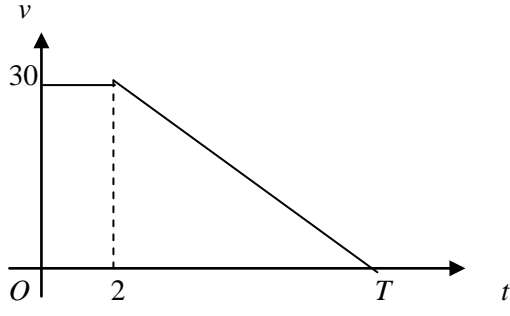
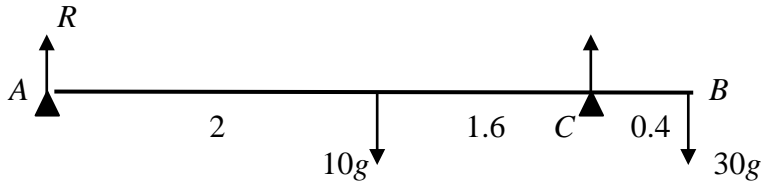
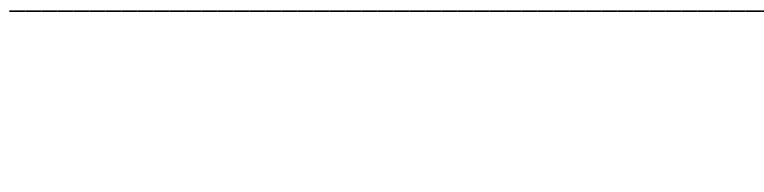


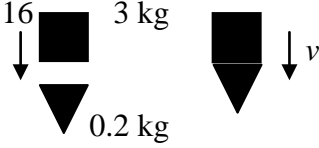
Question Number	Scheme	Marks
1 (a)		<p>Shape B1</p> <p>Figs (2, 30) B1 (2)</p>
(b)	$300 = \frac{1}{2} (2 + T) \times 30$ $\Rightarrow T = \underline{18 \text{ s}}$ <p><b>Or</b> If <math>t</math> is time decelerating (and clear from working):</p> $300 = 30 \times 2 + \frac{1}{2} \cdot 30 \cdot t$ $\Rightarrow t = 16 \text{ s} \Rightarrow \text{total time} = 18 \text{ s}$	<p>M1 A1</p> <p>A1 (3)</p> <p>M1 A1</p> <p>A1 (3)</p>

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## MARK SCHEME

Question Number	Scheme	Marks
2 (a)	$3 \text{ kg: } 3g - T = 3 \times \frac{3g}{7}$ $\Rightarrow T = \frac{12g}{7} \text{ or } 16.8 \text{ N or } 17 \text{ N}$	M1 A1  A1 (3)
(b)	$m \text{ kg: } T - mg = m \cdot \frac{3g}{7}$ $\frac{12g}{7} = mg + \frac{3mg}{7}$ $\Rightarrow m = \underline{1.2}$	M1 A1 ↓ (Sub for $T$ and solve) M1  A1 (4)

Question Number	Scheme	Marks
3 (a)	 <p style="text-align: center;"> <math>M(C): R \times 3.6 + 30g \times 0.4 = 10g \times 1.6</math>  <math>\Rightarrow R = \underline{10.9 \text{ or } 11 \text{ or } 98/9 \text{ N}}</math> </p>	M1 A1 ↓ M1 A1 (4)
(b)	 <p style="text-align: center;"> Tilting about C <math>\Rightarrow</math> reaction at A = 0  <math>M(C): mg \times 3.6 + 10g \times 1.6 = 80g \times 0.4</math>  <math>\Rightarrow m = \underline{4.44 \text{ or } 4.4 \text{ or } 40/9 \text{ kg}}</math> </p>	M1 M1 A1 A1 (4)

Question Number	Scheme	Marks
4 (a)	 <p>CLM: <math>3 \times 16 = 3.2 \times v</math>  <math>\Rightarrow v = \underline{15 \text{ m s}^{-1}}</math></p>	M1 A1 A1 (3)
(b)	<p>Impulse-momentum: <math>(R - 3.2g)0.05 = 3.2 \times 15</math>  <math>\Rightarrow R = 960 + 3.2g \approx \underline{991}</math></p> <p><b>Or:</b> deceleration: <math>0 = 15 + 0.05a \Rightarrow a = -300 \text{ m s}^{-2}</math>  Hence <math>3.2g - R = 3.2 \times -300</math>  <math>\Rightarrow R = 960 + 3.2g \approx \underline{991}</math></p> <hr/> <p>Final M1 needs a three term equation .</p>	M1 A1 A1√ ↓ M1 A1 (5)  M1 A1 A1√ ↓ M1 A1 (5)

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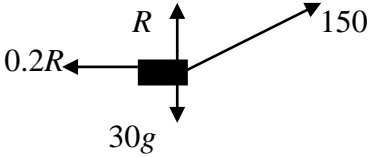
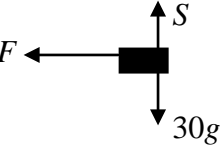
## MARK SCHEME

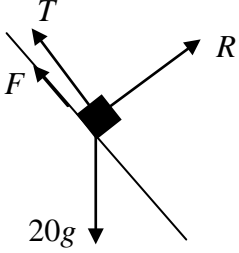

Question Number	Scheme	Marks
5 (a)	$\tan \theta = \frac{3}{2} \quad (\theta = 56.3^\circ)$ angle between $\mathbf{v}$ and $\mathbf{j} = 90 + 56.3 \approx 146^\circ$	M1 M1 A1 (3)
(b)	$\mathbf{v} = 2\mathbf{i} - 3\mathbf{j} + (-\mathbf{i} + 2\mathbf{j})t$ $= (2 - t)\mathbf{i} + (-3 + 2t)\mathbf{j}$	M1 A1 (2)
(c)	$t = 3, \mathbf{v} = -\mathbf{i} + 3\mathbf{j}$ $\text{speed} = \sqrt{(1^2 + 3^2)} = \underline{\sqrt{10} \text{ or } 3.16 \text{ m s}^{-1}}$	M1 M1 A1 (3)
(d)	$\mathbf{v} \text{ parallel to } \mathbf{i} \Rightarrow -3 + 2t = 0$ $\Rightarrow t = \underline{1.5 \text{ s}}$	M1 A1 (2)

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## MARK SCHEME

Question Number	Scheme	Marks
6 (a)	$v^2 = 20^2 + 2 \times 4 \times 78 \Rightarrow v = \underline{32 \text{ m s}^{-1}}$	M1 A1 (2)
(b)	$B: \quad 32 = 20 + 4t \Rightarrow t = 3 \text{ s}$ $A: \quad \text{Distance} = 30 \times t = \underline{90 \text{ m}}$	M1 A1√ ↓ M1 A1 (4)
(c)	$30T = 20T + \frac{1}{2} \cdot 4 \cdot T^2$ $2T^2 - 10T = 0$ $\Rightarrow t = (0 \text{ or}) \underline{5 \text{ s}}$	M1 ↓ M1 A1 ↓ M1 A1 (5)

Question Number	Scheme	Marks
7 (a)	 <p> <math>R(\uparrow) \quad R + 150 \sin 20 = 30g</math>  <math>\Rightarrow R \approx \underline{243 \text{ N}}</math> </p> <p> <math>R(\rightarrow): \quad 150 \cos 20 - 0.2R = 30a</math>  <math>\Rightarrow a \approx \underline{3.08 \text{ m s}^{-2}}</math> </p>  <p> <math>S = 30g \Rightarrow F = 0.2 \times 30g</math> </p> <p> <math>30a' = (-) 0.2 \times 30g \Rightarrow a' = (-) 0.2g (= 1.96)</math> </p> <p> <math>0 = 12^2 - 2 \times 0.2g \times s \quad \text{(using new } a')</math> </p> <p> <math>\Rightarrow s \approx \underline{36.7 \text{ m}}</math> </p>	<p>M1 A1</p> <p>A1 (3)</p> <p>M1 A1</p> <p>A1 (3)</p> <p>M1 A1</p> <p>M1 A1</p> <p>(using new <math>a'</math>) M1</p> <p>A1 (6)</p>

Question Number	Scheme	Marks
8 (a)	 <p>R(perp. to slope): <math>R = 20g \cos 60</math> (<math>= 10g = 98 \text{ N}</math>)</p> <p><math>F = 0.4R</math> (used)</p> <p>R(parallel to slope): <math>T + F = 20g \cos 30</math></p> <p><math>T = 10\sqrt{3}g - 4g \approx \underline{131 \text{ or } 130 \text{ N}}</math></p>	M1 A1 B1 M1 A2, 1, 0 ↓ M1 A1 (8)
(b)	 <p><math>R = 10g</math> as before</p> <p><math>T - 0.4R = 20g \cos 30</math></p> <p><math>T = 10\sqrt{3}g + 4g \approx \underline{209 \text{ or } 210 \text{ N}}</math></p>	B1 √ M1 A1 A1 (4)
(c) (i)	Friction acts down slope (and has magnitude $0.4R$ )	B1
(ii)	Net force on package = 0 (or equivalent), or 'no acceleration'	B1 (2)