

Cambridge Technicals

Engineering

Unit 2: Science for engineering

Level 3 Cambridge Technical Certificate/Diploma in Engineering
05822 - 05825 & 05873

Mark Scheme for June 2025

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 2025

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 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.

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 10.

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. *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: Not applicable in F501

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
	correct response worthy of a mark. number of ticks = no of marks awarded
	incorrect
	missing something
	error carried forward
	benefit of doubt
	benefit of doubt not given
	power of ten error
	contradiction
	rounding error
	significant figure error
	transcription error
	to indicate that a blank page or space has been seen
	blank page

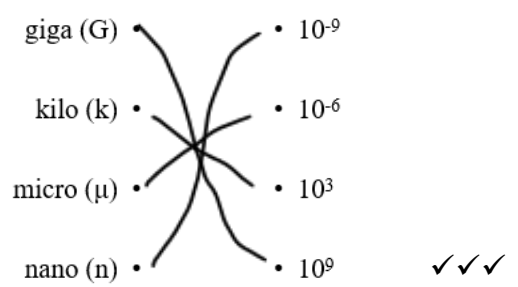
Mark Scheme abbreviations

Coa: correct answer only

Wtte: words to that effect

12. Subject specific marking instructions

In all numerical calculation questions a correct response to 2 sf will gain all marks unless specified otherwise. You do not need to see all the workings if the answer is correct.

Question			Answer	Marks	Guidance
1	a			3	Two correct, 2 marks One correct, 1 mark Two or more lines coming from or going to one row is CON.
	b	i	The measurements are precise but may not be accurate. ✓	1	Bottom box ticked. If more than one box ticked, then no mark is awarded.
		ii	(Percentage error) = $(557-541) \div 557$ ✓ = 0.0287... = 2.9 % ✓ OR (ratio of values) = $541 \div 557 = 0.9713$ OR 97.1% ✓ (percentage error) = $(1 - 0.971) \times 100$ OR $100 - 97.1$ = 2.9% ✓	2	ALLOW 0.029 as long as the % has been crossed out. IGNORE sign on answer line. ALLOW final answer given to 1SF (3%) only if correct working shown. IF 541 is used as denominator to give value of 3.0%. Then only 1 mark can be awarded. (2.96%)
1			TOTAL	6	

Question			Answer	Marks	Guidance
2	a		accelerate ✓ (a mass of) 1 kg ✓ at 1 ms ⁻² ✓	3	IGNORE F=ma
	b	i	6 ² + 16 ² (= 292) ✓ Magnitude of resultant velocity (= √292) = 17 (17.088) (ms ⁻¹) ✓ OR IF scale drawing used: Resultant velocity between 16.8 and 17.3 gains both marks ✓✓	2	ALLOW 2√73 or √292 as final answer. IGNORE any diagonal line drawn on printed diagram – it is not to scale.
		ii	(Substitution into $F = ma$ (any subject)) $16.7 \times 10^6 = 1.6 \times 10^8 \times a$ ✓ (Rearrangement and evaluation) $a = 0.10(43\dots)$ ✓ (Unit) ms ⁻² ✓	3	ALLOW final answer to 1SF $a = 0.1$ ALLOW m/s ² and N/kg

		iii	Evidence that gradient is being used OR speed = change in distance ÷ (elapsed) time. ✓ Evidence of use of steepest section of line. ✓ EITHER Pair of correct coordinates read off from steepest section – between (2000,10) and (1600, 5) OR show values of Δy and Δx from the steepest section. Evaluation of their gradient = eg $5 \div 400 = 0.0125 \text{ (km s}^{-1}\text{)}$ ✓ Final answer given to correct POT between 12 or 13.5 (ms^{-1}) OR 0.13 kms^{-1} (units on answer line amended) ✓	4	NOT speed = distance ÷ time eg $13.5 \div 3000$ scores no marks. IF candidate has drawn a gradient on the graph but not in the steepest section, they can still access the first, third and fourth marks. Max 3 marks. ALLOW candidate to extrapolate line and take read offs for second mark. Gradient of correct line should be between 0.120 and 0.135. IF a different line has been drawn, check read offs and calculation. IGNORE the POT for the second- and third-mark points. ALLOW final mark if the conversion of km to m is seen clearly in a wrong calculation.
2			TOTAL	12	

Question			Answer	Marks	Guidance
3	a		current (through a conductor) is proportional to the potential difference or voltage (applied) ✓ (provided its) temperature remains constant ✓	2	ALLOW $I \propto V$ in symbols. IGNORE $V = IR$
	b		Energy ✓	1	ALLOW work done. IGNORE type of energy
	c	i	Use of correct equation; $P = I^2 R = 1.79^2 \times 126$ ✓ (Evaluation) = 404 (W) ✓	2	ALLOW $I = 0.593$ or 5.37 with $R = 126$ OR $R = 42$ with $I = 1.79$ as evidence of substituting into $P = I^2 R$. NOT if both I and R are incorrect. IGNORE use of $P = V^2 \div R$ and $P = IV$ ALLOW final answer which rounds to 400 to 2SF.
		ii	Ammeter OR multimeter ✓	1	ALLOW misspellings such as ametre, ampmeter etc
	d		Calculation of R_{parallel} ✓ eg $126 \div 3$ OR evidence of substitution into equation $(\frac{1}{R} =) \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ (Evaluation of R_{parallel}) = 42 (Ω) ✓ (Total R) = $42 + 5 =$ 47 (Ω) ✓	3	A value of $\frac{1}{42}$ or $\frac{3}{126}$ or 0.024 for R_{parallel} can gain first mark. ALLOW ECF of their calculated value of total resistance in parallel only if working is shown. $R = 5.024$. max 2 marks.
	e		Almost all the input power is transferred to useful outputs, so the efficiency is probably over 90% ✓	1	Top box ticked. If more than one box ticked, then no mark is awarded.
3			TOTAL	10	

Question			Answer	Marks	Guidance
4	a		Any TWO from: - Low extension / low strain (for large load) - High Young Modulus will be a stiff material - a lift cable shouldn't stretch much when loaded because eg lift won't work properly, passengers wouldn't feel safe, line up with floors etc (sensible reason) ✓	2	IGNORE reference to other properties of steel eg hardness, strength or ductility.
	b	i	Increases ✓	1	ALLOW move apart or separate IGNORE repel
		ii	Decreases OR move back (to original position) ✓	1	ALLOW high tension will cause rows of atoms to slip over one another and they will remain there when tension is removed. IGNORE attract
	c		The atoms both attract and repel one another and those forces are balanced ✓	1	Third box ticked. If more than one box ticked, then no mark is awarded.
	d		(Read-off extension at 6000 N =) 3.2 mm (± 0.05 mm) or shown on graph ✓ Conversion factor of $\times 10^{-3}$ to convert mm to m ✓ Evidence of area of triangle calculation (eg: $\frac{1}{2} \times (3.2 \times 10^{-3}) \times 6000$) ✓ = 9.6 (J) [acceptable range 9.45 to 9.75] ✓	4	IF no (or incorrect conversion) then max 3 marks can be awarded. Evidence of correct conversion factor can gain second mark even with incorrect read off. Evidence of area of triangle method with incorrect values can gain third marking point. ALLOW use of equation $E = 0.5 Fx$ for third mark point.

					.
	e		Any TWO from: ✓✓ • it results in failure / breakage of material • (material) cannot be used after the test, • samples of materials (not actual cables) are tested • to measure one (or more) given physical property • to find useful lifetime of product e.g. stress cycles • to determine product maintenance schedule e.g. inspection cycles	2	No credit for repeating question stem i.e. use of 'destroy' or 'test'. Accept named property e.g. UTS, maximum load, toughness, elastic limit etc NOT just 'limit'. IGNORE reference to cost.
4			TOTAL	11	

Question			Answer	Marks	Guidance
5	a		Turbulent ✓	1	ALLOW non-laminar
	b		Irregular paths ✓ Random (distribution of) velocity ✓	2	ALLOW alternative wording eg 'all in different directions' 'all at different velocities' Speed instead of velocity
	c		Evidence of use of equation to calculate $F = p \times A$ ✓ Substitution of ONE set of values into equation ✓ eg 5740×0.1150 OR 5960×0.1280 Evaluation of ONE value of force ✓ eg 660.1 OR 762.88 (Pa m ²) Calculation of difference = 103 (N) ✓	4	Substitution or rearrangement could be evidence of use. Correct calculation leading to a final answer to 2sf can gain all marks.
	d		Ideal fluid has a (dynamic) viscosity of zero. ✓	1	ALLOW Water's viscosity is not zero.
	e		Density	1	Top box ticked. If more than one box ticked, then no mark is awarded.
5			TOTAL	9	

Question		Answer	Marks	Guidance
6	a	Evidence of use of $pV = nRT$ (substitution or rearrangement $n = PV \div RT$) ✓ $n = (4000 \times 50000) \div (8.31 \times 288)$ ✓ $n = \mathbf{83600}$ (moles) ✓	3	Use of $T = 15$ can only gain the first mark for use of equation. ALLOW final answer which rounds to 84000 to 2SF. IGNORE units given on the answer line.
	b	(In the gas equation $pV = nRT$) p AND T (and R) are constant ✓ V is proportional to n OR V increases with n ✓	2	ALLOW 'don't increase' instead of stay 'constant'. ALLOW V must increase to accommodate more moles or mass of gas.
	c	$V \propto T$, or equivalent (eg $\frac{pV}{T} = \text{constant}$) ✓ (Conversion of temperature to Kelvin) $T = 278\text{K}$ ✓ Calculation of new volume ✓ $V_2 = \frac{T_2}{T_1} \times V_1 = \frac{278}{288} \times 50000 = 48264$ OR Use value for number of moles of gas from part (a) in $PV = nRT$ $V_2 = \frac{nR(278)}{4000} = 48264$ Calculation of difference in $V = 50000 - 48264 = \mathbf{1740\text{ m}^3}$ ✓	4	ALLOW substitution into $pV = nRT$ NO ECF for using $T_2 = 5$. ALLOW ECF of incorrectly calculated value of T in Kelvin from an addition or subtraction (not ratio). Max 3 marks. ALLOW ECF of $T_2 = 283$ to give $V_2 = 49131$, and $\Delta V = 868$. Max 3 marks. IF $pV = nRT$ is used to find V, then allow ECF of candidate's value of n given in part (a). This can access full marks. Correct calculation leading to a final answer to 2sf can gain all marks.

	d	$\Delta V = 0.60 \times \pi 25^2 (= 1180\text{m}^3) \checkmark$ EITHER Evidence of use of Charles' Law relationship ($T_2 / T_1 = V_2 / V_1$) $\checkmark$ $V_1 / V_2 = (50000 - 1180) \div 5\ 0000$ and rearrangement to give $T_2 = 288 \times 48820 / 50000 = \mathbf{281\ (K)} \checkmark$ OR Use value for number of moles of gas from part (a) in $PV = nRT$ $4000 \times (50000 - 1180) = 83600 \times 8.31 \times T \checkmark$ $T = 4000 \times (50000 - 1180) / 83600 \times 8.31 = \mathbf{281\ K} \checkmark$	3	ALLOW alternative method for V_2 . eg. from initial height of tank $h_1 = 50000 \div (25^2 \times \pi) = 25.46$ $h_2 = 25.46 - 0.6 = 24.86$ $V_2 = (25^2 \times \pi) \times 24.86 = 48800\ \text{m}^3$ ALLOW second mark for substitution of ΔV OR $V + \Delta V$ instead of $V - \Delta V$. These lead to final value of 6.8 K or 295 K. Max 2 marks if working shown. If $PV = nRT$ is used to find V, then allow ECF of candidate's value of n given in part (a). This can access full marks. Correct calculation leading to a final answer to 2sf can gain all marks.
6		TOTAL	12	

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



ocr.org.uk



Twitter/ocrextams



/ocrextams



/company/ocr



/ocrextams



CAMBRIDGE
UNIVERSITY PRESS & ASSESSMENT

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 2025 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.