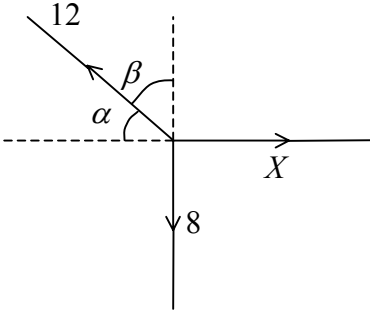
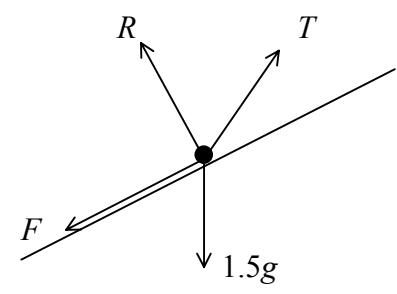
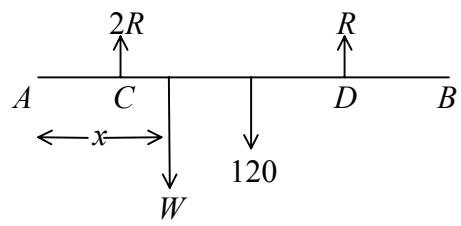
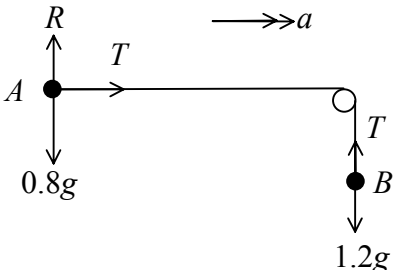
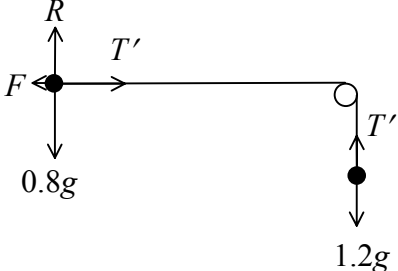


Question Number	Scheme	Marks
1.	<p>(a) CLM: $2000 \times 10 = 2000v + 3000 \times 5$ $v = 2.5 \text{ m s}^{-1}$</p> <p>(b) $I = 3000 \times 5$ (or $2000(10 - 2.5)$) $= 15\,000 \text{ N s}$</p>	<p>M1, A1 B1 (3) M1 A1 (2) (5 marks)</p>
2.	 <p>$R(\uparrow) \quad 8 = 12 \cos \beta$ or $12 \sin \alpha$ $\Rightarrow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

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

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

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