Cambridge National

Engineering

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

Level 1/2 Cambridge National Certificate/Award

Mark Scheme for January 2023

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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.

MARKING INSTRUCTIONS

PREPARATION FOR MARKING
RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood 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 ("scripts") and the **number of required** standardisation responses.

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

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 question 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.   Award No Response (NR) if:
  •   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.   *Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.*

10. For answers marked by levels of response:
     a.   **To determine the level** – start at the highest level and work down until you reach the level that matches the answer
     b.   **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

11. **Annotations**

Annotation	Meaning
BP	Blank page
VG	Vague
✔	Tick
SEEN	Noted but no credit given
?	Unclear
REP	Repeat
BOD	Benefit of doubt
DEV	Development
K	Knowledge
L1	Level 1
L2	Level 2
L3	Level 3

12.   Subject Specific Marking Instructions

Guidance	Meaning
OWTTE	Or words to that effect
AOVR	Allow other valid response
ORA	Or Reverse Argument

MARK SCHEME

Question	Answer / Indicative Content	Mark	Guidance
1 (a)	**Material type** — **Example** Composite — Iron Alloy — Carbon fibre Non-ferrous metal — Tungsten carbide Ceramic — Brass Ferrous metal — Titanium (3x1)	3	1 correct = 1 mark 2 correct = 2 marks 3 or 4 correct = 3 marks **ALLOW** clear indication of links if not shown using lines **ALLOW** brass as a non-ferrous metal
(b)	conductivity testing crack detection (tensile testing) (1x1)	1	
(c)	The ability to withstand abrasion [1] without (surface) damage/**in**dentation[1] (2 x 1)	2	**IGNORE** unqualified ability to withstand a force **ALLOW** does not scratch / wear = 1 **ALLOW** unaffected (surface) **IGNORE** durable / durability **IGNORE** crack / break / dent

(d)		Explanation may include the following points: • the ability of a material to be drawn/stretched **into wires** (without fracture) • reduces grain size • (Normalising) will allow planes of (metal) atoms • to slip/slide over each other • Reduces hardness / increases ductility. (3x1)	**3**	Award 1 mark for each separate point identified. **ALLOW** 2 marks for a single point fully explained **DO NOT ALLOW** bend / misshape / unqualified stretching / stretching easily **IGNORE** references to the actual normalising process
(e)		<u>Cutting</u> tool (tips) / drill bits (1x1)	**1**	**ALLOW** any named cutting tool where tungsten carbide is used **IGNORE** (kitchen) knives **ALLOW** disc brakes / brake pads / surgical cutting tools
			10	

Question			Answer / Indicative Content	Mark	Guidance
2	(a)	(i)	Polycarbonate is transparent / clear / see through / optical clarity (1x1)	1	**OWTTE** **IGNORE** Does not fog up **DO NOT ALLOW** UV resistant
		(ii)	• Strong / lot of force to break • Stiff / high rigidity • Hard • Tough / shatter or chip resistant / durable / hard wearing / impact resistant • Easily moulded • Weather/water resistant • Corrosion resistance • (Easy to) colour • Good insulator • Light weight (2x1)	2	**DO NOT ALLOW** characteristics **DO NOT ALLOW** can be welded
		(iii)	Sheet: **Vacuum moulding/forming / Press moulding/forming** Powder: **Injection moulding** (2x1)	2	**DO NOT ALLOW** thermoforming / line bending **IGNORE** unqualified moulding / pressing **ALLOW** melting and putting into a mould
	(b)		Ability to return to original shape/length/form after stretching/ tensile or compressive deformation (1x1)	1	**OWTTE**
	(c)			4	

Polymer material	Thermoplastic	Thermoset
Polycarbonate	✓	
ABS	✓	
Nylon	✓	
Polyester resin		✓

Question			Answer / Indicative Content	Mark	Guidance
3	(a)	(i)	<table><tr><th>Part of the machine</th><th>Letter</th></tr><tr><td>Die</td><td>D</td></tr><tr><td>Punch</td><td>B</td></tr><tr><td>Hydraulic ram</td><td>A</td></tr></table> (3x1)	3	
		(ii)	• Two switches that must be operated by two hands / two button operation • (Side/rear/safety) guards / safety screen / guard locks • Kick plate / emergency stop pedal /safety brake • Isolator switch (external to machine) • Emergency stop button (wall mounted – external to machine) • Risk assessment displayed / hazard warning signs • Fire extinguisher • Safety area / yellow floor markings (2x1)	2	**DO NOT ALLOW** references to PPE **DO NOT ALLOW** clean tidy work area **DO NOT ALLOW** chuck guard / guard on drill / visor **DO NOT ALLOW** box around machine unless a clear description of safety area. **IGNORE** foot pedal

		(iii)	Any two from:
			• Read the risk assessment
			• Be properly trained
			• Check machine is safe to use before operating /
			  turned off before starting and finishing
			• Ensure emergency stop is operational
			• Maintain a clear/orderly working environment / no
			  tripping hazards/ removal of swarf
			• Ensure work is correctly positioned / use
			  supports/assists when working with heavy sheets
			• Guards in place / down
			• <u>Wear</u> goggles and gloves / PPE / tie back long hair
			  (2x1)
				2	**ALLOW** any other valid responses that are not to do with PPE
					
					PPE must be worn / on

	(b)		Soldering Welding / brazing Soldering (3x1)	**3**	
				10	

Question			Answer / Indicative Content	Mark	Guidance
4	(a)	(i)		4	(Sequence 1 already completed) 1 correct = 1 mark 2 correct = 2 marks 3 correct = 3 marks 4 or 5 correct = 4 marks **ALLOW** any clear indication of the links
		(ii)	Heat until the end of the chisel is showing a blue/purple colour / 175 – 350°C Quench (in water) / Allow to cool in air (2x1)	2	Must be correct order for both marks **DO NOT ALLOW** unqualified heating / certain temperature **DO NOT ALLOW** red / orange / close to melting point / high temperature / **IGNORE** incorrect reference to material properties
		(iii)	To reduce the brittleness / increase toughness So the cold chisel/cutting edge <u>does not break</u> when impacted / is more impact resistant (2x1)	2	**ALLOW** 'so it is tough **IGNORE** withstand force durable / last longer **ALLOW** responses related to use that imply impact e.g. "<u>doesn't break</u> when chiselling / being used" for mp2
	(b)		Any two in any order from • Increased accuracy • Increased precision / consistency • Increased production rate / quicker (production) • Better / smoother finish • Reduced labour requirement/ costs (2x1)	2	**IGNORE** higher standard **IGNORE** safer / efficient (unqualified) / reference to human error **IGNORE** easier
				10	

Question			Answer / Indicative Content	Mark	Guidance
5	(a)	(i)	Any one from • (CNC) milling machine • (CNC) router • (CNC) multi axis machine (1x1) •	1	**DO NOT ALLOW** laser cutter / Water jet cutter **ALLOW** Miller / millor
		(ii)	Any one from: • Upload a different code(s) / CAD design / re-programme • Use <u>different</u> tools • Use <u>different</u> axis (1x1)	1	**IGNORE** set to do different things
	(b)	(i)	(CNC) press brake (machine) (1x1)	1	
		(ii)	Use a different shape die /tool (1x1)	1	
		(iii)	(CNC) punching can make all of the holes at the same time / is quicker / is faster (CNC) laser cutting will heat / burn / distort the metal (2x1)	2	**ORA** for both marking points **IGNORE** cheaper **IGNORE** more efficient unless given with a valid reason e.g. time efficiency =1 mark mp 1 **IGNORE** responses relating to energy **IGNORE** unqualified ruining the material
	(c)		(CNC) turning (CNC) thread cutting Multi axis machining (1x1)	1	**IGNORE** lathe or named machined

	(d)		Up to any three from: • more accurate / more precise / less human error • CNC laser welding can produce deeper welds • less weld volume / no filler used • (Laser welding has) better access to weld site • Less heat required (laser welding) • CNC laser welding melts smaller spots of parent material • Conventional welding tools are larger / require Earth connection • Idea of reduced functionality of the gear assembly due to inaccuracy or weld volume of conventional welding • CNC laser welding has less (overall) heating effect on the component • Less chance of distorting of /damage to the product(3x1)	3	**ORA** for all marking points **IGNORE** references to time take / cost **ALLOW** reference to thicker / bigger weld when conventional welding

Question			Answer / Indicative Content	Mark	Guidance
6	(a)		Any 2 in any order • Increased output/faster (production times)/faster (to market)/ quicker prototyping/ 24/7 working • Improved quality/accuracy/precision / consistency/ right first time/ tighter tolerances • Reduced costs / wages / (material) waste • Safer (2x1)	2	**IGNORE** efficiency unless qualified **IGNORE** references to design **ALLOW** less human error **IGNORE** references to profitability
	(b)		Any two from: • Closer proximity / access to raw materials / customers • Lower production / transport / labour <u>costs</u> • Access to skill / talent base • Markets • Different health and safety regulations • Investment opportunities / government incentives • Increases profitability / profit margins / income • Quicker response to new innovations/trends • Faster / easier to communicate with customers • Tax incentives (2x1) • Assembly of components manufactured in different locations world-wide	2	

Question			Answer	Marks	Guidance
(c)*			**Level 3 (5–6 marks)** Detailed discussion showing a clear understanding of how automation using modern technologies changes the workforce **and** the types of jobs that are done in engineering companies. 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. **Level 2 (3–4 marks)** Adequate discussion showing an understanding of how automation using modern technologies changes the workforce **and** the types of jobs that are done in engineering companies 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. **Level 1 (1–2 marks)** Basic discussion showing limited understanding of how automation using modern technologies changes the workforce **or** the types of jobs that are done in engineering companies There will be little or no use of specialist terms. Answers may be ambiguous or disorganised, and may be comprised of simplistic bullet points Errors of spelling, punctuation and grammar may be intrusive. 0 = a response that is irrelevant and/or not worthy of a mark. Annotate with 'Seen' at end of response.	**6**	Discussion or detailed explanation of how automation using modern technologies changes the workforce and the types of jobs that are done in engineering companies Responses regarding **workforce** may include reference to: • **Reduced** number of employees • Work being done by machines • Redundancies may occur • Reduced labour costs • Loss of traditional skills/tradition • May require retraining / learning • Improved working conditions • Less manual labour • Safer / cleaner working environment • Higher individual salaries Responses regarding **types of jobs** may include reference to: • More shift work (may be required for 24/7 production) • Jobs may become more IT orientated / programming • maintenance roles • training roles • Management roles • Job profiles may change • Different qualifications may be needed

| | | | **Total for paper** | **60** | |

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