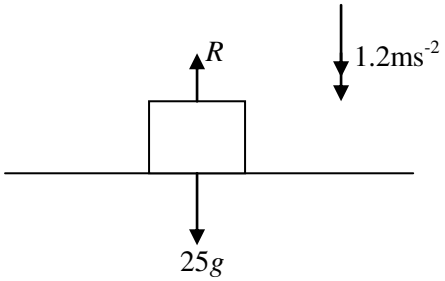
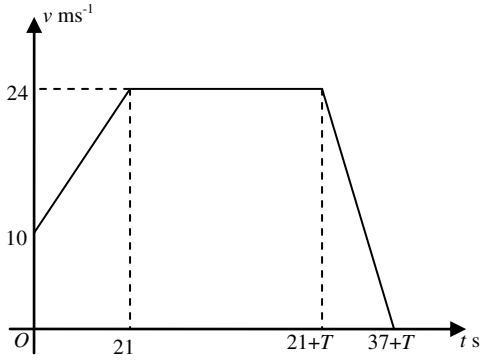
M1

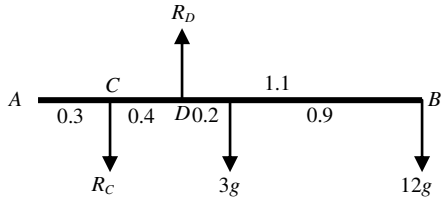
Q	Solution	Mark	Notes
1(a)			
	Apply N2L to crate	M1	*R* and 25*g* opposing. Dim. Correct
	$25g - R = 25 \times 1.2$	A1	correct equation Any form
	$R = \underline{215\ (\text{N})}$	A1	
1(b)	$R = 25g = \underline{245\ (\text{N})}$	B1	

Q	Solution	Mark	Notes
2(a)	Use of $v = u + at$ with u=10, v=24, t=21	M1	oe
	$24 = 10 + 21a$	A1	
	$a = \frac{2}{3}$ (ms^{-2})	A1	accept anything derived from $\frac{2}{3}$ rounded correctly
2(b)	$s = \frac{1}{2}(u + v)t$ with v=0, u=24, t=16	M1	oe
	$s = \frac{1}{2} \times 24 \times 16$	A1	
	$s =$ <u>192 (m)</u>	A1	
2(c)			
		B1	(0, 10) to (21, 24)
		B1	(21, 24) to (21+T, 24)
		B1	(21+T, 24) to (37+T, 0)
		B1	all labels, units and shape.
2(d)	Area under graph = 15000	M1	used
	$0.5(10+24)21 + 24T + 192 = 15000$	A1	ft (b)
		B1	$0.5(10+24)21$ or $24T$ Ft graph
	$24T = 14451$		
	$T =$ <u>602(.125)</u>	A1	Accept 600 from correct working. Cao.

Q	Solution	Mark	Notes
3(a)	Resolve perpendicular to plane		
	$R = mg\cos\alpha$	M1	sin/cos
	$F = \mu mg\cos\alpha$	m1	correct expression
	$F = 0.6 \times 7 \times 9.8 \times \frac{4}{5}$		
	$F = \underline{32.9(28\text{ N})}$	A1	Accept rounding to 32.9.
3(b)	Apply N2L to A	M1	dim correct equation Friction opposes motion 4 terms. Accept cos.
	$T + mg\sin\alpha - F = 7a$ $T + 41.16 - 32.928 = 7a$ $T + 8.232 = 7a$	A1	ft (a)
	Apply N2L to B $3g - T = 3a$	M1 A1	dim correct equation
	$3g + 8.232 = 10a$	m1	one variable eliminated Dep on both M's
	$a = \underline{3.7(632\text{ ms}^{-2})}$	A1	cao
	$T = \underline{18.1(104\text{ N})}$	A1	cao

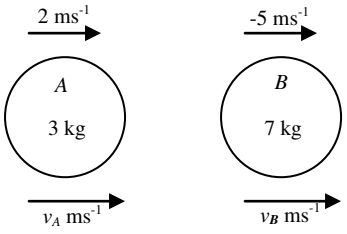
Q	Solution	Mark	Notes

4.



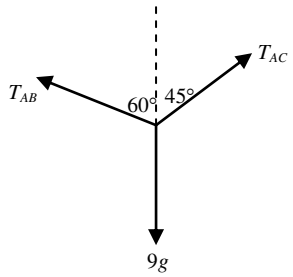
	B1	any 1 correct moment.
Take moments about C	M1	dim correct equation. oe
$0.4R_D = 3g\times0.6 + 12g\times1.5$	A1	correct equ any form
$0.4R_D = 19.8g = 194.04$		
$R_D = 49.5g = \underline{485.1\ (N)}$	A1	cao
Resolve vertically	M1	equation attempted. Or 2nd moment equation.
$R_D = R_C + 15g$	A1	
$R_C = 34.5g = \underline{338.1\ (N)}$	A1	cao
<u>Alternative solution</u>		
Moment equation about A/centre/B	M1	
Correct equation	B1	
Second moment equation	M1	
Correct equation	A1	
Correct method for solving simultaneously	m1	Dep on both M's
$R_C = 34.5g = \underline{338.1\ (N)}$	A1	cao
$R_D = 49.5g = \underline{485.1\ (N)}$	A1	cao

Q	Solution	Mark	Notes
5(a)	Resolve perpendicular to motion	M1	equation, sin/cos
	$20\sin60 + T\sin30 = 28\sin60$	A1	
	$20\frac{\sqrt{3}}{2} + T \times \frac{1}{2} = 28\ \frac{\sqrt{3}}{2}$	A1	convincing
	$T = \underline{8\sqrt{3}}$		
5(b)	N2L in direction of motion	M1	dim correct all forces and No extra force
	$20\cos60 + T\cos30 + 28\cos60 - 16 = 80a$	A2	-1 each error
	$20\times\frac{1}{2} + 8\sqrt{3}\times\frac{\sqrt{3}}{2} + 28\times\frac{1}{2} - 16 = 80a$		
	$a = \underline{0.25\ (ms^{-2})}$	A1	cao
5(c)	N2L $-16 = 80a$	M1	no extra force
	$a = -0.2$	A1	accept +/-
	Use of $v = u + at$, v=4, u=12, a=(+/-)0.2	m1	
	$4 = 12 - 0.2t$	A1	ft if $a<0$
	$t = \underline{40\ (s)}$	A1	ft if a<0

Q	Solution	Mark	Notes
6(a)			
	Conservation of momentum	M1	equation required Only one sign error. Ignore common factors
	$2\times3 - 7\times5 = 3v_A + 7v_B$ $3v_A + 7v_B = -29$	A1	
	Restitution	M1	v_B, v_A opposing consistent with diagram, +/-7 with the 0.6.
	$v_B - v_A = -0.6(-5 - 2)$ $v_B - v_A = 4.2$	A1	
	$-7v_A + 7v_B = 29.4$ $3v_A + 7v_B = -29$		
	$10v_A = -58.4$	m1	one variable eliminated. Dep on both M's.
	$v_A = (-)\underline{5.84}$	A1	cao
	$v_B = (-)\underline{1.64}$	A1	cao
6(b)	Impulse = change of momentum $I = 7v_B - 7(-5)$ $I = -11.48 + 35$	M1	used
	$I = \underline{23.52}$ (Ns)	A1	ft their v_A or v_B
6(c)	$3.65 = e(5.84)$		
	$e = \underline{0.625}$	B1	ft v_A if > 3.65.

Q	Solution	Mark	Notes

7.



Resolve horizontally	M1	equation, no extra force
$T_{AB} \sin 60 = T_{AC} \sin 45$	A1	
$\frac{\sqrt{3}}{2} T_{AB} = \frac{1}{\sqrt{2}} T_{AC}$		
$T_{AB} = \sqrt{\frac{2}{3}} T_{AC}$		
Resolve vertically	M1	equation, no extra force
$T_{AB}\cos 60 + T_{AC}\cos 45 = 9g$	A1	
$T_{AB} + \sqrt{2}\ T_{AC} = 18g$		
$\sqrt{\frac{2}{3}} T_{AC} + \sqrt{2}\ T_{AC} = 18g$	m1	
$T_{AC} =$ 79.(078) (N)	A1	cao allow 79
$T_{AB} =$ 64.(567) (N)	A1	cao allow 65

Alternative Method

Third angle 75°/105°	B1	
$\frac{T_{AB}}{\sin 45} = \frac{9g}{\sin 75}$	M1	sine rule attempted
$T_{AB} = \frac{9g \times \sin 45}{\sin 75}$	A1	si
$T_{AB} =$ 64.(567) (N)	A1	cao allow 65
$\frac{T_{AC}}{\sin 60} = \frac{9g}{\sin 75}$	M1	sine rule attempted
$T_{AC} = \frac{9g \times \sin 60}{\sin 75}$	A1	si
$T_{AC} =$ 79.(078) (N)	A1	cao allow 79

Q	Solution			Mark	Notes
8(a)	mass	AD	AB		
	$ABCD$ 72	6	3	B1	
	XYZ 12	6	2	B1	
	E 24	3	4		
	F 36	9	4	B1	both E and F correct
	Jewel 120	x	y	B1	masses in correct proportions.
8(a)(i)	Moments about AD			M1	masses and moments consistent.
	$120x + 12\times6 = 72\times6 + 24\times3 + 36\times9$			A1	ft table if triangle subt.
	$120x = 756$				
	$x = \frac{63}{10} = \underline{6.3(\text{cm})}$			A1	cao
8(a)(ii)	Moments about AB			M1	masses & moments consistent
	$120y + 12\times2 = 72\times3 + 24\times4 + 36\times4$			A1	ft table if triangle subt.
	$120y = 432$				
	$y = \frac{18}{5} = \underline{3.6\ (\text{cm})}$			A1	cao
8(b)	$PC = 12 - x$				
	$PC = \underline{5.7\ (\text{cm})}$			B1	ft their x if < 12.