



Mark Scheme (Results)

October 2021

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

Question Number	Scheme	Marks
1.		
	1 st Equation in d (or another defined unknown), R and M (as appropriate) only	M1 A1
	2 nd Equation in d (or the same defined unknown, R and M (as appropriate) only	M1 A1
	Possible equations: $(\uparrow), R + 2R = Mg$ $M(C), 2R \times 4.5 = Mg(d - 2.5)$ $M(D), R \times 4.5 = Mg(7 - d)$ $M(A), 2.5R + (7 \times 2R) = Mgd$ $M(B), 6.5R + (2 \times 2R) = Mg(9 - d)$ SC: $M(G), R(d - 2.5) = 2R(7 - d)$	M2 A2,1,0
	Solve for d , must be a numerical value	DM1
	$d = 5.5$	A1 (6)
		(6)
	Notes for question 1	
	N.B. Allow M marks for equations if they use R_c and R_D	
	M1 Correct number of terms, dimensionally correct, condone sign errors and missing g	
	A1 Correct equation	
	M1 Correct number of terms, dimensionally correct, condone sign errors and missing g	
	A1 Correct equation	
	DM1 Dependent on previous two M marks, for solving for d	
	A1 $d = 5.5$ oe Ignore an extra m (but not M)	
	N.B. If g is omitted consistently in both equations, all three A marks are available. If they use Rg consistently in both equations, all three A marks are available. If they have 3 equations, mark the ones that are used to obtain d . If R and $2R$ are consistently the wrong way round, apply the scheme, unless an MR gives a better total.	

Question Number	Scheme	Marks
2.		
2(a)	$2m \times 3u = 2mv + 4m \times 2u$ OR $I = 4m \times 2u$ and $-I = 2m(v - 3u)$ AND add to eliminate I $v = -u$ so speed is u	M1A1
		A1
		(3)
2(b)	Opposite to its original direction, reversed, in opposite direction, direction QP , opposite direction to Q Direction changed is B0	DB1
		(1)
2(c)	$R = 4mg$	B1
	$F = 4ma$; OR $-Ft = 4m(0 - 2u)$ $4mg\mu = 4ma$ (their <u>calculated</u> a or unknown a) $-\mu 4mgt = 4m(0 - 2u)$	M1 A1
	$0^2 = (2u)^2 - 2a\left(\frac{6u^2}{g}\right)$ (their <u>calculated</u> a or an unknown a) OR $\frac{6u^2}{g} = \frac{(0 + 2u)}{2}t$ (their <u>calculated</u> t or an unknown t)	M1A1
	$\mu = \frac{1}{3}$ correctly obtained	A1
		(6)
		(10)
	Notes for question 2	
2(a)	M1 Complete method to give equation in m, u and v only, dimensionally correct, correct no. of terms, condone sign errors and consistent cancelled m 's or extra g 's	
	A1 Correct equation	
	A1 u ; must be positive	
2(b)	DB1 Dependent on an answer of $+u$ or $-u$ in (a)	
2(c)	B1 cao Seen anywhere, e.g. on a diagram	
	M1 Equation of motion (Allow F for friction at this stage)	
	OR Impulse-momentum equation	
	A1 Correct equation with F substituted	
	M1 Use of <i>suvat</i> to obtain an equation in u and a only	
	OR Use of impulse-momentum to obtain an equation in u and t only	
	A1 Correct equation ; equations must be consistent to earn both A marks.	
	A1 Accept 0.33 or better	

Question Number	Scheme	Marks
3(a)	$v^2 = 25^2 - 2 \times 6 \times 48$	M1
	$v = 7 \text{ (m s}^{-1}\text{)}$	A1
		(2)
3(b)	$\frac{25-13}{6} \quad (2)$	M1
	$13^2 = 25^2 - 2 \times 6s \quad \text{OR} \quad 25 \times 2 - \frac{1}{2} \times 6 \times 2^2 \quad \text{OR} \quad \frac{(25+13)}{2} \times 2$ OR $13 \times 2 - \frac{1}{2} \times (-6) \times 2^2 \quad ((s =) 38)$	M1
	Total time = $\frac{(48-38)}{13} + 2$	DM1
	$\frac{36}{13} = 2\frac{10}{13} \text{ (s)} \quad (2.76923\dots)$	A1
		(4)
3(c)	$\frac{25-13}{6} \quad (2) \quad (\text{could be implied by 2.2})$	M1
	$(0.2 \times 25) + (25 \times 2 - \frac{1}{2} \times 6 \times 2^2) \quad (5 + 38)$	M1
	Total time = $\frac{48 - [(0.2 \times 25) + 38]}{13} + 0.2 + 2$	DM1
	$\frac{168}{65} = 2\frac{38}{65} \text{ (s)} \quad (2.58461538\dots)$	A1
		(4)
		(10)
	Notes for question 3	
3(a)	M1 Complete method to find v (condone sign errors)	
	A1 cao	
3(b)	M1 Complete method to find time to reach 13 m s^{-1}	
	M1 Complete method to find distance travelled in reaching 13 m s^{-1} ft on their 2 if necessary	
	DM1 Dependent on previous two M marks, Complete method to find the total time, ft on their 2 and 38	
	A1 Correct answer. Allow 2.8 or better	
3(c)	M1 Complete method to find the time taken to reach 13 m s^{-1} once it starts decelerating	
	M1 Complete method to find total distance travelled in reaching 13 m s^{-1} ft on their 2 if necessary	
	DM1 Dependent on previous two M marks, Complete method to find the total time, ft on their 2 and 38	
	A1 Correct answer. Allow 2.6 or better	

Question Number	Scheme	Marks
	Allow column vectors throughout	
4(a)	$\mathbf{r} = -\mathbf{i} - 3\mathbf{j}$	B1
	$\tan \theta = \pm \frac{1}{3} \text{ or } \pm \frac{3}{1}$	M1
	$162^\circ \text{ or } 198^\circ \text{ nearest degree}$	A1
		(3)
4(b)	$\sqrt{(t-3)^2 + (1-2t)^2} = 2.5$	M1
	$4t^2 - 8t + 3 = 0 \quad (5t^2 - 10t + 3.75 = 0)$	DM1A1
	$t = \frac{1}{2} \text{ or } \frac{3}{2} \text{ isw}$	M (A)1 A1
		(5)
		(8)
	Notes for question 4	
4(a)	B1 cao	
	M1 for any trig ratio of a relevant angle from <u>their</u> \mathbf{r} (trig ratio could be implied by a relevant angle) (cosine could come from use of the scalar product of their \mathbf{r} with \mathbf{j})	
	A1 cao	
4(b)	M1 oe	
	DM1, dependent on first M1, for simplifying to a 3 term quadratic or to a form from use of completing the square.	
	A1 correct quadratic	
	M(A)1 for $t = 0.5$	
	A1 for $t = 1.5$	

Question Number	Scheme	Marks
5(a)	(\uparrow) $\pm F = 0.2g - 2.5 \cos \alpha$ Allow use of (μR) for F	M1 A1
	$F = 0.46$ (N) oe including fractions , upwards	A1
		(3)
5(b)	(\uparrow) $F + 0.2g = 6.125 \cos \alpha$	M1A1
	(\rightarrow) $R = 6.125 \sin \alpha$ (4.9)	M1A1
	$F = \mu R$	B1
	Solve for μ	DM1
	$\mu = 0.35$ oe including fractions.	A1
	N.B. If F and R are interchanged in their equations, max B1 can be scored.	(7)
		(10)
	Notes for question 5	
5(a)	M1 Correct no. of terms, condone sin/cos confusion and sign errors, allow if they have T instead of 2.5	
	A1 Correct equation . Allow $+F$ or $-F$	
	A1 Need both magnitude (must be positive) and direction	
5(b)	M1 Correct terms, condone sin/cos confusion and sign errors errors allow if they have T instead of 6.125 (but M0 if using $T = 2.5$)	
	A1 Correct equation	
	M1 Correct terms, condone sin/cos confusion and sign error allow if they have T instead of 6.125 (but M0 if using $T = 2.5$)	
	A1 Correct equation	
	B1 $F = \mu R$ seen but B0 if they use a value for R found in (a)	
	DM1 Dependent on both M's	
	A1 cao	

Question Number	Scheme	Marks
6(a)	$0 = u - 9.8 \times 2.5$ oe using gradient of graph. Allow g or 9.81 instead of 9.8	M1
	$u = 24.5$ or $25 \text{ (m s}^{-1}\text{)}$ Allow $2.5g$	A1
	Many other methods	(2)
6(b)	$s = 24.5 \times 2 + \frac{1}{2} \times 9.8 \times 2^2$ <p>OR</p> $s = 24.5 \times 7 - \frac{1}{2} \times 9.8 \times 7^2$ <p>OR</p> $s = \frac{1}{2} \times 9.8 \times 4.5^2 - (24.5 \times 2.5 + \frac{1}{2} \times (-9.8) \times 2.5^2)$ <p>OR</p> $s = \frac{1}{2} \times 9.8 \times 4.5^2 - \frac{1}{2} \times 9.8 \times 2.5^2$ <p>Many other methods, using <i>suvat</i> and/or the graph (e.g. similar triangles and area under graph)</p> <p>Allow g or 9.81 instead of 9.8 in all equations.</p>	M1A1ft
	68.6 or 69 (m)	A1
		(3)
		(5)
	Notes for question 6	
	For use of $g = 9.81$, which will only affect the final A mark in each part, penalise once for whole question	
6(a)	M1 for complete method using <i>suvat</i> or the graph to produce an equation in u only, with correct number of terms, condone sign errors.	
	A1 cao (must be positive)	
6(b)	M1 Complete method to give a final displacement, condone sign errors within a <i>suvat</i> equation.	
	A1ft Correct equation ft on their u	
	A1 cao	

Question Number	Scheme	Marks
7(a) (i)	$T - 2mg \sin \alpha - F = 2ma$	M1A1
(ii)	$3mg - T = 3ma$	M1A1
	N.B. Ignore the labelling (i) and (ii)	(4)
7(b)	$R = 2mg \cos \alpha$ Allow if this appears in (a).	M1A1
	$F = \frac{1}{2}R$	B1
	Substitute for trig. and solve for a ,	DM1
	$a = \frac{1}{5}g$	A1
		(5)
7(c)	$T = \frac{12mg}{5}$ (23.52m)	DM1
	$2T \cos\left(\frac{90^\circ - \alpha}{2}\right)$ OR $\sqrt{T^2 + T^2 - 2T^2 \cos(90^\circ + \alpha)}$ OR $\sqrt{(T \cos \alpha)^2 + (T + T \sin \alpha)^2}$	M1
	Substitute for trig and T to obtain an expression in m or mg	DM1
	$\frac{48\sqrt{5}mg}{25}$; Accept 4.3mg or better, 42m or 42.1m	A1
		(4)
7(d)	Tension is the same on either side of the pulley , tension across the pulley is the same.	B1
	B0 for tension is same for A and B or is the same for both strings etc	(1)
		(14)
	Notes for question 7	
	N.B. If m 's are consistently missing, mark (a) and (b) as a MR	
7(a)	M1 Correct no. of terms, condone sin/cos confusion and sign errors	
	A1 Correct equation	
	M1 Correct no. of terms, condone sign errors	
	A1 Correct equation	
	N.B. Could have a replaced by $(-a)$ in both	
7(b)	M1 Correct no. of terms, condone sin/cos confusion and sign errors	
	A1 Correct equation	
	B1 Seen, possibly on a diagram or in (a)	
	DM1, dependent on the two M's in (a), for solving 2 simultaneous equations or using a whole system equation to find a	
	A1 cao	
7(c)	DM1, dependent on the relevant 1 st or 2 nd M1 in (a), for <u>attempt</u> to find their T , must be of form km or kmg . Apply isw if they 'cancel' m 's.	
	M1 for a correct expression in terms of T and α only; α does not need to be substituted	
	DM1, dependent on previous M, for substituting in their T and for trig, to give an expression of form km or kmg	
	A1 cao	
7(d)	B1 for any equivalent statement. B0 for incorrect extras.	

[illegible]