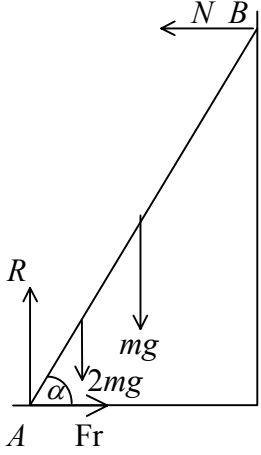











Question number	Scheme	Marks
1. (a)	Use of $(8 + \lambda)m$ i: $3m \times 4 + \lambda m \times 4 = (8 + \lambda)m \times 2$ Solving to $\lambda = 2$ (*) j: $5m \times (-3) + 2m \times 2 = 10m \times k$ $k = -1.1$	B1 M1 M1 A1 (4) M1 A1 A1 (3) <b>(7 marks)</b>
2. (a)	$T_r = \frac{24000}{12} (= 2000)$ N2L: $T_r - 1200 = 1000 \times f$ $f = 0.08$	M1 M1 A1ft A1 (4)
(b)	Work Energy $\frac{1}{2} \times 1000 \times 14^2 = 1200d$ $d = 81 \frac{2}{3}$	M1 A1 awrt 81.7 A1 (3)
(c)	Resistances may vary with speed	B1 (1) <b>(8 marks)</b>

EDEXCEL MECHANICS M2

Question number	Scheme	Marks															
3.	 <p> <math>(\uparrow) \quad R = 3mg</math>  <math>M(B)</math>  <math>mga \cos \alpha + 2mg \times \frac{3}{2} a \cos \alpha + Fr \times 2a \sin \alpha = R \times 2a \cos \alpha</math>                      Solving to <math>Fr = \frac{3}{4} mg</math> </p> <p> <math>Fr \leq \mu R \Rightarrow \frac{3}{4} mg \leq \mu 3mg</math>  <math>\mu \geq \frac{1}{4}</math> (least value is <math>\frac{1}{4}</math>)                 </p>	B1 M1 A2 1,0 M1 A1 M1 M1 A1 (9) <b>(9 marks)</b>															
4. (a)	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%;"></td> <td style="width: 20%; text-align: center;"></td> <td style="width: 20%; text-align: center;"></td> <td style="width: 20%; text-align: center;"></td> <td></td> </tr> <tr> <td>MR</td> <td style="text-align: center;"><math>48a^2</math></td> <td style="text-align: center;"><math>12a^2</math></td> <td style="text-align: center;"><math>60a^2</math></td> <td>B1, B1ft</td> </tr> <tr> <td>CM</td> <td style="text-align: center;"><math>4a</math></td> <td style="text-align: center;"><math>(-)\frac{1}{3} \times 4a</math></td> <td style="text-align: center;"><math>\bar{x}</math></td> <td>B1</td> </tr> </table> <p> <math>48a^2 \times 4a - 12a^2 \times \frac{4}{3} a = 60\bar{x}</math>                      Solving to <math>\bar{x} = \frac{44}{15} a</math> (*)                 </p>						MR	$48a^2$	$12a^2$	$60a^2$	B1, B1ft	CM	$4a$	$(-)\frac{1}{3} \times 4a$	$\bar{x}$	B1	M1 A1 A1 (6) M1 A1 A1 (3) <b>(9 marks)</b>
																	
MR	$48a^2$	$12a^2$	$60a^2$	B1, B1ft													
CM	$4a$	$(-)\frac{1}{3} \times 4a$	$\bar{x}$	B1													
(b)	<p> <math>\lambda M \times 4a = M \times \frac{44}{15} a</math>  <math>\lambda = \frac{11}{15}</math> </p>	A1 (3) <b>(9 marks)</b>															

## EDEXCEL MECHANICS M2

Question number	Scheme	Marks
5.	<p>(a) <math>v = \int a dt = 2t^2 - 8t (+c)</math></p> <p>Using <math>v = 6, t = 0; v = 2t^2 - 8t + 6</math></p> <p><math>v = 0 \Rightarrow 2t^2 - 8t + 6 = 0, \Rightarrow t = 1, 3</math></p> <p><math>S = \int (2t^2 - 8t + 6) dt = \left[ \frac{2}{3}t^3 - 4t^2 + 6t \right]</math></p> <p style="text-align: center;"><math>= 0 - 2\frac{2}{3}</math></p> <p>Distance is <math>(\pm)2\frac{2}{3}</math> m</p>	<p>M1 A1</p> <p>M1 A1 (4)</p> <p>M1 A1</p> <p>M1 A2, 1, 0</p> <p>M1</p> <p>A1 (7)</p> <p><b>(11 marks)</b></p>
6.	<p>(a) L.M. <math>2u = 2x + y</math></p> <p>NEL <math>y - x = \frac{1}{3}u</math></p> <p>Solving to <math>x = \frac{5}{9}u</math> (*)</p> <p style="text-align: center;"><math>y = \frac{8}{9}u</math> (*)</p> <p>(b) <math>(\pm) \frac{8}{9}eu</math></p> <p>L.M <math>\frac{10}{9}u - \frac{8}{9}eu = w</math></p> <p>NEL <math>w = \frac{1}{3} \left( \frac{5}{9}u + \frac{8}{9}eu \right)</math></p> <p>Solving to <math>e = \frac{25}{32}</math> accept 0.7812s</p> <p>(c) <math>Q</math> still has velocity and will <i>bounce back</i> from wall colliding with <i>stationary P</i>.</p>	<p>M1 A1</p> <p>M1 A1</p> <p>M1 A1</p> <p>A1 (7)</p> <p>B1</p> <p>M1 A1</p> <p>M1 A1</p> <p>M1 A1 (7)</p> <p>B1 (1)</p> <p><b>(15 marks)</b></p>

Question number	Scheme	Marks
7.	<p>(a) <math>\mathbf{I} = 0.4(15\mathbf{i} + 16\mathbf{j} + 20\mathbf{i} - 4\mathbf{j})</math> (<math>= 0.4(35\mathbf{i} + 12\mathbf{j}) = 14\mathbf{i} + 4.8\mathbf{j}</math>)</p> <p><math> \mathbf{I}  = \sqrt{(14^2 + 4.8^2)}</math> or <math>0.4\sqrt{(35^2 + 12^2)}</math> M1 for any magnitude</p> <p><math>= 14.8</math> (Ns) A1 (4)</p> <p>(b) Initial K.E. <math>= \frac{1}{2}m(15^2 + 16^2)</math> (<math>= 240.5m = 96.2</math> J) M1</p> <p><math>\frac{1}{2}mv^2 = \frac{1}{2}m(15^2 + 16^2) = m \times 9.8 \times 1.2</math> -1 each incorrect term M1 A2, 1,0</p> <p><math>v^2 = 504.52</math> M1</p> <p><math>v = 22</math> (<math>\text{m s}^{-1}</math>) accept 22.5 A1 (6)</p> <p>(c) <math>\arccos \frac{15}{22.5} = 48^\circ</math> accept <math>48.1^\circ</math> M1 A1 A1 A1 (4)</p> <p>(d) Air resistance Wind (problem not 2 dimensional) Rotation of ball (ball is not a particle) any 2 B1, B1 (2)</p> <p style="text-align: right;"><b>(16 marks)</b></p>	
Alt (b)	<p>Resolve <math>\uparrow</math> with 16 and 9.8</p> <p>(<math>\uparrow</math>) <math>v_y^2 = 16^2 + 2 \times (-9.8) \times (-1.2)</math></p> <p>(<math>v_y^2 = 279.52, v_y \approx 16.7 \dots</math>)</p> <p><math>v^2 = 15^2 + 279.52</math></p> <p><math>v = 22</math> (<math>\text{m s}^{-1}</math>) accept 22.5</p>	<p>M1</p> <p>M1 A1</p> <p>M1 A1</p> <p>A1 (6)</p>
Alt (c)	<p><math>\arctan \frac{16.7}{15} = 48^\circ</math></p>	<p>M1 A1 A1 A1 (4)</p>