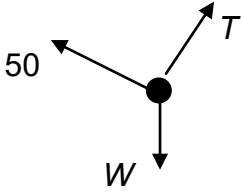
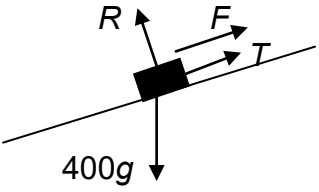


Question Number	Scheme	Marks
1	<div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;">  </div> <div> <p>(a) R (<math>\rightarrow</math>): <math>T \cos 60 = 50 \cos 30</math></p> <math display="block">T = \underline{86.6 \text{ N}}</math> </div> </div> <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;"> <p>(b) R (<math>\uparrow</math>): <math>W = 50 \sin 30 + T \cos 30</math></p> <math display="block">= \underline{100 \text{ N}}</math> </div> </div> <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;"> <p>or R (<math>\parallel</math> to BC): <math>W \cos 60 = 50</math></p> <math display="block">W = \underline{100 \text{ N}}</math> </div> </div>  <p>(a) M1 for a valid equation in T only Treat use of <math>\tan 30/60</math> (e.g. <math>\tan 30 = T/50</math>) as invalid equation unless there is a triangle of Forces</p> <p>(b) M1 for a valid equation involving W (and T if necessary) for first A1 in (i), allow for using their T (i.e. effectively f.t.)</p> <p>Accept each answer as awrt.</p>	<p>M1 A1 A1 (3)</p> <p>M1 A1 A1 (3)</p> <p>M1 A1 A1 (3)</p>


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2	<p>(a) <math>v = u + at</math>: <math>9.5 = 5 + 1.5a \Rightarrow a = 3</math></p> <p>Hence <math>v^2 = 5^2 + 2 \times 3 \times 24</math></p> <p><math>= 169 \Rightarrow v = \underline{13 \text{ m s}^{-1}}</math> (*)</p> <p>(b) <math>I = mv - mu</math>: <math>-30 = 2(v - 13) \Rightarrow v = (-) 2 \text{ m s}^{-1}</math></p> <p>In direction of CA (o.e.)</p> <p>(a) 2<sup>nd</sup> M1 for equation in v (and numbers) only Final A1 is cso</p> <p>(b) M1 for valid impulse = momentum change equn with 3 non-zero terms including '30' and '13' A1 for '30' and '13' with same sign A1 for direction as 'CB' or anything convincing!</p> <p>NB both A's in (b) are cao = cso!</p>	<p>M1 A1 ↓ M1</p> <p>A1 (4)</p> <p>M1 A1</p> <p>A1 (3)</p>

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3	<div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="text-align: center;"> <math>u \longrightarrow</math>            2 kg  </div> <div style="text-align: center;">  4 kg  <math>\longleftarrow v</math>      <math>\longrightarrow w</math> </div> </div> <p style="margin-left: 150px;">CLM: <math>2u = -2v + 4w</math></p> <p style="margin-left: 150px;">Using <math>w = 3v</math> (<math>\Rightarrow 2u = -2v + 12v</math>) and solve</p> <p style="margin-left: 250px;"><math>\Rightarrow v = \frac{1}{5}u</math> (*)</p> <p>(b) <math>10 = 2a \Rightarrow a = 5 \text{ m s}^{-2}</math></p> <p style="margin-left: 100px;"><math>0 = \frac{1}{25}u^2 - 2 \times 5 \times 1.6</math></p> <p style="margin-left: 100px;"><math>\rightarrow u = \underline{20 \text{ m s}^{-1}}</math></p> <p>(a) 1<sup>st</sup> M1 for valid CLM equn        2<sup>nd</sup> M1 for correct equn for 'v' and 'w' and solving for v or w.        Final A1 is cso (dropping u and reinserting loses last A1)</p> <p>(b) Allow B1 for <math>a = \pm 5</math>        M1 for using '<math>v^2 = u^2 + 2as</math>' with <math>v = 0</math> and with a value for a        A1 f.t. on their a (provided this is not g), but signs must be correct</p> <p><b>SC</b> For using u instead of u/5 (<math>\rightarrow u = 4</math>), allow M1 A0 M0.</p> <p>Energy: <math>\frac{1}{2} \times 2 \times (u/5)^2 = 10 \times 1.6</math>      M1 A1 A1</p> <p style="margin-left: 150px;"><math>\rightarrow u = 20</math>      dep M1 A1</p>	<p>M1 A1        ↓        M1</p> <p>A1 cso        (4)</p> <p>B1</p> <p>M1 A1√        ↓        M1 A1        (5)</p>

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4	<p>(a) M(D): <math>20g \times 1.5 + 10g \times 1 = R_B \times 3</math></p> <p style="text-align: center;"><math>\Rightarrow R_B = \underline{40g/3 \approx 131 \text{ or } 130 \text{ N}}</math></p> <p><i>[NB For moments about another point, allow M1 A1 for moments equation dimensionally correct and with correct number of terms; second M1 is for complete method to find <math>R_B</math>.]</i></p> <p>(b) R(<math>\uparrow</math>): <math>R_D + 40g/3 = 20g + 10g</math></p> <p style="text-align: center;"><math>\Rightarrow R_D = \underline{50g/3 \approx 163 \text{ or } 160 \text{ N}}</math></p> <p>or M(B): <math>20g \times 1.5 + 10g \times 2 = R_D \times 3</math></p> <p style="text-align: center;"><math>\Rightarrow R_D = \underline{50g/3 \approx 163 \text{ or } 160 \text{ N}}</math></p> <p><i>[NB For moments about another point, allow M1 for a complete method to find <math>R_D</math>, A1 for a correct equation for <math>R_D</math>.]</i></p> <p>(c) <math>R_B = 0</math></p> <p>M(D): <math>20g \times x = 10g \times 1</math></p> <p style="text-align: center;"><math>x = DF = \underline{0.5 \text{ m}}</math></p> <p><i>For weight/mass confusion, A0 A0 in (a) but allow f.t. in (b) (ans <math>50/3 = 16.7</math>)</i></p> <p><i>General rule of deducting max. 1 per question for &gt; 3 s.f</i></p> <p>(c) 2<sup>nd</sup> M1: must have correct no. of non=zero terms, and equation in x only If use value(s) of R's from (a) or (b): M0.</p>	<p>M1 A1 ↓ M1 A1 (4)</p> <p>M1 A1√ A1 (3)</p> <p>M1 A1 A1 (3)</p> <p>M1</p> <p>M1 A1 A1 (4)</p>

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5	<p>(a)</p>  <p> <math>R = 400g \cos 15^\circ (\approx 3786 \text{ N})</math>  <math>F = 0.2R</math> used  <math>T + 0.2R = 400g \sin 15^\circ</math>  <math>T \approx \underline{257 \text{ or } 260 \text{ N}}</math> </p> <p>(b)</p> <p> <math>400g \sin 15^\circ - 0.2 \times 400g \cos 15^\circ = 400a</math>  <math>a = 0.643(\dots)</math>  <math>50 = \frac{1}{2} \times 0.643 \times t^2</math>  <math>t = \underline{12.5 \text{ or } 12 \text{ s}}</math> </p> <p><i>General rule again about &gt; 3 sf</i></p> <p><i>Weight/mass confusion: treat as MR [<math>\rightarrow T = 26.3/26</math>; <math>a = 0.0656\dots</math>; <math>t = 39(.0)</math>]</i></p> <p>(b) Allow <math>a = 0.64</math></p> <p><i>(Final M1 not dependent but requires an attempt to find an a which is not assumed to be g)</i></p>	<p>B1</p> <p>B1</p> <p>M1 A1 ↓ M1 A1 (6)</p> <p>M1 A1</p> <p>A1</p> <p>M1 A1√</p> <p>A1 (6)</p>

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6	<p>(a) Direction of <math>\mathbf{v} = (7\mathbf{i} - 7.5\mathbf{j}) - (4\mathbf{i} - 6\mathbf{j}) = 3\mathbf{i} - 1.5\mathbf{j}</math></p> $\tan \theta = \frac{1.5}{3} = 0.5 \Rightarrow \theta = 26.565\dots$ <p>Bearing = <u>117</u> (accept awrt)</p> <p>(b) <math>\mathbf{v} = (3\mathbf{i} - 1.5\mathbf{j}) \div \frac{3}{4} = 4\mathbf{i} - 2\mathbf{j}</math></p> $\mathbf{s} = \underline{(4\mathbf{i} - 6\mathbf{j})} + t\underline{(4\mathbf{i} - 2\mathbf{j})}$ <p>(c) At 1015 <math>\mathbf{s} = (4\mathbf{i} - 6\mathbf{j}) + \frac{5}{4}(4\mathbf{i} - 2\mathbf{j}) (= 9\mathbf{i} - 8.5\mathbf{j})</math></p> $\mathbf{m} = 0.25(p\mathbf{i} + q\mathbf{j})$ $\mathbf{s} = \mathbf{m} \Rightarrow \underline{p = 36, q = -34}$ <p>(a) <i>Forming direction for v can be either way round.</i>  M1 for <math>\tan = 'i/j'</math> or <math>'j/i'</math>  A1 for 26.6 or 63.4 (awrt) from a correct direction for v  A1 cao</p> <p>(b) <i>Allow B1 for correct vector for v wherever seen (e.g. in (a))</i></p> <p>(c) <i>line 1: or <math>(7\mathbf{i} - 7.5\mathbf{j}) + \frac{1}{2}(4\mathbf{i} - 2\mathbf{j}) = \dots</math></i>  1<sup>st</sup> M1 allow for a valid attempt with a value of t.  2<sup>nd</sup> M1 using <math>\mathbf{s} = \mathbf{m}</math> and equating at least one coefficient</p>	<p>M1 ↓ M1 A1</p> <p>A1 (4)</p> <p>B1</p> <p>M1 A1√ (3)</p> <p>M1 A1</p> <p>B1 ↓ M1 A1, A1 (6)</p>

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7	 <p>(a) <math>F_1 = \frac{2}{7} \times 4g (= 11.2)</math> or <math>F_2 = \frac{2}{7} \times 6g (= 16.8)</math> B1</p> <p>System: <math>40 - \frac{2}{7} \times 4g - \frac{2}{7} \times 6g = 10a</math> (equin in <math>a</math> and not <math>T</math>) M1 A1</p> <p><math>\Rightarrow \underline{a = 1.2 \text{ m s}^{-2}}</math> (*) A1 (4)</p> <p>(b) <math>P: T - \frac{8}{7}g = 4 \times 1.2</math> or <math>Q: 40 - T - \frac{12}{7}g = 6 \times 1.2</math> M1 A1</p> <p><math>\Rightarrow T = \underline{16 \text{ N}}</math> A1 (3)</p> <p>(c) Accelerations of <math>P</math> and <math>Q</math> are same B1 (1)</p> <p>(d) <math>v = 1.2 \times 7 = 8.4</math> B1</p> <p><math>P: (-) \frac{8}{7}g = 4a \Rightarrow a = (-) \frac{2}{7}g = 2.8</math> M1 A1</p> <p><math>0 = 8.4 - 2.8t \Rightarrow \underline{t = 3 \text{ s}}</math> (*) M1 A1 (5)</p> <p>(e) <math>Q: 40 - \frac{12}{7}g = 6a \Rightarrow a \approx 3.867</math> M1 A1</p> <p><math>v = 8.4 + 3.867 \times 3 = \underline{20 \text{ m s}^{-1}}</math> M1 A1 (4)</p> <p>(a) 1<sup>st</sup> A1 requires values for the <math>F</math>'s. (Allow M1 with just '<math>F</math>'s)</p> <p>(b) Allow M1 A1 for one of these equations wherever seen (e.g. in (a))</p> <p>(c) extra statement about tensions being equal (with the correct ans): B0</p> <p>(d) allow verification</p> <p>No <math>g</math>: allow 1<sup>st</sup> M1 in each of parts (a), (b), (d), (e) as f.t. but other A's are cao</p>	