

Mark Scheme (Results) January 2008

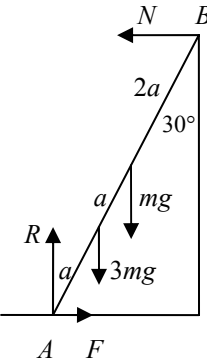
GCE

GCE Mathematics (6678/01)

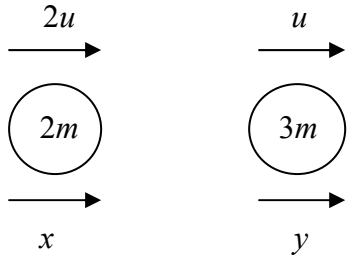


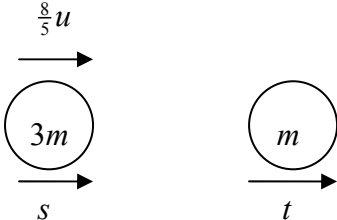


January 2008
6678 Mechanics M2
Mark Scheme

Question Number	Scheme	Marks
1.	<p>(a) KE lost is $\frac{1}{2} \times 2.5 \times 8^2 = 80$ (J)</p> <p>(b) Work energy $80 = R \times 20$ ft their (a) $R = 4$</p> <p>Alternative to (b) $0^2 = 8^2 - 2 \times a \times 20 \Rightarrow a = (-)1.6$ N2L $R = 2.5 \times 1.6$ ft their a $= 4$</p>	<p>M1 A1 (2)</p> <p>M1 A1 ft A1 (3) [5]</p> <p>M1 A1ft A1 (3)</p>
2.	<p>(a) $\dot{\mathbf{p}} = (6t - 6)\mathbf{i} + (9t^2 - 4)\mathbf{j}$ (ms^{-1})</p> <p>(b) $9t^2 - 4 = 0$ $t = \frac{2}{3}$</p> <p>(c) $t = 1 \Rightarrow \dot{\mathbf{p}} = 5\mathbf{j}$ ft their \dot{p} (+/-) $2\mathbf{i} - 6\mathbf{j} = 0.5(\mathbf{v} - 5\mathbf{j})$ $\mathbf{v} = 4\mathbf{i} - 7\mathbf{j}$ (ms^{-1})</p>	<p>M1 A1 (2)</p> <p>M1 DM1 A1 (3)</p> <p>B1ft M1 M1 A1 (4) [9]</p>

Question Number	Scheme	Marks
3.	<p>(a) $20000 = 16F$ ($F = 1250$) \nearrow $F = 550 + 1000 \times 9.8 \sin \theta$ ft their F Leading to $\sin \theta = \frac{1}{14}$ * cso</p> <p>(b) N2L \nearrow $550 + 1000 \times 9.8 \times \sin \theta = 1000a$ $(550 + 1000 \times 9.8 \times \frac{1}{14} = 1000a)$ or $1250 = 1000a$ $(a = (-)1.25)$ $v^2 = u^2 + 2as \Rightarrow 16^2 = 2 \times 1.25 \times y$ $y \approx 102$ accept 102.4, 100</p> <p>Alternative to (b) Work-Energy $\frac{1}{2} \times 1000 \times 16^2 - 1000 \times 9.8 \times \frac{1}{14} y = 550y$ $y \approx 102$ accept 102.4, 100</p>	<p>M1 A1 M1 A1ft A1 (5)</p> <p>M1 A1</p> <p>M1 A1 (4) [9]</p> <p>M1 M1 A1 A1 (4)</p>
4.	<p>(a) Triangle Circle S Mass ratio 126 9π $126 - 9\pi$ \bar{x} 7 5 \bar{x} \bar{y} 4 5 \bar{y} 4, 7 seen</p> <p>$126 \times 7 = 9\pi \times 5 + (126 - 9\pi) \times \bar{x}$ ft their table values $\bar{x} \approx 7.58$ ($\frac{882 - 45\pi}{126 - 9\pi}$) awrt 7.6</p> <p>$126 \times 4 = 9\pi \times 5 + (126 - 9\pi) \times \bar{y}$ ft their table values $\bar{y} \approx 3.71$ ($\frac{504 - 45\pi}{126 - 9\pi}$) awrt 3.7</p> <p>(b) $\tan \theta = \frac{\bar{y}}{21 - \bar{x}}$ ft their \bar{x}, \bar{y} $\theta \approx 15^\circ$</p>	<p>B1 B1ft</p> <p>B1</p> <p>M1 A1ft</p> <p>A1</p> <p>M1 A1ft</p> <p>A1 (9)</p> <p>M1 A1ft</p> <p>A1 (3) [12]</p>

Question Number	Scheme	Marks
<p>5.</p>	<p>(a)</p>  <p>M(A) $N \times 4a \cos 30^\circ = 3mg \times a \sin 30^\circ + mg \times 2a \sin 30^\circ$</p> <p>$N = \frac{5}{4} mg \tan 30^\circ \left(= \frac{5}{4\sqrt{3}} mg = 7.07\dots m \right)$</p> <p>$\rightarrow F_r = N, \quad \uparrow R = 4mg$</p> <p>Using $F_r = \mu R$</p> <p>$\frac{5}{4\sqrt{3}} mg = \mu R$ for their R</p> <p>$\mu = \frac{5}{16\sqrt{3}}$ awrt 0.18</p> <p>Alternative method:</p> <p>M(B): $mg \times 2a \sin 30 + 3mg \times 3a \sin 30 + F \times 4a \cos 30 = R \times 4a \sin 30$</p> <p>$11mga \sin 30 + F \times 4a \cos 30 = R \times 4a \sin 30$</p> <p>$\frac{11mg}{2} + F \frac{4\sqrt{3}}{2} = 2R$</p> <p>$\uparrow R = 4mg,$</p> <p>Using $F_r = \mu R$</p> <p>$8\mu\sqrt{3} = \frac{5}{2}, \quad \mu = \frac{5}{16\sqrt{3}}$</p>	<p>M1 A2(1,0)</p> <p>DM1 A1</p> <p>B1, B1</p> <p>B1</p> <p>M1</p> <p>A1 (10)</p> <p>[10]</p> <p>M1A3(2,1,0)</p> <p>DM1A1</p> <p>B1</p> <p>B1</p> <p>M1 A1</p>

6.	<p>(a) $\rightarrow 30 = 2ut$ $\uparrow -47.5 = 5ut - 4.9t^2$ $-47.5 = 75 - 4.9t^2$ eliminating u or t $t^2 = \frac{75 + 47.5}{4.9} (= 25)$ $t = 5$ * cso</p> <p>(b) $30 = 2ut \Rightarrow 30 = 10u \Rightarrow u = 3$</p> <p>(c) $\uparrow \dot{y} = 5u - 9.8t = -34$ M1 requires both $\rightarrow \dot{x} = 2u = 6$ \dot{x} and \dot{y} $v^2 = 6^2 + (-34)^2$ $v \approx 34.5 \text{ (ms}^{-1}\text{)}$ accept 35</p> <p>Alternative to (c) $\frac{1}{2}mv_B^2 - \frac{1}{2}mv_A^2 = m \times g \times 47.5$ with $v_A^2 = 6^2 + 15^2 = 261$ $v_B^2 = 261 + 2 \times 9.8 \times 47.5 (= 1192)$ $v_B \approx 34.5 \text{ (ms}^{-1}\text{)}$ accept 35</p> <p>BEWARE : Watch out for incorrect use of $v^2 = u^2 + 2as$</p>	<p>B1 M1 A1 DM1 DM1 A1 (6)</p> <p>M1 A1 (2)</p> <p>M1 A1 A1 DM1 A1 (5)</p> <p>[13] M1 A(2,1,0) DM1 A1 (5)</p>
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7.	<p>(a)</p>  <p style="text-align: center;"> $2u$ u \longrightarrow \longrightarrow   \longrightarrow \longrightarrow x y </p> <p>LM $4mu + 3mu = 2mx + 3my$</p> <p>NEL $y - x = \frac{1}{2}u$</p> <p>Solving to $y = \frac{8}{5}u$ *</p> <p>(b)</p> <p style="text-align: center;">$x = \frac{11}{10}u$ or equivalent</p> <p>Energy loss $\frac{1}{2} \times 2m \left((2u)^2 - \left(\frac{11}{10}u \right)^2 \right) + \frac{1}{2} \times 3m \left(u^2 - \left(\frac{8}{5}u \right)^2 \right)$</p> <p style="text-align: center;">$= \frac{9}{20}mu^2$</p> <p>(c)</p>  <p style="text-align: center;"> $\frac{8}{5}u$ \longrightarrow   \longrightarrow \longrightarrow s t </p> <p>LM $\frac{24}{5}mu = 3ms + mt$</p> <p>NEL $t - s = \frac{8}{5}eu$</p> <p>Solving to $s = \frac{2}{5}u(3 - e)$</p> <p>For a further collision $\frac{11}{10}u > \frac{2}{5}u(3 - e)$</p> <p style="text-align: center;">$e > \frac{1}{4}$ ignore $e \leq 1$</p>	<p>M1 A1</p> <p>B1</p> <p>M1 A1 (5)</p> <p>B1</p> <p>M1 A(2,1,0)</p> <p>A1 (5)</p> <p>M1 A1</p> <p>M1</p> <p>A1 (7)</p> <p>[17]</p>