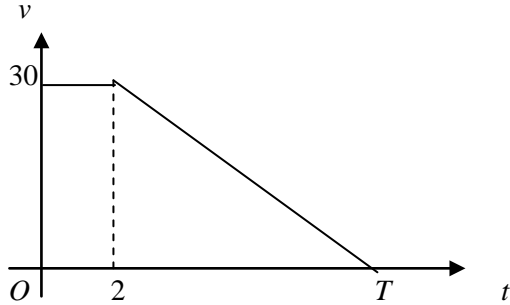
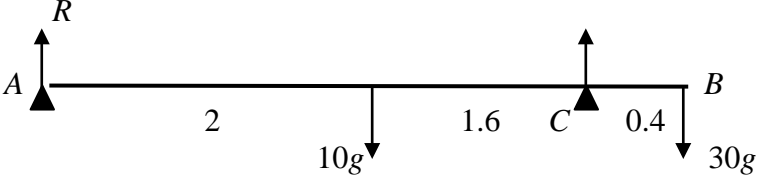
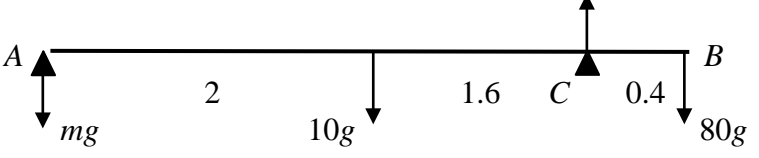
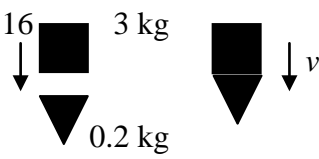


Question Number	Scheme	Marks
1 (a)	 <p data-bbox="223 313 734 616">A velocity-time graph with velocity v on the vertical axis and time t on the horizontal axis. The origin is labeled O. The graph consists of a horizontal line at $v = 30$ from $t = 0$ to $t = 2$, and a straight line from $(2, 30)$ to $(T, 0)$. A dashed vertical line is drawn at $t = 2$.</p>	<p data-bbox="1212 403 1452 436">Shape B1</p> <p data-bbox="1212 481 1492 548">Figs (2, 30) B1 (2)</p>
(b)	$300 = \frac{1}{2} (2 + T) \times 30$ $\Rightarrow T = \underline{18 \text{ s}}$ <p data-bbox="215 840 925 873">Or If t 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 data-bbox="1388 649 1484 683">M1 A1</p> <p data-bbox="1436 728 1500 795">A1 (3)</p> <p data-bbox="1364 907 1460 940">M1 A1</p> <p data-bbox="1420 985 1492 1052">A1 (3)</p>

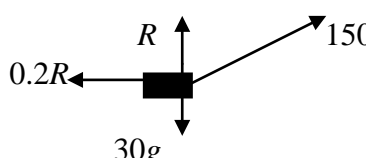
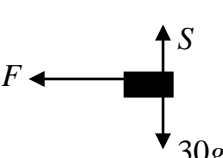
Question Number	Scheme	Marks
2 (a)	$3 \text{ kg: } 3g - T = 3 \times \frac{3g}{7}$ $\Rightarrow T = \frac{12g}{7} \text{ or } 16.8 \text{ N or } 17 \text{ N}$	M1 A1 A1 (3)
(b)	$m \text{ kg: } T - mg = m \cdot \frac{3g}{7}$ $\frac{12g}{7} = mg + \frac{3mg}{7}$ $\Rightarrow m = \underline{1.2}$	M1 A1 ↓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

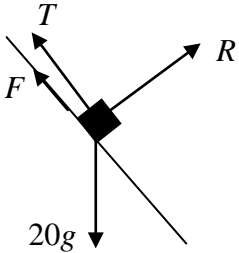
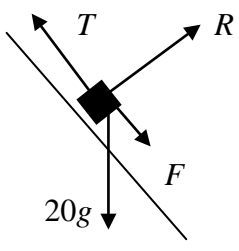
Question Number	Scheme	Marks
3 (a)	 <p style="text-align: center;"> $M(C): R \times 3.6 + 30g \times 0.4 = 10g \times 1.6$ $\Rightarrow R = \underline{10.9 \text{ or } 11 \text{ or } 98/9 \text{ N}}$ </p>	M1 A1 ↓ M1 A1 (4)
(b)	 <p style="text-align: center;"> Tilting about $C \Rightarrow$ reaction at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

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

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)

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)	<p>B: $32 = 20 + 4t \Rightarrow t = 3 \text{ s}$</p> <p>A: Distance = $30 \times t = \underline{90 \text{ m}}$</p>	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)	 $R(\uparrow) \quad R + 150 \sin 20 = 30g$ $\Rightarrow R \approx \underline{243 \text{ N}}$ $R(\rightarrow): \quad 150 \cos 20 - 0.2R = 30a$ $\Rightarrow a \approx \underline{3.08 \text{ m s}^{-2}}$  $S = 30g \Rightarrow F = 0.2 \times 30g$ $30a' = (-) 0.2 \times 30g \Rightarrow a' = (-) 0.2g (= 1.96)$ $0 = 12^2 - 2 \times 0.2g \times s \quad \text{(using new } a')$ $\Rightarrow s \approx \underline{36.7 \text{ m}}$	M1 A1 A1 (3) M1 A1 A1 (3) M1 A1 M1 A1 M1 A1 (6)

Question Number	Scheme	Marks
8 (a)	 <p>R(perp. to slope): $R = 20g \cos 60$ ($= 10g = 98 \text{ N}$)</p> <p>$F = 0.4R$ (used)</p> <p>R(parallel to slope): $T + F = 20g \cos 30$</p>	M1 A1 B1 M1 A2, 1, 0 ↓ M1 A1
(b)	 <p>$T = 10\sqrt{3}g - 4g \approx \underline{131 \text{ or } 130 \text{ N}}$</p> <p>$R = 10g$ as before</p> <p>$T - 0.4R = 20g \cos 30$</p> <p>$T = 10\sqrt{3}g + 4g \approx \underline{209 \text{ or } 210 \text{ N}}$</p>	(8) 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)