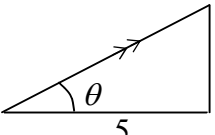
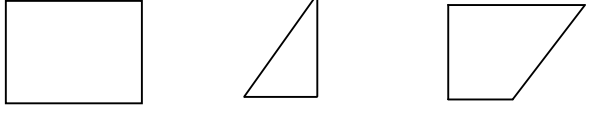
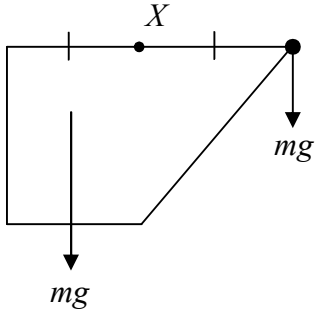
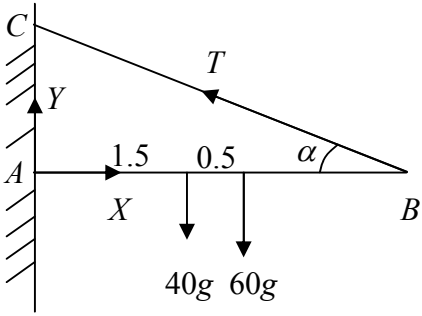
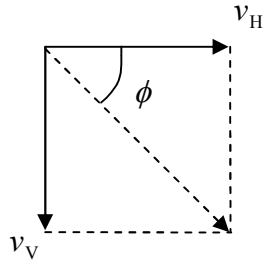
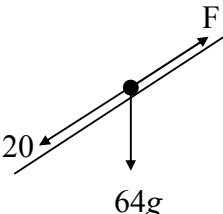
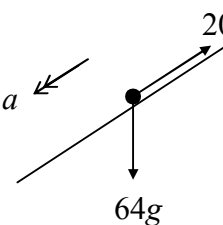
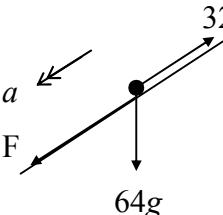


Question Number	Scheme	Marks
1. (a)	$x = \int 6t - 2t^2 \, dx$ $= 3t^2 - \frac{2}{3}t^3$ $v = 0 \Rightarrow 6t - 2t^2 = 0 \Rightarrow t = 3 \text{ (or 0)}$ $t = 3: x = (3 \times 9) - (\frac{2}{3} \times 27) = 9 \text{ m}$	M1 A1 M1 M1 A1 <p style="text-align: right;">(5 marks)</p>
2. (a)	$\mathbf{I} = 0.2[(15\mathbf{i} + 15\mathbf{j}) - (-10\mathbf{i})]$ $= 5\mathbf{i} + 3\mathbf{j}$ $ \mathbf{I} = \sqrt{5^2 + 3^2} = \sqrt{34} = 5.8 \text{ N s}$	M1 M1 M1 A1 (4)
(b)	 $\tan \theta = \frac{3}{5} \Rightarrow \theta = 31^\circ \text{ (nearest degree)}$	M1 A1 (2)
(c)	$\text{K E Gain} = \frac{1}{2} \times 0.2[(15^2 + 15^2) - 10^2] = 35 \text{ J}$	M1 A1 (2)
3. (a)	 <p>Area: $6a^2$ a^2 $5a^2$ (ratio)</p> <p>CM from AD: $\frac{3a}{2}$ $(2a + \frac{2a}{3}) = \frac{8a}{3}$ \bar{x}</p> $6 \times \frac{3a}{2} - 1 \times \frac{8a}{3} = 5\bar{x}$ $\bar{x} = \frac{19a}{15}$	B1 B1 B1 M1 A1 (5)
(b)	 <p>M(X),</p> $Mg\left(\frac{3a}{2} - \frac{19a}{15}\right) = mg \times \frac{3a}{2}$ $\Rightarrow m = \frac{7M}{45}$	M1 A1 ft A1 A1 (4)
(9 marks)		

(ft = follow through mark)

Question Number	Scheme	Marks
<p>4. (a)</p> 	<p>M(A), $40g \times \frac{3}{2} + 60g \times 2 = T \sin \alpha \times 3$ use of $\sin \alpha = \frac{3}{5}$ $60g + 120g = \frac{9T}{5}$ $\Rightarrow T = 100g = 980 \text{ N (*)}$</p> <p>(b) ($\rightarrow$): $X = T \cos \alpha$ (\uparrow) $Y + T \sin \alpha = 100g$ $R = \sqrt{(X^2 + Y^2)} = \sqrt{(784^2 + 392^2)}$ $= 877 \text{ N (3 sf)}$</p> <p>(c) Cable light \Rightarrow tension same throughout \Rightarrow force on rod at D is $60g$</p>	<p>M1 A2, 1, 0 B1 A1 (5) B1 M1 A1 M1 A1 A1 (6) B1 (1) (12 marks)</p>
<p>5. (a)</p>	<p>(\rightarrow): $u \cos \alpha \times T = 8$ $u \times \frac{4}{5} \times T = 8$ $uT = 10 (*)$</p> <p>(b) (\uparrow): $-4 = u \sin \alpha T - \frac{1}{2} g T^2$ $-4 = u \times \frac{3}{5} \left(\frac{10}{u}\right) - \frac{1}{2} \times 9.8 \left(\frac{10}{u}\right)^2$ $u = 7$</p>  <p>$v_H = u \cos \alpha = \frac{28}{5}$ $v_V^2 = (-u \sin \alpha)^2 + 2g \times 4$ $\Rightarrow v_V = 9.8 (= \frac{49}{5})$ $\tan \phi = \frac{49/5}{28/5} = \frac{7}{4}$</p>	<p>M1 A1 (2) M1 A1 M1 M1 A1 (7) B1 ft M1 A1 ft M1 A1 cao (5) (12 marks)</p>

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

Question Number	Scheme	Marks
6. (a)	 $(\nearrow): F = 20 + 64g \sin \alpha$ $= 64.8 \text{ N}$ $P = Fv = 64.8 \times 5 = 324 \text{ W}$	M1 A1 M1 A1 (4)
6. (b)	 $(\searrow): 64g \sin \alpha - 20 = 64a$ $a = 0.3875 \text{ m s}^{-2}$ $v^2 = 5^2 + 2 \times 0.3875 \times 80$ $v = \sqrt{87} = 9.3 \text{ m s}^{-1} \quad (2 \text{ sf})$	M1 A1 A1 M1 A1 (5)
6. (c)	$\frac{8}{5} \times 20 = 32 \text{ N}$	B1 (1)
6. (d)	 $F = \frac{200}{8}$ $\frac{200}{8} + 64g \sin \alpha - 32 = 64a$ $a = 0.59 \text{ m s}^{-2} \quad (2 \text{ sf})$	B1 M1 A1 A1 (4) (14 marks)

Question Number	Scheme	Marks
7. (a)	$u \rightarrow \quad \rightarrow 0 \quad \quad \quad mu = mv_1 + 2mv_2$ $A \begin{array}{c} \textcircled{m} \\ \rightarrow \\ v_1 \end{array} e \begin{array}{c} \textcircled{2m} \\ \rightarrow \\ v_2 \end{array} B \quad \quad \quad eu = -v_1 + v_2$ $v_1 = \frac{u}{3}(1 - 2e); \quad v_2 = \frac{u}{3}(1 + e)$	M1 A1 M1 A1 M1 A1 A1 (7)
(b)	$v_1 > 0 \Rightarrow \frac{u}{3}(1 - 2e) > 0 \Rightarrow e < \frac{1}{2}$	M1 A1 (2)
(c)	$v_2 \rightarrow \quad \rightarrow 0 \quad \quad \quad 2mv_2 = 2mv_3 + 4mv_4$ $A \begin{array}{c} \textcircled{2m} \\ \rightarrow \\ v_3 \end{array} \quad \begin{array}{c} \textcircled{4m} \\ \rightarrow \\ v_4 \end{array} B \quad \quad \quad ev_2 = -v_3 + v_4$ $v_3 = \frac{v_2}{3}(1 - 2e) = \frac{u}{9}(1 - 2e)(1 + e)$	M1 M1 A1
	Further collision if $v_1 > v_3$	
	$\text{i.e. if } \frac{u}{3}(1 - 2e) > \frac{u}{9}(1 - 2e)(1 + e)$	M1
	$\text{i.e. if } 3 > 1 + e \text{ (as } (1 - 2e) > 0)$	
	$\text{i.e. if } 2 > e$	M1
	which is always true, so further collision occurs	A1 cso (6)
		(15 marks)

(cso = correct solution only)