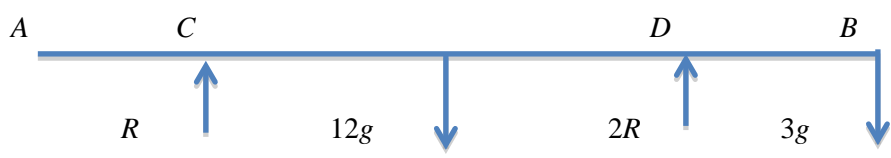


Mark Scheme(Results)

October 2016

Pearson Edexcel International A Level
in Mechanics 1 (WME01/01)

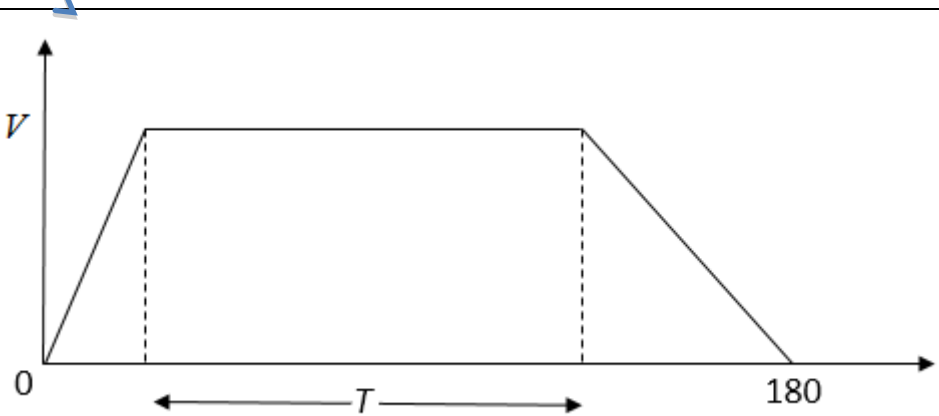
Question Number	Scheme	Marks
2(a)	$(-10\mathbf{i} + a\mathbf{j}) + (b\mathbf{i} - 5\mathbf{j}) + (2a\mathbf{i} + 7\mathbf{j}) = 3(3\mathbf{i} + 4\mathbf{j})$ $a - 5 + 7 = 12 \Rightarrow a = 10$ $-10 + b + 2a = 9 \Rightarrow b = -1$	M1 M1 A1 M1 A1 (5)
(b)	$20\mathbf{i} + 20\mathbf{j} = \mathbf{u} + 4(3\mathbf{i} + 4\mathbf{j})$ $\mathbf{u} = (8\mathbf{i} + 4\mathbf{j})$ $u = \sqrt{8^2 + 4^2} = \sqrt{80} = 8.9 \text{ (or better)}$	M1 A1 M1 A1 (4) 9
Notes		
2(a)	First M1 for applying $\mathbf{F} = m\mathbf{a}$; need all terms but allow slips and allow m instead of 3 Second M1 (independent but M0 if they have $\mathbf{0}$ instead of $m\mathbf{a}$) for equating <i>coefficients</i> of \mathbf{j} First A1 for $a = 10$ Third M1 (independent but M0 if they have $\mathbf{0}$ instead of $m\mathbf{a}$) for equating <i>coefficients</i> of \mathbf{i} Second A1 for $b = -1$	
(b)	First M1 for applying $\mathbf{v} = \mathbf{u} + t\mathbf{a}$; need all terms and must be vector \mathbf{u} First A1 for $8\mathbf{i} + 4\mathbf{j}$ Second M1 (independent) for finding magnitude of their vector \mathbf{u} Second A1 for $\sqrt{80}$ or 8.9 or better	

Question Number	Scheme	Marks
3.	 <p style="text-align: center;"> $(\uparrow) \quad R + 2R = 12g + 3g$ $M(A), \quad 2Rx + 3R = 12g \cdot 4 + 3g \cdot 8$ $x = 5.7$ </p>	<p style="text-align: right;">M1 A2 M1 A2 A1 7</p>
Notes		
<p>First M1 for either a vertical resolution (with correct of terms) or a moments equation (all terms dim correct and correct no. of terms) First A1 and Second A1 for a correct equation in R (or S where $S = 2R$) only or R and x only or S and x only. (-1 each error, A1A0 or A0A0) Second M1 for either a vertical resolution (with correct of terms) or a moments equation (all terms dim correct and correct no. of terms) Third A1 and Fourth A1 for a correct equation in R (or S where $S = 2R$) only or R and x only or S and x only. (-1 each error, A1A0 or A0A0) Fifth A1 for $x = 5.7$ oe</p> <p>N.B. On ePen, first 3 marks are for a vertical resolution, if it appears, second 3 marks are for a moments equation. If no vertical resolution, award marks as they appear for the (two) moments equation(s).</p> <p>(i) In a moments equation, if R and $2R$ (or S and $0.5S$) are interchanged, treat as 1 error. (ii) Ignore diagram if it helps the candidate. (iii) If an equation is correct but contains both R and S, treat as 1 error. (iv) Full marks possible if all g's omitted. (v) For inconsistent omission of g, penalise each omission.</p> <p>$M(B), R \times 5 + S(8 - x) = 12g \times 4$ $M(C), S(x - 3) = 12g \times 1 + 3g \times 5$ $M(D), R(x - 3) + 3g(8 - x) = 12g(x - 4)$</p> <p>N.B. If they use a different variable, other than x, for a length, with it <u>clearly</u> marked on the diagram, they can score all the marks for any moments equation.</p>		

Question Number	Scheme	Marks
4.(a)	$\mathbf{p} = (-5\mathbf{i} + 9\mathbf{j}) + t(\mathbf{i} - 2\mathbf{j})$	M1 A1 (2)
(b)	$2 = 9 - 2t$ $t = 3.5$ $\mathbf{p} = (-5\mathbf{i} + 9\mathbf{j}) + 3.5(\mathbf{i} - 2\mathbf{j}) = (-1.5\mathbf{i} + 2\mathbf{j})$	M1 A1 M1 A1 (4)
(c)	$\frac{2b-1}{5-2b} = \frac{1}{-2}$ $b = -1.5$	M1 A1 DM1 A1 (4) 10
Notes		
4.(a)	M1 for clear attempt at $\mathbf{p} = (-5\mathbf{i} + 9\mathbf{j}) + t(\mathbf{i} - 2\mathbf{j})$ (allow slips but must be ' + ') A1 if correct	
(b)	First M1 for equating the j component of their p to 2 First A1 for $t = 3.5$ Second M1 (independent) for substituting their t value into their p Second A1 for $(-1.5\mathbf{i} + 2\mathbf{j})$	
(c)	First M1 for $\frac{2b-1}{5-2b} = \pm \frac{1}{2}$ or $\frac{2b-1}{5-2b} = \pm \frac{2}{1}$ (must be in b only but allow slips) First A1 for a correct equation in b only Second M1 (dependent on first M1) for solving for b Second A1 for $b = -1.5$	

Question Number	Scheme	Marks
5(a)	$(\square), R = 8\cos 50^\circ + 0.5g\cos 30^\circ$ $(\square), F = 8\cos 40^\circ - 0.5g\sin 30^\circ$ $F = \mu R$ $\mu = 0.39 \text{ or } 0.392$	M1 A2 M1 A2 B1 DM1 A1 <p style="text-align: right;">9</p>
	Notes	
	<p>First M1 for resolving perpendicular to the plane with usual rules and 8 must be used with 40° or 50° and $0.5(g)$ must be used with 30° or 60°</p> <p>First A1 and second A1 for a correct equation – 1 each error (A1A0 or A0A0)</p> <p>Second M1 for resolving parallel to the plane with usual rules and 8 must be used with 40° or 50° and $0.5(g)$ must be used with 30° or 60°</p> <p>Third A1 and fourth A1 for a correct equation – 1 each error (A1A0 or A0A0)</p> <p>B1 for $F = \mu R$ seen</p> <p>Third M1 dependent on both previous M marks for solving for μ</p> <p>Fifth A1 for 0.39 or 0.392</p> <p>N.B. If they resolve in any other directions e.g. horizontally or vertically, apply similar rules to the above for the M mark in each case.</p>	

Question Number	Scheme	Marks
6.	$s_A = 35t + \frac{1}{2} 0.4t^2; s_B = 44t + \frac{1}{2} 0.5t^2$ $44t + \frac{1}{2} 0.5t^2 = 200 + 35t + \frac{1}{2} 0.4t^2$ $\frac{1}{20}t^2 + 9t - 200 = 0$ $(t - 20)(t + 200) = 0$ $t = 20$ $v = 44 + \frac{1}{2} \cdot 20 = 54 \text{ ms}^{-1}$	M1 A1 A1 M1 A1 M1 A1 DM1 A1 9
	Notes	
	First M1 for use of $s = ut + \frac{1}{2}at^2$ for either A or B First A1 for a correct equation for A Second A1 for a correct equation for B Second M1 for producing a quadratic in t only from their $s_A =$ their $s_B \pm 200$ Third A1 for a correct '3 term = 0' equation Third M1 (can be implied by one correct answer) for attempt to solve their quadratic (M0 if linear). Must include 200, must be 3 terms and must have come from using both distance expressions. Fourth A1 for $t = 20$ Fourth M1 dependent on third M1 for correctly using their t value to find v Fifth A1 for 54 N.B. SC for trial and error to find t ; can score max M1A1A1M1A0M0A0M1A1 6/9	

Question Number	Scheme	Marks
7.(a)		<p>B1 shape</p> <p>B1 figs. (V,T,180) (2)</p>
(b)	<p>Time accelerating = $V/1 = V$</p> <p>Time decelerating = $V/0.5 = 2V$</p> <p>Time at constant speed, $T = 180 - (2V + V)$ $T = 180 - 3V$ Printed answer</p>	<p>M1</p> <p>A1 (2)</p>
(c)	$\frac{1}{2}(180 + 180 - 3V)V = 4800$ $V^2 - 120V + 3200 = 0$ $(V - 40)(V - 80) = 0$ $V = 40 \text{ or } 80 \text{ or both, since } (180 - 3 \times 80) < 0$	<p>M1 A1 A1</p> <p>A1</p> <p>DM1 A1, M1 (7) 11</p>
Notes		
7.(a)	<p>First B1 for a trapezium, starting at the origin and finishing on the t-axis. Second B1 for V, T with delineators or marked on the top of the trapezium or oe and 180 correctly positioned.</p>	
(b)	<p>M1 for both Time accelerating = $V/1 = V$ and Time decelerating = $V/0.5 = 2V$ M0 if no working for the $2V$ as it's a 'Show that' or if they use $V/-0.5$ and fudge the $-ve$ sign A1 for $T = 180 - (2V + V) = 180 - 3V$ Printed answer</p>	

(c)	<p>First M1 for attempt at using area under graph = 4800, with appropriate terms, to produce an equation in V only; must have used $\frac{1}{2}$ somewhere.</p> <p>(M0 if one <i>suvat</i> formula used)</p> <p>First A1 and second A1 for a correct equation (A1A0 one error)</p> <p>Third A1 for a correct quadratic expression = 0</p> <p>Second M1 dependent on first M1 for solving their quadratic (can be implied by 1 correct answer)</p> <p>Fourth A1 for $V = 40$ or $V = 80$ or both</p> <p>Third M1 for a correct reason for rejecting $V = 80$. (only available if both correct values have been obtained)</p> <p>Allow: "Since $T > 0$, $V = 40$" oe</p>	
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Question Number	Scheme	Marks
8(a)	$1.4^2 = 2a \times 0.5 \Rightarrow a = 1.96 \text{ ms}^{-2}$ $3g - T = 3a \text{ or } -3a$ $T = 23.5 \text{ N or } 24 \text{ N}$	M1 A1 M1 A1 A1 (5)
(b)	$F = \mu R$ $R = 2g \cos \alpha$ $T - 2g \sin \alpha - F = 2a \text{ or } -2a$ $\mu = 0.5$	B1 M1 A1 M1 A1 A1 DM1 A1 (8) 13
Notes		
8(a)	<p>First M1 for using one or more <i>suvat</i> formulae to produce an equation in <i>a</i> only First A1 for 1.96 (or -1.96 but only if correctly used in the second equation, in which case they <i>could</i> score 5/5) Second M1 for resolving vertically for <i>Q</i> (correct no. of terms but condone sign errors) Second A1 for a correct equation provided <i>a</i> used consistently in their two equations (but <i>a</i> does <u>not</u> need to be substituted) N.B. If they haven't found a value for <i>a</i>, the A1 can be scored for either $3a$ or $-3a$ in the equation of motion. Third A1 for 23.5 or 24</p>	
(b)	<p>B1 for $F = \mu R$ seen First M1 for resolving perpendicular to the plane (correct no. of terms with $2g$ resolved) First A1 for a correct equation (M1A0 for $R = mg \cos \alpha$) Second M1 for resolving parallel to the plane (correct no. of terms with $2g$ resolved but condone sign errors) Second A1 and third A1 for a correct equation (A1A0 for one error) N.B. Neither <i>T</i> nor <i>F</i> nor <i>a</i> needs to be substituted. Third M1 dependent on both previous M marks, for solving for μ (a numerical value) Fourth A1 for $\mu = 0.5$ (A0 for 0.499)</p>	

Mark Scheme(Results)

October 2016

Pearson Edexcel International A Level
in Mechanics 2 (WME02/01)

Q	Scheme	Marks	Notes
	Change in energy $= \pm \left(\frac{1}{2} \times 4 \times 6^2 - 4g \times 10 \sin \alpha \right)$	A2	-1 each error
	$= 72 - 40g \times \frac{1}{7} = 16 \text{ (J) *given answer*}$	A1	-16 is A0. Condone -16 becoming +16
		(4)	
3a alt	Complete strategy using <i>suvat</i> and N2L to find the work done	M1	
	$v^2 = u^2 + 2as \Rightarrow 36 = -20a \quad (a = -1.8)$	A1	
	$Fr + 4g \sin \theta = 4 \times (\text{their } 1.8)$ ($Fr = 1.6$)	A1	
	Work Done = $1.6 \times 10 = 16 \text{ (J)}$ *given answer*	A1	
		(4)	
	NB: For 3(b) must be using work-energy		
3b	Considering the whole journey: $\frac{1}{2} \times 4v^2 = \frac{1}{2} \times 4 \times 36 - 2 \times 16$	M1	Requires all 3 terms. Must be dimensionally correct. Condone sign errors
		A1	Correct unsimplified equation
	$v^2 = 20, \quad v = 4.47 \text{ (m s}^{-1}\text{)} \quad (4.5)$	A1	Accept $2\sqrt{5}$
		(3)	
3b alt	Working from B to A: $\frac{1}{2} \times 4 \times v^2 + 16 = 40g \sin \alpha$	M1	Requires all 3 terms. Must be dimensionally correct. Condone sign errors
		A1	Correct unsimplified equation
	$v^2 = 20, \quad v = 4.47 \text{ (m s}^{-1}\text{)} \quad (4.5)$	A1	Accept $2\sqrt{5}$
		(3)	
		[7]	
4a	Differentiate p to obtain v :	M1	
	$\mathbf{v} = (3t^2 - 9t - 24)\mathbf{i} + (-3t^2 + 6t + 12)\mathbf{j}$	A1	
	Equate coefficients and obtain quadratic in	DM1	Dependent on preceding M1

Q	Scheme	Marks	Notes
5a			
	Take moments about A:	M1	Must be dimensionally correct. Condone sin/cos confusion
	$5N = 4 \cos \theta W$	A1	
	$N = \frac{12}{25}W = 0.48W$ *Given Answer*	A1	
		(3)	
5b	$G = \frac{1}{4}N = 0.12W$	B1	Seen or implied
	Resolve vertically	M1	Needs all terms. Condone sin/cos confusion and sign errors
	$\uparrow: R + N \cos \theta + G \sin \theta = W$	A1	($R = 0.616W$)
	Resolve horizontally	M1	Needs all terms. Condone sin/cos confusion and sign errors
	$\leftrightarrow: F + G \cos \theta = N \sin \theta$	A1	($F = 0.312W$)
	$\mu = \frac{N \sin \theta - G \cos \theta}{W - N \cos \theta - G \sin \theta}$	DM1	Use $F = \mu R$ to find μ Dependent on 2 preceding M marks
	$= \frac{0.48W \times 0.8 - 0.12W \times 0.6}{W - 0.48W \times 0.6 - 0.12W \times 0.8} = \frac{0.312}{0.616}$		
	$= 0.51$ (0.50649...) $\left(\frac{39}{77}\right)$	A1	
		(7)	
		[10]	
	NB, One of the two equations required for part (b) could be a moments equation: M(P) $1 \times W \cos \theta + 5F \sin \theta = 5R \cos \theta$ M(B) $3N + 8R \cos \theta = 4W \cos \theta + 8F \sin \theta$		