

Mathematics M1 January 2013

Solutions and Mark Scheme

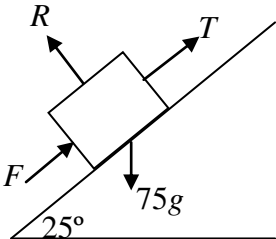
Final Version

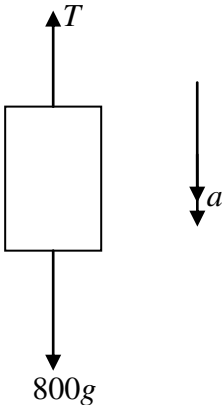
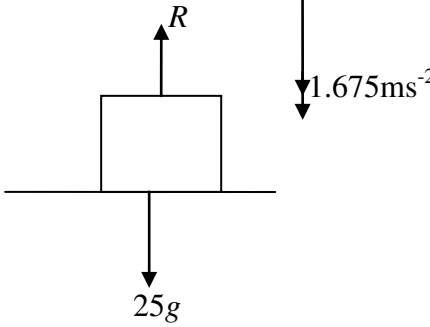
Q	Solution	Mark	Notes
1(a).	Using $v = u + at$ with $u=12$, $v=32$, $t=4$ $32 = 12 + 4a$ $a = \underline{5 \text{ ms}^{-2}}$	M1 A1 A1	o.e. cao
1(b)	Using $s = ut + 0.5at^2$, $u=12$, $t=4$, $a=5$ $s = 12 \times 4 + 0.5 \times 5 \times 4^2$ $s = \underline{88 \text{ m}}$ OR Using $v^2 = u^2 + 2as$, $u=12$,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

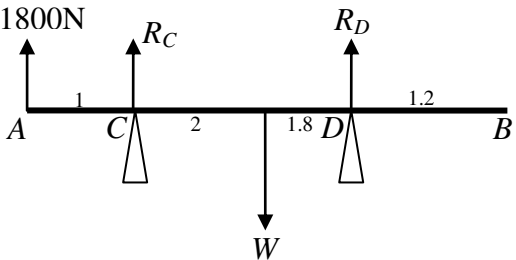
Q	Solution	Mark	Notes
2(a)(i)	$e = 0$	B1	
2(a)(ii)	Conservation of momentum equation $3 \times 4 + 7 \times 0 = 3v_A + 7v_B$ $12 = 10v$ $v = \underline{1.2 \text{ ms}^{-1}}$	M1 A1 A1	zero term not required $v = v_A = v_B$
2(b)(i)	$v' = 0.25 \times 5$ $v' = \underline{1.25}$	M1 A1	
2(b)(ii)	$I = 6(5 +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

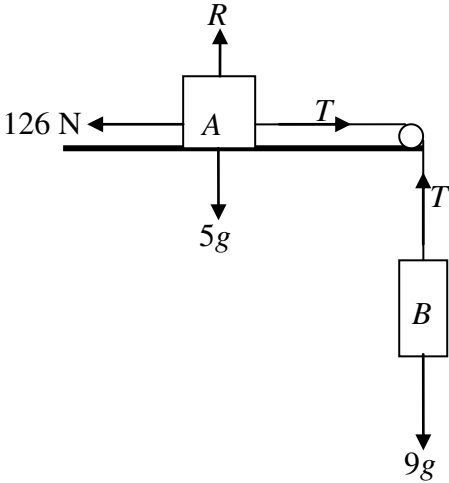
Q	Solution	Mark	Notes
3(a)	$s = ut + 0.5at^2$, $s=(\pm)1.2$, $a=(\pm)9.8$, $u=15$ $-1.2 = 15t + 0.5 \times (-9.8)t^2$ $4.9t^2 - 15t - 1.2 = 0$ Use of correct formula to solve quad eq $t = 3.139$ $t = \underline{3.1 \text{ s (to one d. p.)}}$	M1 A1 m1 A1	complete method
3(b)	For the model used, the time 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 $P\sin 45 + Q\sin 30 = 12$ Resolve in direction of 8N $P\cos 45 = Q\cos 30 + 8$ Attempt to eliminate one variable $Q(\sin 30 + \cos 30) = 4$ $Q = \frac{8}{1 + \sqrt{3}} = 2.928$ $Q = \underline{2.9 \text{ N}}$ $\frac{1}{\sqrt{2}}P = 12 - 0.5 \times Q$ $P = \underline{14.9 \text{ N}}$	M1 A1 M1 A1 m1 A1 A1 PA-1	equation required equation required sensible method if coefficients approximated

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

Q	Solution	Mark	Notes
6(a).	 Apply N2L to lift $800g - T = 800a$ $800a = 800 \times 9.8 - 6500$ $a = \underline{1.675 \text{ ms}^{-2}}$	M1 A1 A1	dim correct, $\pm(T-800g)$ allow 1.68
6(b)	 Apply N2l to parcel $25g - R = 25a$ $R = 25 \times 9.8 - 25 \times 1.675$ $R = \underline{203.125 \text{ N}}$	M1 A1 A1	dim correct $\pm(25g-R)$ ft (a) ft (a)

Q	Solution	Mark	Notes
7.			
7(a)	When beam about to tilt about D, $R_C=0$ Moments about D $1800 \times (6 - 1.2) + (R_C \times 3.8) = W \times 1.8$ $W = \underline{4800 \text{ N}}$	B1 M1 B1 A1 A1	equation required (or 2 equations) correct moment correct equation (or 2 correct equations) cao
7(b)	Moments about C $R_D \times 3.8 = 4800 \times 2$ $R_D = \underline{2526.32 \text{ N}}$ Resolve vertically $R_C + R_D = 4800$ $R_C = \underline{2273.68 \text{ N}}$	M1 A1 A1 M1 A1	dim correct equation ft W ft W ft W

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

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