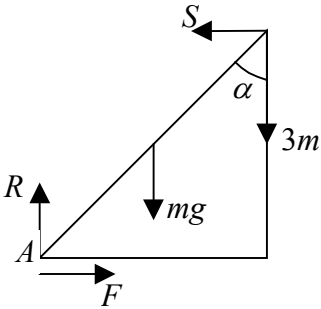
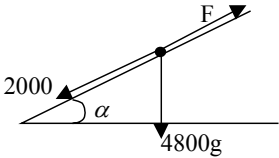
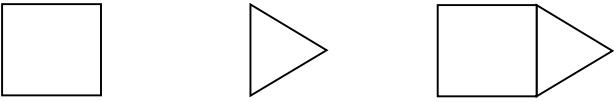
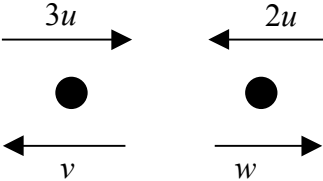


Question Number	Scheme	Marks
1.	$0.5\mathbf{v} - 0.5(-20\mathbf{i}) = 15\mathbf{i} + 10\mathbf{j}$ $\Rightarrow \mathbf{v} = 10\mathbf{i} + 20\mathbf{j}$ $\therefore \text{Speed} = \sqrt{(10^2 + 20^2)} \approx 22.4 \text{ m s}^{-1}$	M1 A1 A1 M1 A1 ft (5) <b>(5 marks)</b>
2.	$F \times 0.02, = \frac{1}{2} \times 0.006 (400^2 - 250^2)$ $F \approx 14600 \text{ N}$	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.	$R(\uparrow) \quad R = mg + 3mg = 4mg$ $R(\rightarrow) \quad S = F$ $M(A) \quad mg \cdot a \sin \alpha + 3mg \cdot 2a \sin \alpha = S \cdot 2a \cos \alpha$ $\rightarrow S = \frac{7}{2} mg \tan \alpha$  $\therefore F = S = \frac{7}{2} mg \tan \alpha, R = 4mg$ $F \leq \frac{1}{4} R \Rightarrow \frac{7}{2} mg \tan \alpha \leq mg \Rightarrow \tan \alpha \leq \frac{2}{7}$	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>(11 marks)</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>(12 marks)</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;"> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;"></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 style="text-align: center;">Area</td> <td></td> <td></td> <td></td> <td style="text-align: right;">M1 A1</td> </tr> <tr> <td style="text-align: center;">Distance of CM from <i>AE</i></td> <td style="text-align: center;">9</td> <td style="text-align: center;"><math>18 + \frac{1}{3} \cdot 12 = 22</math></td> <td style="text-align: center;"><math>\bar{x}</math></td> <td style="text-align: right;">B1 B1 ft</td> </tr> <tr> <td></td> <td colspan="3" style="text-align: center;"><math>9 \cdot 324 + 22 \cdot 108 = 432 \bar{x}</math></td> <td style="text-align: right;">M1 A1</td> </tr> <tr> <td></td> <td colspan="3" style="text-align: center;"><math>\bar{x} = 12.25 \text{ cm}</math></td> <td style="text-align: right;">A1 (9)</td> </tr> </table> </p> <p>(b) Distance of <i>G</i> from <i>BD</i> = 9 cm</p> <p style="text-align: center;"> <math display="block">\tan \theta = \frac{18 - 12.25}{9}</math> <math display="block">\theta = 32.6^\circ</math> </p>		324	108	432		Area				M1 A1	Distance of CM from <i>AE</i>	9	$18 + \frac{1}{3} \cdot 12 = 22$	$\bar{x}$	B1 B1 ft		$9 \cdot 324 + 22 \cdot 108 = 432 \bar{x}$			M1 A1		$\bar{x} = 12.25 \text{ cm}$			A1 (9)	<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;"><b>(13 marks)</b></p>
	324	108	432																								
Area				M1 A1																							
Distance of CM from <i>AE</i>	9	$18 + \frac{1}{3} \cdot 12 = 22$	$\bar{x}$	B1 B1 ft																							
	$9 \cdot 324 + 22 \cdot 108 = 432 \bar{x}$			M1 A1																							
	$\bar{x} = 12.25 \text{ cm}$			A1 (9)																							

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>	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)	<p data-bbox="454 985 893 1064">rebound speed of B = <math>\frac{1}{6}(1 + 4e)u</math></p> <p data-bbox="486 1086 1069 1153">2<sup>nd</sup> collision <math>\Rightarrow \frac{1}{6}(1 + 4e)u &gt; \frac{1}{3}(8e - 1)u</math></p> $1 + 4e > 16e - 2$ $3 > 12e$ $e < \frac{1}{4}$	B1 M1 M1 A1 (4) <b>(13 marks)</b>