CAMBRIDGE
International Education

Cambridge International AS & A Level

MATHEMATICS **9709/43**

Paper 4 Mechanics **May/June 2025**

MARK SCHEME

Maximum Mark: 50

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptions for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:
Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:
Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:
Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:
Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:
Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:
Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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Mathematics-Specific Marking Principles

1 Unless a particular method has been specified in the question, full marks may be awarded for any correct method. However, if a calculation is required then no marks will be awarded for a scale drawing.

2 Unless specified in the question, non-integer answers may be given as fractions, decimals or in standard form. Ignore superfluous zeros, provided that the degree of accuracy is not affected.

3 Allow alternative conventions for notation if used consistently throughout the paper, e.g. commas being used as decimal points.

4 Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored (isw).

5 Where a candidate has misread a number or sign in the question and used that value consistently throughout, provided that number does not alter the difficulty or the method required, award all marks earned and deduct just 1 A or B mark for the misread.

6 Recovery within working is allowed, e.g. a notation error in the working where the following line of working makes the candidate's intent clear.

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Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
^	More information required
A0	Accuracy mark awarded zero
A1	Accuracy mark awarded one
B0	Independent accuracy mark awarded zero
B1	Independent accuracy mark awarded one
B2	Independent accuracy mark awarded two
BOD	Benefit of the doubt
BP	Blank Page
	Incorrect
Dep	Used to indicate DM0 or DM1

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Annotation	Meaning
DM1	Dependent on the previous M1 mark(s)
FT	Follow through
~~	Indicate working that is right or wrong
Highlighter	Highlight a key point in the working
ISW	Ignore subsequent work
J	Judgement
JU	Judgement
M0	Method mark awarded zero
M1	Method mark awarded one
M2	Method mark awarded two
MR	Misread
O	Omission or Other solution
Off-page comment	Allows comments to be entered at the bottom of the RM marking window and then displayed when the associated question item is navigated to.
On-page comment	Allows comments to be entered in speech bubbles on the candidate response.
PE	Judgment made by the PE
Pre	Premature approximation
SC	Special case
SEEN	Indicates that work/page has been seen

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Annotation	Meaning
SF	Error in number of significant figures
✓	Correct
TE	Transcription error
XP	Correct answer from incorrect working

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Mark Scheme Notes

The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Types of mark

M Method mark, awarded for a valid method applied to the problem. Method marks are not 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. Correct application of a formula without the formula being quoted obviously earns the M mark and in some cases an M mark can be implied from a correct answer.

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).

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

DM or **DB** When a part of a question has two or more 'method' steps, the M marks are generally independent unless the scheme specifically says otherwise; and similarly, when there are several B marks allocated. The notation DM or DB is used to indicate that a particular M or B mark is dependent on an earlier M or B (asterisked) mark in the scheme. When two or more steps are run together by the candidate, the earlier marks are implied and full credit is given.

FT Implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A or B marks are given for correct work only.

- A or B marks are given for correct work only (not for results obtained from incorrect working) unless follow through is allowed (see abbreviation FT above).
- For a numerical answer, allow the A or B mark if the answer is correct to 3 significant figures or would be correct to 3 significant figures if rounded (1 decimal place for angles in degrees).
- The total number of marks available for each question is shown at the bottom of the Marks column.
- Wrong or missing units in an answer should not result in loss of marks unless the guidance indicates otherwise.
- Square brackets [ ] around text or numbers show extra information not needed for the mark to be awarded.

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Abbreviations

AEF/OE	Any Equivalent Form (of answer is equally acceptable) / Or Equivalent
AG	Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)
CAO	Correct Answer Only (emphasising that no 'follow through' from a previous error is allowed)
CWO	Correct Working Only
ISW	Ignore Subsequent Working
SOI	Seen Or Implied
SC	Special Case (detailing the mark to be given for a specific wrong solution, or a case where some standard marking practice is to be varied in the light of a particular circumstance)
WWW	Without Wrong Working
AWRT	Answer Which Rounds To

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Question	Answer	Marks	Guidance
1(a)	$0.1\times 4u - 0.3\times u = 0.1\times 2 + 0.3\times 4$ or $0.1\times 4u - 0.3\times u = 0.1\times(-2) + 0.3\times 4$	**M1**	For use of conservation of momentum once. Must have correct number of terms. Allow g included with all 4 masses and sign errors only.
	$u = 14$	**A1**	Must be positive.
	$u = 10$	**A1**	Must be positive. Allow Max **M1 A1 A0** if g included with the masses. Note: $0.1\times 4u - 0.3\times u = 0.1\times 2 + 0.3\times(-4)$ leading to $u = 10$ (or –10) scores **A0**. Maximum **M1 A1** if more than 2 values of u stated.
		3	
1(b)	$\pm\left(\frac{1}{2}\times 0.1\times(4\times \textit{their}14)^2 + \frac{1}{2}\times 0.3\times(\textit{their}14)^2 - \frac{1}{2}0.1\times 2^2 - \frac{1}{2}\times 0.3\times 4^2\right)$ $\left[= \pm(156.8 + 29.4 - 0.2 - 2.4)\right]$	**M1**	For expression or equivalent difference. Allow sign errors only. Using *their*14 which is the larger of the 2 values found in part **(a)**. If only one value of u found in part **(a)** then **M0**. If no value for u substituted, then **M0**.
	Largest loss = 183.6J	**A1**	Allow -183.6, $\pm\frac{918}{5}$. **This mark is dependent on full marks in part (a)**. Condone negative values for u and v used. If calculating both KE losses, then largest must be chosen for this mark. Condone ± 184 CWO.
		2	

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Question	Answer	Marks	Guidance
2	Attempt at Newton's Second law on either van, trailer or the system	*M1	Must have correct number of terms. Allow sign errors. Dimensionally correct.
	$T-120=350\times0.4$ $2500-X-T=4500\times0.4$ $2500-X-120=(4500+350)\times0.4$	A1	Any 2 correct equations.
	Attempt to solve for either T or X	DM1	From equation(s) with correct number of dimensionally correct terms. Must get $T=$ or $X=$.
	$T=260$ $X=440$	A1	Both correct.
		4	

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Question	Answer	Marks	Guidance
3(a)	Velocity at $t = 20$ is $\left[5 + \frac{3}{4} \times 20 =\right]$ 20 m s^{-1}	**B1**	Allow if seen on diagram.
	Speed at $t = 50$ is 10 m s^{-1}	**B1**	When v is minimum. Allow if seen on diagram. Allow -10.
	Displacement at $t = 40$ is $\frac{1}{2}(5 + \textit{their}\ 20) \times 20 + \frac{1}{2} \times 20 \times \textit{their}\ 20 [= 450]$ OR $\frac{1}{2}((\textit{their}\ 20 - 5) \times 20) + 20 \times 5 + \frac{1}{2} \times 20 \times \textit{their}\ 20 [= 450]$ OR Displacement at $t = 50$ is $\frac{1}{2}(5 + \textit{their}\ 20) \times 20 + \frac{1}{2} \times (\textit{their}\ 20 - 10) \times 30 [= 400]$	***M1**	Correct method to find the displacement up to $t = 40$ or $t = 50$. Follow through *their* 20.
	$\frac{1}{2} \times (T - 40) \times \textit{their}\ 10 = \textit{their}\ 450$ OR $\frac{1}{2} \times (T - 50) \times \textit{their}\ 10 + \frac{1}{2} \times 10 \times \textit{their}\ 10 = \textit{their}\ 450$ OR $\frac{1}{2} \times (T - 50) \times \textit{their}\ 10 = \textit{their}\ 400$	**DM1**	For an equation in T (or t) involving their displacement at either $t = 40$ or $t = 50$ and using *their positive* 10 which must have come from $\left\lvert \textit{their}\ 20 + \left(\frac{0 - \textit{their}\ 20}{20}\right) \times 30 \right\rvert$. Must lead to a value of $T > 0$ unless correctly recovered.
	$T = 130$	**A1**	Condone $t = 130$ or 130
		5	

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Question	Answer	Marks	Guidance
3(b)	Acceleration $= \dfrac{their\,10}{their\,130-50}$ OR $0=\left(their(-10)\right)+a\times\left(their\,130-50\right)$	**M1**	Correct method to find the acceleration using their 10 (or -10) and their T – dependent on both **M** marks in part **(a)** and must lead to a positive value for the acceleration.
	Acceleration $= \frac{1}{8}$ m s^{-2} or 0.125 m s^{-2}	**A1**	
		2	

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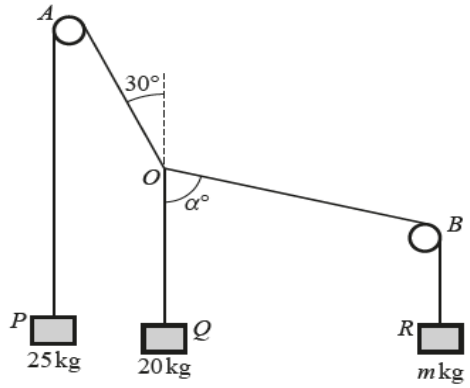
Question	Answer	Marks	Guidance
4	For resolving in either direction to form an equation – diagram for reference:  	*M1	Correct number of terms. Allow sin/cos mix. Allow sign errors. Allow g missing. Equation must be in terms of m and α only (so no marks until tensions replaced). For reference: $T_P = 25g$, $T_R = mg$, $T_Q = 20g$, $T_P \cos 30 = T_R \cos\alpha + T_Q$, $T_R \sin\alpha = T_P \sin 30$.
	$25g\cos 30 - 20g - mg\cos\alpha = 0$ $[216.506\ldots - 200 - 10m\cos\alpha = 0]$	A1	**A0** if g missing.
	$25g\sin 30 - mg\sin\alpha = 0$ $[125 - 10m\sin\alpha = 0]$	A1	**A0** if g missing.
	$\alpha = \tan^{-1}\left(\dfrac{25g\sin 30}{25g\cos 30 - 20g}\right)$ OR $\alpha = \sin^{-1}\left(\dfrac{25g\sin 30}{(their\ m)g}\right)$	DM1	For attempt to find α. Must get to '$\alpha =$' Must come from equations with the correct number of relevant terms.
	$mg = \sqrt{(25g\sin 30)^2 + (25g\cos 30 - 20g)^2}$ OR $m = \dfrac{25g\sin 30}{g\sin(their\ \alpha)}$	DM1	For attempt to find m or mg. Must get to '$m=$' or '$mg=$' OR finding the tension in string *OR* (for reference if correct is 126.085…) and then using $T_R = mg$. Must come from equations with the correct number of relevant terms.
	$\alpha = 82.5$ and $m = 12.6$	A1	AWRT 82.5, 12.6 ($\alpha = 82.4775\ldots$ $m = 12.608\ldots$) **A0** if g missing from original equations.
		6	

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Question	Answer	Marks	Guidance
5(a)	$62500 = k \times 50^2 \times 50$ or $1250 = k \times 50^2$	**M1**	For use of Power = $DF \times v$ - allow 62.5×10^3 for 62500, allow $62500 = k \times 50^3$.
	$k = 0.5$	**A1**	**AG** – allow a correct equation followed by $k = 0.5$.
	$\frac{62500}{25} - 0.5 \times 25^2 = 2500a$ $[2500 - 312.5 = 2500a]$	**M1**	For N2L with 3 terms; dimensionally correct but allow sign errors. If using $\frac{62500}{50} (= 1250)$ for the *DF* then **M0**.
	Acceleration = 0.875 m s^{-2}	**A1**	Allow $\frac{7}{8}$.
		4	

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Question	Answer	Marks	Guidance
5(b)	Attempt at Newton's second law at least once to form an equation	***M1**	With 4 relevant terms; allow sign errors; Allow sin/cos mix; condone 30 with $5a$, 20 with a, but must be dimensionally correct.
	$\frac{62500}{30} - 0.5\times 30^2 - 2500g\sin\theta = 2500a$ $[2083.33\ldots - 450 - 25000\sin\theta = 2500a]$ and $\frac{62500}{20} - 0.5\times 20^2 - 2500g\sin\theta = 2500\times 5a$ $[3125 - 200 - 25000\sin\theta = 12500a]$	**A2**	**A1** for either correct equation.
	$\frac{62500}{20} - 0.5\times 20^2 - \left(\frac{62500}{30} - 0.5\times 30^2\right) = 10000a$	**DM1**	For attempt to solve for a or θ – from equations with the correct number of relevant terms.
	$\theta = 3[.00]$ and $a = 0.129$	**A1**	Allow $a = \frac{31}{240}$, 0.129167… Allow 0.130 (0.129973…) from using $\theta = 3$ but not 0.13 unless greater accuracy seen.
		5	

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Question	Answer	Marks	Guidance
6(a)	$R = 80g \times 0.6 [= 480]$	**B1**	Allow $80g \times \cos 53$ (or better for $\theta = 53.1301\ldots$)
	$F = 0.1 \times 80g \times 0.6 [= 48]$	***M1**	For use of $F = 0.1R$ with $R = 80g \times 0.6$ or $R = 80g \times 0.8$ or equivalent with $\cos 53$ or $\sin 53$ or better.
	$80g \times 0.8 - F = 80a$ $[\Rightarrow a = 7.4]$	***M1**	For attempt to find an equation for a using N2L with 3 terms; allow sign errors; allow sin/cos mix for the weight component with $\cos 53$ or $\sin 53$ or better. Allow F or their F.
	$v^2 = (0+)2 \times (\textit{their } a) \times 5$	**DM1**	For attempt to find v^2 or v using their positive a.
	Velocity = 8.60 m s^{-1}	**A1**	Allow $\sqrt{74}$ but **A0** for 8.6 if 3sf or better (8.6023…) answer not seen.
	Alternative for Q6(a) for candidates who use an energy method		
	$R = 80g \times 0.6 [= 480]$	**B1**	Allow $80g \times \cos 53$ (or better for $\theta = 53.1301\ldots$).
	$F = 0.1 \times 80g \times 0.6 [= 48]$	***M1**	For use of $F = 0.1R$ with $R = 80g \times 0.6$ or $R = 80g \times 0.8$, or equivalent with $\cos 53$ or $\sin 53$ or better.
	[Loss in] PE = $\pm 80g \times 5 \times 0.8 [= \pm 3200]$ OR work done [against] friction = $\pm 0.1 \times 80g \times 0.6 \times 5 [= \pm 240]$	**B1**	Allow $\cos 53$ or better for the 0.6 in the WD against friction term **or** sin 53 or better for the 0.8 in the PE term.
	$80g \times 5 \times 0.8 - 0.1 \times 80g \times 0.6 \times 5 = \frac{1}{2} \times 80 \times v^2$ $[3200 - 240 = 40v^2]$	**DM1**	For attempt at work energy equation. 3 relevant terms; allow sign errors; allow sin/cos mix (using 53 or better) but must be dimensionally correct, terms that need a component should have a component. **M0** if the distance in the WD against friction term is not 5.

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Question	Answer	Marks	Guidance
6(a)	Velocity = $8.60\,\text{m}\,\text{s}^{-1}$	**A1**	Allow $\sqrt{74}$ but **A0** for 8.6 if 3sf or better (8.6023…) answer not seen.
		5	
6(b)	Change in KE = $\pm\left(\frac{1}{2}\times 80\times 11^2-\frac{1}{2}\times 80\times\left(their\,v^2\right)\right)$	**B1FT**	FT their v^2 from part **(a)** .
	Change in PE = $\pm 80g\times 2.5$ $\left[=\pm 2000\right]$	**B1**	Including PE from A is **B0**.
	$80g\times 2.5-W=\frac{1}{2}\times 80\times 11^2-\frac{1}{2}\times 80\times\left(their\,v^2\right)$ $\left[2000-W=4840-40\times\left(their\,v^2\right)\right]$	**M1**	For attempt at work energy equation. 4 relevant terms; allow sign errors but must be dimensionally correct. **M0** if using change in PE from A to C.
	Work done = 120 J	**A1**	Allow 118(.4) from using 8.6(0) from part **(a).** Working must lead to a positive answer for the work done (so –120 oe is **A0**).
		4	

Question	Answer	Marks	Guidance
7(a)	$v=0.6t+0.6$	**B1**	Allow un-simplified.
	Velocity at t = 4 is 3 m s^{-1}	**B1**	
		2	

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Question	Answer	Marks	Guidance
7(b)(i)	For attempt at integration of $0.3t^{\frac{1}{2}}$ to $kt^{\frac{3}{2}}(+c)$	*M1	Answer must be of the form $kt^{\frac{3}{2}}$ where $k \neq 0$ or 0.3 Use of $v = at$ or $v = k_1(t-4)^{\frac{3}{2}} + \ldots$ scores **M0**. Do not penalise missing c.
	Their $3 = 0.2(4)^{\frac{3}{2}} + c$ leading to $c = \ldots$ $\left[\Rightarrow v = 0.2t^{\frac{3}{2}} + 1.4\right]$	DM1	Use of *their* 3 from part **(a)** and $t = 4$ to find c (for reference if correct then $c = 1.4$) OR using correct limits of 4 and T in their equation for v e.g. $\left[0.2t^{\frac{3}{2}}\right]_4^T = 0.2\left(T^{\frac{3}{2}} - 8\right)$.
	$14.2 = 0.2T^{\frac{3}{2}} + \textit{their}\,1.4$	DM1	For equating to 14.2. Allow in terms of t Dependent on both previous **M** marks OR equivalent e.g. $14.2 - \textit{their}\,3 = 0.2\left(T^{\frac{3}{2}} - 8\right)$.
	$T = 16$	A1	Allow 16 or $t = 16$.
		4	

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Question	Answer	Marks	Guidance
7(b)(ii)	Distance travelled in first 4 seconds = 7.2 m	**B1**	
	$s = 0.08t^{\frac{5}{2}} + 1.4t$	***B1FT**	For integrating their v from part **(b)(i)** correctly which must be of the form $\alpha t^{\frac{3}{2}} + \beta$ with $\alpha, \beta \neq 0$ – allow un-simplified.
	$\left(0.08(16)^{\frac{5}{2}} + 1.4\times 16\right) - \left(0.08(4)^{\frac{5}{2}} + 1.4\times 4\right)$ $\left[= 81.92 + 22.4 - 2.56 - 5.6 = 104.32 - 8.16 = 96.16\right]$	**DM1**	Correct use of limits 4 and *their* 16 (> 4) must be equivalent to F(*their* 16) – F(4).
	Distance = 103.36 m	**A1**	Condone 103 or better CWO, $\frac{2584}{25}$. Do not ISW if, for example, 103.36 + 7.2 = 110.56. If constant of integration c found, then must be correct, that is $c = -0.96$. If no integration seen than max **B1** for 7.2 and **B1** for 103 m or better.
		4	

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