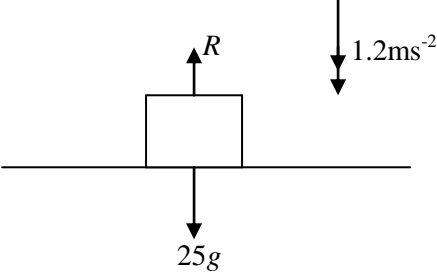
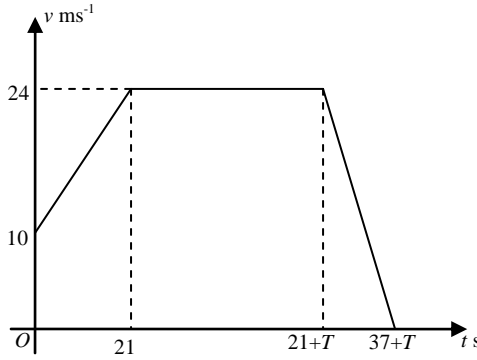


M1

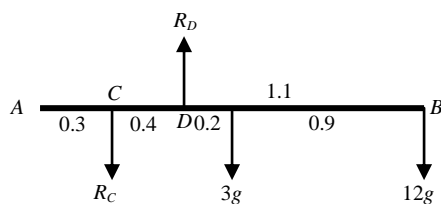
Q	Solution	Mark	Notes
1(a)	 <p>Apply N2L to crate</p> $25g - R = 25 \times 1.2$ $R = \underline{215 \text{ (N)}}$	M1 A1 A1	R and $25g$ opposing. Dim. Correct correct equation Any form
1(b)	$R = 25g = \underline{245 \text{ (N)}}$	B1	

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

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

Q	Solution	Mark	Notes
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4.



	B1	any 1 correct moment.
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Take moments about C

M1	dim correct equation. oe
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$$0.4R_D = 3g \times 0.6 + 12g \times 1.5$$

A1	correct equ any form
----	----------------------

$$0.4R_D = 19.8g = 194.04$$

$$R_D = 49.5g = \underline{485.1 \text{ (N)}}$$

A1	cao
----	-----

Resolve vertically

M1	equation attempted. Or 2 nd moment equation.
----	--

$$R_D = R_C + 15g$$

A1	
----	--

$$R_C = 34.5g = \underline{338.1 \text{ (N)}}$$

A1	cao
----	-----

Alternative solution

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
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$$R_C = 34.5g = \underline{338.1 \text{ (N)}}$$

A1	cao
----	-----

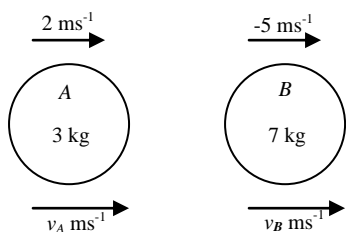
$$R_D = 49.5g = \underline{485.1 \text{ (N)}}$$

A1	cao
----	-----

Q	Solution	Mark	Notes
5(a)	Resolve perpendicular to motion $20\sin 60 + T\sin 30 = 28\sin 60$ $20\frac{\sqrt{3}}{2} + T \times \frac{1}{2} = 28\frac{\sqrt{3}}{2}$ $T = \underline{8\sqrt{3}}$	M1 A1 A1	equation, sin/cos convincing
5(b)	N2L in direction of motion $20\cos 60 + T\cos 30 + 28\cos 60 - 16 = 80a$ $20 \times \frac{1}{2} + 8\sqrt{3} \times \frac{\sqrt{3}}{2} + 28 \times \frac{1}{2} - 16 = 80a$ $a = \underline{0.25 \text{ (ms}^{-2}\text{)}}$	M1 A2 A1	dim correct all forces and No extra force -1 each error cao
5(c)	N2L $-16 = 80a$ $a = -0.2$ Use of $v = u + at$, $v=4$, $u=12$, $a=(+/-)0.2$ $4 = 12 - 0.2t$ $t = \underline{40 \text{ (s)}}$	M1 A1 m1 A1 A1	no extra force accept +/- ft if $a < 0$ ft if $a < 0$

Q	Solution	Mark	Notes
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6(a)



Conservation of momentum

$$2 \times 3 - 7 \times 5 = 3v_A + 7v_B$$

$$3v_A + 7v_B = -29$$

Restitution

$$v_B - v_A = -0.6(-5 - 2)$$

$$v_B - v_A = 4.2$$

$$-7v_A + 7v_B = 29.4$$

$$3v_A + 7v_B = -29$$

$$10v_A = -58.4$$

$$v_A = \underline{(-)5.84}$$

$$v_B = \underline{(-)1.64}$$

M1 equation required
Only one sign error.
Ignore common factors

A1

M1 v_B, v_A opposing consistent
with diagram, +/-7 with
the 0.6.

A1

m1 one variable eliminated.
Dep on both M's.

A1 cao

A1 cao

6(b) Impulse = change of momentum

$$I = 7v_B - 7(-5)$$

$$I = -11.48 + 35$$

$$I = \underline{23.52 \text{ (Ns)}}$$

M1 used

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 .

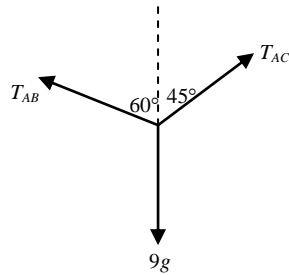
Q

Solution

Mark

Notes

7.



Resolve horizontally

$$T_{AB} \sin 60 = T_{AC} \sin 45$$

$$\frac{\sqrt{3}}{2} T_{AB} = \frac{1}{\sqrt{2}} T_{AC}$$

$$T_{AB} = \sqrt{\frac{2}{3}} T_{AC}$$

M1

equation, no extra force

A1

Resolve vertically

$$T_{AB} \cos 60 + T_{AC} \cos 45 = 9g$$

$$T_{AB} + \sqrt{2} T_{AC} = 18g$$

$$\sqrt{\frac{2}{3}} T_{AC} + \sqrt{2} T_{AC} = 18g$$

M1

equation, no extra force

A1

m1

$$T_{AC} = \underline{79.(078) \text{ (N)}}$$

$$T_{AB} = \underline{64.(567) \text{ (N)}}$$

A1

cao allow 79

A1

cao allow 65

Alternative Method

Third angle $75^\circ/105^\circ$

B1

$$\frac{T_{AB}}{\sin 45} = \frac{9g}{\sin 75}$$

$$T_{AB} = \frac{9g \times \sin 45}{\sin 75}$$

$$T_{AB} = \underline{64.(567) \text{ (N)}}$$

M1

sine rule attempted

A1

si

A1

cao allow 65

$$\frac{T_{AC}}{\sin 60} = \frac{9g}{\sin 75}$$

$$T_{AC} = \frac{9g \times \sin 60}{\sin 75}$$

$$T_{AC} = \underline{79.(078) \text{ (N)}}$$

M1

sine rule attempted

A1

si

A1

cao allow 79

Q	Solution	Mark	Notes
8(a)	mass	<i>AD</i> <i>AB</i>	
	<i>ABCD</i> 72	6 3	B1
	<i>XYZ</i> 12	6 2	B1
	<i>E</i> 24	3 4	
	<i>F</i> 36	9 4	B1 both <i>E</i> and <i>F</i> correct
	Jewel 120	<i>x</i> <i>y</i>	B1 masses in correct proportions.
8(a)(i)	Moments about <i>AD</i>	M1	masses and moments consistent.
	$120x + 12 \times 6 = 72 \times 6 + 24 \times 3 + 36 \times 9$	A1	ft table if triangle subt.
	$120x = 756$		
	$x = \frac{63}{10} = \underline{6.3(\text{cm})}$	A1	cao
8(a)(ii)	Moments about <i>AB</i>	M1	masses & moments consistent
	$120y + 12 \times 2 = 72 \times 3 + 24 \times 4 + 36 \times 4$	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 <i>x</i> if < 12.