



Mark Scheme (Results)

October 2024

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

Q	Scheme	Marks	Notes
1			
(a)	Use of CLM Or equating impulses	M1	Dimensionally correct. Condone sign errors and allow missing m 's and extra g 's.
	$(4m \times 2x) - 3mx = (3m \times 5y) - 4my$ Or: $3m(5y - -x) = 4m(y - -2x)$	A1	Correct unsimplified equation and must see all 4 terms but allow missing m 's.
	$y = \frac{5}{11}x$ *	A1*	Obtain given answer from correct working with m 's seen. Allow $y = \frac{5x}{11}$ but A0 if x is <i>clearly</i> in the denominator of the fraction.
		[3]	
(b)	Use of $I = mv - mu$	M1	Dimensionally correct. Condone sign errors and y not substituted but mass and velocities must match. M0 if m is used for mass or g is included or m is missing.
	$\pm 3m \left(\frac{25}{11}x + x \right)$ or $\left(\pm 4m \left(\frac{5}{11}x + 2x \right) \right)$	A1	Correct unsimplified expression
	$\frac{108}{11}mx$ oe	A1	$9.8mx$ or better (9.8181.. mx), must be positive.
		[3]	
		(6)	

Q	Scheme	Marks	Notes
2a	Resolve vertically or take moments	M1	First equation in R_C and/or R_D . Dimensionally correct, correct no. of terms. Condone sign errors. N.B. $3R_C + 2R_D = 75g$ or $5R_C = 75g$ are both M0A0 unless they recover.
			N.B. They may use: $R_C = 2R$ and $R_D = 3R$ so $5R = 75g$ is M1A1
	$\uparrow R_C + R_D = 50g + 25g (= 75g)$	A1	Correct unsimplified equation but A0 if they assume $R_C = R_D$. N.B. This mark can be awarded even if they clearly have $R_C = 3X$ and $R_D = 2X$ oe
	Form a moments equation or resolve vertically	M1	Second equation in R_C and/or R_D . Dimensionally correct, correct no. of terms. Condone sign errors
	M(D): $50gx + 25g \times 1.2 = 3.3R_C$ M(A): $0.9R_C + 4.2R_D = 3 \times 25g + (4.2 - x)50g$ M(B): $5.1R_C + 1.8R_D = 3 \times 25g + (1.8 + x)50g$ M(C): $3.3R_D = 2.1 \times 25g + (3.3 - x)50g$ M(E): $2.1R_C = (x - 1.2)50g + 1.2R_D$ M(G): $R_D x = 25g(x - 1.2) + R_C(3.3 - x)$	A1	Correct unsimplified equation in R_D or R_C seen but give A0 if the equation is incorrect e.g if they put $3R$ (in place of R_C) straight into the equation. A0 if they assume $R_C = R_D$.
	$(2R_D = 3R_C \Rightarrow R_C = 30g)$ $50x + 30 = 99$	M1	Complete method, using either $2R_D = 3R_C$ or $2R_C = 3R_D$ to find an equation in x only
	$x = \frac{69}{50} = 1.38$ * N.B. Two correct equations and use of $2R_C = 3R_D$ leads to $x = 2.37$ and could score max : M1A1M1A1M1A0*	A1*	Obtain given answer from correct working, with no incorrect equations seen.
		[6]	
2b	Complete method to form an equation in M only.	M1	e.g. moments about D or vertical resolution and

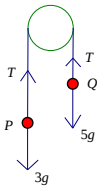
			moments about another point or two moments equations. Dimensionally correct equation. Condone sign errors
	$M(D) \quad 25g \times 1.2 + 50g \times 1.38 = 1.8Mg$ OR any two of : $(50 + 25 + M)g = R_D$ $M(A) \quad 4.2R_D = 3 \times 25g + (4.2 - 1.38)50g + 6Mg$ $M(B) \quad 1.8R_D = 3 \times 25g + (1.8 + 1.38)50g$ $M(C) \quad 3.3R_D = 2.1 \times 25g + (3.3 - 1.38)50g + 5.1Mg$ $M(E) \quad 3Mg = (1.38 - 1.2)50g + 1.2R_D$ $M(G) \quad R_D \times 1.38 = 25g(1.38 - 1.2) + Mg(1.38 + 1.8)$ AND R_D eliminated	A1	Correct unsimplified equation in M
	$(M) = 55$	A1	Correct only
		[3]	
		(9)	

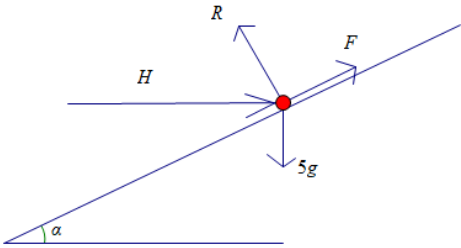
			Allow use of column vectors apart from in given answer.
Q	Scheme	Marks	Notes
3a	Use of $\mathbf{v} = \frac{\mathbf{r} - \mathbf{r}_0}{2}$ to find $\mathbf{v}$	M1	Or equivalent, allow difference reversed. Allow 120 min
	$\mathbf{v} = \frac{1}{2}((55\mathbf{i} + 34\mathbf{j}) - (25\mathbf{i} + 10\mathbf{j}))$ $(= 15\mathbf{i} + 12\mathbf{j})$	A1	Correct unsimplified expression for $\mathbf{v}$
	$\mathbf{r}_A = 25\mathbf{i} + 10\mathbf{j} + t(15\mathbf{i} + 12\mathbf{j})$	M1	With the correct structure Possible use of $\mathbf{r}_A = (55\mathbf{i} + 34\mathbf{j}) + (t - 2)(15\mathbf{i} + 12\mathbf{j})$.
	$(\mathbf{r}_A =) (25 + 15t)\mathbf{i} + (10 + 12t)\mathbf{j} *$	A1*	We are looking for the RHS only to be correct. Allow order of terms to be reversed in the brackets. N.B Use of i's and j's in columns i.e. poor notation, can score Max M1A1M1A0*
		[4]	
3b	$\sqrt{12^2 + 15^2}$	M1	Correct use of Pythagoras for their $\mathbf{v}$
	$\sqrt{12^2 + 15^2} \times \frac{1000}{3600} = \frac{5\sqrt{369}}{18} = \frac{5\sqrt{41}}{6}$	A1	5.3 or better (5.3359.....)
		[2]	
3c	Position of B at $t = 1.5$ (allow $t = 1.30$)	M1	Correct use of position and direction vectors with correct structure.
	$\mathbf{r}_B = (35\mathbf{i} + 51\mathbf{j}) + 1.5(20\mathbf{i} - 6\mathbf{j})$	A1	Correct unsimplified
	$\Rightarrow \begin{pmatrix} 65 \\ 42 \end{pmatrix} = \begin{pmatrix} 25 + 15t \\ 10 + 12t \end{pmatrix} \text{ oe}$	M1	Use $\mathbf{r}_p = \mathbf{r}_A$ and use one component to solve for t N.B. If they use $\frac{65}{42} = \frac{25 + 15t}{10 + 12t}$ oe and solve for t , it's M0 unless they go on and substitute $t = \frac{8}{3}$ into $\mathbf{r}_A$ and obtain $65\mathbf{i} + 42\mathbf{j}$, in which case it is M1A1, and could earn the final A1* with a correct conclusion.
	Obtain $t = \frac{8}{3}$ for one component	A1	N.B. Allow $t = 2.7$ or better for A1 but not for the second A1* but allow 2.6 recurring for both A marks.

	Obtain $t = \frac{8}{3}$ for both components and hence confirm A passes through P OR sub $t = \frac{8}{3}$ into $\mathbf{r}_A$ and obtain $65\mathbf{i} + 42\mathbf{j}$ and hence confirm A passes through P	A1*	Obtain given result from correct work. N.B Use of i's and j's in columns i.e. poor notation, can score Max M1A1M1A1A0* but only penalise ONCE for the whole question.
		[5]	
		(11)	

Q	Scheme	Marks	Notes
4a	Correct method to form an equation in V only using either area = distance travelled or <i>suvat</i> .	M1	Condone confusion over units for time.
	$120 = \frac{1}{2}(42 + 33) \times V$ OR $\frac{1}{2} \times 9V + 33V = 120$ OR $42V - \frac{1}{2} \times 9V = 120$	A1	Correct unsimplified equation in V only.
	$V = 3.2 *$	A1*	Obtain given answer from correct working Allow v . N.B. A correct equation is required but NO intermediate line(s) of working.
		[3]	
4b	$a = \frac{3.2}{9}$	M1	Correct method
	$= \frac{16}{45} = 0.3555... = 0.36$ or better (ms^{-2})	A1	cao
		[2]	
4c		B1	Correct shape for Q. Allow crossing before $t = 9$ and ignore gradients but horizontal line must be above the P graph. B0 if it starts at the origin.
		DB1	3.6 and 6 marked
		B1	Correct shape for P (line extended) and both ending at $t = 54$ (or equiv) marked
	N.B. Allow dotted vertical lines but withhold the first B1 if any continuous vertical lines.		
		[3]	

4d	Dist. travelled by $P = 120 + (12 \times 3.2)$ OR $\frac{1}{2}(54 + 45) \times 3.2$ OR $\frac{3.2 \times 9}{2} + (45 \times 3.2)$	B1	Seen, or implied by 158.4 used
	Distance travelled by Q: Clear attempt to use area or <i>suvat</i> to form an expression in T only. Must be attempting to use 54 i.e extended graph, with correct structure (i.e. triangle + rectangle or trapezium)	M1	Any complete method.
	$\frac{(48 + (48 - T))}{2} \times 3.6$ OR $\frac{1}{2} \times T \times 3.6 + (48 - T) \times 3.6$	A1	Correct unsimplified expression in T only.
	$\frac{(48 + (48 - T))}{2} \times 3.6 = 158.4$ ($= \frac{1}{2}(54 + 45) \times 3.2$)	DM1	Dependent on previous M mark, form and solve an equation in T only using total distances.
	$T = 8$	A1	Correct only
		[5]	
		(13)	

Q	Scheme	Marks	Notes
5a			N.B. If they use 3 <i>m</i> AND 5 <i>m</i> consistently, can score for (a), (b) and (c), Max M1A0 in (a) Max M1A0 DM1 A0 in (b) Max M1A0 in (c). Max B1M1A1ftM1A0 in (d).
	Equation of motion for <i>P</i>	M1	Require all terms. Condone sign errors
	$T - 3g = 3a$ oe	A1	Correct unsimplified equation
		[2]	
5b	Equation of motion for <i>Q</i>	M1	Require all terms. Condone sign errors
	$Q : 5g - T = 5a$ oe	A1	Second correct equation.
			Condone combined equation $5g - 3g = (5 + 3)a$ in place of one of the above
	Solve for <i>T</i>	DM1	Dependent on both previous M marks, for solving for <i>T</i> . N.B. They could solve using a calculator, in which case this DM could be implied by a correct answer.
	$T = 36.8$	A1	Accept $\frac{15g}{4}$ oe or 37 N.B. Must be a numerical value.
		[4]	
5c	Force on pulley = $2T$	M1	Correct for their <i>T</i> , provided $T \neq 0$
	$F = 73.5$	A1ft	Accept $\frac{15g}{2}$ or 74 (not 73.6), ft on their <i>T</i> value. N.B. Must be a numerical value.
		[2]	
5d	Use of $a = \frac{g}{4}$ oe	B1	Must be used in (d).
	Complete method to find <i>v</i> or v^2 with $a \neq g$	M1	M0 if $s = 8$ is used
	$v^2 = 2 \times a \times 2 \left(v^2 = 2 \times \frac{g}{4} \times 2 \right)$	A1ft	Correct unsimplified equation in <i>v</i> or v^2 . ft on their $a \neq \pm g$
	Speed at ground	M1	Complete method with $a = \pm g$, $s = 8$, and a calculated v^2 at $s = 2$, condone sign errors.
	$w^2 = v^2 + 2 \times g \times 8$ $w = 12.9(13)(\text{ms}^{-1})$	A1	3 sf or 2 sf N.B. Only penalise overaccuracy after $g = 9.8$, ONCE for the whole question.
		[5]	
		(13)	

Q	Scheme	Marks	Notes
6a			$\tan \alpha = 0.75$ N.B. If they use 5m consistently, can score Max M1A0M1A0 B1A0 in (a) Max B0B1M1A0M1A0 in (b)
	First equation e.g. resolve perpendicular to the slope	M1	Need all terms. Condone sign errors and sin/cos confusion.
	$R = 5g \cos \alpha + H \sin \alpha$	A1	Correct unsimplified equation
	Second equation e.g. resolve parallel to the slope	M1	Need all terms. Condone sign errors and sin/cos confusion.
	$H \cos \alpha + F = 5g \sin \alpha$	A1	Correct unsimplified equation
	N.B. Consistent omission of g from both equations, penalise ONCE so can score max: M1A0M1A1B1A0		
	Alternative equations: Resolve horizontally: $H + F \cos \alpha (= H + \mu R \cos \alpha) = R \sin \alpha$ Resolve vertically: $5g = R \cos \alpha + F \sin \alpha (= R \cos \alpha + \mu R \sin \alpha)$		
	N.B. If they use the wrong values for $\sin \alpha$ and $\cos \alpha$, still allow the A marks for the equations, provided it's clear that the correct ratios have been used.		
	$F = \frac{1}{4} R$	B1	Seen or implied. Allow $F \leq \frac{1}{4} R$
	$H = 20.6$ or 20.7 or 21 or $\frac{40g}{19}$	A1	Must be 3 sf or 2 sf or exact multiple of g . A0 for $\frac{392}{19}$
		[6]	
			N.B. No marks available in (b) if they use R and F from (a).
6b	N.B. If they use the wrong values for $\sin \alpha$ and $\cos \alpha$, still allow the A marks for the equations, provided it's clear that the correct ratios have been used. N.B. If g is omitted consistently, can score max : B0B1M1A1M1A0		
	$S = 5g \cos \alpha (= 4g)$	B1	Seen or implied
	$F = \frac{1}{4} S$	B1	Used with a new value for the reaction.
	Equation of motion for P: $5g \sin \alpha - g (= 3g - g) = 5a$ oe	M1	Need all terms. Condone sign errors and sin/cos confusion.

	$a = \frac{2g}{5}$ or 3.92	A1	Correct value for a N.B. Allow -ve value provided it's clear that their a was up the plane.
	$1.5 = \frac{1}{2} \times \frac{2g}{5} \times T^2$	M1	Complete method to form an equation in T only. Follow their $a \neq g$.
	$(T) = 0.875$ or 0.87	A1	3 sf or 2 sf N.B. Only penalise overaccuracy after $g = 9.8$, ONCE for the whole question.
		[6]	
		(12)	

Q	Scheme	Marks	Notes
7a	$-8 = 8 - gT_1$ OR $0 = 8T_1 - \frac{1}{2} \times 9.8T_1^2$ OR $0 = 8 - gt$ and $T_1 = 2 \times \frac{8}{g}$	M1	Complete method using <i>suvat</i> . Condone sign error
	$T_1 = 1.63$ *	A1*	Given single answer correctly obtained (Allow T or $t = 1.63$ or just 1.63)
		[2]	
7b	$0 = u^2 - 2g \times 2$	M1	Complete method to find speed immediately after 1st impact N.B. Could use energy.
	$u = 2\sqrt{g} = 6.26099..$	A1	Seen or implied. Do not penalise for > 3 sf
	Use of $I = mv - mu$	DM1	Dependent on M1, condone sign errors and a recalculated '8'.
	$I = 0.1(8 - (-6.3))$	A1	Must have 8 and 6.3 or better.
	$= 1.4$ or 1.43 (Ns)	A1	2sf or 3sf
		[5]	
7c	Equal heights	M1	Complete method using <i>suvat</i> to form an equation in T_2 Allow with $T_2 + 1, T_2$ with $T_2 + 1$ used for A and T_2 used for B Allow t instead of T_2 N.B. M0 if they use the same times for both or a mixture of t and $t + 1$. ALT 1 At $t = 1$, A is $(8 - 4.9) = 3.1\text{m}$ above the ground and moving downwards with speed $(9.8 - 8) = 1.8 \text{ m s}^{-1}$ then use $h - s_A = s_B$ oe to find $T_2 - 1$. Must find both height and speed.
	$8T_2 - \frac{1}{2}gT_2^2 = 5(T_2 - 1) - \frac{1}{2}g(T_2 - 1)^2$ OR $8(T_2 + 1) - \frac{1}{2}g(T_2 + 1)^2 = 5T_2 - \frac{1}{2}gT_2^2$	A1 A1 A1 A1	One distance correct Both distances correct One distance 'correct' Both distances 'correct'

	ALT 1: $3.1 - (1.8t + 4.9t^2) = (5t - 4.9t^2)$	A1 A1	Allow t instead of T_2 in either. One side correct Both sides correct
	$(t = \frac{3.1}{6.8}) \quad (T_2 =) \quad 1.5 \text{ or } 1.46$ ALT 2: $8(T_1 - T_2) - \frac{1}{2}g(T_1 - T_2)^2 = 5(T_2 - 1) - \frac{1}{2}g(T_2 - 1)^2$	A1 A1 A1	Must be rounded to 2 sf or 3 sf A0 for $\frac{99}{68} = 1.45588..$ N.B. Only penalise overaccuracy after $g = 9.8$, ONCE for parts (b) and (c) only.
		[4]	
		(11)	