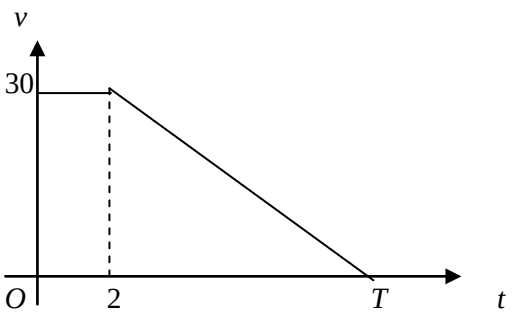
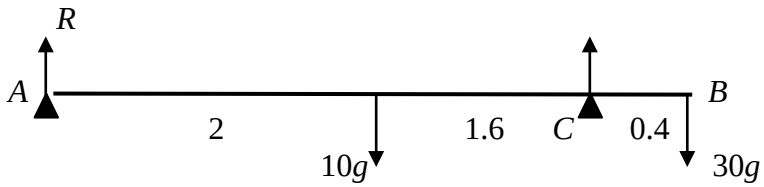
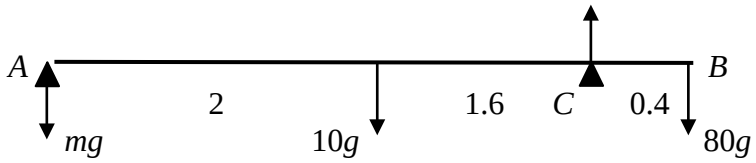
Question Number	Scheme	Marks
1 (a)		Shape B1 Figs (2, 30) B1 (2)
(b)	$300 = ½ (2 + T) \times 30$	M1 A1
	$\Rightarrow T = \underline{18 \text{ s}}$	A1 (3)
	Or If t is time decelerating (and clear from working):	
	$300 = 30 \times 2 + ½ .30.t$	M1 A1
	$\Rightarrow t = 16 \text{ s} \Rightarrow$ total time = 18 s	A1 (3)

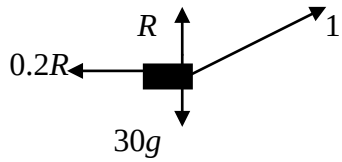
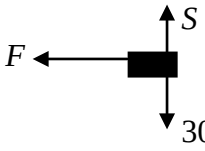
Question Number	Scheme	Marks
2 (a)	3 kg: $3g - T = 3 \times \frac{3g}{7}$	M1 A1
	$\Rightarrow T = \underline{\frac{12g}{7} \text{ or } 16.8 \text{ N or } 17 \text{ N}}$	A1
		(3)
(b)	m kg: $T - mg = m.\frac{3g}{7}$	M1 A1
	$\frac{12g}{7} = mg + \frac{3mg}{7}$ (Sub for T and solve)	M1
	$\Rightarrow m =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

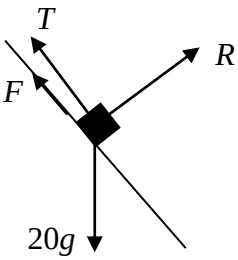
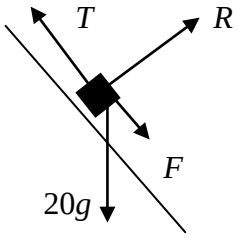
Question Number	Scheme	Marks
3 (a)		
	M(C): R x 3.6 + 30g x 0.4 = 10g x 1.6	M1 A1
	$\Rightarrow$ R = <u>10.9 or 11 or 98/9 N</u>	↓ M1 A1
		(4)
(b)		
	Tilting about C $\Rightarrow$ reaction at A = 0	M1
	M(C): mg x 3.6 + 10g x 1.6 = 80g x 0.4	M1 A1
	$\Rightarrow$ m = <u>4.44 or 4.4 or 40/9 kg</u>	A1
		(4)

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

Question Number	Scheme	Marks
5 (a)	$\tan\theta = \frac{3}{2}$ $(\theta = 56.3°)$	M1
	angle between **v** and **j** $= 90 + 56.3 \approx 146°$	M1 A1 (3)
(b)	$\mathbf{v} = 2\mathbf{i} - 3\mathbf{j} + (-\mathbf{i} + 2\mathbf{j})t$	M1
	$= (2 - t)\mathbf{i} + (-3 + 2t)\mathbf{j}$	A1 (2)
(c)	$t = 3$, $\mathbf{v} = -\mathbf{i} + 3\mathbf{j}$	M1
	speed $= \sqrt{(1^2 + 3^2)} = \underline{\sqrt{10 \text{ or } 3.16 \text{ m s}^{-1}}}$	M1 A1 (3)
(d)	**v** parallel to **i** $\Rightarrow$ $-3 + 2t = 0$	M1
	$\Rightarrow t = \underline{1.5 \text{ s}}$	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)	*B*: $32 = 20 + 4t \Rightarrow t = 3$ s	M1 A1√ ↓
	A: Distance $= 30 \times t = \underline{90 \text{ m}}$	M1 A1 (4)
(c)	$30T = 20T + \frac{1}{2} .4.T^2$	M1 ↓
	$2T^2 - 10T = 0$	M1 A1 ↓
	$\Rightarrow t = (0 \text{ or}) \underline{5 \text{ s}}$	M1 A1 (5)

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

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