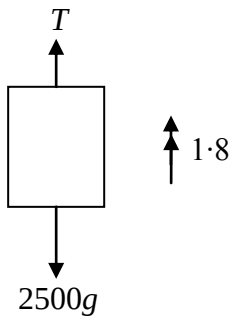
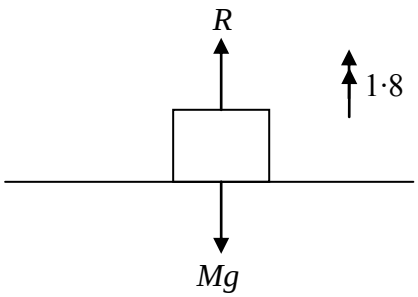
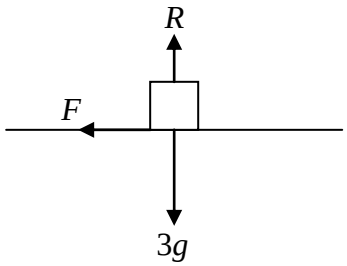
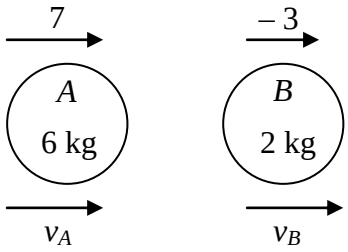
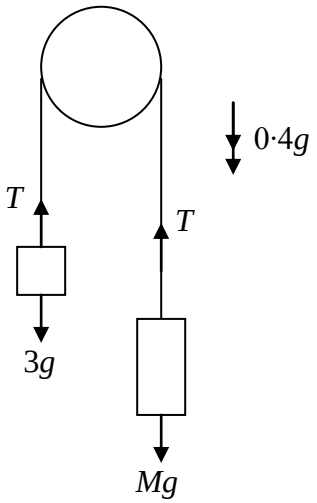
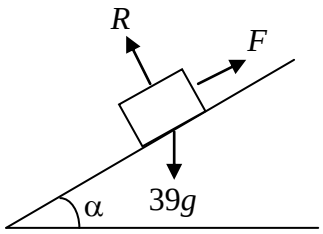
M1

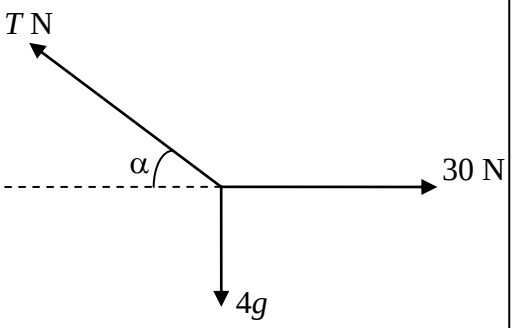
Q	Solution	Mark	Notes
1(a).			
	N2L dim correct equation attempted	M1	T, 2500g opposing
	T – 2500g = 2500 × a	A1	Any form correct equ.
	T = 2500(9.8 + 1.8)		
	T = <u>29000 (N)</u>	A1	cao
1(b)			
	N2L attempted	M1	R, Mg opposing, no extra forces
	R – Mg = Ma	A1	Any form correct equ.
	696 = M(9.8 + 1.8)		
	M = <u>60 (kg)</u>	A1	cao

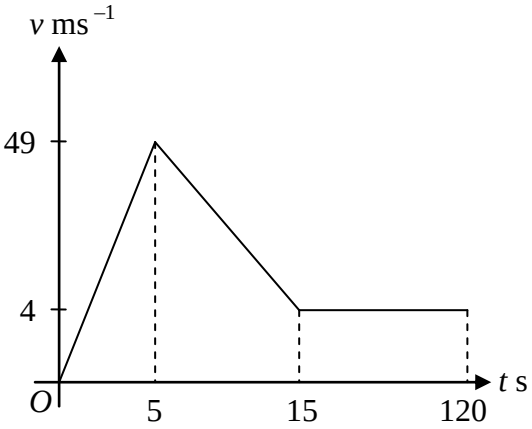
Q	Solution	Mark	Notes
2(a).			
	Resolve vertically R = 3g	B1	May be implied
	$F = \mu R = \frac{6}{49} \times 3 \times 9 \cdot 8$		
	F = 3.6 (N)	B1	
	N2L F = ma	M1	used
	±3.6 = 3a		
	a = -1.2 (ms^{-2})	A1	needs to see -
2(b)	Using $v^2 = u^2 + 2as$ with u=9, v=0,a=(-)1.2	M1	allow sign errors, oe
	$0 = 9^2 + 2 \times (-1.2)\ s$	A1	
	s = 33.75 (m)	A1	allow -33.75

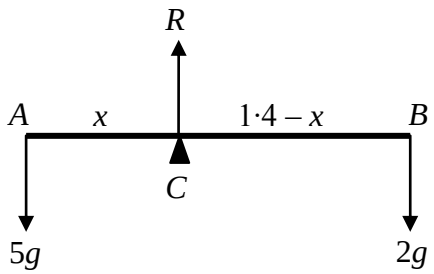
Q	Solution	Mark	Notes
3.			
3(a)	Conservation of momentum $6 \times 7 + 2 \times (-3) = 6v_A + 2v_B$ $v_B = 2\,v_A$ $42 - 6 = 6v_A + 2 \times 2v_A$ $36 = 10\,v_A$ $v_A = 3.6$ $v_B = \underline{7.2\ (ms^{-1})}$	M1 A1 m1 A1	dim correct equation used
3(b)	Restitution equation $7.2 - 3.6 = -e(-3 - 7)$ $3.6 = 10e$ $e = \underline{0.36}$	M1 A1 A1	attempted, ft c's vs, e on correct side. No more than one sign error. cao
3(c)	$I = 2 \times 7.2 - 2 \times (-3)$ $I = 14.4 + 6$ $I = \underline{20.4\ (Ns)}$	M1 A1	allow 6(7-3.6) cao

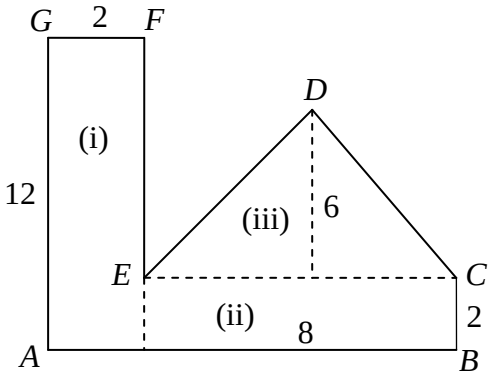
Q	Solution	Mark	Notes
4.			
	Apply N2L to B Mg – T = Ma	M1 A1	dim correct equation
	Apply N2L to A T – 3g = 3a	M1 A1	dim correct equation
	Adding Mg – 3g = 0.4g(M + 3) M – 3 = 0.4M + 1.2 0.6M = 4.2 M = 7	m1 A1	correct method. dep on both M's cao
	T = 3 × 9.8 + 3 × 0.4 × 9.8 T = 41.16 (N)	 A1	 cao
	Alternative solution Apply N2L to A T – 3g = 3a T = 3(9.8 + 0.4 × 9.8) T = 41.16 (N)	 M1 A1 A1	 dim. correct equation cao
	Apply N2L to B Mg – T = Ma 9.8M – 0.4 × 9.8M = 41.16 5.88M = 41.16 M = 7	M1 A1 m1 A1	dim correct equation cao

Q	Solution	Mark	Notes
5.			
5(a)	Resolve perp to plane $R = 39g\cos\alpha$ $R = 39 \times 9 \cdot 8 \times \frac{12}{13} = 352.8$ N $F = \mu R$ $F = 0.3 \times 352.8$ $F = 105.84$ N	M1 m1 A1	allow sin or cos si
	N2L down slope $39g\sin\alpha - F = 39a$ $39 \times 9 \cdot 8 \times \frac{5}{13} - 105 \cdot 84 = 39a$ $a = 1.0554$ $a = \underline{1.06\ (ms^{-2})}$	M1 A1 A1	dim correct equation, -F
5(b)	N2L up slope $T - 39g\sin\alpha - F = 39a$ $T = 147 + 105.84 + 39 \times 0.4$ $T = \underline{268.44\ (N)}$	M1 A1 A1	dim correct equation, all forces, sin/cos, -F cao

Q	Solution	Mark	Notes
6.			
	Resolve vertically $T\sin\alpha = 4g$	M1 A1	
	Resolve horizontally $T\cos\alpha = 30$	M1 A1	
	Dividing $\tan\alpha = \frac{4 \times 9 \cdot 8}{30}$ $\alpha = \underline{52.5(7)°}$	 m1 A1	 dep on both M's cao
	$T^2 = (4 \times 9.8)^2 + (30)^2$ $T = \underline{49.36\ (N)}$	m1 A1	 cao

Q	Solution	Mark	Notes
7(a)	Using v = u + at with u=0, a=(±)9.8, t=5	M1	
	v = 0 + 9.8 × 5	A1	
	v = <u>49 (ms^{-1})</u>	A1	accept -49
7(b)			
		B1	units, labels and correct shape starting (0,0)
		B1	(0, 0) to (5, v)
		B1	(5, v) to (15, 4)
		B1	(15, 4) to (120, 4)
7(c)	Distance = Area under graph	M1	oe
	Distance = 0.5 × 5 ×49 + 0.5(4 + 49) ×10 + 105 × 4	B1	any one correct area, ft graph
	Distance = 122.5 + 265 + 420		
	Distance = <u>807.5 (m)</u>	A1	ft graph

Q	Solution	Mark	Notes
8.			
8(a)	Resolve vertically R = 5g + 2g R = <u>7g (N)</u>	M1 A1	
8(b)	Moments about C 5gx = 2g(1.4 – x) 5x = 2.8 – 2x 7x = 2.8 x = 0.4 AC = <u>0.4 (m)</u> <u>Alternative solution</u> Moments about A 7gx = 2g × 1.4 x = <u>0.4 (m)</u>	M1 A1 A1 A1 M1 A1 A1 A1 SC1	dim correct equation, no extra forces rhs correct lhs correct cao dim correct equation rhs correct lhs correct cao No marks at all, one correct moment, sc1.

Q	Solution	Mark	Notes
9.			
9(a)	Area from AG from AB		
	(i) 24 1 6	B1	correct distances
	(ii) 12 5 1	B1	correct distances
	(iii) 18 5 4	B1	correct distances
	Lamina 54 x y	B1	areas all correct
	Moments about AG	M1	
	$54x = 24 \times 1 + 12 \times 5 + 18 \times 5$	A1	ft table if 2 or more B marks for distances gained.
	$x = \frac{29}{9} = 3.22$	A1	cao
	Moments about AB	M1	
	$54y = 24 \times 6 + 12 \times 1 + 18 \times 4$	A1	ft table
	$y = \frac{38}{9} = 4.22$	A1	cao
9(b)	$\theta = \tan^{-1}\left(\frac{x}{12-y}\right)$	M1	correct triangle
	$= \tan^{-1}\left(\frac{29}{12\times 9 - 38}\right)$	A1	correct equation, ft x, y
	$\theta = \underline{22.5°}$	A1	ft x and y