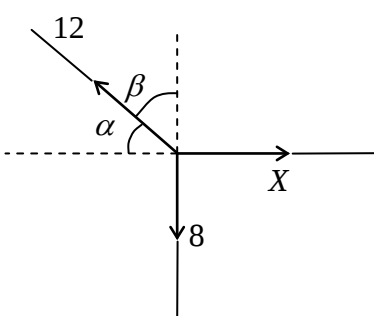
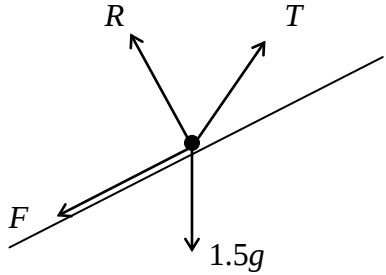
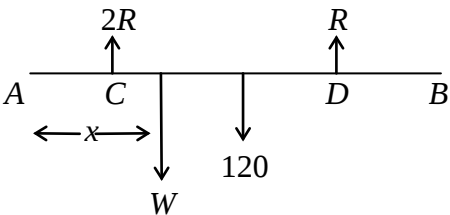
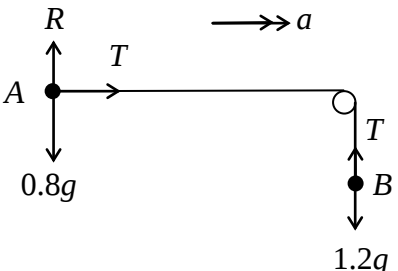
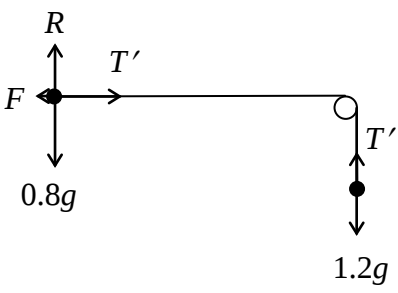


Question Number	Scheme	Marks
1.	(a) CLM: $2000 \times 10 = 2000v + 3000 \times 5$ $v = 2.5 \text{ m s}^{-1}$ (b) $I = 3000 \times 5$ (or $2000(10 - 2.5)$) $= 15\,000 \text{ N s}$	M1, A1 B1 (3) M1 A1 (2) (5 marks)
2.	 $R(\uparrow) \quad 8 = 12 \cos \beta \text{ or } 12 \sin \alpha$ $\Rightarrow \beta = 41.8^\circ \text{ or } \alpha = 48.2^\circ$ $\Rightarrow \theta = 138.2^\circ$ (b) $R(\rightarrow) \quad X = 12 \cos 41.8^\circ$ (or $12 \sin 48.2^\circ$) $= 8.94$	M1 A1 A1 (3) M1 A1ft A1 (3) (6 marks)
3.	(a) $\mathbf{a} = [-14\mathbf{i} + 21\mathbf{j} - (6\mathbf{i} - 27\mathbf{j})] \div 4$ $= (-5\mathbf{i} + 12\mathbf{j}) \text{ m s}^{-2}$ (b) $\mathbf{a} = \sqrt{5^2 + 12^2} = 13$ $\mathbf{F} = m \mathbf{a} = 0.4 \times 13 = 5.2 \text{ N}$	M1 A1 A1 (3) M1 M1 A1 (3) (6 marks)
Alt (b)	$\mathbf{F} = 0.4(5\mathbf{i} + 12\mathbf{j}) = 2\mathbf{i} + 4.8\mathbf{j}$ $\mathbf{F} = \sqrt{2^2 + 4.8^2} = 5.2 \text{ N}$	M1 M1 A1 (3)

Question Number	Scheme	Marks
4.	(a) $\mathbf{p} = 10t\mathbf{j}$ $\mathbf{q} = (6\mathbf{i} + 12\mathbf{j}) + (-8\mathbf{i} + 6\mathbf{j})t$ (b) $t = 3: \mathbf{p} = 30\mathbf{j}, \mathbf{q} = -18\mathbf{i} + 30\mathbf{j}$ $\Rightarrow$ dist. apart = 18 km Alt. (b) $\mathbf{PQ} = \mathbf{q} - \mathbf{p} = (6 - 8t)\mathbf{i} + (12 - 4t)\mathbf{j}$ $t = 3: \mathbf{PQ} = -18\mathbf{i} + 0\mathbf{j}$ Dist. = 18 km (c) Q north of P $\Rightarrow 6 - 8t = 0$ $t = \frac{3}{4}$ or $\mathbf{PQ} ^2 = (6 - 8t)^2 + (12 - 4t)^2$ $t = 3 \rightarrow \mathbf{PQ} = 18$	B1 M1 A1 (3) M1 A1 A1 (3) M1 A1 A1 M1 A1 (2) (8 marks)
5.	 R($\nearrow$): $T \cos 20^\circ = F + 1.5g \sin 30^\circ$ R($\nwarrow$): $T \sin 20^\circ + R = 1.5g \cos 30^\circ$ Using $F = \frac{1}{3}R$ Eliminating R, solve T $T = 11$ or 11.0 N	M1 A2,1,0 M1 A2,1,0 M1 M1, M1 A1 (10 marks)
6.	 (a) M(A): $Wx + 120 \times 1.5 = R \times 2 + 2R \times 1$ R($\uparrow$) $3R = W + 120$ Hence $Wx + 180 = 3R = W = 120$ $W(1 - x) = 60$ $W = \frac{60}{1 - x}$ (b) $W > 0 \Rightarrow x < 1$	M1 A2, 1, 0 M1 A1 M1 A1 M1 A1cso (8) M1 A1 (2) (10 marks)

Question Number	Scheme	Marks
7.	(a) $v^2 = u^2 + 2as$: $0 = u^2 - 2 \times 9.8 \times 25.6$ $u^2 = 501.76 \Rightarrow u = 22.4$ (★) (b) $-1.5 = 22.4T - 4.9T^2$ $4.9T^2 - 22.4T - 1.5 = 0$ $T = \frac{22.4 \pm \sqrt{22.4^2 + 4 \times 1. \times 4.9}}{9.8}$ $= 4.64$ s (c) Speed at ground $v = 22.4 - 9.8 \times 4.64$ $v = -23.07$ (or $v^2 = 22.4^2 + 2 \times 9.8 \times 1.5$, $v = 23.05$) $v^2 = u^2 + 2as$: $0 = 23.07^2 + 2 \times a \times 0.025$ $(\rightarrow a = -10644.5)$ $F - 0.6g = 0.6a$ $F = 6390$ N (3 sf) (d) Air resistance; variable F;	M1 A1 A1cso (3) M1 A1 M1 A1 (4) M1 A1 M1 A1ft M1 A1 (6) B1 (1) (14 marks)

Question Number	Scheme	Marks
8.	(a)  $A: T = 0.8a$ $B: 1.2g - T = 1.2a$ Solve: $T = 0.48g = 4.7 \text{ N}$	B1 M1 A1 M1 A1 (5)
	(b) $a = 0.6g = 5.88$ Hence $0.6 = \frac{1}{2} \times 0.6g \times t^2$ $t = 0.45 \text{ or } 0.452 \text{ s}$  $F = \mu R = \frac{1}{5} \times 0.8g$ $A: T' - F = 0.8a'$ $B: 1.2g - T' = 1.2a'$ Solve: $a' = 0.52g$ $0.6 = \frac{1}{2} \times 0.52g \times t^2$ $t = 0.49 \text{ or } 0.485 \text{ s}$	M1 M1 A1 (3) B1 M1 A1 B1 M1 A1 M1 A1 (8) (16 marks)