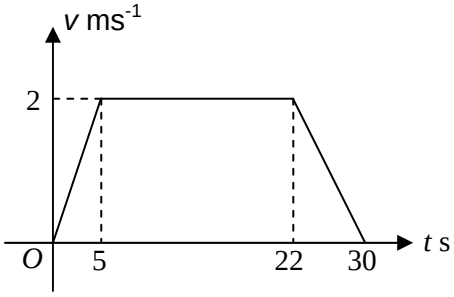
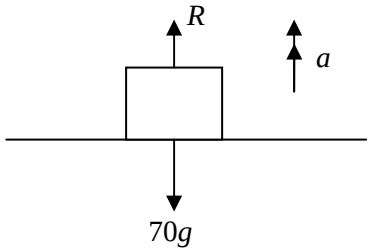
Mathematics M1 January 2012

Q	Solution	Mark	Notes
1(a)	Using $v = u + at$ with $u = 0$, $a = 0.4$, $v = 2$	M1	o.e. Complete method.
	$2 = 0 + 0.4t$	A1	
	$t = \underline{5 \text{ s}}$	A1	cao
1(b)		M1	(0, 0) to (cand's t, 2)
		A1	second correct segment
		A1	all correct, labels, units
1(c)	Total distance = area under graph	M1	used, oe
	$= 0.5(17 + 30)\times 2$	A1	any expression for correct area
	$= \underline{47 \text{ m}}$	A1	cao
1(d)			
	N2L applied to man (upwards positive)	M1	R and $70g$ opposing dimensionally correct
	$R - 70g = 70a$	A1	correct equation
	Greatest R when $a = 0.4$	m1	si
	$R = 70(9.8 + 0.4)$		
	$R = \underline{714 \text{ N}}$	A1	

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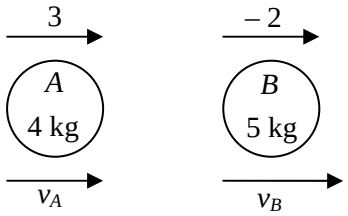
2.			
2(a)	Conservation of momentum $4 \times 3 + 5 \times (-2) = 4v_A + 5v_B$ $4v_A + 5v_B = 2$	M1 A1	attempted correct equation
	Restitution $v_B - v_A == -0.2(-2 - 3)$ $-4v_B + 4v_A = 4$ $9v_B = 6$	M1 A1 m1	attempted correct equation attempt to eliminate
	$v_B = \frac{2}{3}$	A1	cao
	$v_A = -\frac{1}{3}$	A1	cao
2(b)	Speed after collision with wall $= 0.6v_B$ $= 0.4$	M1 A1	 ft cand's v_B
	Impulse $= m_B\left(\frac{2}{3} + \frac{2}{5}\right)$	M1	
	$= \frac{16}{3}$ Ns	A1	ft candidate's speeds

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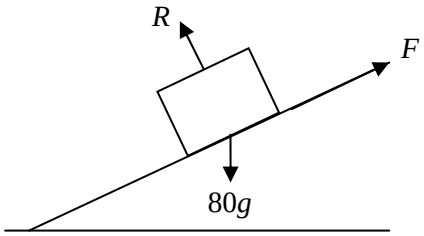
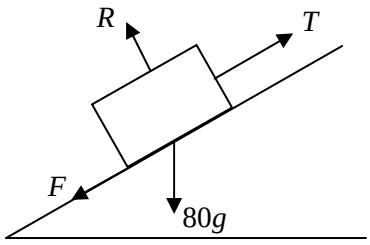
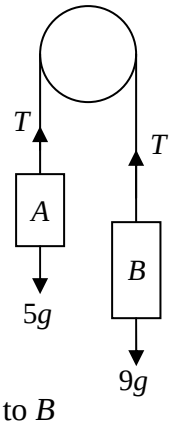
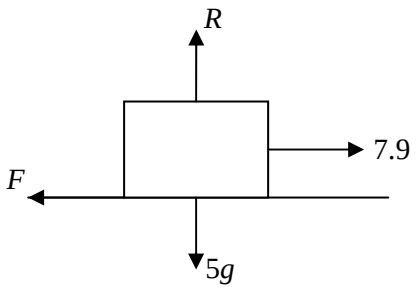
3(a)			
	Resolve perpendicular to plane $R = 80g \cos \alpha \ (=64g)$	M1 A1	dimensionally correct
3(b)	Resolve parallel to plane $F = 80g \sin \alpha \ (=48g)$	M1 A1	dimensionally correct
	$\mu = \frac{F}{R}$	m1	
	$\mu = \frac{3}{4}$	A1	cao
3(c)			
	N2L applied to body	M1	attempted. Dim correct 4 terms
	$T - F - 80g \sin \alpha = ma$ $F = \mu R$ $= 0.75 \times 64g$ $= 48g$ $T = 80 \times 0.7 + 48g + 48g$	A2	-1 each error
	$T = \underline{996.8 \text{ N}}$	A1	ft μ

Q	Solution	Mark	Notes
4(a)	Using $s = ut + 0.5at^2$ with $a = (\pm)9.8$,		
	$u = 14.7$, $s = (\pm)49$	M1	complete method
	$-49 = 14.7t - 4.9t^2$	A1	
	$t^2 - 3t - 10 = 0$		
	$(t + 2)(t - 5) = 0$		
	$t = \underline{5\text{ s}}$	A1	
4(b)	Using $v^2 = u^2 + 2as$ with $u = 14.7$,		
	$a = (\pm)9.8$, $s = (\pm)49$	M1	
	$v^2 = 14.7^2 + 2 \times 9.8 \times 49$	A1	ft t
	$v = \underline{34.3\text{ ms}^{-1}}$	A1	ft t
5(a)			
	Apply N2L to B	M1	$9g$ and T opposing, dim. correct
	$9g - T = 9a$	A1	correct equ, allow –ve a
	Apply N2L to A	M1	$5g$ and T opposing, dim. Correct
	$T - 5g = 5a$	A1	correct equ consistent With first equation
	Adding	m1	
	$14a = 4g$		
	$a = \underline{2.8\text{ ms}^{-2}}$	A1	cao
	$T = \underline{63\text{ N}}$	A1	cao
5(b)	Assuming the string to be light allows the tension throughout the string to be constant.	B1	

Q	Solution	Mark	Notes
6(a)	Resolve in 12 N direction	M1	
	$X = 12 - 16\cos 60°$	A1	
	$= 4$ N		
	Resolve in 7 N direction	M1	
	$Y = 7 - 16\cos 30°$	A1	
	Resultant = $\sqrt{(4)^2 + (-6\cdot 8565)^2}$	M1	
	$= \underline{7.938 \text{ N}}$	A1	cao
	$\theta = \tan^{-1}\left(\frac{6.8565}{4}\right)$	M1	allow other way up
	$\theta = \underline{59.74°}$	A1	ft X, Y
6(b)			
	$R = 5g$	B1	
	F == $0.1R$ ($= 0.1 \times 5 \times 9.8$)	B1	ft R
	N2L applied to particle	M1	dim correct, all forces
	$7.9 - F = 5a$		
	$a = \underline{0.60 \text{ ms}^{-2}}$	A1	cao

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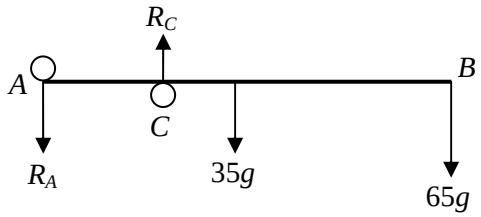
7.			
7(a)	Moment of weight of rod about A $= 35g \times 2$ $= \underline{686 \text{ Nm}}$	 B1 B1	correct expression
7(b)	Take moments about A $R_C \times 1.2 = 35g \times 2 + 65g \times 4$ $R_C = 275g$ $= \underline{2695 \text{ N}}$ Resolve vertically $R_C = R_A + 35g + 65g$ $R_A = 275g - 100g$ $= 175g$ $= \underline{1715 \text{ N}}$	M1 A1 A1 M1 A1 A1	dim correct equation, all forces dim correct equation, all forces
8	Area from AD from AB ABCD 6 1.5 1 $PQRS$ 1 2 1 Lamina 7 x y $y = 1$ Moments about AD $6 \times 1.5 + 1 \times 2 = 7x$ $9 + 2 = 7x$ $x = \frac{11}{7}$	 B1 B1 B1 B1 M1 A1 A1	 c of m of $ABCD$ c of m of $PQRS$ all areas (7 and +) or (5 and -) ft table cao