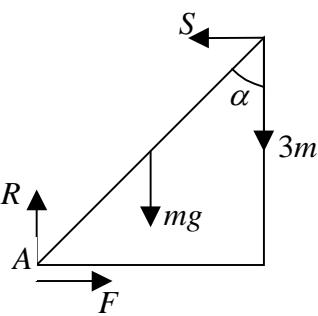
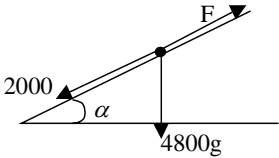


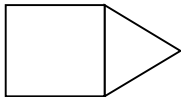
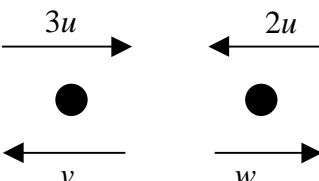


Question Number	Scheme	Marks
1.	$0.5\mathbf{v} - 0.5(-20\mathbf{i}) = 15\mathbf{i} + 10\mathbf{j}$ $\Rightarrow \mathbf{v} = 10\mathbf{i} + 20\mathbf{j}$ $\therefore \text{Speed} = \sqrt{(10^2 + 20^2)} \approx 22.4 \text{ m s}^{-1}$	M1 A1 A1 M1 A1 ft (5) <b>(5 marks)</b>
2.	$F \times 0.02, = \frac{1}{2}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

Question Number	Scheme	Marks
5.	<p>(a)</p> $F = 2000 + 4800g \cdot \frac{1}{20}, = 4352 \text{ N}$ $P = 12 \times 4652 \text{ W} \approx 52.2 \text{ kW}$  <p>(b)</p> $4800a = 4352 - 2000$ $a = 0.49 \text{ m s}^{-2}$ <p>(c) Max speed <math>\frac{52224}{V} = 2000</math></p> $V \approx 26.1 \text{ ms}^{-1}$	<p>M1 A1, A1</p> <p>M1 A1 ft</p> <p>(5)</p> <p>M1 A1 ft</p> <p>A1 (3)</p> <p>M1 A1</p> <p>A1 (3)</p> <p>(11 marks)</p>
6.	<p>(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>(b) <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>(c) One of, e.g., air resistance; spin of ball; variation in <math>g</math>; wind.</p>	<p>B1</p> <p>M1</p> <p>A1</p> <p>A1 ft (4)</p> <p>B1</p> <p>M1 A1</p> <p>M1 A1 A1 ft</p> <p>A1 (7)</p> <p>B1 (1)</p> <p>(12 marks)</p>

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

Question Number	Scheme	Marks
8.		
(a)	$3mu - 2mu = 2mw - mv$ $4eu = w + v$ $\text{Solve } w = \frac{1}{3}(1 + 4e)u$	M1 A1 M1 A1 M1 A1 (6)
(b)	$v = \frac{1}{3}(8e - 1)u$ $v > 0 \Rightarrow e > \frac{1}{8}$	M1 A1 A1 (3)
(c)	$\text{rebound speed of } B = \frac{1}{6}(1 + 4e)u$ $2^{\text{nd}} \text{ collision} \Rightarrow \frac{1}{6}(1 + 4e)u > \frac{1}{3}(8e - 1)u$ $1 + 4e > 16e - 2$ $3 > 12e$ $e < \frac{1}{4}$	B1 M1  M1 A1 (4) <b>(13 marks)</b>