Cambridge National

Engineering Manufacture

R014/01: Principles of engineering manufacture

Level 1/2 Cambridge National Certificate/Award/Diploma

Mark Scheme for January 2025

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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 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 available in RM Assessor

3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

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, email or via the RM Assessor messaging system.

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 the annotation 'SEEN' to confirm that the work has been seen and mark any responses using the annotations in section 11.

7. There is a NR (**No Response**) option. Award NR (No Response):

   - if there is nothing written at all in the answer space
   - OR if there is a comment which does not in any way relate to the question (e.g., 'can't do', 'don't know')

- OR if there is a mark (e.g., a dash, a question mark) which is not an attempt at the question.

Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

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.**

9. A*ssistant 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:
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

Annotations

Annotation	Meaning
SEEN	Seen
	Tick
REP	Repetition
BOD	Benefit of the doubt
L1	Level 1
L2	Level 2
L3	Level 3
	Highlight Tool

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

Question	Answer	Mark	Guidance
1	**(d)** Self-tapping screw	1	Correct answer only
2	**(b)** Laser-cutting	1	Correct answer only
3	**(c)** International standards	1	Correct answer only
4	**(b)** resist scratches and abrasion	1	Correct answer only
5	**(d)** Tungsten carbide	1	Correct answer only
6	**(a)** Engineering drawing conventions	1	Correct answer only
7	**(b)** A preventative approach to quality, putting in place systems to reduce defects	1	Correct answer only
8	**(d)** Production of products in small groups over a set time	1	Correct answer only
9	**(d)** Urea formaldehyde	1	Correct answer only
10	**(b)** Inventory management system	1	Correct answer only

Question			Answer	Mark	Guidance
11	(a)		Any **one** from: • Aluminium (alloy) • Carbon reinforced polymer/CRP • Titanium • Duralumin **Award credit for any other appropriate response.**	**1**	1 mark for any suitable material. Accept aluminium.
11	(b)		Any **two** from: • Sheet/sheets • Blank • Plate • Tubes / Pipe • Bar / Billet • Rod • Strips • Extrusions **Award credit for any other appropriate response.**	**2**	1 mark for each relevant form of supply up to maximum of 2 marks. Accept any typical forms of supply for the material identified in 11 (a). Marks can be awarded for correct forms of supply for the material identified in 11 (a), even if this material is not appropriate for the application given in the question. Do not accept pole or block.

Question			Answer	Mark	Guidance
11	**(c)**		Up to **four** marks for an evaluation e.g.: • Lightweight material (1) so the aircraft would be able to take off/fly (1) • Corrosion resistant (1) so would withstand the effects of the weather (1) • Good flexibility (1) so can bend in the air without breaking (1) • Good malleability (1) so can be easily shaped(1) • Good strength (1) so can cope with the high levels of forces/stresses whilst in the air (1) • High thermal resistance (1) so can withstand the very low temperatures found at high altitudes (1) **Award credit for any other appropriate response.**	**4**	1 mark for each appropriate point or explanation up to maximum of 4 marks. Marks can be awarded for correct points of evaluation of required properties even if the material identified in 11 (a) is incorrect. Do not accept material characteristics.
11	**(d)**		Any **three** from: • Boat/ship hulls (1) • Car bodies (1) • Train parts (1) • Engine blocks (1) • Structural components (1) **Award credit for any other appropriate response.**	**3**	1 mark for each relevant application up to maximum of 3 marks. Accept any relevant applications for the material identified in 11 (a). Do not accept generic responses such as “cars”, “boats”, “bikes” unless specific part identified i.e. Car bodies.

Question			Answer	Mark	Guidance
12	(a)		Up to **four** marks for any of the correct steps, e.g.: • Generate an STL/export file for the funnel design (1) • Slicing/transforming the STL file into G-code (1) • Set up/calibrate the 3D printer (1) • Load the material into the 3D printer (1) • Press the start/go button to begin printing (1) • Check progress of print (1) • Remove the finished funnel once completed (1) • Inspect for defects (1) • Remove the part from any supports, and clean up the surface of the product / sand / polish / prime (1) **Award credit for any other appropriate response.**	**4**	1 mark for each relevant step described, up to a maximum of 4 marks. Steps do not need to be given in the correct order to gain marks. Do not award marks for the design of the funnel. Allow reference to the steps carried out by the machine i.e: melt thermoplastic, build layer by layer etc.

Question			Answer	Mark	Guidance
12	(b)		Up to **two** marks for **one** safety measure explained e.g.: • Ensure there is good ventilation / extraction (1), to avoid inhaling dust/fumes (1). • If an enclosed machine, ensure guards/doors closed during use (1), to prevent access to moving parts/nozzle (1). • Stop the machine immediately if starts to overheat (1), to prevent fires (1). • Wear appropriate PPE during post-processing / cleaning up the part (1), to prevent breathing in or ingesting material particles when sanding / filing / painting (1) • Appropriate training on how to use the machine (1), to prevent misuse/accidents from happening (1) • Regularly check progress of print (1), to prevent print failures becoming a hazard (1) **Award credit for any other appropriate response.**	**2**	1 mark for any relevant safety measure given. 1 mark for explaining safety measure given.

Question			Answer	Mark	Guidance

12	(c)		Up to **two** marks for **each** reason explained e.g.:
			• High accuracy/consistency of manufacture (1)
			  ○ which is needed for the funnel to be able to correctly channel the flow of liquid / fit into a container with a small opening (1)
			  ○ reduction of human error (1)
			• Ability to create the shaping required for the funnel (1)
			  ○ which would otherwise be difficult / complex / time consuming to produce (1)
			  ○ additive processes are well-suited for creating hollow shapes / parts (1)
			• Very little waste material (1)
			  ○ as product is built up in layers / not cut from a larger block of material (1)
			• Lower labour cost (1)
			  ○ as fewer workers required (1)
			• Repeatability (1)
			  ○ as print file can be easily reprinted multiple times (1)
			
			Award credit for any other appropriate response.
				4	1 mark for each valid reason given up to a maximum of 2 marks.
					
					1 mark for explaining each reason given, up to maximum of 2 marks.

Question			Answer	Mark	Guidance
13	(a)		• Transportation – the unnecessary transportation of parts/products/materials that does not add value (1) reducing these decreases overall product miles / wating time (1) • Over production – producing more products than are required by the customer (1) reducing this decreases the number of products that are left unsold/results in less wasted production time (1) • Defects – products that are unfit for purpose/ do not meet customer expectations (1) reducing this decreases the number of products that have to be repaired/remade (1) **Award credit for any other appropriate response.**	6	1 mark for correct description of each category of waste up to maximum of 3 marks. 1 mark for stating how reducing each waste improves the performance of manufacturing, up to maximum of 3 marks. An increase or reduction in time / cost / waste must be qualified for credit to be awarded i.e: waiting time / production time / material cost / production cost / waste material.
13	(b)	(i)	**One** mark from: • Painting processes use less time (1) • Painting cost less than the other methods (1) • The product may cost less (1)	1	1 mark for any correct answer.
13	(b)	(ii)	Up to **two** marks from: Powder coating is a dry (1) finishing process where a fine powder or electrically charged particles (1) is applied / sprayed (1) to a surface, forming a durable, protective layer (1) which is then baked to cure (1). **Award credit for any other appropriate response.**	2	1 mark for each relevant point up to maximum of 2 marks.

Question			Answer	Mark	Guidance
13	**(b)**	**(iii)**	**One** mark from: • Powder coating produces a more durable finish (1) • Powder coating is better at resisting scratches and chipping (1) • Powder coating is better at resisting corrosion (1) • Powder coating can produce a textured finish (1) **Award credit for any other appropriate response.**	**1**	1 mark for any relevant advantage.
14	**(a)**		Maximum hole diameter - 5.2 mm (1) Minimum hole diameter - 4.8 mm (1)	**2**	1 mark for correct maximum diameter. 1 mark for correct minimum diameter.
14	**(b)**		Up to **four** marks for any of the correct steps, e.g.: • Mark out the piece of material to precisely where the hole is to be drilled (1) • Use of centre punch (1) • Secure workpiece in work holding device (1) • Set up correct drill speeds/feeds for material (1) • Check size of drill bit/fit correct size drill bit (1) • Ensure drill/drill bit is vertically aligned (1) • Place drill bit over intended location of hole (1) • Slowly move the drill bit through the marked point to create the hole (1) • Raise the drill bit back to its starting position (1) • Check size of drilled hole (1) • Use of pilot hole (1) **Award credit for any other appropriate response.**	**4**	1 mark for each relevant step described, up to maximum of 4 marks. Steps do not need to be given in the correct order to gain marks

Question			Answer	Mark	Guidance
14	**(c)**		Up to **two** marks for **each** safety measure explained e.g.: • Wear PPE such as safety glasses/goggles (1), to protect eyes from flying debris/ejected workpiece (1) • Keep hands away from moving parts (1), to avoid entanglement/cuts (1) • Ensure guard is in place (1), to prevent hands from touching the rotating tool (1) • Use emergency stop button (1) to cut power if there is a problem (1) • Tie long hair back (1) to prevent entanglement in rotating machinery (1) • Wear PPE such as labcoat/apron or tuck in loose clothing (1) to prevent loose clothing becoming entangled (1) **Award credit for any other appropriate response.**	**4**	1 mark for each relevant safety measure given up to a maximum of 2 marks. 1 mark for explaining each safety measure given, up to maximum of 2 marks. Safety measures can relate to either a manual or machine drill.

Question			Answer	Mark	Guidance
15	(a)		Up to **four** marks for two products described e.g.: • Mobile phones (1) assembled from various different components/parts (1) • Automotive parts (1) finished by being spray painted (1) • Windows/doors (1) cut/shaped to the correct sizes/tolerances (1) • Children's plastic toys (1) automated injection/blow moulded process described (1) Other products could include: • Printed circuit boards (PCB) • Tablet computers • Televisions • Aerospace parts • Sports equipment • Kitchen equipment • Food products • Medical products **Award credit for any other appropriate response.**	**4**	1 mark for each relevant product given up to a maximum of 2 marks. 1 mark for describing how fully automated robotic control is used to manufacture each product up to maximum of 2 marks.

Question			Answer	Mark	Guidance
15	**(b)**		Up to **six** marks for a discussion or detailed explanation: **Level 3 (5-6 marks)** A thorough discussion. A good understanding with a range of advantages and limitations being clearly identified and developed. Consistently uses appropriate terminology. Typically, two or more points for both advantages and limitations. **Level 2 (3-4 marks)** An adequate discussion which shows some understanding, with some advantages and limitations identified and limited development. Uses some appropriate terminology. Typically, one or two points for both advantages and limitations. **Level 1 (1-2 marks)** A basic discussion which shows limited/poor understanding. Some advantages or limitations identified but no development. Little or no use of appropriate terminology. Typically, only one point discussed. Answers only cover one side of the discussion (advantages OR limitations). **0 marks** Response is not worthy of credit.	**6**	Points of discussion might cover areas such as: Advantages • Ensures high levels of manufacturing accuracy by guiding the tool into the correct position. • Improved precision, repeatability and consistency of manufacture e.g. a jig will ensure a hole is always drilled in the same place on the workpiece every time. • Reduction in defects due to reduced chance of human error (reduced manual positioning of tool). • Greater rate of production and increased speed of manufacture, thus enabling mass manufacturing output targets to be met. Limitations • Initial cost of purchasing, designing and/or producing jigs for each required operation. • Lack of flexibility – new or different operations would need new jigs to be produced or purchased. • Time required to initially set up jigs and to change them over for different mass manufacturing operations. **Other relevant points should be credited.**

Question			Answer	Mark	Guidance
16	**(a)**	**(i)**	Across flats	**1**	1 mark for correct answer.
16	**(a)**	**(ii)**	Diameter	**1**	1 mark for correct answer.
16	**(a)**	**(iii)**	Material	**1**	1 mark for correct answer.
16	**(a)**	**(iv)**	Square	**1**	1 mark for correct answer.
16	**(b)**	**(i)**	Up to **two** marks for a description of the meaning: Hidden (1) detail shows edges that are not visible (1). **Award credit for any other appropriate response.**	**2**	1 mark for identifying the line type, 1 mark for giving its meaning up to maximum of 2 marks.
16	**(b)**	**(ii)**	Up to **two** marks for a description of the meaning: Centre (1) line shows circular/cylindrical features (1). **Award credit for any other appropriate response.**	**2**	1 mark for identifying the line type, 1 mark for giving its meaning up to maximum of 2 marks.
16	**(c)**		Up to **two** marks for an explanation: Using resources in a way that meets current needs (1) without preventing future generations from meeting theirs (1). **Award credit for any other appropriate response.**	**2**	1 mark for each relevant point up to maximum of 2 marks. Responses could refer to reducing / reusing / recycling / rethinking / repairing products.

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