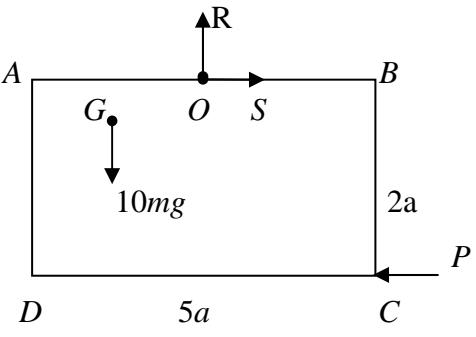


Question Number	Scheme	Marks
1. (a)	$T = \frac{10000}{20}$ or equivalent $T - R - 400 \text{ g sin } \theta = 0$ $R = 220$	M1 A1 M1 A1 A1 (5 marks)
2. (a)	$\mathbf{a} = 2\mathbf{i} - 6\mathbf{j}$ $t = 4: \mathbf{a} = 8\mathbf{i} - 6\mathbf{j}$ $ \mathbf{F} = 0.75 \sqrt{(8^2 + 6^2)} = 7.5\text{N}$	M1 dep. M1 M1 M1 A1 (5)
(b)	$\mathbf{I} = 9\mathbf{i} - 9\mathbf{j}$ $9\mathbf{i} - 9\mathbf{j} = \frac{3}{4}(\mathbf{v} - (27\mathbf{i} - 30\mathbf{j}))$ $\mathbf{v} = 39\mathbf{i} - 42\mathbf{j} \text{ m s}^{-1}$	B1 M1 A1 f.t. A1 (4) (9 marks)
3. (a)	$\frac{1}{2} \times 2 \times 10^2 - \frac{1}{2} \times 2 \times v^2 = 2g \sin 30^\circ$ $v = 8.4 \text{ m s}^{-1}$ (8.40 m s ⁻¹) Or $(a = -g \sin 30^\circ)$ $v^2 = 10^2 - 2g \sin 30^\circ \times 3$ $v = 8.4 \text{ m s}^{-1}$ (8.40 m s ⁻¹)	M1 A1 A1 A1 (4) M1 A1 A1 A1 (4)
(b)	$R = 2g \cos 30^\circ$ $3F; \frac{1}{2} \times 2 \times 10^2 - \frac{1}{2} \times 2 \times 7^2; 2g \times 3 \sin 30^\circ$ $3\mu R = \frac{1}{2} \times 2 \times 10^2 - \frac{1}{2} \times 2 \times 7^2 - 2g \times 3 \sin 30^\circ$ $\mu = 0.42(4)$ OR $R = 2g \cos 30^\circ$ $a = \frac{(7^2 - 10^2)}{2 \times 3} = \frac{17}{2}; -F; -2g \sin 30^\circ$ $-\mu R - 2g \sin 30^\circ = -\frac{17}{2} \times 2$ $\mu = 0.42(4)$	B2 (-1 e.e.o.o) M1 A1 (5) B1 B2 (-1 e.e.o.o) M1 A1 (5) (9 marks)

Question Number	Scheme	Marks
4. (a)	$M(B), N 2a \cos \theta = W a \cos \theta + \frac{1}{4} W \frac{3a}{2} \sin \theta$	M1 A2 (-1 e.e.)
	$N = \frac{7W}{8}$	dep. M1 A1 (5)
	$R = \frac{1}{4} W; F + N = W$	B1; B1
(b)	$F \leq \mu R$ or $F = \mu R$	M1
	$\frac{1}{2} \leq \mu *$ (exact)	A1 c.s.o. (5)
	It does not bend Or has negligible thickness	B1 (1)
		(10 marks)
5. (a)	$2ut = 735$	M1 A1
	$0 = 3ut - \frac{1}{2} gt^2$	M1 A1
	eliminating t	dep. M1
(b)	$u = 24.5 *$	A1 (6)
	$t = \frac{735}{49} = 15$	M1 A1 (2)
	Initially: $v^2 = (2u)^2 + (3u)^2$ (7803.25)	M1
(c)	$\frac{1}{2} mv^2 - \frac{1}{2} m 65^2 = mgh$	M1 A1
	$h = 180 \text{ m}$ (183 m)	A1 (4)
	OR $v_y^2 = 65^2 - (2u)^2$ (1824)	M1
	$v_y^2 = (3u)^2 - 2gh$	M1 A1
	$h = 180 \text{ m}$ (183 m)	A1 (4)
	(12 marks)	

(ft = follow through mark; cao = correct answer only; (*) indicates final line is given on the paper)

Question Number	Scheme	Marks
6. (a)	$u \rightarrow \rightarrow 0$ CLM: $mu = mv_1 + 3mv_2$ $m \quad 3m$ NIL: $eu = -v_1 + v_2$ $v_1 \rightarrow \quad v_2 \rightarrow$ solving, $v_2 = \frac{u}{4}(1+e)^*$	B1 M1 A1 dep. M1 A1 (5)
(b)	Solving for v_1 ; $\left \frac{u}{4}(1-3e) \right $	M1 A1 (2)
(c)	$\frac{1}{2}m\frac{u^2}{16}(1-3e)^2 + \frac{1}{2}3m\frac{u^2}{16}(1+e)^2 = \frac{1}{6}mu^2$ $e^2 = \frac{1}{9}$ $e = \frac{1}{3}$	M1 A1 f.t. A1 dep. M1 A1 A1 (6)
(d)	$v_1 = \frac{u}{4}(1-3 \times \frac{1}{3}) = 0 \Rightarrow$ at rest.	A1 c.s.o. (1)
		(14 marks)

Question Number	Scheme	Marks
7. (a)	$AD: 10m\bar{x} = 3m \frac{5a}{2} + 3m \times 5a$ $\bar{x} = 2.25a *$	M1 A1 A1 (3)
(b)	$AB: 10m\bar{y} = 2m \times 2a + 3m \times a$ $\bar{y} = 0.7a$	M1 A1 (2)
(c)	$\tan \theta = \frac{2.5a - \bar{x}}{\bar{y}}$ $\theta = 20^\circ$	M1 A1 f.t. A1 (3)
		
	$M(0), 10mg \times \frac{a}{4} = P \times 2a$ (OR: $4mg \times \frac{5a}{2} - 3mg \times \frac{5a}{2} = P \times 2a$)	M1 A1 A1
	$P = \frac{5mg}{4} *$ (exact)	A1 (4)
(e)	$S = \frac{5mg}{4}; R = 10mg$ $F = \sqrt{S^2 + R^2} = \frac{5mg\sqrt{65}}{4}$ (10.1 mg)	B1; B1 M1 A1 (4)
		(16 marks)