

**GCE**

Edexcel GCE

Mathematics

Mechanics 2 M2 (6678)

June 2008

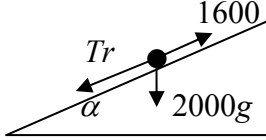
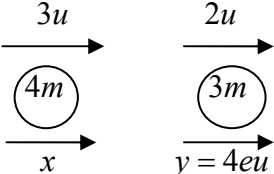
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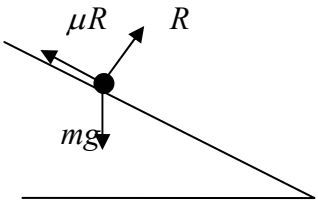
Final Mark Scheme

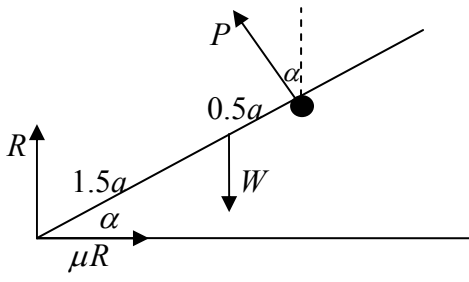
## General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

June 2008  
6678 Mechanics M2  
Mark Scheme

Question Number	Scheme	Marks
1.	 <p>Resolve <math>\nearrow</math>: <math>T_r + \frac{2000g \times \sin \alpha}{(T_r = 816)} = 1600</math></p> <p><math>P = 816 \times 14 \text{ (W)}</math> ft their <math>T_r</math> <math>\approx 11 \text{ (kW)}</math> accept 11.4</p>	<p>M1 <u>A1</u> A1</p> <p>M1 A1ft</p> <p>A1 cso <b>(6)</b> <b>[6]</b></p>
2.	<p>(a)</p>  <p>LM NEL</p> $12mu + 6mu = 4mx + 12meu$ $4eu - x = eu$ <p>Eliminating <math>x</math> to obtain equation in <math>e</math></p> <p>Leading to <math>e = \frac{3}{4} *</math> cso</p> <p>(b)</p> <p><math>x = 3eu</math> or <math>\frac{9}{4}u</math> or <math>4.5u - 3eu</math> seen or implied in (b)</p> <p>Loss in KE = <math>\frac{1}{2}4m(3u)^2 + \frac{1}{2}3m(2u)^2 - \frac{1}{2}4m\left(\frac{9}{4}u\right)^2 - \frac{1}{2}3m(3u)^2</math></p> <p>ft their <math>x</math></p> $= 24mu^2 - 23\frac{5}{8}mu^2 = \frac{3}{8}mu^2 = 0.375mu^2$	<p>B1</p> <p>M1 A1</p> <p>DM1</p> <p>A1 <b>(5)</b></p> <p>B1</p> <p>M1 A1ft</p> <p>A1 <b>(4)</b> <b>[9]</b></p>

Question Number	Scheme	Marks
<p>3.</p>	<p>(a) <math>\Delta KE = \frac{1}{2} \times 3.5(12^2 - 8^2)</math> (= 140) or KE at A, B correct separately  <math>\Delta PE = 3.5 \times 9.8 \times 14 \sin 20^\circ</math> (<math>\approx 164.238</math>) or PE at A, B correct separately  <math>\Delta E = \Delta KE + \Delta PE \approx 304, 300</math></p> <p>(b) Using Work-Energy  <math>F_r = \mu \times 3.5g \cos 20^\circ</math>  <math>304.238 \dots = F_r \times 14</math> ft their (a), <math>F_r</math>  <math>304.238 \dots = \mu 3.5g \cos 20^\circ \times 14</math>  <math>\mu \approx 0.674, 0.67</math></p> <p>Alternative using N2L</p>  <p><math>F_r = \mu \times 3.5g \cos 20^\circ</math>  <math>v^2 = u^2 + 2as \Rightarrow 8^2 = 12^2 - 2a \times 14</math>  <math>\left(a = \frac{20}{7}\right) (2.857 \dots)</math>  N2L <math>R \perp</math> : {their <math>F_r</math>} - <math>mg \sin 20^\circ = ma</math>  ft their <math>F_r</math>.  Leading to <math>\mu \approx 0.674</math> or 0.67</p>	<p>B1  M1 A1  DM1 A1 (5)</p> <p>M1 A1  M1 A1 ft</p> <p>A1 (5)  [10]</p> <p>M1 A1</p> <p>M1 A1ft  A1 (5)</p>
<p>4.</p>	<p>(a) N2L <math>(6t - 5)\mathbf{i} + (t^2 - 2t)\mathbf{j} = 0.5\mathbf{a}</math>  <math>\mathbf{a} = (12t - 10)\mathbf{i} + (2t^2 - 4t)\mathbf{j}</math>  <math>\mathbf{v} = (6t^2 - 10t)\mathbf{i} + \left(\frac{2}{3}t^3 - 2t^2\right)\mathbf{j}</math> (+C) ft their <math>\mathbf{a}</math>  <math>\mathbf{v} = (6t^2 - 10t + 1)\mathbf{i} + \left(\frac{2}{3}t^3 - 2t^2 - 4\right)\mathbf{j}</math></p> <p>(b) When <math>t = 3</math>,  <math>\mathbf{v}_3 = 25\mathbf{i} - 4\mathbf{j}</math>  <math>-5\mathbf{i} + 12\mathbf{j} = 0.5(\mathbf{v} - (25\mathbf{i} - 4\mathbf{j}))</math> ft their <math>\mathbf{v}_3</math>  <math>\mathbf{v} = 15\mathbf{i} + 20\mathbf{j}</math>  <math> \mathbf{v}  = \sqrt{(15^2 + 20^2)} = 25 \text{ (ms}^{-1}\text{)}</math> cso</p>	<p>M1  A1  M1 A1ft+A1ft  A1 (6)</p> <p>M1  M1 A1ft  A1  M1 A1 (6)  [12]</p>

Question Number	Scheme	Marks
5.	<p>(a)</p>  <p style="text-align: center;"><math>R(\uparrow) \quad R + P \cos \alpha = W</math></p> <p style="text-align: center;"><math>M(A) \quad P \times 2a = W \times 1.5a \cos \alpha</math></p> <p style="text-align: center;"><math>\left( P = \frac{3}{4} W \cos \alpha \right)</math></p> <p style="text-align: center;"><math>R = W - P \cos \alpha = W - \frac{3}{4} W \cos^2 \alpha</math></p> <p style="text-align: center;"><math>= \frac{1}{4} (4 - 3 \cos^2 \alpha) W \quad *</math></p> <p>(b) Using <math>\cos \alpha = \frac{2}{3}</math>, <math>R = \frac{2}{3} W</math></p> <p style="text-align: center;"><math>R(\rightarrow) \quad \mu R = P \sin \alpha</math></p> <p style="text-align: center;">Leading to <math>\mu = \frac{3}{4} \sin \alpha</math></p> <p style="text-align: center;"><math>\left( \sin \alpha = \sqrt{1 - \frac{4}{9}} = \frac{\sqrt{5}}{3} \right)</math></p> <p style="text-align: center;"><math>\mu = \frac{\sqrt{5}}{4}</math></p>	<p>M1 A1</p> <p>M1 A1</p> <p>DM1</p> <p>cso A1 (6)</p> <p>B1</p> <p>M1 A1</p> <p>awrt 0.56 DM1 A1 (5)</p> <p style="text-align: right;"><b>[11]</b></p>

Question Number	Scheme	Marks
6.	<p>(a) <math>M(Oy)</math> <math>(8+k)m \times 6.4 = 5m \times 8 + km \times 8</math>  <math>1.6k = 11.2 \Rightarrow k = 7</math> *</p> <p>(b) <math>M(Oy)</math> <math>27m\bar{x} = 12m \times 4 + 5m \times 8 + 7m \times 8</math>  <math>\bar{x} = \frac{16}{3}</math></p> <p><math>M(Ox)</math> <math>27m\bar{y} = 12m \times 2.5 + 8m \times 5</math>  <math>\bar{y} = \frac{70}{27}</math></p> <p>(c) <math>\tan \theta = \frac{\bar{y}}{\bar{x}} = \frac{35}{72}</math>  <math>\theta \approx 26^\circ</math></p>	<p>M1 A1  DM1 A1 (4) cso</p> <p>M1 A1  5.3 or better  A1</p> <p>M1 A1  2.6 or better  A1 (6)</p> <p>M1 A1ft  awrt <math>25.9^\circ</math>  A1 (3)  [13]</p>

Question Number	Scheme	Marks
7.	(a) (↓) $u_y = 25 \sin 30^\circ (= 12.5)$ $12 = 12.5t + 4.9t^2$ Leading to $t = 0.743$ , $0.74$	B1 M1 A2 (1, 0) A1 (5)
	(b) (→) $u_x = 25 \cos 30^\circ \left( = \frac{25\sqrt{3}}{2} \approx 21.65 \right)$ $OB = 25 \cos 30^\circ \times t (\approx 16.094 58)$ $TB \approx 1.1$ (m)	B1 ft their (a) awrt 1.09 M1 A1ft A1 (4)
	(c) (→) $15 = u_x \times t \Rightarrow t = \frac{15}{u_x} (= \frac{2\sqrt{3}}{5} \approx 0.693$ or $0.69)$	M1 A1
	either (↓) $v_y = 12.5 + 9.8t (\approx 19.2896)$  $V^2 = u_x^2 + v_y^2 (\approx 840.840)$ $V \approx 29$ (ms <sup>-1</sup> ) , $29.0$	M1  M1 A1 (5)
	or (↓) $s_y = 12.5t + 4.9t^2 (\approx 11.0)$  $\frac{1}{2}m \times 25^2 + mg \times s_y = \frac{1}{2}mv^2$ $V \approx 29$ (ms <sup>-1</sup> ) , $29.0$	M1  M1A1 [14]