



Pearson
Edexcel

Mark Scheme (Results)

January 2019

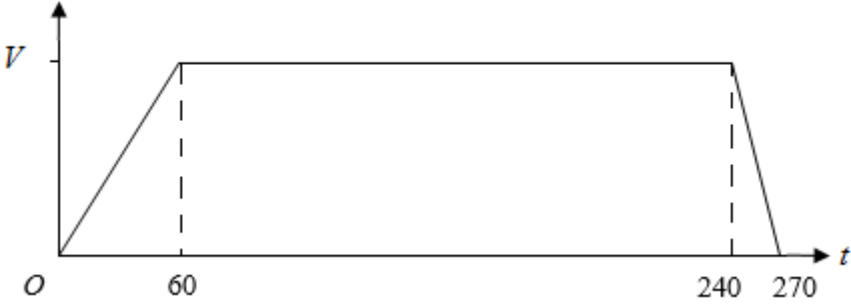
Pearson Edexcel International Advanced Level In
Mechanics M1 (WME01/01)

Question Number	Scheme	Marks
2(a)	$\tan \theta = \frac{6}{7}$ $\theta = 40.60^\circ \dots$ <p>Bearing is $360^\circ - 40.60^\circ = 319^\circ$ nearest degree</p>	M1 A1 A1 (3)
(b)	$\mathbf{r}_A = (20\mathbf{i} - 17\mathbf{j}) + 4(-6\mathbf{i} + 7\mathbf{j}) = (-4\mathbf{i} + 11\mathbf{j})$ $\mathbf{r}_B = (-8\mathbf{i} + 9\mathbf{j}) + 4(p\mathbf{i} + 2p\mathbf{j}) = (-8 + 4p)\mathbf{i} + (9 + 8p)\mathbf{j}$ $\mathbf{r}_A - \mathbf{r}_B = (4 - 4p)\mathbf{i} + (2 - 8p)\mathbf{j}$ $-8 + 4p - -4 = 9 + 8p - 11$ $p = -0.5$ $\mathbf{v}_B = (-0.5\mathbf{i} - \mathbf{j})$ $ \mathbf{v}_B = \sqrt{(-0.5)^2 + (-1)^2}$ $= \frac{\sqrt{5}}{2} = 1.1 \text{ ms}^{-1} \text{ or better}$	M1 A1 A1 DM1 M1 A1 A1 M1 M1 A1 (10) 13
Notes		
2(a)	M1 for any trig ratio using 6 and 7: $\tan \theta = \pm \frac{6}{7} \text{ or } \pm \frac{7}{6} : \sin \theta \text{ or } \cos \theta = \pm \frac{6}{\sqrt{6^2 + 7^2}} \text{ or } \pm \frac{7}{\sqrt{6^2 + 7^2}}$	
	A1 for a correct angle from their <i>correct</i> equation e.g. $49^\circ, 41^\circ, 139^\circ, 131^\circ, \dots$	
	A1 for 319° cao	
2(b)	First M1 for attempt at use of $\mathbf{r}_4 = \mathbf{r}_0 + 4\mathbf{v}$ for either <i>A</i> or <i>B</i>	
	First A1 for $(-4\mathbf{i} + 11\mathbf{j})$ i's and j's must be collected at some stage	
	Second A1 for $(-8 + 4p)\mathbf{i} + (9 + 8p)\mathbf{j}$ i's and j's must be collected at some stage	
	Second DM1 , dependent on first M1, for finding the difference between their two \mathbf{r}_4 vectors (must be an attempt to subtract both i and j components)	
	Third M1 for equating the i cpt and j cpt of their difference (M0 if no difference) to give an equation in <i>p</i> only. oe e.g. $\frac{(4 - 4p)}{(2 - 8p)} = \frac{(-)1}{(-)1}$	
	Third A1 for a correct equation in <i>p</i> only	
	Fourth A1 for a correct value of <i>p</i>	
	Fourth M1 for using their <i>p</i> value to obtain a velocity vector for <i>B</i>	
	Fifth M1 for finding the magnitude of their \mathbf{v}_B (N.B. This M mark is available, even if their \mathbf{v}_B does not have the correct form)	
	Fifth A1 for $\frac{\sqrt{5}}{2}$ oe or 1.1 or better	

Question Number	Scheme	Marks
3(a)	$560 - mg = 1.4m$	M1 A1 (2)
(b)	$2800 - Mg - 560 = 1.4M$	M1 A1 (2)
(c) (i)	$560 = 11.2m$	DM1
(ii)	$m = 50$	A1
	$2240 = 11.2M$	A1 (3) 7
	$M = 200$	
	Notes	
(a)	M1 for equation of motion for the person only, with usual rules, condone sign errors, and with at least one value (560 or 1.4) substituted. <i>Credit given for this equation only if it appears in (a).</i>	
	A1 for a correct equation	
(b)	M1 for equation of motion for the lift only, with usual rules, condone sign errors, and with at least one value (2800, 560 or 1.4) substituted. <i>Credit given for this equation only if it appears in (b).</i>	
	A1 for a correct equation	
(c)	Hence: DM1, dependent on appropriate previous M mark, for solving one of their equations, <u>wherever it appears</u> , for either m or M Otherwise: DM1, dependent on appropriate previous M mark, for solving one of their equations and/or the whole system equation, <u>wherever they appear</u> , for either m or M N.B. There are no marks available for the whole system equation	
	First A1 for $m = 50$	
	Second A1 for $M = 200$	

Question Number	Scheme	Marks
4(a)	$M(R), 40g(x-3) + 2.5g \times 2 = 30g \times 0.5$ $x = 3.25 \text{ m from } P$	M1 A2 A1 (4)
(b)	Mass of the box is concentrated at the point Q oe	B1 (1)
(c)	$M(R), 3Mg + 30g \times 0.5 = 2.5g \times 2 + 40g \times 2$ $M = \frac{70}{3}, 23 \text{ or better}$	M1 A2 A1 (4) 9
Notes		
4(a)	M1 for moments about R to give an equation in x (or another unknown distance) <i>only</i> (i.e. M0 if reaction at P is non-zero) Correct no. of terms, dimensionally correct	
	A2 for a correct equation in x <i>only</i> (allow consistent omission of g) -1 each error	
	<p>Alternative: Instead of $M(R)$, they may write down 2 equations and eliminate the normal reaction at R, N_R, to obtain an equation in a distance <i>only</i> :</p> $(\uparrow)N_R = 40g + 30g + 2.5g$ <p>Possible equations:</p> $M(P), 40gx + 30g \times 2.5 + 2.5g \times 5 = 3N_R$ $M(Q), 40g(5-x) + 30g \times 2.5 = 2N_R$ $M(G), 40g(2.5-x) + 0.5N_R = 2.5g \times 2.5$ <p>Equations must have correct no. of terms and be dimensionally correct but M0 if reaction at P is non-zero</p>	
	Third A1 for $\frac{13}{4}$ m oe Allow 3.3 m	
(b)	B1 for <i>mass</i> or <i>weight</i> of box acts at Q but B0 if extra wrong answers	
(c)	M1 for moments about R to give an equation in M <i>only</i> (i.e. M0 if reaction at P is non-zero) Correct no. of terms, dimensionally correct	
	A2 for a correct equation in M <i>only</i> (allow consistent omission of g) -1 each error	
	<p>Alternative: Instead of $M(R)$, they may write down 2 equations and eliminate the normal reaction at R, S_R, to obtain an equation in M <i>only</i> :</p> $(\uparrow)S_R = 40g + 30g + 2.5g + Mg$ <p>Possible equations:</p> $M(P), 42.5g \times 5 + 30g \times 2.5 = 3S_R$ $M(Q), Mg \times 5 + 30g \times 2.5 = 2S_R$ $M(G), Mg \times 2.5 + 0.5S_R = 42.5g \times 2.5$ <p>Equations must have correct no. of terms and be dimensionally correct but M0 if reaction at P is non-zero</p>	
	Third A1 for $\frac{70}{3}$ oe or 23 or better Accept 24	

Question Number	Scheme	Marks
5.	$PM = 3.5 - 2 \tan 45^\circ = 1.5 \quad \text{OR} \quad PB = \sqrt{3.5^2 + \left(\frac{2}{\sin 45^\circ}\right)^2 - 2 \times 3.5 \times \left(\frac{2}{\sin 45^\circ}\right) \cos 45^\circ} = 2.5$ $\tan \alpha = \frac{1.5}{2}; \cos \alpha = \frac{4}{5}; \sin \alpha = \frac{3}{5}$ <p>OR $\alpha = 37^\circ$ or $(90^\circ - \alpha) = 53^\circ$ (at least 2SF)</p> $T_P \cos \alpha + T_Q \cos 45^\circ = 6g$ $T_P \sin \alpha = T_Q \cos 45^\circ$ $T_P = \frac{30g}{7} = 42 \text{ N}; \quad T_Q = 36 \text{ or } 35.6 \text{ N}$	M1 A1 M1 A2 -1 ee M1 A1 DM1 A1; A1 10
	Notes	
	First M1 for finding the length of PM or PB	
	First A1 for a correct trig ratio for α or $(90^\circ - \alpha)$ or a correct value for α or $(90^\circ - \alpha)$ Do not penalise accuracy here if their final answers for the tensions are correct.	
	N.B. If they assume the tensions are the same, no further marks available If they think $\alpha = 30$ or 60 or....., they could get all 5 resolving marks as a value of α is not required but if $\alpha = 45$, only M marks available. However, if α and 45 are interchanged in the resolving equations - no marks available for resolving	
	Second M1 for resolving vertically with usual rules	
	Second/Third A1's for a correct equation, (α does not need to be substituted) -1 each error	
	Third M1 for resolving horizontally with usual rules	
	Fourth A1 for a correct equation (α does not need to be substituted but if it is, follow through on their value)	
	Fourth DM1, dependent on all THREE previous M marks, for solving for either tension	
	Fifth A1 for T_P Allow 42.0 Units not needed	
	Sixth A1 for T_Q Units not needed	
	Alternative , using Triangle of Forces/Lami's Theorem, for middle 5 marks.	
	$\frac{T_P}{\sin 45^\circ} = \frac{6g}{\sin(45^\circ + \alpha)} \quad \text{OR} \quad \frac{T_Q}{\sin(180^\circ - \alpha)} = \frac{6g}{\sin(45^\circ + \alpha)}$	M1 A2 -1 ee
	$\frac{T_Q}{\sin(180^\circ - \alpha)} = \frac{6g}{\sin(45^\circ + \alpha)} \quad \text{OR} \quad \frac{T_P}{\sin 45^\circ} = \frac{6g}{\sin(45^\circ + \alpha)} \quad \text{OR}$ $\frac{T_P}{\sin 45^\circ} = \frac{T_Q}{\sin(180^\circ - \alpha)}$	M1 A1
	N.B. Treat omission of g as one error	

Question Number	Scheme	Marks
6(a)		B1 Shape B1 Figs. and V (2)
(b)	$4500 = \frac{(270+180)}{2}V \quad \text{OR} \quad 4500 = \frac{1}{2}60V + 180V + \frac{1}{2}30V$ $V = 20$	M1 A1 A1 (3)
(c)	$\frac{(T+T-60)}{2} \times 20 = 2250 \quad \text{OR} \quad \frac{1}{2}60.20 + (T-60).20 = 2250$ $T = 142.5 \text{ s}$	M1 A2 ft A1 (4)
(d)	$T_1 = \frac{1}{4} \times 60$ $= 15$ $T_2 = 270 - \left(\frac{1}{4} \times 30\right) \quad \text{OR} \quad 240 + \left(\frac{3}{4} \times 30\right)$ $= 262.5$	M1 A1 M1 A1 A1 (5) 14
Notes		
6(a)	First B1 for a trapezium (not to scale) starting and finishing on the t -axis but B0 if solid vertical lines included	
	Second B1 for 3 figs. (60, 270 and use of 30 with a delineator or 240) and V . 270 can be implied by 3 correct delineators	
6(b)	M1 for a complete method to produce an equation, in V only, with the correct structure i.e. one trapezium or two triangles + rectangle or triangle + trapezium or trapezium + triangle or rectangle – two triangles = 4500 (allow 4.5 for the M mark) (M0 if a single <i>suvat</i> equation is used)	
	First A1 for a correct unsimplified equation	
	Second A1 for $V = 20$	
6(c)	M1 for a complete method to produce an equation, in <i>ONE</i> variable e.g. t where $t = (T - 60)$, with the correct structure i.e. one trapezium or triangle + rectangle or rectangle – triangle = 2250 (allow 2.25 for the M mark) (M0 if a single <i>suvat</i> equation is used)	
	First and second A1's for a correct unsimplified equation ft on their 20 -1 each error	
	Third A1 for 142.5 (s) cao <u>Accept 143.</u>	
6(d)	First M1 for a complete method to give an equation in T_1 only	

	First A1 for 15 (independent of V so allow even if their V is wrong)	
	Second M1 for a complete method to give an equation in T_2 <i>only</i>	
	Second A1 for a correct equation	
	Third A1 for 262.5 (independent of V so allow even if their V is wrong) Accept 263	
	N.B. Accept $T_1 = 262.5$ and $T_2 = 15$	

	Special Case: Allow max M1A1DM0A0 if m is lost from their T but expression for R is otherwise correct.	
	First A1 for a correct expression for R in terms of T and α	
	Second DM1 for substituting in their expression for T and a correct value for α but must be in terms of m	
	Second A1 for a correct answer (any equivalent surd form)	



Pearson
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Mark Scheme (Results)

January 2019

Pearson Edexcel International Advanced Level In
Mechanics M2 (WME02/01)

Q	Scheme	Marks	Notes
6b alt	Moments about C: $20 \times 0.5 \cos \theta + F \times 2.5 \sin \theta = R \times 2.5 \cos \theta$	M1	1 st equation. Dimensionally correct. Condone sin/cos confusion and sign errors
	$(40 + 7.5F = 10R)$	A1	Correct unsimplified equation
	Resolve parallel rod:	M1	2 nd equation. Dimensionally correct. Condone sin/cos confusion and sign errors
	$P + F \cos \theta + R \sin \theta = 20 \sin \theta (=12)$	A1	Correct unsimplified equation
	Use $F = \frac{1}{4}R$: ($8.125R = 40$, $R = 4.92\dots$)	B1	
	Solve for P: $P = 12 - \frac{R}{4} \times \frac{4}{5} - R \times \frac{3}{5} = 12 - \frac{4}{5}R = 8.06\dots$	DM1	Dependent on the preceding 2 M marks
	Solve for μ : $P = \mu N$,	DM1	Dependent on the preceding M mark
	$\mu = 0.630$ (0.63)	A1	
		(8)	
6alt	If the use of moments about C is part of the solution to (a)		
	Moments about C and use: $20 \times 0.5 \cos \theta + F \times 2.5 \sin \theta = R \times 2.5 \cos \theta$	M1	From (b) Dimensionally correct. Condone sin/cos confusion and sign errors
	Use of $F = \frac{1}{4}R$	B1	From (b)
	$R = \frac{64}{13}$, ($R = 4.92\dots$)	A1	From (b)
	Resolve perpendicular to the rod:	M1	*From (a)
	$N + R \cos \theta = \mu R \sin \theta + W \cos \theta$	A1	From (a) Correct unsimplified equation
	$N = 12.8$ (N)	A1	From (a)
	Resolve parallel rod:	M1	*Dimensionally correct. Condone sin/cos confusion and sign errors
	$P + F \cos \theta + R \sin \theta = 20 \sin \theta (=12)$	A1	Correct unsimplified equation
	Solve for P: $P = 12 - \frac{R}{4} \times \frac{4}{5} - R \times \frac{3}{5} = 12 - \frac{4}{5}R = 8.06\dots$	DM1	
	Solve for μ : $P = \mu N$,	DM1	
	$\mu = 0.630$ (0.63)	A1	
			* could use an alternative pair of resolutions
		[11]	