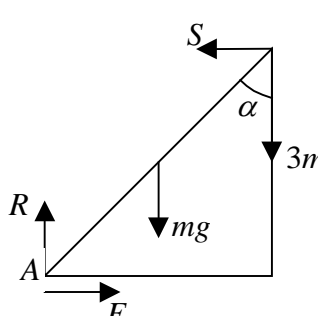
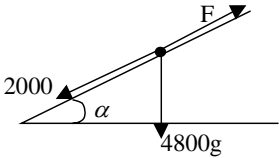
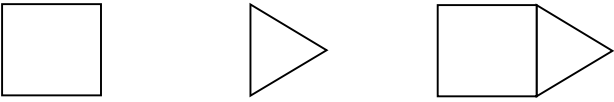
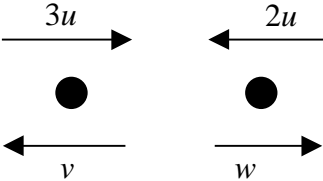


Question Number	Scheme	Marks
1.	$0.5\mathbf{v} - 0.5(-20\mathbf{i}) = 15\mathbf{i} + 10\mathbf{j}$ $\Rightarrow \mathbf{v} = 10\mathbf{i} + 20\mathbf{j}$ $\therefore \text{Speed} = \sqrt{(10^2 + 20^2)} \approx 22.4 \text{ m s}^{-1}$	M1 A1 A1 M1 A1 ft (5) <b>(5 marks)</b>
2.	$F \times 0.02 = \frac{1}{2} \times 0.006 (400^2 - 250^2)$ $F \approx 14600 \text{ N}$	M1 A1, M1 A1 A1 ft (5) <b>(5 marks)</b>
3.	(a) $\mathbf{u} = (3t^2 - 3)\mathbf{i} + 8t\mathbf{j}$ (b) $\parallel^e \mathbf{i} + \mathbf{j} \Rightarrow 3t^2 - 3 = 8t$ $3t^2 - 8t - 3 = 0$ $(3t + 1)(t - 3) = 0$ $t = -\frac{1}{3}, 3 \quad t = 3$	M1 A1 (2) M1 A1 ft M1 A1 A1 ft (5) <b>(7 marks)</b>
4.	$R(\uparrow) \quad R = mg + 3mg = 4mg$ $R(\rightarrow) \quad S = F$ $M(A) \quad mg \cdot a \sin \alpha + 3mg \cdot 2a \sin \alpha = S \cdot 2a \cos \alpha$ $\rightarrow S = \frac{7}{2} mg \tan \alpha$  $\therefore F = S = \frac{7}{2} mg \tan \alpha, \quad R = 4mg$ $F \leq \frac{1}{4} R \Rightarrow \frac{7}{2} mg \tan \alpha \leq mg \Rightarrow \tan \alpha \leq \frac{2}{7}$	M1 A1 B1 M1 A1 A1 ft M1 M1 A1 (9) <b>(9 marks)</b>

Question Number	Scheme	Marks
<p>5. (a)</p>	$F = 2000 + 4800g \cdot \frac{1}{20}, = 4352 \text{ N}$ $P = 12 \times 4652 \text{ W} \approx 52.2 \text{ kW}$ 	<p>M1 A1, A1</p> <p>M1 A1 ft</p> <p>(5)</p>
<p>(b)</p>	$4800a = 4352 - 2000$ $a = 0.49 \text{ m s}^{-2}$	<p>M1 A1 ft</p> <p>A1 (3)</p>
<p>(c)</p>	<p>Max speed <math>\frac{52224}{V} = 2000</math></p> $V \approx 26.1 \text{ ms}^{-1}$	<p>M1 A1</p> <p>A1 (3)</p> <p><b>(11 marks)</b></p>
<p>6. (a)</p>	<p>Initial vertical speed = “<math>u \sin \alpha</math>” = <math>25 \frac{5}{13} \text{ ms}^{-1}</math></p> <p>“<math>v^2 = u^2 + 2as</math>”      <math>100 = 2gh</math></p> $h = \frac{100}{2g} \approx 5.1 \text{ m}$ <p><math>\therefore Ht + 5.1 + 0.8 = 5.9 \text{ m}</math></p>	<p>B1</p> <p>M1</p> <p>A1</p> <p>A1 ft (4)</p>
<p>(b)</p>	<p><math>\leftrightarrow</math> Horizontal speed = “<math>u \cos \alpha</math>” = <math>24 \text{ ms}^{-1}</math></p> <p>Time to window <math>36 = 24t \Rightarrow t = 1.5 \text{ s}</math></p> $h = 0.8 + 10 \times 1.5 - \frac{1}{2} \times 9.8 \times 1.5^2$ <p><math>\approx 4.8 \text{ m}</math></p>	<p>B1</p> <p>M1 A1</p> <p>M1 A1 A1 ft</p> <p>A1 (7)</p>
<p>(c)</p>	<p>One of, e.g., air resistance; spin of ball; variation in <math>g</math>; wind.</p>	<p>B1 (1)</p> <p><b>(12 marks)</b></p>

Question Number	Scheme	Marks
7. (a)	<p style="text-align: center;"> <math display="block">\text{Ht of } \Delta = \sqrt{(15^2 - 9^2)}</math> <math display="block">= 12 \text{ cm}</math> </p> <div style="display: flex; justify-content: space-around; align-items: center;">  </div> <p style="text-align: center;">           Area                      324                      108                      432         </p> <p style="text-align: center;">           Distance of CM from <math>AE</math>                      9                      <math>18 + \frac{1}{3} \cdot 12 = 22</math>                      <math>\bar{x}</math> </p> <p style="text-align: center;"> <math>9 \cdot 324 + 22 \cdot 108 = 432 \bar{x}</math> </p> <p style="text-align: center;"> <math>\bar{x} = 12.25 \text{ cm}</math> </p>	<p>M1 A1</p> <p>M1 A1</p> <p>B1 B1 ft</p> <p>M1 A1</p> <p>A1                      (9)</p> <p>B1</p> <p>M1 A1</p> <p>A1                      (4)</p> <p style="text-align: right;"><b>(13 marks)</b></p>
	(b) Distance of $G$ from $BD = 9 \text{ cm}$	
	$\tan \theta = \frac{18 - 12.25}{9}$	
	$\theta = 32.6^\circ$	

Question Number	Scheme	Marks
8.	 <p data-bbox="422 309 746 488"> <math display="block">3u \rightarrow \quad \leftarrow 2u</math> <math display="block">\bullet \quad \bullet</math> <math display="block">\leftarrow v \quad w \rightarrow</math> </p>	
(a)	$3mu - 2mu = 2mw - mv$ $4eu = w + v$ <p data-bbox="462 683 758 750">Solve <math>w = \frac{1}{3}(1 + 4e)u</math></p>	<p data-bbox="1289 566 1380 600">M1 A1</p> <p data-bbox="1289 622 1380 656">M1 A1</p> <p data-bbox="1289 701 1487 734">M1 A1 (6)</p>
(b)	$v = \frac{1}{3}(8e - 1)u$ $v > 0 \Rightarrow e > \frac{1}{8}$	<p data-bbox="1289 801 1380 835">M1 A1</p> <p data-bbox="1289 902 1487 936">A1 (3)</p>
(c)	<p data-bbox="454 992 893 1059">rebound speed of B = <math>\frac{1}{6}(1 + 4e)u</math></p> <p data-bbox="486 1081 1069 1160">2<sup>nd</sup> collision <math>\Rightarrow \frac{1}{6}(1 + 4e)u &gt; \frac{1}{3}(8e - 1)u</math></p> $1 + 4e > 16e - 2$ $3 > 12e$ $e < \frac{1}{4}$	<p data-bbox="1289 1003 1332 1037">B1</p> <p data-bbox="1289 1104 1332 1137">M1</p> <p data-bbox="1289 1328 1487 1361">M1 A1 (4)</p> <p data-bbox="1337 1395 1487 1429"><b>(13 marks)</b></p>