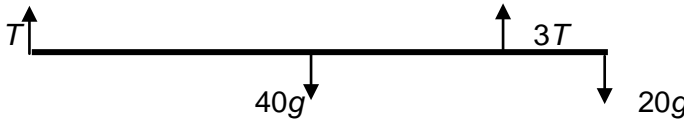


January 2005

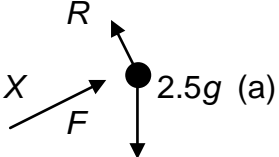
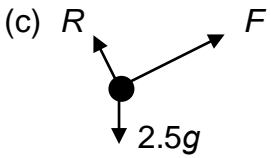
## 6677 Mechanics M1

Mark Scheme

Question Number	Scheme	Marks
1	<div style="text-align: center; margin-bottom: 10px;"> </div> <p>(a) CLM: <math>1.5 \times 3 - 2.5 \times 4 = -1.5 \times 2.5 + 2.5 \times v</math></p> <p style="margin-left: 100px;"><math>\Rightarrow v = \underline{-0.7 \text{ m s}^{-1}}</math> so speed = <math>0.7 \text{ m s}^{-1}</math></p> <p>(b) Direction of Q unchanged</p> <p>(c) Impulse = <math>1.5 (3 + 2.5)</math></p> <p style="margin-left: 100px;">= <u>8.25, Ns</u></p>	<p>M1 A1</p> <p style="text-align: right;">A1 (3)</p> <p style="text-align: right;">A1✓ (1)</p> <p>M1</p> <p style="text-align: right;">A1, B1 (3)</p>

Question Number	Scheme	Marks
2	 <p>(a) R(<math>\uparrow</math>): <math>T + 3T = 40g + 20g</math>  <math>T = 15g</math>, so tension at C is <u>45g or 441 N or 440 N</u></p> <p>(b) M(B) <math>15g \times 3 + 45g \times d = 40g \times 1.5</math>  Solve: <math>d = \underline{1/3 \text{ or } 0.33 \text{ or } 0.333 \text{ m}}</math></p>	<p>M1  A1  (2)</p> <p>M1 A2,1,0✓  ↓  M1 A1  (5)</p>

Question Number	Scheme	Marks
3	(a) Distance = $\frac{1}{2} \times 4 \times 9 + 16 \times 9$ <b>or</b> $\frac{1}{2} (20 + 16) \times 9$ $= \underline{162 \text{ m}}$	M1 A1 (2)
	(b) Distance over last 5 s = $\frac{1}{2}(9 + u) \times 5$ $162 + \frac{1}{2}(9 + u) \times 5 = 200$ $\Rightarrow u = \underline{6.2 \text{ m s}^{-1}}$	M1 M1 A1√ A1 (4)
	(c) $6.2 = 9 + 5a$ $a = (-) \underline{0.56 \text{ m s}^{-2}}$	M1 A1√ A1 (3)

Question Number	Scheme	Marks
4	<div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 25%;">  <p>(a)</p> </div> <div style="width: 50%;"> <math display="block">R = 2.5g \cos 20</math> <math display="block">\approx \underline{23.0 \text{ or } 23 \text{ N}}</math> </div> <div style="width: 20%; text-align: right;"> <p>M1</p> <p>A1 (2)</p> </div> </div> <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 25%;"> <p>(b)</p> </div> <div style="width: 50%;"> <math display="block">X = 0.4 \times 23.0 + 2.5g \sin 20</math> <math display="block">\approx \underline{17.6 \text{ or } 18 \text{ N}}</math> </div> <div style="width: 20%; text-align: right;"> <p>M1 A2,1,0√</p> <p>A1 (4)</p> </div> </div> <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 25%;">  <p>(c)</p> </div> <div style="width: 50%;"> <p>In equilb. <math>F = 2.5g \sin 20 \approx 8.38 \text{ or } 8.4 \text{ N}</math></p> <math display="block">\mu R = 0.4 \times 2.5g \cos 20 \approx 9.21 \text{ or } 9.2 \text{ N}</math> <math display="block">8.4 &lt; 9.2 \text{ (using 'F &lt; } \mu R' \text{ not } F = \mu R)</math> <p>Since <math>F &lt; \mu R</math> remains in equilibrium</p> </div> <div style="width: 20%; text-align: right;"> <p>B1</p> <p>B1</p> <p>M1</p> <p>(cso) A1 (4)</p> </div> </div>	

Question Number	Scheme	Marks
5	<p>(a) 's = ut + ½at<sup>2</sup>' for B: <math>0.4 = \frac{1}{2} a(0.5)^2</math>  <math>a = \underline{3.2 \text{ m s}^{-2}}</math></p> <p>(b) N2L for B: <math>0.8g - T = 0.8 \times 3.2</math>  <math>T = \underline{5.28 \text{ or } 5.3 \text{ N}}</math></p> <p>(c) A: <math>F = \mu \times 0.5g</math>  N2L for A: <math>T - F = 0.5a</math>  Sub and solve <math>\mu = \underline{0.75 \text{ or } 0.751}</math></p> <p>(d) Same acceleration for A and B.</p>	<p>M1 A1  A1  (3)</p> <p>M1 A1√  ↓  M1 A1  (4)</p> <p>B1</p> <p>M1 A1  ↓  M1 A1  (5)</p> <p>B1  (1)</p>

Question Number	Scheme	Marks
6	<p>(a) <math>16^2 = 20^2 - 2 \times a \times 24 \Rightarrow a = \underline{3 \text{ m s}^{-2}}</math></p> <p>(b) <math>v^2 = 20^2 - 2 \times 3 \times 30</math>  <math>v = \underline{\sqrt{220} \text{ or } 14.8 \text{ m s}^{-1}}</math></p> <p>(c) <math>0.3 = m \times 3 \Rightarrow m = 0.1 \text{ kg } (*)</math></p> <p>(d) <math>0.1(w + \sqrt{220}) = 2.4</math>  <math>w = 9.17</math>  <math>0 = 9.17 - 3 \times t</math>  <math>t \approx \underline{3.06 \text{ s}}</math></p>	<p>M1 A1 (2)</p> <p>M1 A1√ A1 (3)</p> <p>M1 A1 (2)</p> <p>M1 A1√ A1 ↓ M1 A1√ A1 (6)</p>

Question Number	Scheme	Marks
7	<p>(a) <math>\mathbf{v}_P = \{(29\mathbf{i} + 34\mathbf{j}) - (20\mathbf{i} + 10\mathbf{j})\}/3 = \underline{(3\mathbf{i} + 8\mathbf{j}) \text{ km h}^{-1}}</math></p> <p>(b) <math>\mathbf{p} = (20\mathbf{i} + 10\mathbf{j}) + (3\mathbf{i} + 8\mathbf{j})t</math>  <math>\mathbf{q} = (14\mathbf{i} - 6\mathbf{j}) + 12t\mathbf{j}</math></p> <p>(c) <math>\mathbf{q} - \mathbf{p} = (-6 - 3t)\mathbf{i} + (-16 + 4t)\mathbf{j}</math>  <math>d^2 = (-6 - 3t)^2 + (-16 + 4t)^2</math>  <math>= 36 + 36t + 9t^2 + 16t^2 - 128t + 256</math>  <math>= 25t^2 - 92t + 292</math> (*)</p> <p>(d) <math>25t^2 - 92t + 292 = 225</math>  <math>25t^2 - 92t + 67 = 0</math>  <math>(t - 1)(25t - 67) = 0</math>  <math>t = 67/25</math> or 2.68  time <math>\approx</math> 161 mins, or 2 hrs 41 mins, or 2.41 am, or 0241</p>	<p>M1 A1 (2)</p> <p>M1 A1√</p> <p>M1 A1 (4)</p> <p>M1 A1 ↓ M1 ↓ M1 A1 (cso) (5)</p> <p>M1 A1 ↓ M1 A1</p> <p>A1 (5)</p>