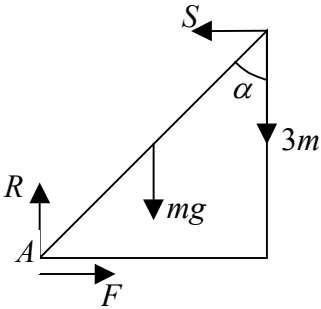
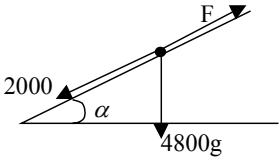


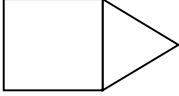
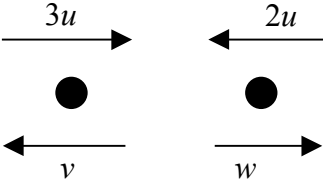


Question Number	Scheme	Marks
1.	$0.5\mathbf{v} - 0.5(-20\mathbf{i}) = 15\mathbf{i} + 10\mathbf{j}$ $\Rightarrow \mathbf{v} = 10\mathbf{i} + 20\mathbf{j}$ $\therefore \text{Speed} = \sqrt{(10^2 + 20^2)} \approx 22.4 \text{ m s}^{-1}$	M1 A1 A1 M1 A1 ft (5) (5 marks)
2.	$F \times 0.02, = \frac{1}{2} \times 0.006 (400^2 - 250^2)$ $F \approx 14600 \text{ N}$	M1 A1, M1 A1 A1 ft (5) (5 marks)
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) (7 marks)
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) (9 marks)

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

Question Number	Scheme	Marks																				
7. (a)	<p style="text-align: center;"> $\text{Ht of } \Delta = \sqrt{(15^2 - 9^2)}$ $= 12 \text{ cm}$ </p> <div style="display: flex; justify-content: space-around; align-items: center;">    </div> <p style="text-align: center;"> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Area</td> <td style="width: 20%; text-align: center;">324</td> <td style="width: 20%; text-align: center;">108</td> <td style="width: 20%; text-align: center;">432</td> <td style="width: 10%;"></td> </tr> <tr> <td>Distance of CM from AE</td> <td style="text-align: center;">9</td> <td style="text-align: center;">$18 + \frac{1}{3} \cdot 12 = 22$</td> <td style="text-align: center;">\bar{x}</td> <td></td> </tr> <tr> <td></td> <td colspan="3" style="text-align: center;">$9 \cdot 324 + 22 \cdot 108 = 432 \bar{x}$</td> <td></td> </tr> <tr> <td></td> <td colspan="3" style="text-align: center;">$\bar{x} = 12.25 \text{ cm}$</td> <td></td> </tr> </table> </p> <p>(b) Distance of G from $BD = 9 \text{ cm}$</p> <p style="text-align: center;"> $\tan \theta = \frac{18 - 12.25}{9}$ $\theta = 32.6^\circ$ </p>	Area	324	108	432		Distance of CM from AE	9	$18 + \frac{1}{3} \cdot 12 = 22$	\bar{x}			$9 \cdot 324 + 22 \cdot 108 = 432 \bar{x}$					$\bar{x} = 12.25 \text{ cm}$				<p>M1 A1</p> <p>M1 A1 B1 B1 ft M1 A1 A1 (9)</p> <p>B1 M1 A1 A1 (4)</p> <p style="text-align: right;">(13 marks)</p>
Area	324	108	432																			
Distance of CM from AE	9	$18 + \frac{1}{3} \cdot 12 = 22$	\bar{x}																			
	$9 \cdot 324 + 22 \cdot 108 = 432 \bar{x}$																					
	$\bar{x} = 12.25 \text{ cm}$																					

Question Number	Scheme	Marks
8.	 <p data-bbox="236 562 272 600">(a)</p> $3mu - 2mu = 2mw - mv$ $4eu = w + v$ <p data-bbox="464 683 751 757">Solve $w = \frac{1}{3}(1 + 4e)u$</p> <p data-bbox="236 801 272 840">(b)</p> $v = \frac{1}{3}(8e - 1)u$ $v > 0 \Rightarrow e > \frac{1}{8}$ <p data-bbox="236 1003 272 1041">(c)</p> <p data-bbox="459 987 895 1061">rebound speed of B = $\frac{1}{6}(1 + 4e)u$</p> $2^{\text{nd}} \text{ collision} \Rightarrow \frac{1}{6}(1 + 4e)u > \frac{1}{3}(8e - 1)u$ $1 + 4e > 16e - 2$ $3 > 12e$ $e < \frac{1}{4}$	<p data-bbox="1289 562 1374 600">M1 A1</p> <p data-bbox="1289 622 1374 660">M1 A1</p> <p data-bbox="1289 696 1485 734">M1 A1 (6)</p> <p data-bbox="1289 801 1374 840">M1 A1</p> <p data-bbox="1289 898 1485 936">A1 (3)</p> <p data-bbox="1289 1003 1326 1041">B1</p> <p data-bbox="1289 1099 1326 1137">M1</p> <p data-bbox="1289 1317 1485 1355">M1 A1 (4)</p> <p data-bbox="1337 1400 1485 1438">(13 marks)</p>