Mark Scheme (Results)

Summer 2025

Pearson Edexcel International Advanced Level In Mechanics M1 (WME01) Paper 01

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

EDEXCEL IAL MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

- **M** marks: Method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations
   These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN.

   - bod – benefit of doubt
   - ft – follow through
   - the symbol $\surd$ will be used for correct ft
   - cao – correct answer only
   - cso - correct solution only. There must be no errors in this part of the question to obtain this mark
   - isw – ignore subsequent working
   - awrt – answers which round to
   - SC: special case
   - oe – or equivalent (and appropriate)
   - d… or dep – dependent
   - indep – independent
   - dp decimal places
   - sf significant figures
   - * The answer is printed on the paper or ag- answer given
   - $\lfloor$ or d… The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected. If you are using the annotation facility on ePEN, indicate this action by 'MR' in the body of the script.

6. If a candidate makes more than one attempt at any question:
    - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
    - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer.

General Principles for Mechanics Marking

(NB specific mark schemes may sometimes override these general principles)

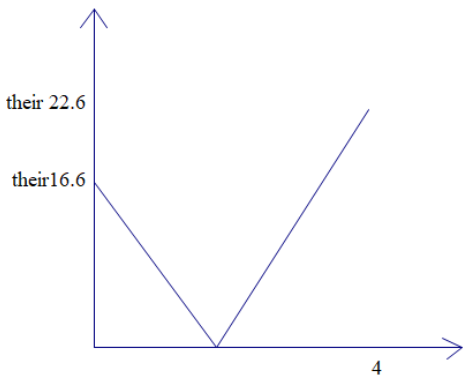
- Rules for M marks:
  - correct no. of terms
  - dimensionally correct
  - all terms that need resolving (i.e. multiplied by cos or sin) are resolved.
- Omission or extra g in a resolution is an accuracy error not method error.
- Omission of mass from a resolution is a method error.
- Omission of a length from a moments equation is a method error.
- Omission of units or incorrect units is not (usually) counted as an accuracy error.
- DM indicates a dependent method mark, i.e. one that can only be awarded if a previous specified method mark has been awarded.
- Any numerical answer which comes from use of g = 9.8 should be given to 2 or 3 SF.
- Use of g = 9.81 should be penalised once per (complete) question.
  - N.B. Over-accuracy or under-accuracy of correct answers should only be penalised *once* per complete question. However, premature approximation should be penalised every time it occurs.
- Marks must be entered in the same order as they appear on the mark scheme.
- In all cases, if the candidate clearly labels their working under a particular part of a question i.e. (a) or (b) or (c)…then that working can only score marks for that part of the question.
- Accept column vectors in all cases.
- Misreads – if a misread does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, bearing in mind that after a misread, the subsequent A marks affected are treated as A ft

Mechanics Abbreviations

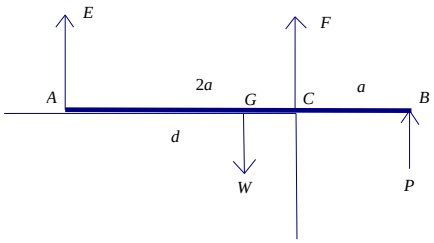
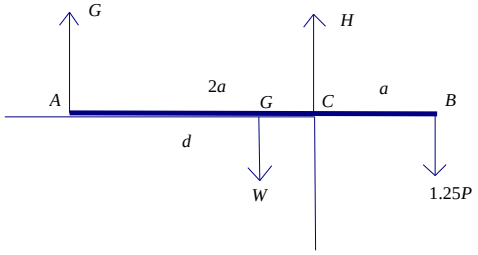
M(A)	Taking moments about A
N2L	Newton's Second Law (Equation of Motion)
NEL	Newton's Experimental Law (Newton's Law of Impact)
HL	Hooke's Law
SHM	Simple harmonic motion
PCLM	Principle of conservation of linear momentum
RHS	Right hand side
LHS	Left hand side

1a	Impulse on Q or equivalent complete method to obtain v in terms of u:	M1	Complete method to form an equation in (m), v and u only. **N.B**.allow consistent missing m's. Include all relevant terms. Dimensionally correct . Condone sign errors. Need to have correct masses and speeds and pairings.
	$4.5mu = 3mv - 3m \times 2u$	A1	Correct unsimplified equation
	$v = 3.5u$ oe	A1	Correct answer only. A0 for $10.5u/3$.
		(3)	
1b	Impulse on P or CLM **OR** Impulse on Q AND CLM	M1	Complete method to form an equation in (m), k and (u) only. **N.B**.allow consistent missing m's and/or u's. Include all relevant terms. Dimensionally correct Condone sign errors. If using CLM only, must have found and be using a v in terms of u.
	$-4.5mu = km \times 2u - km \times 5u$ **OR** $km \times 5u + 3m \times 2u = km \times 2u + 3m \times 3.5u$	A1	Correct unsimplified equation
	$k = 1.5$ oe	A1	Correct answer only
	N.B. They may do (b) first, using the impulse on P, then use their k value in CLM to answer (a). All marks available.		
		(3)	
		(6)	

Q	Scheme	Marks	Notes
	Allow column vectors throughout apart from in the answers to (a) and (b).		
2a	Use of $\frac{1}{3}\left(10\mathbf{i}+4\mathbf{j}-(-5\mathbf{i}+16\mathbf{j})\right)$	M1	Condone subtraction in the wrong order and missing brackets
	$=\left(5\mathbf{i}-4\mathbf{j}\right)\left(\text{m s}^{-1}\right)$	A1	Correct only
		(2)	
2b	$\left\{-5\mathbf{i}+16\mathbf{j}-2\left(5\mathbf{i}-4\mathbf{j}\right)\right\}+t\left(5\mathbf{i}-4\mathbf{j}\right)$ **OR** $\left\{10\mathbf{i}+4\mathbf{j}-5\left(5\mathbf{i}-4\mathbf{j}\right)\right\}+t\left(5\mathbf{i}-4\mathbf{j}\right)$	M1	Any equivalent unsimplified form using their **v,** with correct structure.
	$=\left(-15+5t\right)\mathbf{i}+\left(24-4t\right)\mathbf{j}$	A1	Correct simplified form
		(2)	
2c	Finding **AB** (or **BA)** at $t = 5$ $(\mathbf{AB}=-5\mathbf{i}-12\mathbf{j})$ Must use given **r** at $t = 5$.	M1	Seen or implied, allow slips.
	e.g. $\theta=\tan^{-1}(\pm\frac{5}{12})$ or $\tan^{-1}(\pm\frac{12}{5})$ or $\sin^{-1}(\pm\frac{5}{13})$ or $\sin^{-1}(\pm\frac{12}{13})$ etc etc	M1	Correct use of trig to find a relevant angle, using their **AB** or **BA**, seen or implied
	Bearing $203(^\circ)$	A1	Correct only, to nearest degree.
		(3)	
		(7)	

3a	Use *suvat* to form an equation in U only	M1	Complete method using *suvat* Condone sign errors
	$-12 = 4U - \frac{1}{2}g \times 16$	A1	Correct unsimplified equation in U only
	Obtain $U = 16.6$ or $U = 17$	A1	Correct answer only A0 for $2g - 3$
		(3)	
3b	Use *suvat* to form an equation in the speed or the velocity only	M1	Complete method using *suvat* Condone sign errors. **N.B.** Allow this mark, even if the U that was found in (a) came from an incorrect method.
	e.g $12 = 4v - \frac{1}{2}g \times 16$ **OR** $-v = 16.6 - 4g$ **OR** $v = \sqrt{16.6^2 + 2g \times 12}$ **OR** $12 = \frac{(-16.6 + v)}{2} \times 4$ **OR** $h = \frac{16.6^2}{2g}$ and $v = \sqrt{2g \times (h + 12)}$	A1	Correct unsimplified equation in the speed or the velocity only. Allow $\pm v$
	speed $= 22.6$ or $23 \left(\text{ms}^{-1} \right)$	A1	Correct answer only, must be positive A0 for $2g + 3$
		(3)	
3c		B1	Correct V shape with a longer 2nd line and the vertex on the t-axis. Two lines with gradients of (roughly) equal magnitude. B0 if a continuous vertical line at $t = 4$
		B1**ft**	Values 4 and their 16.6 and 22.6 marked correctly Dependent on the correct shape, a longer 2nd line and the vertex on the t-axis and two lines with gradients of (roughly) equal magnitude.
		(2)	
		(8)	

4a	Resolve perpendicular to the direction of motion to form an equation in α only. **OR** sine rule on a vector triangle.	M1	Dimensionally correct. Both forces resolved. Condone sign errors. Condone sine / cosine confusion but M0 for $800\cos 25° + 500\cos \alpha° = 0$ if **clearly** resolving in the direction of motion.
	$800\sin 25° = 500\sin \alpha°$ oe	A1	Correct unsimplified equation
	43 or better (must be correctly rounded to however many figs they choose)	A1	$\alpha = 42.5465...$ is A0
		(3)	
4b	Use $F = ma$ parallel to the direction of the motion, to form an equation in α and a only. **N.B.** The resultant of the two tensions may be found using the sine rule or cosine rule on a vector triangle.	M1	Dimensionally correct. Both forces resolved. Condone sine / cosine confusion. Condone sign errors. All relevant terms. Condone 15 or incorrect zeros for the mass. **N.B**. An extra g in a resolution is counted as an A error not an M error.
	$800\cos 25° + 500\cos \alpha° - 750 = 15000a$ **OR** $\frac{500\sin(180^o - 25^o - \alpha^o)}{\sin 25^o} - 750 = 15000a$ **OR** $\frac{800\sin(180^o - 25^o - \alpha^o)}{\sin \alpha^o} - 750 = 15000a$ **OR** $F - 750 = 15000a$ where $F = \sqrt{800^2 + 500^2 - 2\times 800\times 500\cos(180^\circ - 25^\circ - \alpha^\circ)}$	A1 A1	Unsimplified equation with at most one error. Correct unsimplified equation. α does not need to be substituted. **N.B**. If they haven't attempted part (a) and use a 'random' numerical value for α, can score max A1A0. **N.B**. Allow a replaced by $-a$
	Accept 0.023 $\left(\text{m s}^{-2}\right)$ or better, (must be correctly rounded to however many figs they choose)	A1	$a = 0.02289...$ is A0 **N.B.** Penalise the use of … in their answer, ONCE for the question.
		(4)	
		(7)	

5	 M(A) **OR** $\begin{cases} F=0, E+P=W \text{ and} \\ \text{M}(C), \text{M}(B), \text{or M}(G) \end{cases}$	M1	Use of sufficient equations to form an equation in a, d, P and W only All equations dimensionally correct with correct no. of terms. **N.B.** Must be using P in this case, unless a clear misread. $\text{M}(C): aP+W(2a-d)=2aE$ $\text{M}(B): 3aE=(a+2a-d)W$ $\text{M}(G): P(a+2a-d)=dE$
	$3aP=dW$	A1	Correct unsimplified equation in a, d, P and W only
	 M (C) **OR** $\begin{cases} G=0, H=1.25P+W \text{ and} \\ \text{M}(A), \text{M}(B), \text{or M}(G) \end{cases}$	M1	Use of sufficient equations to form another equation in a, d, P and W only All equations dimensionally correct with correct no. of terms. **N.B.** Must be using $1.25P$ in this case, unless a clear misread. $\text{M}(A): Wd+3a\times1.25P=2aH$ $\text{M}(B): aH=(a+2a-d)W$ $\text{M}(G): 1.25P(a+2a-d)=(2a-d)H$
	$1.25Pa=W(2a-d)$	A1	Correct unsimplified equation in a, d, P and W only
	Solve for d in terms of a	DM 1	Complete method. Dependent on the two preceding M marks
	Obtain $(d=)\dfrac{24a}{17}$	A1	Accept $d=1.4a$ or better (d = 1.41176…a) but NOT $\dfrac{6a}{4.25}$ or similar.
			N.B. If W is replaced by say, Mg or M etc, can score all the marks but if they use Wg with P in their equations, can score max M1A0M1A0DM1A0.
		(6)	
		(6)	
	N.B. Enter marks on ePEN for the two equations in the same order as they appear in the MS.		

6a	Resolve perpendicular to the slope: $R = mg\cos\theta \left(= \frac{4}{5}mg \right)$ **OR** $R = W\cos\theta \left(= \frac{4}{5}W \right)$	M1	Condone sine / cosine confusion and use of α, or similar, for θ
	Use of $F = \frac{1}{4}R$	M1	R does not need to be substituted.
	Friction = $\frac{1}{4} \times mg\cos\theta$	A1	Seen or implied.
	Equation of motion	M1	Need all 3 terms. Condone sign errors and sine / cosine confusion
	$F + mg\sin\theta = ma$ **OR** $F + W\sin\theta = \frac{W}{g}a$	A1	Correct unsimplified equation. Allow with $-a$
	$\left(a = \right)\frac{4}{5}g$ *	A1*	Given answer A0 for 0.8g If using $-a$, allow $-a = \frac{4}{5}g$ but not $a = -\frac{4}{5}g$ as the final answer.
			N.B. Full marks available if m replaced with 2 throughout.
			N.B. The first 3 marks are for finding the friction and just stating that $F = \frac{1}{5}mg$, scores M0M0A0. **N.B.** Since this is a 'Show that…' question the final A1* can only be scored for a fully correct solution, including use of $\cos\theta = \frac{4}{5}$ and $\sin\theta = \frac{3}{5}$,
		(6)	
6b	Use of *suvat* to form an equation in U only	M1	e.g. $0 = U^2 - 2 \times \frac{4}{5}g \times 1.5$ **N.B.** Must use $a = \pm\frac{4}{5}g$
	Obtain $U = 4.8$ or $U = 4.85$	A1	2 sf or 3 sf only Not $\sqrt{\frac{12}{5}g}$ nor $\frac{14\sqrt{3}}{5}$
		(2)	

6c	Resolve parallel to the slope: $X + F = 2g\sin\theta$	M1	Correct terms. M0 if using R in their equation. Condone sign errors and sine / cosine confusion. **N.B.** Allow m for the mass.
	$X + \frac{1}{4}2g\cos\theta = 2g\sin\theta$	A1	Correct unsimplified equation in X and θ
	$X = \frac{4}{5}g = 7.8$ or 7.84	A1	2 sf or 3 sf only Allow $\frac{4}{5}g$ or $0.8g$
		(3)	
		(11)	

	Allow column vectors throughout apart from in the answers to (b) and (c).		
7a	$\lvert\mathbf{a}\rvert = \sqrt{1^2+(-4)^2}$ or $\sqrt{1^2+4^2}$	M1	Complete method to find the magnitude using the correct vector or the correct vector with just a sign error. They may use $\mathbf{a} = \frac{\mathbf{v}_p - \mathbf{v}_q}{p-q}$ for two specific times p and q, allow subtraction either way round and slips in arithmetic
	$= \sqrt{17}$. Accept $4.1\left(\text{km h}^{-2}\right)$ or better	A1	$= 4.123105\ldots\ \left(\text{km h}^{-2}\right)$ Must come from a correct **a** (if seen.)
		(2)	
7b	$\frac{(\mathbf{i}-5\mathbf{j})-(4\mathbf{i}+\mathbf{j})}{3}$	M1	Condone subtraction the wrong way round
	$= -\mathbf{i}-2\mathbf{j}\quad\left(\text{km h}^{-2}\right)$	A1	Must be in **i** and **j**
		(2)	
7c	$4\mathbf{i}+\mathbf{j}-2(-\mathbf{i}-2\mathbf{j})$ **OR** $\mathbf{i}-5\mathbf{j}-5(-\mathbf{i}-2\mathbf{j})$	M1	Or equivalent for their **a**
	$= 6\mathbf{i}+5\mathbf{j}\quad\left(\text{km h}^{-1}\right)$	A1	Must be in **i** and **j**. Isw if they find the speed.
			N.B. In (b) and (c), penalise the use of column vectors in the answers ONCE.
		(2)	
7d	Express both velocities in component form, with **i**'s and **j**'s collected, using their answers to (b) and (c) for $\mathbf{v}_B$.	M1	$\mathbf{v}_A = (2+t)\mathbf{i}+(3-4t)\mathbf{j}$ $\mathbf{v}_B = (6-t)\mathbf{i}+(5-2t)\mathbf{j}$ Seen or implied. Allow slips. **N.B.** This mark can be earned in part (e).
	Correct use of Pythagoras to form an equation in T_1 (or t) only, with or without square roots.	M1	For given $\mathbf{v}_A$ and their $\mathbf{v}_B$
	$(6-T_1)^2+(5-2T_1)^2 = (2+T_1)^2+(3-4T_1)^2$ $\left(T_1^2+T_1-4=0\right)$	A1**ft**	Correct unsimplified equation in T_1 (or t), without square roots. Follow their answers from (b) and (c)
	$\frac{-1+\sqrt{17}}{2}$ only	A1	cao accept exact equivalent
		(4)	
7e	Use ratios to form an equation in T_2 (or t) only	M1	Allow reciprocal on one side **N.B**. Allow if **i**'s and **j**'s are left in

	$\Rightarrow \frac{5-2T_2}{6-T_2} = \frac{3-4T_2}{2+T_2}$ (allow *t* at this stage)	A1**ft**	Or equivalent ft on their $\mathbf{v_B}$
	$\Rightarrow 3T_2^{\,2} - 14T_2 + 4 = 0$ *	A1*	Obtain **correct answer** from full and correct working with no errors. Must see at least $10 + 5T_2 - 4T_2 - 2T_2^{\,2} = 18 - 24T_2 - 3T_2 + 4T_2^{\,2}$ **OR** $10 + T_2 - 2T_2^{\,2} = 18 - 27T_2 + 4T_2^{\,2}$ (Allow *t* at this stage but must be T_2 in final answer) $\Rightarrow 3T_2^{\,2} - 14T_2 + 4 = 0$ *
		(3)	
		(13)	

8a	Equation of motion for P **N.B.** In (a) and (b), for both equations of motion, must be using the correct mass to score the M mark.	M1	Dimensionally correct. Need all terms. Condone sign errors. **N.B**. Allow if a is used instead of $\frac{1}{5}g$
	$T - kMg = \frac{1}{5}kMg$	A1	Correct only. **N.B.** A0 if a is used here unless subsequently is replaced by $\frac{1}{5}g$ at any stage in the question.
		(2)	
8b	Another equation of motion	M1	Condone whole system equation. **N.B**. Allow if a is used instead of $\frac{1}{5}g$
	For Q: $3Mg - T = \frac{3}{5}Mg$ **OR** For system: $3Mg - kMg = \frac{1}{5}(kM + 3M)g$	A1	or equivalent in either case. **N.B.** A0 if a is used here unless subsequently is replaced by $\frac{1}{5}g$ at any stage.
	Obtain $k = 2$	A1	Correct only
		(3)	
8c	Complete method to obtain equation in T only e.g. $T - g = \frac{1}{5}g$ **OR** $1.5g - T = \frac{3}{5} \times 0.5g$	M1	Use of their $k = 2$ and/or $M = 0.5$ in **their** equation of motion for P or Q Condone sign errors.
	Use of force = $2T$	M1	Their T must be substituted. Independent M mark.
	$\frac{12}{5}g = 24$ or 23.5(N)	A1	2 sf or 3 sf only Allow $\frac{12}{5}g$ oe
		(3)	
8d	Complete method to obtain the speed of Q when it hits the ground, must be using $a = \frac{1}{5}g$ and $s = 2.5$ e.g. $v = \sqrt{2 \times \frac{1}{5}g \times 2.5}$	M1	Condone sign errors.

	$v=\sqrt{g}=\frac{7}{\sqrt{5}}=3.13049...$	A1	Any of these but allow 3.1 or better
	$\pm 1.5\left(0.4-\left(-v\right)\right)$	M1	Condone sign errors, *v* does not need to be substituted. **N.B.** Allow use of 3*M*, *M* or 0.5 for mass.
	$=\pm 1.5\left(0.4+\sqrt{g}\right)$ oe	A1	Or with $\sqrt{g}$ = 3.1 or better
	Obtain 5.3 or 5.30 (Ns)	A1	2 sf or 3 sf only
		(5)	
8e	Use of *suvat* with correct acceleration to find an equation in t_1 OR t_2 only. e.g. For t_1, any of : $\sqrt{g}=\frac{1}{5}gt_1$ $2.5=\frac{1}{2}\times\frac{1}{5}gt_1^2$ $2.5=\frac{1}{2}(0+\sqrt{g})t_1$ $2.5=\sqrt{g}t_1-\frac{1}{2}\times\frac{1}{5}gt_1^{\,2}$ **OR** e.g. For t_2 $0=\sqrt{g}-gt_2$ or any other complete method e.g. find *s* (0.5) and use it to find t_2	M1	Complete *suvat* method to find an equation in a relevant time. Condone sign errors. **N.B**. If using their *v* ($\sqrt{g}$) from part (d), it must have come from a correct method. **N.B.** t_1 may have been found in (d) but must be used in (e) to gain credit.
	Obtain $t_1=\frac{5}{\sqrt{g}}=\frac{5\sqrt{5}}{7}=1.5971..$ **OR** $t_2=\frac{1}{\sqrt{g}}=\frac{\sqrt{5}}{7}=0.319438..$	A1	Any of these but allow t_1 = 1.6 or better **OR** Any of these but allow $t_2=0.3$ or better
	Complete correct method for total time = t_1+t_2	M1	Correct use of *suvat* and correct accelerations
	$1.9\left(\text{s}\right)$ or $1.92\left(\text{s}\right)$	A1	2 sf or 3 sf only
		(4)	
		(17)	

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