CAMBRIDGE
International Education

Cambridge International AS & A Level

MATHEMATICS **9709/41**

Paper 4 Mechanics **May/June 2026**

MARK SCHEME

Maximum Mark: 50

Published

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

This document consists of **17** printed pages.

[Turn over

General marking principles

All examiners must apply these marking principles when marking candidate responses.

1	Examiners must award marks for each response in line with: • the specific **content** defined in the mark scheme • the specific **skills** defined in the mark scheme or in the level descriptions • the **standard of response** required as exemplified by the standardisation scripts.
2	Examiners must award **whole marks** (not half marks, or other fractions).
3	Examiners must award marks **positively**. This means that: • marks are not deducted for errors or omissions • marks are awarded for correct/valid answers as defined in the mark scheme and also for **other valid answers** which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate • the quality of spelling, punctuation and grammar are judged **only** when the mark scheme indicates that these features are **specifically assessed** in the question. However, the meaning of all responses must be unambiguous.
4	Examiners must **consistently** apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.
5	Examiners must use the **full range of marks** defined in the mark scheme, unless limited by the quality of the candidate responses seen.
6	Examiners must award marks according to the mark scheme and **must not** award marks with grade thresholds or grade descriptions in mind.

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.

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
	Accuracy mark awarded zero
	Accuracy mark awarded one
	Independent accuracy mark awarded zero
	Independent accuracy mark awarded one
	Independent accuracy mark awarded two
	Benefit of the doubt
	Blank Page
	Incorrect
Dep	Used to indicate DM0 or DM1

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

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.

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

Question	Answer	Marks	Guidance
1	Resolving either direction	*M1	Correct number of relevant terms; allow sign errors; allow sin/cos mix.
	$[Y =] \pm (55\cos 60 - 23\sin 15 - 20\sin 40)$ $[= \pm 8.69140\ldots]$	A1	Resolving vertically.
	$[X =] \pm (55\sin 60 + 23\cos 15 - 20\cos 40 - 16)$ $[= \pm 38.5268\ldots]$	A1	Resolving horizontally.
	Attempt to find $\theta = \tan^{-1}\left(\frac{8.69140\ldots}{38.5268\ldots}\right)$	DM1	From expressions/equations with correct number of relevant terms.
	Attempt to find $\sqrt{(38.5268\ldots)^2 + (8.69140\ldots)^2}$	DM1	From expressions/equations with correct number of relevant terms.
	Magnitude 39.5 N and a direction of 12.7° above the positive x-axis Accept equivalent answers for direction e.g. 77.3 to the upward vertical clockwise Or give the bearing as (0)77.3 Or 12.7° above the horizontal to the right. Or 12.7° anticlockwise from the positive x-axis	A1	39.495… and 12.712… Giving an angle only is insufficient. Direction may be seen on a diagram, with minimum of the angle marked and an arrow on resultant. Arrows on both components only is **A0** as it doesn't show the direction of the resultant. If both words and diagram are contradictory mark the words. However, the direction is stated, it must be able to be drawn uniquely.
		6	

Question	Answer	Marks	Guidance
2(a)	$D = \frac{27000}{18}$ $[=1500]$	**B1**	Use of $P = D \times v$ with $P = 27\,000$.
	$\frac{27000}{18} - 600 = 1200a$	**M1**	Attempt at N2L – correct number of terms. Allow sign errors and $1200g$ for the mass. Allow D for driving force.
	$0.75\ \text{m s}^{-2}$	**A1**	OE, e.g. $\frac{900}{1200}$.
		3	
2(b)	[Component of weight parallel to plane =] $1200g\sin\theta$	**B1**	
	$\frac{22000}{12} - 650 - 1200g\sin\theta = 0$	**M1**	Attempt at N2L, dimensionally correct – correct number of terms. Allow sign errors. Allow sin/cos mix.
	$\theta = 5.7°$	**A1**	5.65919… or in radians 0.09877… AWRT $5.7°$.
		3	

Question	Answer	Marks	Guidance
3(a)	$s = 4t^3 - 39t^2 + 120t \Rightarrow [v =] 12t^2 - 78t + 120$	***M1**	Attempt to differentiate s; of the form $At^2 + Bt + 120$ with a change in coefficient and A not zero, and B not zero. Allow un-simplified; $a = \frac{v}{t}$ is **M0**.
	$12t^2 - 78t + 120 = 0$	**DM1**	Setting their three-term quadratic expression for v equal to zero.
	$t = 2.5$ and $t = 4$	**A1**	Both correct answers. CWO.
		3	
3(b)	$s(1) = 85, s(2.5) = 118.75, s(4) = 112$	***B1**	Calculating at least two of $s(1)$, $s(2.5)$, $s(4)$.
	Total distance travelled is 40.5 m	**DB1**	
		2	
3(c)	$[a =] 24t - 78$	***M1**	Attempt to differentiate their v from **3(a)** that has come from differentiation. Decrease power by 1 and a change in coefficient in at least one term (which must be the same term); allow un-simplified.
	$24 \times 3 - 78 = \ldots$	**DM1**	Dependent on previous **M** mark – substitute $t = 3$ into their expression for a.
	[Magnitude of acceleration is] 6 m s^{-2}	**A1**	Must be positive.
		3	

Question	Answer	Marks	Guidance
4(a)	Attempt at Newton's 2nd Law	***M1**	For either *A* or combined *BC or* system; correct number of terms, dimensionally consistent, allow sign errors.
	$37.5-3g=3a$ $(m+1.5)g-37.5=(m+1.5)a$ $(m+1.5)g-3g=(m+1.5+3)a$	**A1**	Any 2 correct – allow in terms of *T* or with 37.5 substituted.
	$a=2.5\Rightarrow(m+1.5)g-37.5=(m+1.5)\times 2.5$ OR $\dfrac{m+1.5}{3}=\dfrac{(m+1.5)g-37.5}{37.5-3g}$	**DM1**	Solve for *a* from equations with correct number of relevant terms and substitute to obtain an equation in *m* only. OR eliminate a to get an equation in m ONLY from equations with correct number or terms.
	$m=3.5$	**A1**	OE.
		4	

Question	Answer	Marks	Guidance
4(b)	$v^2 = 0^2 + 2\times 2.5\times 0.8$	***B1FT**	From $v^2 = u^2 + 2as$ with their a from **4(a)**, or calculated a in this part. $u = 0$ and $s = 0.8$ to form an equation in v or v^2 (if correct then $v = 2$).
	$2 = 0 + 2.5t_1$ or $0.8 = \frac{1}{2}\times 2.5\times t_1^2$	**B1**	From $v = u + at$ with $u = 0$, their v and a from **4(a)** or $s = ut + \frac{1}{2}at^2$ with $u = 0$ and their a from **4(a)** to form an equation for the time until B falls away – if correct then $t_1 = 0.8$.
	Attempt at Newton's 2nd Law	***M1**	For both A **and** B **or** system; correct number of terms, dimensionally consistent; allow sign errors.
	$T_1 - 3g = 3a$ **and** $1.5g - T_1 = 1.5a$ or $1.5g - 3g = (3 + 1.5)a$	**A1**	Both correct (**or** correct system equation) – if solved correctly then $a = -\frac{10}{3}$.
	$0 = 2 + \left(-\frac{10}{3}\right)t_2$	**DM1**	Use of $v = u + at$ (or other complete method) to find an equation for the second time (until A comes to rest) that would lead to a positive t_2 – if correct then $t_2 = 0.6$. (dependent on first **B** and previous **M** mark).
	Total time $[= 0.6 + 0.8] = 1.4$ s	**A1**	
		6	

Question	Answer	Marks	Guidance
5(a)	Resolving perpendicular or parallel to the plane	***M1**	Correct number of terms, dimensionally consistent, allow sin/cos mix.
	$R = 3.6g\cos 30 + 24\sqrt{3}\sin 30$	**A1**	$R = 1.8g\sqrt{3} + 12\sqrt{3} = 30\sqrt{3}$.
	$F + 3.6g\sin 30 = 24\sqrt{3}\cos 30$	**A1**	$F + 1.8g = 36 \Rightarrow F = 18$.
	$24\sqrt{3}\cos 30 - 3.6g\sin 30 = \mu\left(3.6g\cos 30 + 24\sqrt{3}\sin 30\right)$	**DM1**	Use of $F = \mu R$ or $F \leqslant \mu R$ with their expressions/values for F and R, with correct number of relevant terms to get an equation in μ only.
	$24\sqrt{3}\times\frac{\sqrt{3}}{2} - 3.6g\times\frac{1}{2} = \mu\left(3.6g\times\frac{\sqrt{3}}{2} + 24\sqrt{3}\times\frac{1}{2}\right)$ $\Rightarrow 36 - 18 = \mu\left(18\sqrt{3} + 12\sqrt{3}\right)$ so $\mu = \frac{18}{30\sqrt{3}} = \frac{1}{5}\sqrt{3}$	**A1**	**AG** any error/slip seen is **A0**. Must see minimum $18 = \mu\ \ 30\sqrt{3}$ OE for **A1**.
		5	

Question	Answer	Marks	Guidance
5(b)	**EITHER:** $R = 3.6g\cos 30$ $[=18\sqrt{3}]$	**(*B1**	Correct expression for the normal contact force. Allow $R = mg\cos 30$ if m used consistently and never replaced with 3.6.
	$3.6g\sin 30 - F_1 = 3.6a$	***M1**	Attempt at N2L; correct number of relevant terms, allow sign errors and sin/cos mix, dimensionally consistent. Allow $mg\sin 30 - F_1 = ma$ if m used consistently and never replaced with 3.6.
	$3.6g\sin 30 - \frac{\sqrt{3}}{5}(3.6g\cos 30) = 3.6a \Rightarrow a = \ldots$	**DM1**	Use given value of μ to set up an equation in a only and attempt to solve – if correct then $a = 2$
	$v^2 = 0^2 + 2\times 2\times 1.5$	**DM1**	Use of $v^2 = u^2 + 2as$ with $u = 0$ and $s = 1.5$ and their positive acceleration (or any other complete method to get v or v^2) – **dependent on all previous marks**.
	$2.45\ \text{m s}^{-1}$	**A1)**	2.449489… or exact $\sqrt{6}$
	OR: **Alternative using energy**		
	$R = 3.6g\cos 30$ $[=18\sqrt{3}]$	**(*B1**	Correct expression for the normal contact force. Allow $R = mg\cos 30$ if m used consistently and never replaced with 3.6.
	$\pm\frac{\sqrt{3}}{5}(3.6g\cos 30)(1.5)$	***B1**	Correct expression for the work done against friction.
	$\pm 3.6g\sin 30(1.5)$	***B1**	Correct expression for the potential energy.

Question	Answer	Marks	Guidance
5(b)	$3.6g\sin 30(1.5)-\frac{\sqrt{3}}{5}(3.6g\cos 30)(1.5)=\frac{1}{2}(3.6)v^2$	**DM1**	Complete work-energy equation with correct number of relevant terms, dimensionally consistent, allow sign errors - **dependent on all previous marks**.
	2.45 m s^{-1}	**A1)**	2.449489… or exact $\sqrt{6}$.
	Available marks	**5**	

Question	Answer	Marks	Guidance
6(a)	Attempt at CLM for the collision between *A* and *B*	***M1**	Correct number of terms, allow sign errors.
	$m\times 2m-(m+2)\times 2=m\times 2+2\times 3.25$	**A1**	
	$2m^2-4m-10.5=0\Rightarrow m=\ldots$	**DM1**	Arrange to quadratic equation in *m* and attempt to solve to find at least one value of *m.*
	$m=3.5$ only	**A1**	OE.
		4	

Question	Answer	Marks	Guidance
6(b)	$2\times3.25=2v_B+4v_C$ $[\Rightarrow v_B+2v_C=3.25]$	***M1**	Attempt at CLM for the collision between B and C; correct number of terms, allow sign errors. Allow with their possibly incorrect v_B or v_C.
	Attempt at change in KE $=\pm6.875$	***M1**	Correct number of terms and difference attempted. Use correct masses with correct corresponding speeds.
	$\frac{1}{2}\times2\times3.25^2-\frac{1}{2}\times2\times v_B^2-\frac{1}{2}\times4\times v_C^2=6.875$	**A1**	Correct equation – allow un-simplified (for reference: $v_B^2+2v_C^2=3.6875$).
	$(3.25-2v_C)^2+2v_C^2=3.6875$ OR $v_B^2+2\left(\frac{3.25-v_B}{2}\right)^2=3.6875$	**DM1**	Eliminate one variable to obtain an equation in either v_B or v_C only.
	$6v_C^2-13v_C+6.875=0$ OR $3v_B^2-6.5v_B+3.1875=0$ $\Rightarrow v_C=\frac{5}{4},\frac{11}{12}$ or $v_B=\frac{3}{4},\frac{17}{12}$	**A1**	Either both correct values for v_B **or** v_C only **or** one pair of correct solutions. Allow A1 for $v_B=0.75$.
	$v_B=\frac{17}{12}$, $v_C=\frac{11}{12}$ is not possible. So $v_B=\frac{3}{4}[0.75]$, $v_C=\frac{5}{4}$ and 2 > 0.75 so yes there is a further collision between A and B	**A1**	Correct conclusion that there is another collision between A and B – WWW.
		6	