Mathematics M1 January 2013

Solutions and Mark Scheme

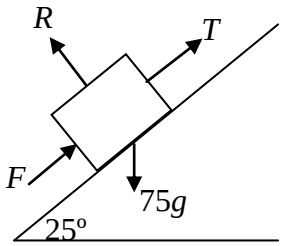
Final Version

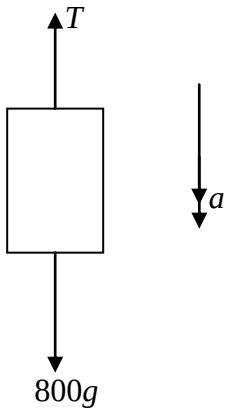
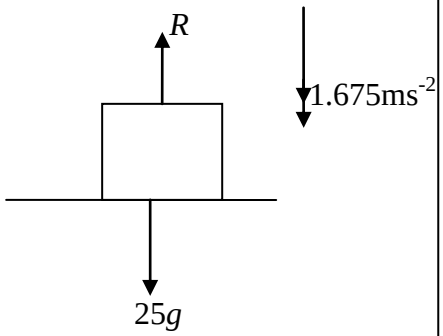
Q	Solution	Mark	Notes
1(a).	Using $v = u + at$ with $u=12$, $v=32$, $t=4$	M1	o.e.
	$32 = 12 + 4a$	A1	
	$a = \underline{5\ ms^{-2}}$	A1	cao
1(b)	Using $s = ut + 0.5at^2$, $u=12$,$t=4$, $a=5$	M1	
	$s = 12x\ 4 + 0.\ 5x\ 5\ x\ 4^2$	A1	
	$s = \underline{88\ m}$	A1	cao
	OR		
	Using $v^2 = u^2 + 2as$, $u=12$, $v=32$, $a=5$	M1	
	$32^2 = 12^2 + 2\ x\ 5s$	A1	
	$s = \underline{88\ m}$	A1	cao
	OR		
	Using $s = 0.5(u + v)t$, $u=12$, $v=32$, $t=4$	M1	
	$s = 0.5(12 + 32)\ x\ 4$	A1	
	$s = \underline{88m}$	A1	cao
1(c)	Using $v^2 = u^2 + 2as$, $u=12$, $a=5$, $s=44$	M1	ft answer in (b) for s
	$v^2 = 12^2 + 2\ x\ 5\ x\ 44$	A1	ft (b)
	$v = \underline{24.2\ ms^{-1}}$	A1	ft (b)

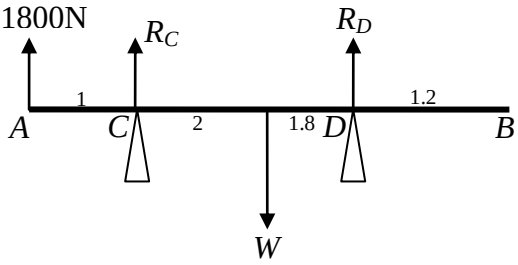
Q	Solution	Mark	Notes
2(a)(i)	e = 0	B1	
2(a)(ii)	Conservation of momentum equation $3 \times 4 + 7 \times 0 = 3v_A + 7v_B$ $12 = 10v$ $v = \underline{1.2\ ms^{-1}}$	M1 A1 A1	zero term not required $v = v_A = v_B$
2(b)(i)	$v' = 0.25 \times 5$ $v' = \underline{1.25}$	M1 A1	
2(b)(ii)	$I = 6(5 + 1.25)$ $I = \underline{37.5}$ Units for I is Ns	M1 A1 B1	allow –I Ft answer in (b(i)) allow dimensions $kgms^{-1}$

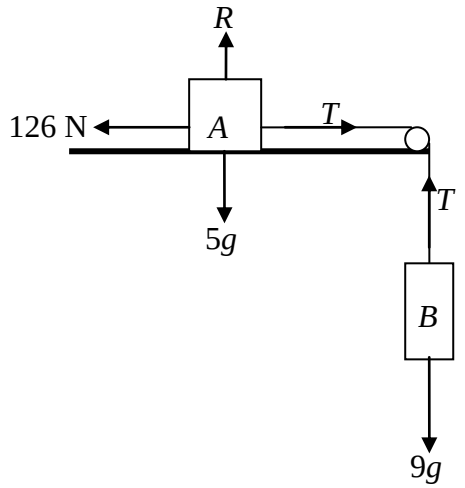
Q	Solution	Mark	Notes
3(a)	$s = ut + 0.5at^2$, $s=(\pm)1.2$, $a=(\pm)9.8$, $u=15$	M1	complete method
	$-1.2 = 15t + 0.5 \times (-9.8)t^2$	A1	
	$4.9t^2 - 15t - 1.2 = 0$		
	Use of correct formula to solve quad eq	m1	
	$t = 3.139$		
	$t =$ <u>3.1 s (to one d. p.)</u>	A1	
3(b)	For the model used, the time taken for the particle to reach the ground is independent of the weight of the particle. I would expect the time to be the same as that in (a).	E1	no reason given gets E0

Q	Solution	Mark	Notes
4.	Resolve in direction of 12 N $P\sin45 + Q\sin30 = 12$	M1 A1	equation required
	Resolve in direction of 8N $P\cos45 = Q\cos30 + 8$	M1 A1	equation required
	Attempt to eliminate one variable $Q(\sin30 + \cos30) = 4$ $Q = \frac{8}{1+\sqrt{3}} = 2.928$	m1	sensible method
	$Q = \underline{2.9\ N}$	A1	
	$\frac{1}{\sqrt{2}} P = 12 - 0.5 \times Q$		
	$P = \underline{14.9\ N}$	A1 PA-1	if coefficients approximated

Q	Solution	Mark	Notes
5.			
5(a)	Resolve perp. to plane		
	$R = 75g \cos \alpha$	M1	
	$F = \mu R$	M1	used
	$F = 0.3 \times 75 \times 9.8 \cos 25°$	A1	
	$F = 199.84$ N		
	N2L parallel to plane	M1	dim correct, all forces eq Allow –F, 75a on RHS
	$T + F - 75g \sin 25° = 0$	A1	
	$T = 75 \times 9.8 \times \sin 25° - 199.84$		
	$T = \underline{110.78 \text{ N}}$	A1	cao
5(b)	N2L parallel to plane	M1	dim correct eq Comp wt and F opposing
	$75g \sin 25° - F = 75a$	A1	
	$75a = 75 \times 9.8 \times \sin 25° - 199.84$		
	$a = \underline{1.48 \text{ ms}^{-2}}$	A1	Ft T in (a), allow consistent –ve ans

Q	Solution	Mark	Notes
6(a).			
	Apply N2L to lift 800g – T = 800a 800a = 800 x 9.8 – 6500 a = <u>1.675 ms^{-2}</u>	M1 A1 A1	dim correct, ±(T-800g) allow 1.68
6(b)			
	Apply N2l to parcel 25g – R = 25a R = 25 x 9.8 – 25 x 1.675 R = <u>203.125 N</u>	M1 A1 A1	dim correct ±(25g-R) ft (a) ft (a)

Q	Solution	Mark	Notes
7.			
7(a)	When beam about to tilt about D, R_C=0	B1	
	Moments about D	M1	equation required (or 2 equations)
		B1	correct moment
	1800 x (6 – 1.2) + (R_C x 3.8) = W x 1.8	A1	correct equation (or 2 correct equations)
	W = <u>4800 N</u>	A1	cao
7(b)	Moments about C	M1	dim correct equation
	R_D x 3.8 = 4800 x 2	A1	ft W
	R_D = <u>2526.32 N</u>	A1	ft W
	Resolve vertically		
	$R_C + R_D$ = 4800	M1	
	R_C = <u>2273.68 N</u>	A1	ft W

Q	Solution	Mark	Notes
8.			
	Apply N2L to particle A/B 126 – T = 5a	M1 A1	dim correct correct eq allow ±a
	Apply N2L to B/A T – 9g = 9a	M1 A1	dim correct consistent with 1st eq
	Eliminating T a = $\underline{2.7\ ms^{-2}}$ T = $\underline{112.5\ N}$	m1 A1 A1	reasonable method cao allow – if correct cao

Q	Solution	Mark	Notes
9(a)	shape Area fr AD fr AB		
	ABCD 30 2.5 3	B1	one correct row/column
	XYZ 1.5 3.5 2	B1	c of m all correct
	Lamina 28.5 x y	B1	correct areas
	Moments about AD	M1	equation required
	$28.5x + 1.5 \times 3.5 = 30 \times 2.5$	A1	Ft table
	$x = \frac{93}{38} = \underline{2.447}$	A1	cao
	Moments about AB	M1	equation required
	$28.5y + 1.5 \times 2 = 30 \times 3$	A1	Ft table
	$y = \frac{58}{19} = \underline{3.053}$	A1	cao
9(b)	$\theta = \tan^{-1}\left(\frac{116}{93}\right) = \tan^{-1}\left(\frac{3.053}{2.447}\right)$	M1	correct triangle
		A1	ft (a) correct values
	$\theta = \underline{51.3°}$	A1	ft (a) PA-1 if 1 dp used
9(c)	$DP = \frac{93}{38} = \underline{2.447}$	B1	Ft x