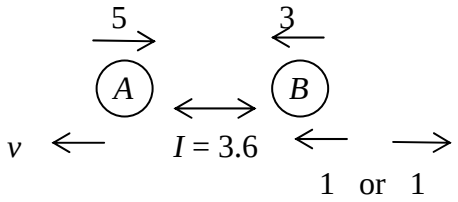
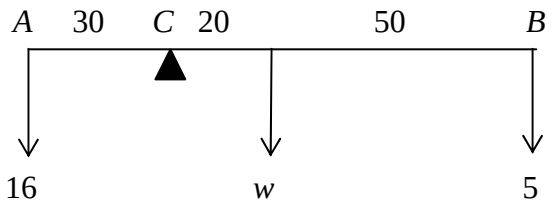
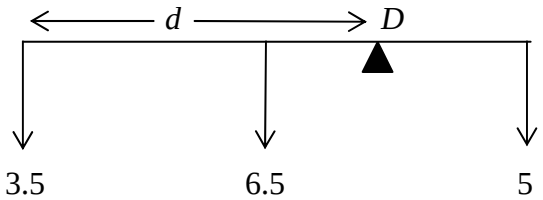
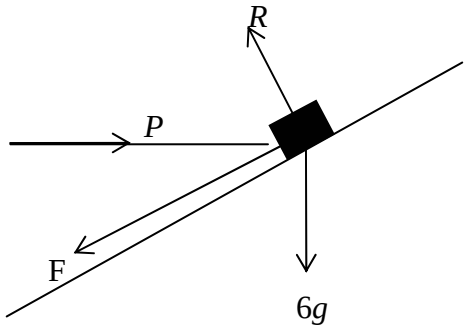
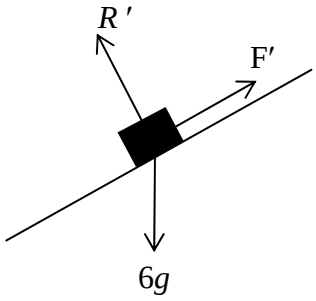
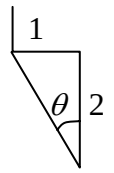
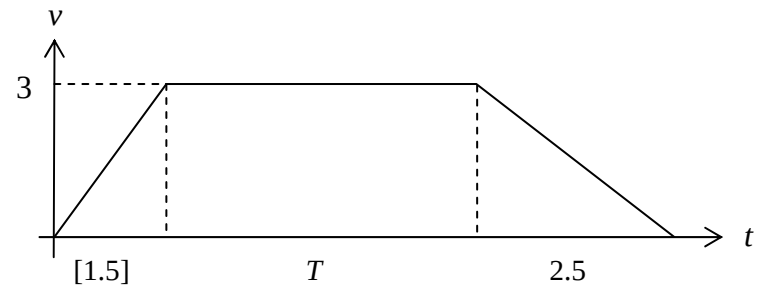
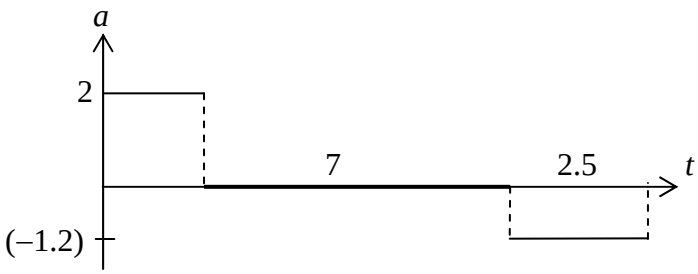
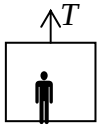
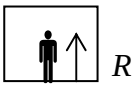
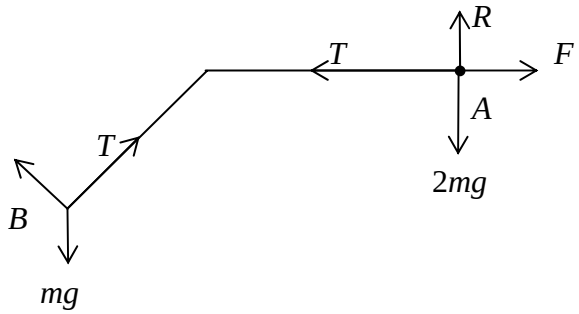
Question Number	Scheme	Marks
1. (*a*)	$s = ut + \frac{1}{2}at^2$: $50 = 5 \times 4 + \frac{1}{2} \times a \times 4^2$	M1 A1
	$\Rightarrow 30 = 8a \Rightarrow a = 3.75$ m s^{-1}	A1 **(3)**
(*b*)	$30^2 = 5^2 + 2 \times 3.75 \times s$	M1 A1 ft
	$\Rightarrow s = 116\frac{2}{3}$ m	A1 **(3)**
		(6 marks)
2.		
	Considering momentum of *A*: $3.6 = 0.5(5 + v)$	M1 A1
	$\Rightarrow v = 2.2$ m s^{-1}	A1 **(3)**
	Considering momentum of *B*: $3.6 = m(3 + 1)$ or $m(3 – 1)$	
	$m = 0.9$ or $m = 1.8$	M1 A1 (one) M1 A1 (both)
		(4)
		(7 marks)
3. (*a*)		
	M(*C*): $16 \times 30 = w \times 20 + 5 \times 70$ (3 terms)	M1 A1
	$\Rightarrow w = 6.5$ N	A1 **(3)**
(*b*)		
	M(*D*): $3.5d + 6.5(d – 50) = 5(100 – d)$	M1 A2ft (–1 eeoo)
	$\Rightarrow d = 55$ cm	A1 **(4)**
(*c*)	Tension equal along string, i.e. tensions = weights throughout *or* no contributions from strings in moments equation	B1 **(1)**
		(8 marks)

(ft = follow through mark; –1eeoo = minus one mark for each error or omission)

Question Number	Scheme	Marks
4. (*a*)		
	$F = \frac{2}{5}R$	B1
	R(↑): $R\cos 30° - F\cos 60° = 6g$	M1 A1
	$R\frac{\sqrt{3}}{2} - \frac{2}{5}R - \frac{1}{2} = 6g$	
	$\Rightarrow R = 88.3$ N (or 88 N)	A1 **(4)**
(*b*)	R(←): $P = R\cos 60° + F\cos 30°$	M1 A1
	$= 74.7$ N (or 75 N)	A1 **(3)**
(*c*)		
	Component of weight (↙) $= 6g\cos 60°$	
	$= 29.4$ N	B1
	$R' = 6g\cos 30° = 50.9$ N	M1 A1
	$F_{max} = 0.4R' = 20.36$ N	M1
	Since 29.4 > 20.36, the box moves	A1 cso **(5)**
		(12 marks)
5. (*a*)		
	$\tan\theta = \frac{1}{2} \Rightarrow \theta = 26.6°$	M1 A1
	angle required $= 153.4°$	A1 **(3)**
(*b*)	$\mathbf{a} = \frac{1}{3}[(\mathbf{i} - 2\mathbf{j}) - (-5\mathbf{i} + 7\mathbf{j})]$	M1
	$= (2\mathbf{i} - 3\mathbf{j})$ m s^{-2}	A1 **(2)**
(*c*)	$\mathbf{F} = m\mathbf{a} = 4\mathbf{i} - 6\mathbf{j}$	M1
	$\lvert\mathbf{F}\rvert = \sqrt{(16 + 36)} = 7.21$ N	M1 A1 **(3)**
(*d*)	$\mathbf{v} = (-5 + 2t)\mathbf{i} + (7 - 3t)\mathbf{j}$	M1 A1ft **(2)**
(*e*)	$\mathbf{v}$ parallel to $\mathbf{i} + \mathbf{j} \Rightarrow \frac{-5 + 2t}{7 - 3t} = 1$	M1
	$\Rightarrow t = 2.4$ s	M1 A1 **(3)**
		(13 marks)

(cso = correct solution only)

Question Number	Scheme	Marks
6. (*a*)	 shape	B1
	(3, 2.5)	B1 **(2)**
(*b*)	Area = $27 = \frac{1}{2} \times 1.5 \times 3 + 3T + \frac{1}{2} \times 2.5 \times 3$	M1 A1
	$\Rightarrow \quad T = 7$ s	A1 **(3)**
(*c*)	 shape $0 \leq t \leq 8.5$	B1
	shape $t > 8.5$	B1
	(2, 7 (ft), 2.5)	B1 **(3)**
(*d*)	 (System)	
	$T - 200g = 200 \times 2$	M1 A1
	$\Rightarrow T = 2360$ N	A1 **(3)**
(*e*)	 (Man)	
	$R - 80g = -80 \times 1.2$	M1 A1
	$\Rightarrow R = 688$ N	A1 **(3)**
		(14 marks)

Question Number	Scheme	Marks
7. (*a*)		
	$R = 2mg \Rightarrow F = 2\mu mg$	B1
	$A: T - 2\mu mg = 2ma$	M1 A1
	$B: mg \times \frac{1}{2} - T = ma$	M1 A1
	Eliminating T: $3ma = \frac{1}{2}mg - 2\mu mg$	M1
	$a = \frac{1}{6}(1 - 4\mu)g$ (✱)	A1 **(7)**
(*b*)	$\mu = 0.2 \Rightarrow a = \frac{1}{30}g$	B1
	when string breaks: $v^2 = 2 \times \frac{1}{30}g \times h = \frac{1}{15}gh$	M1 A1
	A decelerating with deceleration $f \Rightarrow 2mf = 2\mu mg$	
	$f = \mu g = \frac{1}{5}g$	B1
	Hence distance travelled during deceleration is given by $\frac{1}{15}gh = 2 \times \frac{1}{5}gd$	M1
	$\Rightarrow d = \frac{1}{6}h$	
	$\therefore$ Total distance $= \frac{7}{6}h$	A1 cso **(6)**
(*c*)	Any two from: weight of pulley; friction at pulley; friction on slope; weight of string; string extensible; 'spin' of particle	B1 B1 **(2)**
		(15 marks)

((✱) indicates final line is given on the paper; cso = correct solution only)