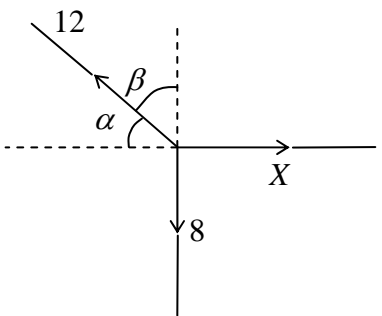
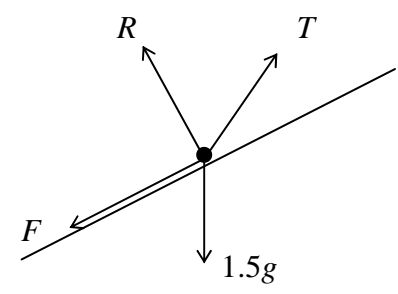
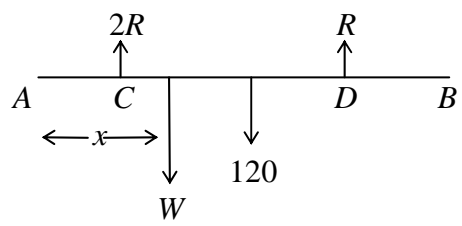
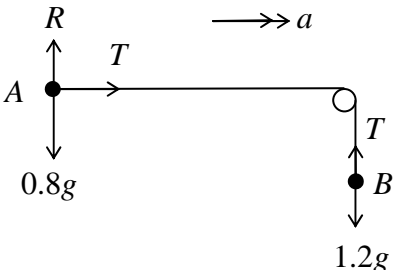
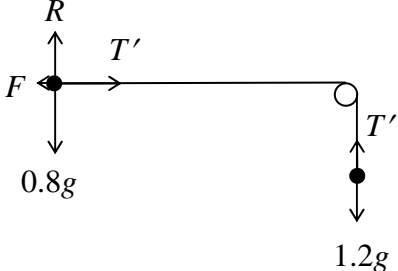


Question Number	Scheme	Marks
1.	<p>(a) CLM: <math>2000 \times 10 = 2000v + 3000 \times 5</math>  <math>v = 2.5 \text{ m s}^{-1}</math></p> <p>(b) <math>I = 3000 \times 5</math> (or <math>2000(10 - 2.5)</math>)  <math>= 15\,000 \text{ N s}</math></p>	<p>M1, A1                      B1 (3)                      M1                      A1 (2)                      (5 marks)</p>
2.	 <p>(a) <math>R(\uparrow) \quad 8 = 12 \cos \beta</math> or <math>12 \sin \alpha</math>  <math>\Rightarrow \beta = 41.8^\circ</math> or <math>\alpha = 48.2^\circ</math>  <math>\Rightarrow \theta = 138.2^\circ</math></p> <p>(b) <math>R(\rightarrow) \quad X = 12 \cos 41.8^\circ</math> (or <math>12 \sin 48.2^\circ</math>)  <math>= 8.94</math></p>	<p>M1                      A1                      A1 (3)                        M1 A1ft                      A1 (3)                      (6 marks)</p>
3.	<p>(a) <math>\mathbf{a} = [-14\mathbf{i} + 21\mathbf{j} - (6\mathbf{i} - 27\mathbf{j})] \div 4</math>  <math>= (-5\mathbf{i} + 12\mathbf{j}) \text{ m s}^{-2}</math></p> <p>(b) <math> \mathbf{a}  = \sqrt{5^2 + 12^2} = 13</math>  <math> \mathbf{F}  = m \mathbf{a}  = 0.4 \times 13 = 5.2 \text{ N}</math></p>	<p>M1 A1                      A1 (3)                      M1                      M1 A1 (3)                      (6 marks)</p>
Alt (b)	<p><math>\mathbf{F} = 0.4(5\mathbf{i} + 12\mathbf{j}) = 2\mathbf{i} + 4.8\mathbf{j}</math>  <math> \mathbf{F}  = \sqrt{2^2 + 4.8^2} = 5.2 \text{ N}</math></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><math>\mathbf{p} = 10t\mathbf{j}</math></p> <p><math>\mathbf{q} = (6\mathbf{i} + 12\mathbf{j}) + (-8\mathbf{i} + 6\mathbf{j})t</math></p> <p><math>t = 3: \mathbf{p} = 30\mathbf{j}, \mathbf{q} = -18\mathbf{i} + 30\mathbf{j}</math></p> <p><math>\Rightarrow</math> dist. apart = 18 km</p> <p><math>\mathbf{PQ} = \mathbf{q} - \mathbf{p} = (6 - 8t)\mathbf{i} + (12 - 4t)\mathbf{j}</math></p> <p><math>t = 3: \mathbf{PQ} = -18\mathbf{i} + 0\mathbf{j}</math></p> <p>Dist. = 18 km</p> <p><math>Q</math> north of <math>P \Rightarrow 6 - 8t = 0</math></p> <p style="text-align: center;"><math>t = \frac{3}{4}</math></p> <p style="margin-left: 200px;">or <math> \mathbf{PQ} ^2 = (6 - 8t)^2 + (12 - 4t)^2</math></p> <p style="margin-left: 200px;"><math>t = 3 \rightarrow  \mathbf{PQ}  = 18</math></p>	<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;"><b>(8 marks)</b></p>
<p>5.</p>	 <p>R(<math>\nearrow</math>): <math>T \cos 20^\circ = F + 1.5g \sin 30^\circ</math></p> <p>R(<math>\nwarrow</math>): <math>T \sin 20^\circ + R = 1.5g \cos 30^\circ</math></p> <p>Using <math>F = \frac{1}{3}R</math></p> <p>Eliminating <math>R</math>, solve <math>T</math></p> <p><math>T = 11</math> 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;"><b>(10 marks)</b></p>
<p>6.</p> <p>(a)</p> <p>(b)</p>	 <p>M(A): <math>Wx + 120 \times 1.5 = R \times 2 + 2R \times 1</math></p> <p>R(<math>\uparrow</math>) <math>3R = W + 120</math></p> <p>Hence <math>Wx + 180 = 3R = W + 120</math></p> <p style="text-align: center;"><math>W(1 - x) = 60</math></p> <p style="text-align: center;"><math>W = \frac{60}{1 - x}</math></p> <p><math>W &gt; 0 \Rightarrow x &lt; 1</math></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> <p style="text-align: right;"><b>(10 marks)</b></p>

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)
7. (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)
7. (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)
7. (d)	Air resistance; variable $F$ ;	B1 (1)  <b>(14 marks)</b>

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