

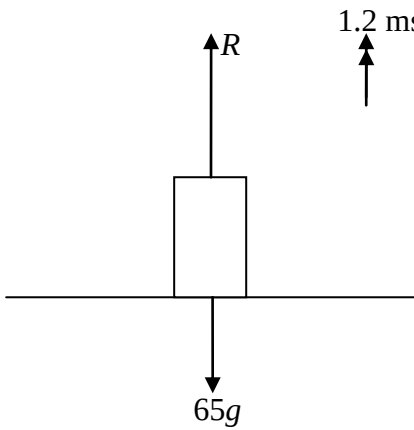
Mathematics M1 January 2014

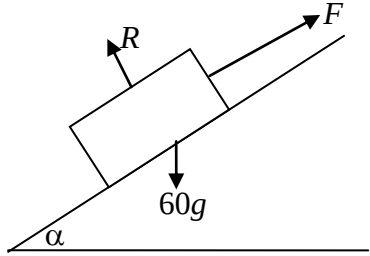
Solutions and Mark Scheme

Final Version

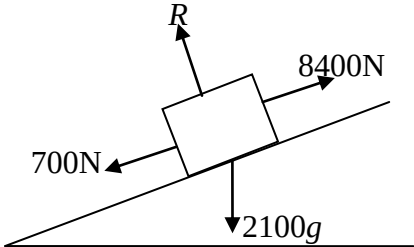
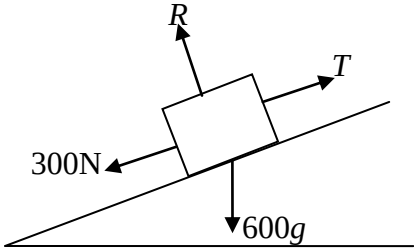
Q	Solution	Mark	Notes
1(a)		B1 B1	(0, 18) to (48, 18) Or (48, 18) to (60, 3) graph all correct, with units, labels.
1(b)	magnitude of deceleration = $\frac{18 - 3}{12}$ = <u>1.25 (ms⁻²)</u>	M1 A1	A0 if negative
1(c)	Distance = area under graph Distance = $48 \times 18 + 0.5(18 + 3) \times 12$ Distance = <u>990 (m)</u>	M1 B1 A1	attempt at total area. one correct area seen cao

Q	Solution	Mark	Notes
2(a)	Use of $v = u + at$, $v=0$, $u=(\pm)7$, $a=(\pm)9.8$ $0 = 7 - 9.8t$ $t = \frac{7}{9.8} = \frac{5}{7}(\text{s})$	M1 A1	oe correct equ solvable for t A1
2(b)	Use of $s = ut + 0.5at^2$, $u=(\pm)7$, $a=(\pm)9.8$, $t=4$ $s = 7 \times 4 + 0.5(-9.8) \times 4^2$ $s = 28 - 4.9 \times 16$ $s = -50.4$ Height of cliff is <u>50.4 (m)</u>	M1 A1 A1	 if staged method, one correct distance cao, allow -ve

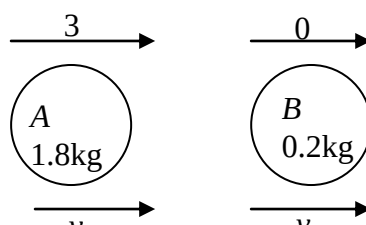
Q	Solution	Mark	Notes
3	 N2L applied to man $R - 65g = 65a$ $R = 65 \times 1.2 + 65 \times 9.8$ $R = \underline{715 \text{ (N)}}$	M1 A1 A1	dim correct and R and $65g$ opposing. cao

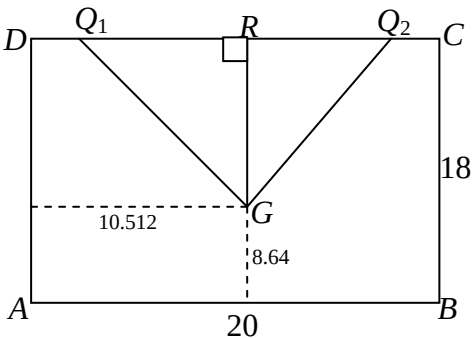
Q	Solution	Mark	Notes
4(a)(i)	 $R = 60g \cos \alpha$ $F = \mu R$ $F = 60 \times 9.8 \cos \alpha \times 0.3$ $F = \underline{159.87 \text{ (N)}}$	B1 B1	
4(a)(ii)	N2L applied to object $60g \sin \alpha - F = 60a$ $60a = 60 \times 9.8 \sin 25^\circ - 159.87$ $a = \underline{1.48 \text{ (ms}^{-2}\text{)}}$	M1 A1 A1	all forces, dim correct. ft F
4(b)	If object remains stationary, component Of weight down slope $\leq$ Friction $60g \sin \alpha \leq \mu \times 60g \cos \alpha$ $\therefore \text{least } \mu = \tan 25^\circ$ $= 0.4663$ $= \underline{0.47 \text{ (to 2 d.p.)}}$	M1 A1 A1	si

Q	Solution	Mark	Notes
5	Resolve in Q direction $Q = 9\sin 60^\circ$ $= 9 \times \frac{\sqrt{3}}{2} = \underline{7.794}$ Resolve in P direction $P + 9\cos 60^\circ = 6$ $P = 6 - 9 \times 0.5$ $P = \underline{1.5}$	M1 A1 M1 A1 A1	equation required cao equation required, all forces correct equation cao

Q	Solution	Mark	Notes
6(a)	 N2L on whole system $8400 - 700 - 2100g\sin\alpha = 2100a$ $8400 - 700 - 5762.4 = 2100a$ $a = \underline{0.923 \text{ (ms}^{-2}\text{)}}$	M2 (M1) A2 A1	all forces in same dir, dim correct. 8400N and resistance opposing. one force missing but must have comp of wt. and resistance.) -1 each error cao 3 dp required.
6(b)	 N2L applied to trailer $T - 300 - 600g\sin\alpha = 600a$ $T - 300 - 600 \times 9.8 \times \frac{7}{25} = 600 \times \frac{346}{375}$ $T = \underline{2500 \text{ (N)}}$	M1 A2 A1	all forces, no extra. Dim correct. Either resist. or comp wt opposing -1 each error ft a. answers rounding to 2500

Q	Solution	Mark	Notes
7(a)			
7(a)(i)	Moments about Y $Mg \times 1.2 = R_X \times 2.4 + 84g \times 0.4$ $(9.8 \times 1.2)M = 2.4 \times 156.8 + 84 \times 9.8 \times 0.4$ $M = \underline{60}$	M1 B1 A1	dim. Correct, all forces, equation, oe any correct moment.
7(a)(ii)	Resolve vertically $R_X + R_Y = Mg + 84g$ $R_Y = 144 \times 9.8 - 156.8$ $R_Y = \underline{1254.4 \text{ (N)}}$	M1 A1 A1	all forces ft M
7(b)(i)	When plank about to tilt about Y $R_Y = 0$ Resolve vertically $R_X = 60g + 84g$ $R_X = \underline{1411.2 \text{ (N)}}$	M1 M1 A1	si all forces ft M
7(b)(ii)	Moments about X $84g \times x = 60g \times 1.2$ $x = \frac{6}{7} = \underline{0.86}$ Distance of the person from X = 0.86 (m)	M1 A1	dim correct ft M

Q	Solution	Mark	Notes
8(a)(i)	 Conservation of momentum $1.8 \times 3 + 0.2 \times 0 = 1.8v + 0.2v$ $2v = 5.4$ $v = \underline{2.7 \text{ (ms}^{-1}\text{)}}$	M1 A1 A1	allow different v's convincing
8(a)(ii)	$e = \underline{0}$	B1	
8(b)(i)	N2L applied to combined object $-8 = 2a$ $a = -4 \text{ ms}^{-2}$ $a = \underline{4 \text{ (ms}^{-2}\text{)}}$	M1 A1	dim correct
8(b)(ii)	Use of $v = u + at$, $u = 2.7$, $a = (\pm)4$, $t = 0.5$ $v = 2.7 - 4 \times 0.5$ $v = \underline{0.7 \text{ (ms}^{-1}\text{)}}$	M1 A1 A1	oe ft a if <0 . ft a if <0 .
8(b)(iii)	Use of $v^2 = u^2 + 2as$, $u = 2.7$, $v = 2$, $a = (\pm)4$ $2^2 = 2.7^2 - 2 \times 4s$ $s = \underline{0.41(125 \text{ m})}$	M1 A1 A1	oe ft a if <0 . ft a if <0 .

Q	Solution	Mark	Notes																				
9(a)	<table> <tr> <th></th><th>Area</th><th>from AD</th><th>from AB</th></tr> <tr> <td>ABCD</td><td>360</td><td>10</td><td>9</td></tr> <tr> <td>Circle</td><td>21</td><td>6</td><td>12</td></tr> <tr> <td>XYZ</td><td>36</td><td>13</td><td>7</td></tr> <tr> <td>Lamina</td><td>375</td><td>x</td><td>y</td></tr> </table>		Area	from AD	from AB	ABCD	360	10	9	Circle	21	6	12	XYZ	36	13	7	Lamina	375	x	y	B1 B1 B1 B1	all 4 correct areas
	Area	from AD	from AB																				
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Lamina	375	x	y																				
9(a)(i)	Moments about AD $360 \times 10 + 36 \times 13 = 375x + 21 \times 6$ $x = \underline{10.5(12 \text{ cm})}$	M1 A1 A1	consistent use of signs for areas and moments. ft table if +XYZ and -circ cao																				
9(a)(ii)	Moments about AB $360 \times 9 + 36 \times 7 = 375y + 21 \times 12$ $y = \underline{8.6(4 \text{ cm})}$	M1 A1 A1	consistent use of signs for areas and moments. ft table if +XYZ and -circ cao																				
9(b)	 Consider triangle RQ_1G Angle $RGQ = \text{angle } RQG = 45^\circ$ $\therefore RQ = RG$ Let $DQ_1 = x$ $10.512 - x = 18 - 8.64$ $x = 10.512 - 9.36$ $DQ_1 = \underline{1.1(52 \text{ cm})}$ $DQ_2 = 10.512 + (18 - 8.64)$ $DQ_2 = \underline{19.8(72 \text{ cm})}$	M1 A1 M1 A1	ft x, y ft x, y																				