GCE

Mathematics A

H230/02: Pure Mathematics and Mechanics

AS Level

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% (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. 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**
✓and ✗	
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working
M0, M1	Method mark awarded 0, 1
A0, A1	Accuracy mark awarded 0, 1
B0, B1	Independent mark awarded 0, 1
SC	Special case
^	Omission sign
MR	Misread
BP	Blank Page
Seen	
Highlighting	

Other abbreviations in mark scheme	Meaning
dep*	Mark dependent on a previous mark, indicated by *. The * may be omitted if only one previous M mark
cao	Correct answer only
oe	Or equivalent
rot	Rounded or truncated
soi	Seen or implied
www	Without wrong working
AG	Answer given
awrt	Anything which rounds to
BC	By Calculator
DR	This question included the instruction: In this question you must show detailed reasoning.

Subject Specific Marking Instructions

a. Annotations must be used during your marking. For a response awarded zero (or full) marks a single appropriate annotation (cross, tick, M0 or ^) is sufficient, but not required.

For responses that are not awarded either 0 or full marks, you must make it clear how you have arrived at the mark you have awarded and all responses must have enough annotation for a reviewer to decide if the mark awarded is correct without having to mark it independently.

It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

Award NR (No Response)
- if there is nothing written at all in the answer space and no attempt elsewhere in the script
- 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, a picture) which isn't an attempt at the question.

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

If a candidate uses the answer space for one question to answer another, for example using the space for 8(b) to answer 8(a), then give benefit of doubt unless it is ambiguous for which part it is intended.

b. An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme is designed to assist in marking incorrect solutions. Correct solutions leading to correct answers are awarded full marks but work must not always be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working must always be looked at and anything unfamiliar must be investigated thoroughly. Correct but unfamiliar or unexpected methods are often signalled by a correct result following an apparently incorrect method. Such work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, escalate the question to your Team Leader who will decide on a course of action with the Principal Examiner.

If you are in any doubt whatsoever you should contact your Team Leader.

c. The following types of marks are available.

M
A suitable method has been selected and applied in a manner which shows that the method is essentially understood. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M mark may be specified.
A method mark may usually be implied by a correct answer unless the question includes the DR statement, the command words "Determine" or "Show that", or some other indication that the method must be given explicitly.

A
Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

B
Mark for a correct result or statement independent of Method marks.

Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where a candidate passes through the correct answer as part of a wrong argument.

d. When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation 'dep*' is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, when two or more steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.

e. The abbreviation FT implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A and B marks are given for correct work only – differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable. In such cases, what is acceptable will be detailed in the mark scheme. If this is not the case please, escalate the question to your Team Leader who will decide on a course of action with the Principal Examiner.

Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will often be 'follow through'. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not shown within the image zone. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-question.

f. We are usually quite flexible about the accuracy to which the final answer is expressed; over-specification is usually only penalised where the scheme explicitly says so.
   - When a value is **given** in the paper only accept an answer correct to at least as many significant figures as the given value.
   - When a value is **not given** in the paper accept any answer that agrees with the correct value to **3 s.f.** unless a different level of accuracy has been asked for in the question, or the mark scheme specifies an acceptable range.
     NB for Specification B (MEI) the rubric is not specific about the level of accuracy required, so this statement reads "2 s.f".

   Follow through should be used so that only one mark in any question is lost for each distinct accuracy error.
   Candidates using a value of 9.80, 9.81 or 10 for g should usually be penalised for any final accuracy marks which do not agree to the value found with 9.8 which is given in the rubric.

g. Rules for replaced work and multiple attempts:
   - If one attempt is clearly indicated as the one to mark, or only one is left uncrossed out, then mark that attempt and ignore the others.
   - If more than one attempt is left not crossed out, then mark the last attempt unless it only repeats part of the first attempt or is substantially less complete.
   - if a candidate crosses out all of their attempts, the assessor should attempt to mark the crossed out answer(s) as above and award marks appropriately.

h. For a genuine misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain unaltered, mark according to the scheme but following through from the candidate's data. A penalty is then applied; 1 mark is generally appropriate, though this may differ for some units. This is achieved by withholding one A or B mark in the question. Marks designated as cao may be awarded as long as there are no other errors.
   If a candidate corrects the misread in a later part, do not continue to follow through. Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

i. If a calculator is used, some answers may be obtained with little or no working visible. Allow full marks for correct answers, provided that there is nothing in the wording of the question specifying that analytical methods are required such as the bold "In this question you must show detailed reasoning", or the command words "Show" or "Determine". Where an answer is wrong but there is some evidence of method, allow appropriate method marks. Wrong answers with no supporting method score zero. If in doubt, consult your Team Leader.

j. If in any case the scheme operates with considerable unfairness consult your Team Leader.

Question			Answer	Marks	AO	Guidance	
1			$3x + 6y - 5 = 0 \Rightarrow y = \frac{5}{6} - \frac{1}{2}x$ so gradient of given line is $-\frac{1}{2}$	M1*	1.1	Rearrange (oe) to find the gradient of given line. Allow $y = c \pm \frac{1}{2}x$ oe.	Possibly implied by later working
			$y - 3 = 2(x - 1)$	M1dep*	1.1	For use of $y - 3 = m(x - 1)$ where m is their perpendicular gradient (so must be the negative reciprocal of their $-\frac{1}{2}$)	Using $y = mx + c$ c must be evaluated using $x = 1, y = 3$ and m as in previous guidance
			$2x - y + 1 = 0$	A1	1.1	www Must be of the form $ax + by + c = 0$	Allow correct multiples e.g. $-6x + 3y - 3 = 0$
				[3]			

Question			Answer	Marks	AO	Guidance	
2			**DR**				
			$(BC =)\dfrac{12}{3-\sqrt{3}}$	**B1**	**3.1a**	Correct expression for BC	Can be implied by $6+2\sqrt{3}$
			$\dfrac{12}{3-\sqrt{3}}\times\dfrac{3+\sqrt{3}}{3+\sqrt{3}}=\dfrac{36+12\sqrt{3}}{9-3}$	**M1**	**1.1**	Multiply numerator and denominator by $\pm(3+\sqrt{3})$ to obtain a numerator with at least two terms and a denominator (not 0 or 1)	If correct, then $\dfrac{36+12\sqrt{3}}{6}$ or $6+2\sqrt{3}$
			$2(3-\sqrt{3})+2('6+2\sqrt{3}')$	**M1**	**1.1**	Correct method **seen** for finding perimeter with their AD/BC	Do not award if BC is never rationalised.
			$18+2\sqrt{3}$	**A1**	**1.1**	$a = 18$ and $b = 2$	
				[4]			

Question			Answer	Marks	AO	Guidance	
3	(a)		$\cos CAB = \frac{4^2 + 9^2 - 7^2}{2(4)(9)}$	M1	1.1	Correct application of cosine rule $\cos CAB$ does not have to be the subject	Condone $\cos\theta$ oe May see $7^2 = 4^2 + 9^2 - 2(4)(9)\left(\frac{2}{3}\right)$
			$= \frac{16+81-49}{72} = \frac{2}{3}$	A1 [2]	2.1	**AG –** at least one step of simplification from applying the formula to given answer	49 = 49 without intermediate step is **A0**
3	(b)		$\sin^2 CAB + \left(\frac{2}{3}\right)^2 = 1$	M1	3.1a	Correct use of $\sin^2 X + \cos^2 X = 1$ (oe) soi	Or using Pythagoras correctly with a right-angle triangle with hypotenuse 3 and another side 2 and attempt to find $\sin CAB$
			$\frac{\sqrt{5}}{3}$	A1 [2]	1.1	cao – accept any equivalent exact form	$\pm\frac{\sqrt{5}}{3}$ only is **M1 A0**
3	(c)		Area $= \frac{1}{2}(4)(9)\left(\frac{\sqrt{5}}{3}\right)$	M1	1.1	Correct use of $\frac{1}{2}(AC)(AB)\sin CAB$ with $AC = 4, AB = 9$ and their $\sin CAB$ soi	This mark can be earned for non-exact working as long as CAB is acute
			$= 6\sqrt{5}$ (cm^2)	A1 [2]	1.1	cao – accept any equivalent exact form www	

Question			Answer	Marks	AO	Guidance	
4	(a)			M1*	3.1a	Attempt to differentiate f(x) with at least one of the first two terms correct	
			$(\mathrm{f}'(x) =)6x^2 - 2kx + 4$	A1	1.1	Correct derivative	
			$\mathrm{f}'(2) = 16 \Rightarrow 6(2)^2 - 2(2)k + 4 = 16$	M1dep*	1.1	Using $\mathrm{f}'(2) = 16$ to set up a linear equation in k	Or checking $k = 3$ when $x = 2$
			$24 - 4k + 4 = 16$ $-4k = -12 \Rightarrow k = 3$	A1 [4]	1.1	**AG** so sufficient working must be shown (at least one step from substitution of $x = 2$ to given result)	Obtaining 16 showing sufficient working
4	(b)		$\mathrm{f}(-\frac{1}{2}) = 2(-\frac{1}{2})^3 - 3(-\frac{1}{2})^2 + 4(-\frac{1}{2}) + 3$	M1	1.1	Substitute $x = \pm\frac{1}{2}$ into given f(x)	
			$= 0$ therefore $(2x + 1)$ is a factor (of f(x))	A1 [2]	2.4	**AG** so conclusion must be given	
4	(c)		$\mathrm{f}(x) = (2x + 1)(x^2 + bx + c)$	M1*	1.1	Attempt to factorise f(x) as the product of a linear and quadratic factor (allow any non-zero values for b and c)	Or by long division to get $x^2 + px + q$ (possibly with a remainder). Allow any non-zero values for p and q
			$x^2 - 2x + 3$	A1	1.1		
			$\Delta = (-2)^2 - 4(1)(3)$	M1dep*	1.1	Correctly calculate the discriminant (oe) for their three-term quadratic. This discriminant may be in the quadratic formula	Or correctly solve their three-term quadratic by any correct method or BC

Question			Answer	Marks	AO	Guidance	
			$\Delta < 0$ so the only root of the equation is the solution of the linear equation $2x + 1 = 0$ (which is $x = -\frac{1}{2}$)	A1 [4]	2.2a	Showing the discriminant is negative **and** an indication of only one real root (e.g. stating the root)	Or stating the quadratic has no real roots **and** an indication of only one real root (e.g. stating the root)

Question			Answer	Marks	AO	Guidance	
5			**DR**				
			$3(x-2)(2x+1) \leqslant 9$	**M1***	**3.1a**	Setting up an inequality or equation with the correct three lengths and 9	Allow any inequality sign or equals
			$2x^2 - 3x - 5 \ (\leqslant 0)$	**M1dep***	**1.1**	Forming a three-term quadratic expression with all terms on the same side	Allow a single sign slip when simplifying
			$(2x-5)(x+1) \ (\leqslant 0)$ $x = \frac{5}{2}, \quad x = -1$	**B1**	**1.1**	Solving their three-term quadratic correctly by factorisation (oe)	If using factorisation then when expanded x^2 term and at least one other term correct for this mark Dependent on both **M** marks
			Either $\lambda \leqslant x \leqslant \frac{5}{2}$ **or** $\lambda \leqslant x$, $x \leqslant \frac{5}{2}$	**A1**	**2.2a**	Dependent on the first two **M** marks – allow strict inequalities for this mark or a mixture of strict and non-strict – can be implied by correct answer	Where $\lambda = -1, 0$ or 2
			$\left(2, \frac{5}{2}\right]$	**A1** **[5]**	**2.5**	cao	Dependent on both **M** marks

Question			Answer	Marks	AO	Guidance	
6	(a)		$y = \ln\left(\frac{1}{3}x\right)$ or $y = \ln\frac{1}{3} + \ln x$ or $y = \ln x - \ln 3$	B2 [2]	1.1 1.1	**B2** for a correct **equation** Condone $y = \ln\frac{1}{3}x$ **B1** for $\ln\left(\frac{1}{3}x\right)$ (so '$y =$' missing) or $(y =)\ln(3x)$ (oe) or $\ln\frac{1}{3}x$ or $\ln 3x$	Must be '$y = \ldots$' oe e.g. $\ln\frac{1}{3} + \ln x$
6	(b)		$y = x^2 - 6x + 8 \Rightarrow y = (x \pm 3)^2 \pm 9 + 8$	M1	3.1a	Attempt to complete the square (oe)	e.g. attempt to differentiate and set equal to zero (to find the minimum point) or a minimum point shown in the 4th quadrant on a graph with x-coordinate 3
			$(x-3)^2 - 1$	A1	1.1	Correct expression required May just see $f(x-3) - 2$	$(3, -1)$ or $\begin{pmatrix} 3 \\ -1 \end{pmatrix}$ seen would imply **M1 A1**
			translation only	B1	1.2	Do not accept shift/move/transform etc.	Condone 'translate'
			$\begin{pmatrix} 3 \\ -2 \end{pmatrix}$	A1 [4]	2.2a	Or equivalent in words – the correct vector (oe) implies **M1 A1 A1** Mark the vector before description/words cao	If using words do not accept in/on/along/to/ about/across/through/towards the axes, not "to the right" only, not "down" only (must be 'in the positive x-direction' or 'parallel to the positive x-axis' etc.)

Question			Answer	Marks	AO	Guidance	
7	(a)		$(y =)\ k(x \pm 3)^2 \pm 16$	M1*	2.1	Using the given minimum point $(3, -16)$ to form an expression with (unknown) constant k with $k \neq 1$	
			$0 = k(1-3)^2 - 16 \Rightarrow k = \ldots$	M1dep*	1.1	Using (1, 0) to find k	If correct $k = 4$
			$y = 4(x-3)^2 - 16 \Rightarrow y = 4(x^2 - 6x + 9) - 16$ so $f(x) = 4x^2 - 24x + 20$ or $y = 4x^2 - 24x + 20$	A1	1.1	**AG –** sufficient working must be shown	
			Alternative method 1				
			$(y =)ax^2 + bx + c$ $(y' =)2ax + b$ therefore $2a(3) + b = 0$	M1		Using the fact that the minimum point is when $x = 3$ to obtain an equation in a and b	Allow a single slip when differentiating
			Either $a + b + c = 0$ **or** $a(3)^2 + 3b + c = -16$	B1		A correct equation in a, b and c using either (1, 0) or $(3, -16)$	
			Solving correctly leading to $a = 4, b = -24, c = 20$	A1		**AG –** sufficient working must be shown	
			Alternative method 2				
			$4 - 24 + 20 = 0$ (therefore, the curve passes through the point (1, 0))	B1		Convincingly showing that the given curve passes through (1, 0)	
			$(y' =)\ 8x - 24$ and at a stationary point $y' = 0$ therefore $8x - 24 = 0$ leading to $x = \ldots$	M1		Differentiate given equation, set equal to zero and solve for x	Allow a single slip when differentiating
			$x = 3 \Rightarrow y = 4(3)^2 - 24(3) + 20$ so $y = -16$	A1		AG – convincingly show that there is a stationary point at $(3, -16)$	

Question			Answer	Marks	AO	Guidance	
			Alternative method 3 $y = 4x^2 - 24x + 20$ $= 4[x^2 - 6x] + 20$ $= 4[(x-3)^2 - 9] + 20$ $= 4(x-3)^2 - 36 + 20$	**M1**		Attempt to complete the square on given quadratic Also possible to obtain $(2x-6)^2 - 16$	Allow sign errors only
			$= 4(x-3)^2 - 16$ so, there is a stationary point at $(3, -16)$	**A1**		Correctly showing that $(3, -16)$ is a stationary point on the curve	
			$4 - 24 + 20 = 0$ (therefore, the curve passes through the point (1, 0))	**B1**		Convincingly showing that the given curve passes through (1, 0)	or $4(1-3)^2 - 16$ $= 16 - 16 = 0$
			Alternative method 4 The (quadratic) curve crosses the axis where $x = 5$	**B1**		soi eg by symmetry	
			$y = k(x-1)(x-5)$ $-16 = k(3-1)(3-5) \Rightarrow k = \ldots$	**M1**		Substitutes $(3, -16)$ in an equation of the form $y = k(x-1)(x-a)$ to find k	Where $k \neq 1$ and $k > 0$ and $a > 3$
			$k = 4 \Rightarrow y = 4(x-1)(x-5)$ $y = 4(x^2 - 6x + 5)$ $y = 4x^2 - 24x + 20$	**A1**		**AG** – sufficient working must be shown	
				[3]			

Question			Answer	Marks	AO	Guidance	
7	(b)		Curve also intersects the x-axis at 5	B1	3.1a	BC or by symmetry/inspection	
			$\int 4x^2 - 24x + 20\,\mathrm{d}x$	M1*	1.1	Attempt to integrate – at least one term with power increased by 1 and a change in coefficient of that term.	Ignore limits for the first **M1 A1** **SC** $\int x^2 - 6x + 5\mathrm{d}x$ scores **B1M1*M1dep*M1** max 4 out of 6
			$= \frac{4}{3}x^3 - \frac{24}{2}x^2 + 20x\ (+c)$	A1	1.1	Correct integration (allow unsimplified)	
			$\left(\frac{4}{3}a^3 - 12a^2 + 20a\right) - \left(\frac{4}{3}(5)^3 - 12(5)^2 + 20(5)\right) = \frac{100}{3}$	M1dep*	2.1	Set up a cubic equation in a using correct limits and the given $\frac{100}{3}$	Must be applying limits correctly (but allow one slip)
			$a^3 - 9a^2 + 15a = 0$ so ($a = 0$ or) $a = \frac{9 \pm \sqrt{21}}{2}$	M1	1.1	BC solves their 3 (or 4) term cubic – if correct equation then allow the stating of only the correct value for this mark. If incorrect cubic then must state all possible real roots for this mark. Can be awarded for inexact solutions	Dependent on both previous **M** marks If correct $a = 0$, $6.7912\ldots, 2.20871\ldots$
			$a = \frac{9+\sqrt{21}}{2}$ as $a > 5$	A1	3.2a	Correct exact root together with justification.	
				[6]			

Question			Answer	Marks	AO	Guidance	
8	(a)		$e^x = 1 + 2e^y \Rightarrow 2(1 + 2e^y) + 3e^{2y} = 41$ therefore $3e^{2y} + 4e^y - 39 = 0$ (answer given)	B1 [1]	2.1	eg rearrange, substitute and obtain the correct simplified 3-term quadratic equation in e^y www	AG
8	(b)		**DR** $(3e^y + 13)(e^y - 3)$ $e^y = 3$ only as $e^y \neq -\frac{13}{3}$ $e^y = 3 \Rightarrow y = \ln 3$ $e^x - 2(3) = 1$ or $2e^x + 3(3)^2 = 41$ or $e^x - 2(e^{\ln 3}) = 1$ or $2e^x + 3(e^{\ln 3})^2 = 41$ $P(\ln 7, \ln 3)$ or $x = \ln 7, y = \ln 3$ only	B1 B1 M1 M1 A1 [5]	1.1 2.3 1.1 1.1 1.1	Correctly factorises the given 3-term quadratic in e^y or u Correct value of e^y stated and other root rejected. Crossing out rejected answer is acceptable for **B1** Correctly solves their $e^y = a$ $(a > 0)$ Substitute their value of e^y or y to obtain an equation in x only cao	Or $\frac{-4 \pm \sqrt{4^2 - 4(3)(-39)}}{2(3)}$ Both roots must appear and be correct

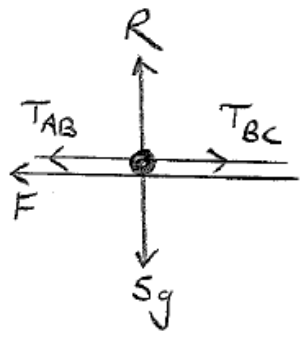
Question			Answer	Marks	AO	Guidance	
9	(a)		$\left(\frac{dv}{dt}=\right)0.1t-0.4$ $t=6 \Rightarrow a=0.2$ (m s^{-2})	M1 A1 [2]	3.4 1.1	Attempt to differentiate given expression for v (with at least one (non-zero) term correct) soi oe	
9	(b)		$0.1t-0.4=0 \Rightarrow t=...$ $0.05(4)^2-0.4(4)+k=6.6$ $0.8-1.6+k=6.6 \Rightarrow k=7.4$	M1* M1dep* A1 [3]	3.1b 3.4 1.1	Sets their linear expression for acceleration equal to zero and solve for t Substitute their t into given expression for v with v set equal to 6.6 **AG** – sufficient working to show given result eg $k=6.6-0.05(4)^2+0.4(4)$	Or other complete method to find t at the minimum No justification that this is the minimum speed required
			Alternative Method $6.6=0.05t^2-0.4t+k$ So eg $(-0.4)^2-4(0.05)(k-6.6)$	M1*		Set the given quadratic to 6.6, take everything to one side **and** use b^2-4ac correctly for their quadratic (allow sign errors only)	
			$(-0.4)^2-4(0.05)(k-6.6)=0$	M1dep*		Set their $b^2-4ac=0$	
			$0.16-0.2k+1.32=0$ $k=7.4$	A1		**AG** – sufficient working to show given result. At least one step of working must be shown	
				[3]			

Question			Answer	Marks	AO	Guidance	
9	(c)		$\int_0^{13.1} 0.05t^2 - 0.4t + 7.4\,\mathrm{d}t$	M1	1.1	Correct integral expression for the required distance or attempt to integrate – at least one term with power increased by 1 and a change in coefficient of that term, and use of 13.1 (0 may be implied) which indicates that they are trying to do the correct integral	Can be implied by correct answer
			100 (m)	A1 [2]	1.1	BC (3sf answer or better)	100.0861833…

Question			Answer	Marks	AO	Guidance	
10	(a)		$(v_P =)15 - 0.4t$	M1	3.4	Attempt to find a linear expression for the velocity of P for $t < 20$ soi	Condone $a = 0.4$ May see $y = 15 - 0.4x$
			$15 - 0.4t = 10 \Rightarrow t = 12.5$	A1 [2]	1.1	Condone $x = 12.5$	
10	(b)		Speed of P at $t = 20$ is given by $15 + (-0.4)(20)$	M1	1.1	Attempt to find speed of P at $t = 20$ May be seen on the diagram but needs to be seen or used in **(b)**	If correct speed is 7
			Distance travelled by Q is given by $10t$	B1	3.4	Possibly seen in subsequent working oe	Condone $10x$
			$10t = \frac{1}{2}(15 + '7')(20) + '7'(t - 20)$ $10t = \frac{1}{2}(15 - '7')(20) + '7't$ $10T + 20(10) = '7'T + \frac{1}{2}(15 + '7')(20)$	A1FT	3.4	Correct equation with their speed of P at $t = 20$ Condone any inequality rather than equation here Where T is the time from 20s until Q overtakes P	Condone x Condone t
			$t = 26.7$	A1 [4]	1.1	Allow 26.7 or better (26.6666…)	Condone exact value $\frac{80}{3}$ or $26\frac{2}{3}$

Question			Answer	Marks	AO	Guidance	
11	(a)			M1*	3.3	Attempt to apply N2L for at least one of the three masses – condone sign errors	Condone using the same T in both strings for **M1** only
			$3g - T_{BC} = 3a$ $T_{BC} - T_{AB} = 5a$ $T_{AB} - 2g = 2a$	A1	1.1	All three equations correct	
			$(3g - 3a) - (2g + 2a) = 5a \Rightarrow a = \ldots$	M1dep*	3.4	Solve 3 equations involving all required terms (may have sign errors) simultaneously to find a or T_{BC} or T_{AB}	If correct $a = \frac{g}{10}$ (=0.98) $T_{AB} = \frac{11}{5}g$ (=21.56) ($T_{BC} = 26.46$)
			$T_{BC} = 3g - 3\left(\frac{g}{10}\right) = \frac{27}{10}g$	A1	1.1	cao (must be in terms of g)	Accept $2.7g$ (oe)
			Alternative method				
				M1*		Attempt to apply N2L correctly for the whole system **or** the 3kg mass Condone sign errors	
			$3g - 2g = (2 + 5 + 3)a$ $3g - T_{BC} = 3a$	A1		Both equations correct	
				M1dep*		Solve 2 equations involving all required terms (may have sign errors) simultaneously to find T_{BC}	If correct $a = \frac{g}{10}$ (=0.98) ($T_{BC} = 26.46$)
			$T_{BC} = 3g - 3\left(\frac{g}{10}\right) = \frac{27}{10}g$	A1		cao (must in terms of g)	Accept $2.7g$ (oe)
				[4]			

Question			Answer	Marks	AO	Guidance	
11	(b)		$(s_1 =)\frac{1}{2}\times\frac{g}{10}\times 3^2$ (= 4.41)	B1FT	1.1	Correct (follow through) expression for s_1 where s_1 is the distance travelled by B in the first 3 seconds	Using their value for initial acceleration (most likely seen in part **(a)**) coming from some attempt at N2L Not an acceleration of $\pm g$
			$3g - T = 3a_1$ and $T = 5a_1$	M1*	3.1b	Applying N2L for both B and C	Where T is the tension in string BC and a_1 is the acceleration of the system after the string breaks
			$a_1 = \frac{3}{8}g$ or 3.675	A1	1.1		
			$(v =)\frac{g}{10}\times 3$ (= 2.94)	B1FT*	1.1	Correct (follow through) expression for the velocity of B at the instant when the string breaks	Not an acceleration of $\pm g$. Acceleration coming from some attempt at N2L
			$s_2 = 2.94\times 2 + \frac{1}{2}\times\frac{3}{8}g\times 2^2$ (=13.23)	M1dep*	3.4	Attempt to find distance travelled, using $s = ut + 0.5at^2$, in the 2 seconds after the string breaks	So must be using t = 2
			Length of surface = 5 + 4.41 + 13.23 = 22.64 (m)	A1 [6]	3.2a	Allow 22.6 www	
11	(c)		Eg. The tension is not the same throughout the string oe	B1 [1]	3.5a	Any statement which suggests the tension is not constant (throughout the string)	

Question			Answer	Marks	AO	Guidance	
11	(d)			B1 [1]	3.5c	All five forces correct – F must be acting towards the left, **B0** if T used on both strings Might see $T_{BC} = 3g, T_{AB} = 2g, F = g,$ $R = 5g$ Allow W or mg used for the weight	F and R may be replaced by a single contact force acting in the correct direction Do not allow $F = \mu R$
11	(e)		g or 9.8 because for B to remain in equilibrium the frictional force must be equal to $T_{BC} - T_{AB}$ which is equal to $3g - 2g$	B1 [1]	2.4	Correct value together with correct justification (must mention the tension in the two strings or the weights of the other two masses)	

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/ocrexams

/ocrexams

/company/ocr

/ocrexams

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.