Cambridge National

Engineering Manufacture

R014/01: Principles of engineering manufacture

Level 1/2 Cambridge National Certificate/Award/Diploma

Mark Scheme for June 2024

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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
SEEN	Seen
✔	Tick
REP	Repetition
BOD	Benefit of the doubt
✎	Highlight
L1	Level 1
L2	Level 2
L3	Level 3

Applying the annotations

Every page must have a stamp on it to indicate you have checked all the pages that are available. If a page is blank, use the 'seen' stamp.
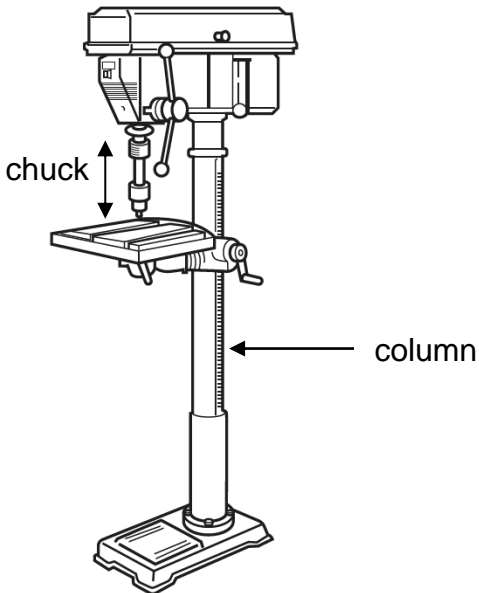
Levels of response questions
- Do **not** use ticks, use the highlighter tool to indicate relevant sections. The number of highlighted sections does **not** equal the number of marks awarded.
- Always stamp the level number at the end of the question, e.g. L2

Do **not** use crosses.

12. **Subject Specific Marking Instructions**

Question			Answer / Indicative Content	Mark	Guidance
1			(a) Brazing	**1**	Correct answer only
2			(d) Wasting	**1**	Correct answer only
3			(b) Ductility	**1**	Correct answer only
4			(b) Forging	**1**	Correct answer only
5			(a) Acrylonitrile-Butadiene-Styrene	**1**	Correct answer only
6			(b) Composite	**1**	Correct answer only
7			(a) Dimension	**1**	Correct answer only
8			(c) High hardness	**1**	Correct answer only
9			(d) Template	**1**	Correct answer only
10			(d) Knurl	**1**	Correct answer only

Question			Answer	Mark	Guidance
11	(a)			2	Correct answer only. Column must be clearly identified. Chuck must be clearly identified. Chuck can be identified from within the line shown.
11	(b)		Any three from: • Chuck key left in chuck (1) • Drill bit breaking (1) • Flying swarf / dust / chips (1) • Spinning work piece/not secured (1) • Entanglement of hair (1) • Entanglement of loose clothing e.g. tie (1) • No guard in place (1) • Chuck not tightened (1) **Award credit for any other appropriate response.**	3	Do not accept precautions such as "wear goggles".

Question			Answer	Mark	Guidance
11	**(c)**		Any three from: • Goggles / safety glasses / eye protection / face shield/visor (1) • Apron / overalls / workshop cloak (1) • Protective footwear (1) • Hair net (1) • Ear protection / ear defenders (1) **Award credit for any other appropriate response.**	3	Do not award "gloves". Do not award "glasses". Do not award responses relating to hair being tied up (e.g. hair band/bobble) or clothing being tucked in.
11	**(d)**		Any two from: • Isolator switch (1) • Emergency stop (1) • Drill guard (1) • Emergency brake (1) • Safety area markings on floor (1) • Safety signage (1) • Secured vice/clamp (e.g. toggle clamp) (1) **Award credit for any other appropriate response.**	2	Allow clear description of safety area markings. Allow "guard". Do not allow "power button".

Question			Answer	Mark	Guidance
12	**(a)**		Any two from: • aluminium (1) • copper (1) • brass (1) • bronze (1) • gold (1) • silver (1) **Award credit for any other appropriate response.**	**2**	Allow any other non-ferrous metals or alloys.
12	**(b)**		Either: Non-ferrous metals do not rust/corrode (1) or Non-ferrous metals are not magnetic (1)	**1**	Allow corrosion resistant.
12	**(c)**		1. (Round) rod / billet / bar (1) 2. (Round) tube / pipe (1) 3. Sheet / blank / plate (1)	**3**	Correct answers only.
12	**(d)**	**(i)**	The form will be melted down to a molten (1) form prior to casting.	**1**	Allow melted down / reference to liquid form of material.

Question			Answer	Mark	Guidance
12	**(d)**	**(ii)**	Any two valid points or one point plus extension: e.g.: Sand casting produces a poor surface finish (1) which needs to be removed before selling/final finishing (1) Sand may need cleaning off/removing (1) before the part can be painted (1) Runner / riser / excess material needs removing (1) as not required (1) **Award credit for any other appropriate response.**	2	Award one mark for one valid point. Award two marks for two valid points. OR Award two marks for one valid point plus extension / explanation / example. Accept variations of poor surface finish such as rough edges or not smooth.
12	**(d)**	**(iii)**	Defects can be melted down and defect products / excess material can be recast / reused / recycled / reprocessed (1)	1	Allow reference to molten metal/melting material back down.

Question			Answer	Mark	Guidance
13	**(a)**		Engineering ceramic = Silicon carbide (1) Smart material = quantum tunnelling composite (1)	**2**	Correct answers only. Allow QTC.
13	**(b)**	**(i)**	A material that reversibly changes it properties/ shape/appearance (1) according to external stimuli / a change in its environment/surroundings (1)	**2**	Do not award marks for repeating question (e.g. changes colour)
13	**(b)**	**(ii)**	Thermochromic (1)	**1**	Correct answers only.
13	**(c)**		One mark for a valid use. One mark for a corresponding valid property, e.g.: **Use(s):** Cutting tool tips (1) Drills (1) Saws (1) Chisels (1) Dies (1) Surgical instruments (1) Ball bearings / ballpoint pen (1) Jewellery (1) **Properties:** Durability (1) Hardness (very hard) (1) Strength (1) Ridged (1) Impact resistant / high resistance to deformation (1) High melting point / heat resistance (1) **Award credit for any other appropriate response.**	**2**	Only credit the property if it is relevant to the use.

Question			Answer	Mark	Guidance
13	**(d)**		One mark for a valid use. One mark for relating the property to the use. One mark for why/how that this useful in the situation. E.g. Frames for eye glasses (1) Glasses can easily get bent (1) and when they do, applying heat restores them to original shape (1) Dental braces (1) Can be moulded/shaped to patients teeth(1), heat can be applied to change the shape and straighten teeth(1). **Award credit for any other appropriate response.**	**3**	Other uses/applications may include but not limited to: Fire alarm systems / paper clips / stents / springs

Question			Answer	Mark	Guidance
14	**(a)**		Any two from: • Hole (1) • 10mm diameter (1) • 20mm depth (1) • 1.5 mm pitch (1) • Threaded (1)	**2**	Do not award hidden detail. Accept thread.
14	**(b)**		(30mm) dia(meter) (1)	**1**	Correct answer only. Do not accept symbol for diameter.
14	**(c)**		Any **one** from: • Turn(ing) • Part(ing) / facing off • Thread(ing) • Drill(ing) • Mill(ing)	**1**	Correct answer only.

Question			Answer	Mark	Guidance
14	**(d)**		Any six from the following: • A lathe is used for turning cylindrical items (1) • A lathe is the only machine required (1) for the manufacture of the part • A lathe is suitable for shaping / turning / wasting (1) using parting/cutting tool (1) • A lathe would remove material to create the different diameters of the component (1) • A lathe can be used for producing the hole using a drill bit (1) • A lathe can be used for creating the thread using a tap (1) • Press brake machine would not be suitable (1) as it is designed for folding flat sheets (1) • A milling machine (1) could be used for creating the external shape of the part (1) **Award credit for any other appropriate response.**	6	

Question			Answer	Marks	Guidance
15	**(a)**		(Computer Aided Manufacture) is using computer software to control machine tools (1) **Award credit for any other appropriate response.**	1	Accept reference to G-code / CNC. Answer must relate to computer / software / code controlling the machine.

	Question		Answer	Marks	Guidance
15	(b)		Any **one** from: (CAM / CNC) lathe (1) (CAM / CNC) milling machine (1) (CAM / CNC) router (1) (CAM / CNC) laser cutter (1) (CAM / CNC) drill (1) **Award credit for any other appropriate response.**	1	Allow any other wastage CNC machine used in CAM. Do not accept multi-axis machine. Do not accept additive machines (e.g. 3D printer).
15	(c)		Any one from: • Cars / car parts (1) • Nails (1) • Nuts (1) • Bolts (1) • Toys (1) **Award credit for any other appropriate response.**	1	Award any valid mass-produced products using automated / computer-controlled production line. Do not award bespoke / individual / one-off products. Do not accept "food" unless specified item has an automated production line process (e.g. baked beans / tinned tomatoes).
15	(d)		Any one from: • Jig and fixture production (1) • Screws (1) • Toys (1) • Clothes (1) • Furniture (1) **Award credit for any other appropriate response.**	1	Award any valid batch produced product/s using an automated / computer-controlled production line. Do not award bespoke / individual / one-off products. Do not accept "food" unless specified item has an automated production line process (e.g. bread / baked goods).

Question			Answer	Marks	Guidance
15	(e)		**Level 3 (5–6 marks)** A **thorough** discussion including a **range** of advantages **and** disadvantages of using CAM in mass **and** one-off manufacturing, 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 using CAM in mass **and/or** one-off manufacturing, 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 using CAM in mass **and/or** one-off manufacturing, 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 advantages and disadvantages of using CAM in mass and one-off manufacture. If response does not clearly link to mass or one-off then the maximum mark is in Level 1. Advantages of CAM manufacture could include: • Good for producing consistently high quality, accurate products • Potential high output / production rate • Reduced number of employees • Reduced labour costs • 24/7 manufacturing • Improved / safer working conditions Disadvantages of CAM manufacture could include: • Cost of machines / investment may be prohibitive • Requires specialist knowledge • Require specialist maintenance **Award credit for any other appropriate advantages / disadvantages.**

Question			Answer	Mark	Guidance
16	**(a)**	**(i)**	One mark for type of waste. Up to two marks for two valid methods of reduction. (One mark for one valid method of reduction.) e.g.: Waste: Movement / Waiting (1) • Move the lathe closest to the warehouse (1) • Have the lathe closer to the milling machine (1) • Place the machines in correct order of use (1) **Award credit for any other appropriate response.**	3	Accept swapping positions of quality station and lathe / milling machine. Accept "motion" as category of waste.
		(ii)	Any three points from: • Cost of storage facilities reduced (1) • Raw materials getting damaged / deteriorating in storage is reduced (1) • Capital tied up in inventory which could be used elsewhere reduced (1) • Fewer containers to hold the inventory (1) • Reduction in storage space needed / buildings required for inventory (1) • No room for error mentality within workforce (1) • Stock only ordered when required (1) **Award credit for any other appropriate response.**	3	Inventory can relate to materials / components / products.

Question			Answer	Mark	Guidance
16	**(b)**		One mark for reference to what quality control is. One mark for link to why Step 6 is quality control. One mark for reference to what quality assurance is. One mark for why Step 6 is not quality assurance. Points might include: • Quality control is a reactive approach measuring completed items (1) • Quality assurance is a preventative approach /system monitoring each stage of production (1) • Quality assurance will identify problems during production processes, before the item is completed allowing for corrections to be made (1) • Step 6 is measuring the product after it is made (1) • Quality assurance is steps taken to ensure that the product is made correctly (1) • Quality control without quality assurance can result in more waste (1) **Award credit for any other appropriate response.**	**4**	Responses may give examples of quality assurance tasks / processes to justify why step 6 is not quality assurance.

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