). • Designs can be produced to high tolerances • Design ideas can be shared electronically all over the world with other departments (Global Company) (1) • easily discuss designs remotely with clients in real time (1) • reducing travel time/costs, or delays. (1) • Iterations / alterations can be shared/sent to clients/customers quickly for approval • Once approved, ideas from CAD system can be transferred to CAM production. 	3	<p>Allow similar explanations</p> <p>IGNORE easily</p> <p>IGNORE correct / accurate</p>

Question	Answer	Marks	Guidance
(c)*	<p>Up to six marks for a discussion or detailed explanation of the impact of automation on engineering production output.</p> <p>Level 3 (5–6 marks) Detailed discussion showing a clear understanding of the impact of automation on engineering production output.</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>Level 2 (3–4 marks) Adequate discussion showing an understanding of the impact of automation on engineering production output.</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>Level 1 (1–2 marks) Basic discussion showing limited understanding of the impact of automation on engineering production output.</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>Indicative points may include:</p> <p>Understanding</p> <ul style="list-style-type: none"> • Automation makes use of programmed machines / Robots / less humans • Faster production rates / quicker • Suitable for mass manufacture • They can work 24/7 • Increased quality • less waste / rejects • Costs associated with modern technology • Don't get tired or bored and don't need breaks • Can repeat the same process over and over • Can be programmed to change processes after a certain time • Significant loss of production if the machine goes down • Can carry out menial and complicated tasks • Can carry out operations that are hazardous to humans • Can lift, move heavy items efficiently increasing production output <p>Clear understanding</p> <ul style="list-style-type: none"> • Changes to respond to customer /product requirements can be programmed in, such as tolerances, slight changes in dimensions • (very) high tolerances (at high production rates). • Increased consistency /less human error • Automation can include quality control systems (to monitor progress and warn of problems/dangers/faults, avoiding waste)

Question			Answer	Marks	Guidance
					<ul style="list-style-type: none"> Automation can include production and packaging ready for dispatch saving time and resources Automation reduces errors increasing production output Automation can reduce foreign bodies/material entering system, leading to less rejected products. Increased need for quality control due to large number of defects if incorrect product made Requires costly / specialist maintenance Production stops if machine or programme goes down
			Total	[10]	
			Total for paper	60	

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