



Oxford Cambridge and RSA

## **Cambridge National**

### **Engineering**

#### **R014/01: Principles of engineering manufacture**

Level 1/2 Cambridge National Certificate/Award

### **Mark Scheme for January 2024**

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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.

© OCR 2024

## 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.

- 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.
- 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.
- 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

## 11. Annotations

Annotation	Meaning
	Blank page
	Seen
	Tick
	Cross
	Irrelevant
	Repetition
	Vague
	Unclear
	Benefit of the doubt
	Level 1
	Level 2
	Level 3

Question		Answer / Indicative Content	Mark	Guidance
1		(c) Shaping	1	Correct answer only
2		(c) Hardness	1	Correct answer only
3		(c) Powder metallurgy of ceramic products	1	Correct answer only
4		(b) Epoxy resin	1	Correct answer only
5		(a) Ceramic	1	Correct answer only
6		(b) Centre line	1	Correct answer only
7		(a) High brittleness	1	Correct answer only
8		(c) Nuts and bolts	1	Correct answer only
9		(c) Mould	1	Correct answer only
10		(b) 20.05 mm	1	Correct answer only

Question		Answer	Mark	Guidance
11	(a)	(i) (Centre) Lathe (1)	1	Award credit where “Lathe” is stated.
		(ii) One mark for one relevant reason. Two marks for two relevant reasons or for one relevant reason plus justification, e.g.:  The machine can turn cylindrical (1) items and drilling holes along the centre axis (1) of the cylindrical item.  All processes can be carried out on the same machine facing/parting off (1) and drilling the centre hole (1).  Ability to manufacture precise/accurate (1) cylindrical (1) parts.  The shape of the component is a cylinder (1). The lathe is used to create features on cylindrical objects by rotating (1) them.  <b>Award credit for any other appropriate response.</b>	2	Do not award credit for repeated reasons.  Two relevant points or one justified answer.
	(b)	(i) In the following order:  Chuck (1) Hold / turn / rotates the workpiece (1)	2	1 mark for identifying “chuck”. 1 mark for appropriate function. Accept “grip” for function.
		(ii) Any one of the following:  Ensure chuck key is removed (1), The workpiece is secured /held tightly in the chuck (1)	1	Must relate directly to a safety measure for part A.



Question		Answer	Mark	Guidance
		<p><b>(iii)</b> One mark for one relevant reason. Two marks for two relevant reasons or for one relevant reason plus justification, e.g.:</p> <p>So that chuck key / workpiece is not thrown out of the machine (1) and injure someone (1).</p> <p><b>Award credit for any other appropriate response.</b></p>	2	<p>Must relate to the answer provided in 11(b) (ii) to be awarded credit.</p> <p>Two relevant points or one justified answer.</p>
	<b>(c)</b>	<p><b>(i)</b> Any one of the following:</p> <p>When removing swarf from / cleaning down the machine (1).</p> <p>When removing manufactured items as they could be hot (1).</p> <p><b>Award credit for any other appropriate response.</b></p>	1	Must require gloves to be worn.
		<p><b>(ii)</b> Any one of the following:</p> <p>Entanglement hazard (1).</p> <p>The gloves could get caught in the lathe (1).</p> <p>More difficult to be precise with movements (1).</p> <p><b>Award credit for any other appropriate response.</b></p>	1	Must relate to why the gloves would not be appropriate.

Question		Answer	Mark	Guidance
12	(a)	<p>Any three of the following:</p> <ul style="list-style-type: none"> <li>• Material in hopper/load material?</li> <li>• Setup/clamping/closing mould</li> <li>• Heating polymer</li> <li>• Injection</li> <li>• Dwelling</li> <li>• Cooling</li> <li>• Mould opening</li> <li>• Ejection</li> <li>• Closing mould (if described after ejection)</li> </ul>	3	<p>Award one mark per step.</p> <p>All 3 steps must be in the correct order for 3 marks.</p> <p>Max. 2 marks if one step is out of sequence.</p> <p>Steps do not necessarily need to directly follow on from each other, but they must be in the correct order for credit to be awarded as above.</p> <p>If only two steps identified out of sequence award 1 mark only.</p> <p>Credit can only be awarded once for closing mould.</p>
	(b)	<p>(i) Any two of the following:</p> <ul style="list-style-type: none"> <li>• Lightweight</li> <li>• Durable</li> <li>• Rigid</li> <li>• Non-toxic</li> <li>• Does not corrode</li> <li>• Compressive/Tensile/Yield Strength</li> <li>• (Easily) coloured</li> <li>• Easily moulded</li> <li>• Suitable for mass manufacture methods.</li> </ul> <p><b>Award credit for any other appropriate response.</b></p>	2	<p>Do not award 'safe' unless qualified e.g. safe to put in mouth.</p> <p>Do not award "strong/strength" unless qualified e.g. tensile strength.</p> <p>Do not award "light".</p>

		<p><b>(ii)</b> Any two of the following:</p> <ul style="list-style-type: none"> <li>• Not too heavy for a child to play with</li> <li>• Will not poison the child if licked or swallowed</li> <li>• Will continue to look attractive for extended periods of time</li> <li>• Will not break when played with</li> <li>• Easy to make visually appealing</li> <li>• Can be made into a wide variety of shapes</li> </ul> <p><b>Award credit for any other appropriate response.</b></p>	2	<p>Does not need to link to answer provided in 12(b)(i)</p> <p>Two relevant points or one justified answer.</p>
12	<b>(c)</b>	<p>Granules/powder/pellets (1)</p> <p>Then any two of the following:</p> <ul style="list-style-type: none"> <li>• Free flowing</li> <li>• Can be poured into the hopper/machine</li> <li>• Does not need to be broken up before use</li> <li>• Readily available for mass production</li> <li>• Easy/quick to melt</li> <li>• Increases speed of manufacture</li> </ul> <p><b>Award credit for any other appropriate response.</b></p>	3	<p>Award 1 mark for an appropriate form of supply.</p> <p>Award a maximum of 2 marks for suitability reasons.</p> <p>Reasons can be stated and do not need to be explained.</p> <p>For 2 marks accept two relevant reasons or one relevant reason with justification.</p> <p>Suitability reasons must relate to the identified form of supply for credit to be awarded.</p>

Question		Answer	Mark	Guidance
13	(a)	<p>Any two of the following:</p> <ul style="list-style-type: none"> <li>• High tensile strength</li> <li>• Lightweight</li> <li>• Durable</li> <li>• High strength to weight ratio</li> </ul> <p><b>Award credit for any other appropriate response.</b></p>	2	<p>Do not accept “light”.</p> <p>Do not accept “strong/strength” unless qualified e.g. tensile strength.</p>
	(b)	<p>Any four steps from:</p> <ul style="list-style-type: none"> <li>• Carbon fibre / pre in sheets or strips</li> <li>• Mould release agent used/applied</li> <li>• Laid up into a mould</li> <li>• Resin added to mould</li> <li>• Liquid resin / mould is heated to liquefy resin</li> <li>• Pressure used to ensure shape of mould is taken</li> <li>• Resin is allowed to solidify/cure</li> </ul> <p><b>Award credit for any other appropriate response.</b></p>	4	<p>Award one mark per correctly identified step.</p> <p>Do not award credit for “mould” unless an appropriate moulding method is being used.</p>
	(c)	<p>Refer to guidance for clarification:</p> <p>An alloy mixture of metals (1), whereas a composite is a mixture of materials (1).</p> <p>An example of a alloy is brass is made of copper and zinc (1).</p>	3	<p>One mark for identifying an alloy is a mixture of metals.</p> <p>One mark for identifying a composite is a mixture of materials.</p> <p>One mark for appropriate example of either a composite material or an alloy. Examples must have the correct component materials to be awarded the mark.</p>

Question		Answer	Mark	Guidance
		<p>An example of a composite is concrete made of cement and sand with stones (1).</p> <p>Fibreglass / GRP is a composite made up of glass fibre and a polymer/resin (1)</p> <p><b>Award credit for any other appropriate response.</b></p>		
	<b>(d)</b>	<p>Any one of the following:</p> <ul style="list-style-type: none"> <li>• Glass reinforced plastic / GRP / fiberglass.</li> <li>• Concrete</li> </ul> <p><b>Award credit for any other appropriate response.</b></p>	1	

Question		Answer	Mark	Guidance
14	(a)	10(mm) (1) Radius (1)	2	Do not need to specify mm.
	(b)	10(mm) (1) Diameter / Hole (1)	2	Do not need to specify mm.
	(c)	<p>Any six mark points from the following:</p> <ul style="list-style-type: none"> <li>• Pillar drill would be used (1) for the features labelled B (1) with a 10mm bit (1)</li> <li>• Lathe would not be used (for this manufacture) (1)</li> <li>• (Lathes are used) for turning/manufacturing cylindrical items, but the bracket shown is flat sheet. (1)</li> <li>• It will not matter if feature B is made before feature C (1) as they do not affect each other (1)</li> <li>• A milling machine would be suitable for manufacturing feature C (1) as it is sheet material (1)</li> <li>• Appropriate use of specified CNC machine (1) e.g. plasma cutting for both features (1)</li> </ul> <p><b>Award credit for any other appropriate response.</b></p>	6	Do not award repeated points.

Question		Answer	Mark	Guidance
15	(a)	<p>One mark for one relevant reason. Two marks for two relevant reasons or for one relevant reason plus justification, e.g.:</p> <p>Templates reduce waste by ensuring all pieces of metal are cut to the <u>correct</u> size (1)</p> <p>The pieces of each product will be the same / an identical size to the template (1) reducing wasted time and materials (1)</p> <p>Templates used for consistency in the cutting process allow for a greater rate of production, saving time (1) as fewer cut pieces are scrapped. (1)</p> <p><b>Award credit for any other appropriate response.</b></p>	2	<p>Do not award a repeat of the question stem.</p> <p>Response must relate to reducing waste.</p>
	(b)	<p>Any two of the following:</p> <ul style="list-style-type: none"> <li>• Jigs/templates</li> <li>• Fixtures</li> <li>• Moulds</li> </ul> <p><b>Award credit for any other appropriate response.</b></p>	2	<p>Response must relate to Quality Assurance as a preventative approach putting in place systems to reduce occurrence of defects.</p>

Question	Answer	Marks	Guidance
(c)	<p><b>Level 3 (5–6 marks)</b> A <b>thorough</b> discussion of the extent to which the scale of the manufacture <b>and</b> the value of the product impacts on achieving consistent quality showing <b>detailed</b> understanding of any points made. <b>Consistent</b> use of appropriate technology. Typically, 2 or more points developed with a discussion, debate or pros and cons.</p> <p><b>Level 2 (3–4 marks)</b> An <b>adequate</b> discussion of the extent to which the scale of manufacture <b>and/or</b> the value of the product impacts on achieving consistent quality showing understanding of <b>some</b> of the points made. <b>Some</b> use of appropriate terminology. Typically, 1 or 2 valid points with some justification / development.</p> <p><b>Level 1 (1–2 marks)</b> A <b>brief</b> discussion of the extent to which the scale of manufacture <b>and/or</b> the value of the product impacts on achieving quality showing <b>limited</b> understanding of any points made. <b>Limited</b> or no use of appropriate terminology. Typically, 1 or 2 brief points or statements with or without superficial expansion on these.</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>Up to 6 marks for a discussion or detailed explanation of different approaches/strategies to ensure <b>consistency in quality</b>, considering manufacturing scale and the value of the product.</p> <p>Responses regarding <b>CNC machining</b> may include reference to:</p> <ul style="list-style-type: none"> <li>• Can be used for mass produced products</li> <li>• Suited to small volume high value</li> <li>• Can be used for products requiring very tight tolerances</li> <li>• Ability to deploy 24/7 manufacturing</li> <li>• Can be used for products where manufacturing may present a safety issue</li> <li>• Machine costs are high</li> <li>• May require specialist training</li> </ul> <p>Responses regarding templates/jigs may include reference to:</p> <ul style="list-style-type: none"> <li>• Smaller production scales</li> <li>• Hand manufacture</li> <li>• Low cost</li> <li>• Good for low value products</li> <li>• Good for bespoke manufactures</li> <li>• Straight forward to use</li> <li>• Less tight tolerances</li> </ul>



Question		Answer	Mark	Guidance
16	(a)	<p>Overproduction / Excess (1)</p> <p>Then any two of the following points:</p> <p>The manufacture makes too many products increasing the amount of time / labour / materials (1) and storage needed for excess products (1). Energy is wasted (1) as a result.</p> <p><b>Award credit for any other appropriate response.</b></p>	3	<p>Award 1 mark for appropriate category.</p> <p>Award a maximum of 2 marks for impacts. Reasons can be stated and do not need to be explained. (Two relevant reasons or one justified answer).</p> <p>Award credit for impacts even if category is incorrect/not stated.</p>
16	(b)	<p>Defects (1)</p> <p>Then any two of the following:</p> <p>Implementing a quality system / quality assurance processes (1) to intercept defects early in the manufacturing process (1)</p> <p>Implement quality assurance (1) processes to prevent defects occurring (1).</p> <p><b>Award credit for any other appropriate response.</b></p>	3	<p>Award 1 mark for appropriate category.</p> <p>Award a maximum of 2 marks for reduction methods. Methods can be stated and do not need to be explained. (Award 2 marks for two relevant methods or for one relevant method plus justification).</p> <p>Award credit for reduction methods even if category is incorrect/not stated.</p>
16	(c)	<p>One mark for each element of JIT manufacturing, one mark for each connected benefit to the company up to a max of 4 marks, e.g.:</p> <p>Any Materials/supplies are ordered to arrive just in time for manufacturing (1), reducing the amount of stock held (1).</p>	4	<p>Do not award marks for repeated points.</p>

Question		Answer	Mark	Guidance
		<p>The correct quantity of materials is ordered (1) to reduce excess materials, saving money (1).</p> <p>Less excess materials reduce manufacturing costs (1) and saves storage space which is an additional cost (1).</p> <p>Products are manufactured as the order is received (1) so products are not kept on stock waiting to be sold (1) reducing capital tied up on unsold products (1) and reducing the risk of overproduction (1).</p> <p>Only the number of products ordered are manufactured (1) which reduces over production (1). Products are delivered to the customer when finished (1) as this reduces storage (1).</p> <p><b>Award credit for any other appropriate response.</b></p>		

## Need to get in touch?

If you ever have any questions about OCR qualifications or services (including administration, logistics and teaching) please feel free to get in touch with our customer support centre.

### Call us on

**01223 553998**

### Alternatively, you can email us on

**support@ocr.org.uk**

### For more information visit

 [ocr.org.uk/qualifications/resource-finder](https://ocr.org.uk/qualifications/resource-finder)

 [ocr.org.uk](https://ocr.org.uk)

 [Twitter/ocrexams](https://twitter.com/ocrexams)

 [/ocrexams](https://twitter.com/ocrexams)

 [/company/ocr](https://www.linkedin.com/company/ocr)

 [/ocrexams](https://www.youtube.com/ocrexams)



OCR is part of Cambridge University Press & Assessment, a department of the University of Cambridge.

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored. © OCR 2024 Oxford Cambridge and RSA Examinations is a Company Limited by Guarantee. Registered in England. Registered office The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA.

Registered company number 3484466. OCR is an exempt charity.

OCR operates academic and vocational qualifications regulated by Ofqual, Qualifications Wales and CCEA as listed in their qualifications registers including A Levels, GCSEs, Cambridge Technicals and Cambridge Nationals.

OCR provides resources to help you deliver our qualifications. These resources do not represent any particular teaching method we expect you to use. We update our resources regularly and aim to make sure content is accurate but please check the OCR website so that you have the most up-to-date version. OCR cannot be held responsible for any errors or omissions in these resources.

Though we make every effort to check our resources, there may be contradictions between published support and the specification, so it is important that you always use information in the latest specification. We indicate any specification changes within the document itself, change the version number and provide a summary of the changes. If you do notice a discrepancy between the specification and a resource, please [contact us](#).

Whether you already offer OCR qualifications, are new to OCR or are thinking about switching, you can request more information using our [Expression of Interest form](#).

Please [get in touch](#) if you want to discuss the accessibility of resources we offer to support you in delivering our qualifications.