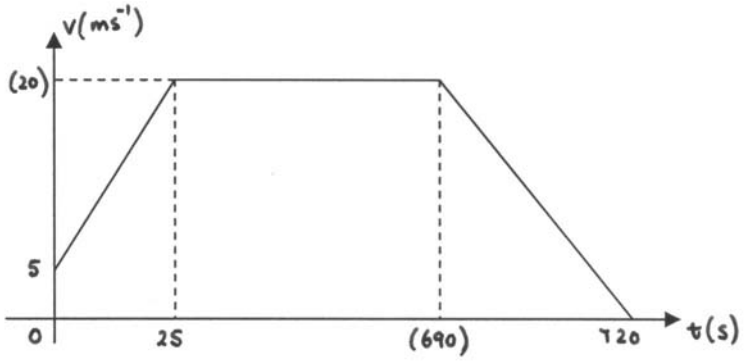
MATHEMATICS M1

1. *(a)* Using $v = u + at$ with $u = 5$, $a = 0.6$, $t = 25$ — M1
$v = 5 + 0.6 \times 25$ — A1
$v = \underline{20\ \text{ms}^{-1}}$ — A1

(b)



M1 A1 A1

(c) Using $v = u + at$ with $u = 20$, $v = 0$, $t = 30$ — M1

$a = -\dfrac{20}{30}$

magnification of deceleration $= -\dfrac{2}{3}$ — ft(a) — A1

(d) Distance = Area under graph — used — M1
Distance = $0.5\ (5 + 20)\ 25 + 20(690 - 25) + 0.5\ (20)(30)$ — B1(ft)
Distance = $\underline{13912.5\text{m}}$ — A1(ft)

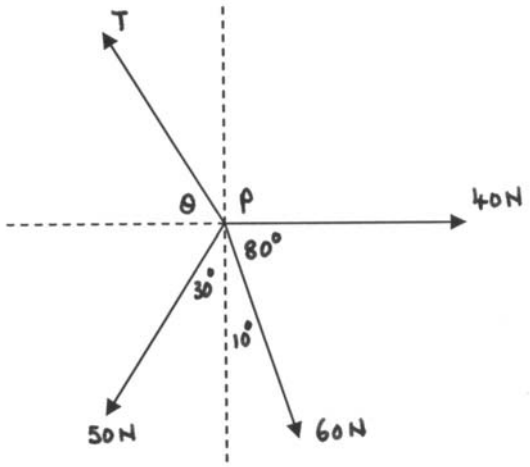
2. *(a)* Using $s = ut + 0.5at^2$ with $s = (-)1.75$, $a = (-)9.8$, $t = 2.5$ — M1
$-1.75 = 25u - 4.9 \times 2.5^2$ — A1
$u = \underline{11.55\text{ms}^{-1}}$

(b) Using $v^2 = u^2 + 2as$ with $v = 0$, $u = 11.55$(c), $a = (-)9.8$ — M1
$0 = 11.55^2 - 2 \times 9.8s$ — A1
$s = 6.80625$
Therefore greatest height above ground $= 6.80625 + 1.75$
$= \underline{8.55625\ \text{m}}$ — cao — A1

(c) Using $v = u + at$ with $u = 11.55$(c), $a = (-)9.8$, $t = 2.5$ — M1
$v = 11.55 - 9.8 \times 2.5$ — A1
$v = \underline{-12.95\ \text{ms}^{-1}}$
Therefore speed $= \underline{12.95}\ \text{ms}^{-1}$ — cao — A1

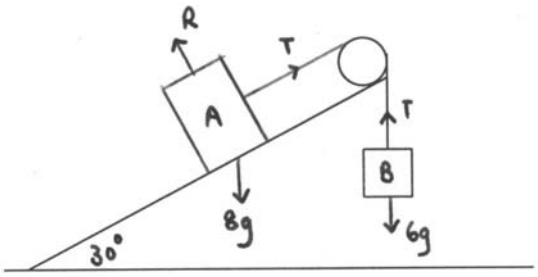
(d) Speed after bounce $= 0.8 \times 12.95$ — M1
$= \underline{10.36\ \text{ms}^{-1}}$ — ft(c) — A1

3.



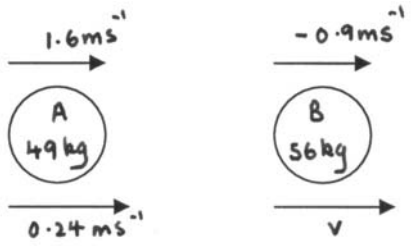
Resolve in any direction.		M1
$T\cos\theta + 50\sin 30^o = 40 + 60\cos 80^o$		B1 A1
$T\cos\theta = 40 - 25 + 60\cos 80^o$		
$= 15 + 60\cos 80^o$		
Resolve in a direction to obtain independent equation		M1
$T\sin\theta = 50\cos 30^o + 60\cos 10^o$		A1 A1
sensible attempt to eliminate variable.		M1
$\tan\theta = \dfrac{50\cos 30° + 60\cos 10°}{15 + 60\cos 80°}$		
$\theta = \underline{76.06°}$	cao	A1
$T = \sqrt{(15 + 60\cos 80°)^2 + (50\cos 30° + 60\cos 10°)^2}$		
$T = \underline{105.5\text{ N}}$	cao	A1

4.



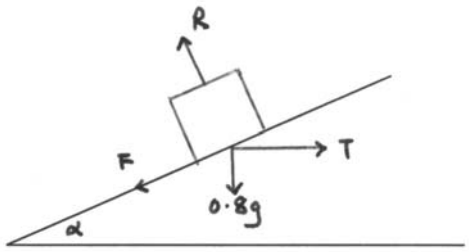
(a)	Apply N2L to B		M1
	$6g - T = 6a$		A1
	Apply N2L to A		M1
	$T - 8g\sin 25° = 8a$		A1
	Adding $6g - 8g\sin 25° = 14a$		m1
	$a = 1.4\text{ ms}^{-2}$	cao	A1
	$T = 6(g - a)$		
	$T = \underline{50.4\text{ N}}$	cao	A1
(b)	Magnitude of acceleration of A and B are equal.		B1

5.



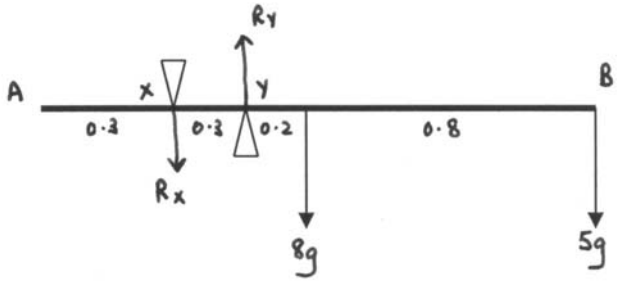
(a)	Conservation of momentum		M1
	$49 \times 1.6 - 56 \times 0.9 = 49 \times 0.24 + 56v$		A1
	$v = \underline{0.29}$	convincing	A1
(b)	Restitution		M1
	$0.29 - 0.24 = -e(-0.9 - 1.6)$		A1
	$e = \dfrac{0.05}{2.5} = 0.02$	cao	A1
(c)	$\lvert I \rvert = 56(0.29 + 0.9)$		M1
	$= \underline{66.64 \text{ Ns}}$		A1 B1
(d)	Objects are modelled as particles.		B1

6.



Resolve vertically	all forces, dim. correct	M1
$R \cos \alpha = 0.8g + F \sin \alpha$		A1
$F = 0R$		M1
$0.8R = 0.8g + 0.4R \times 0.6$		
$R = 14$ N	substitution of F	A1
Resolve horizontally	all forces, dim. Correct	M1
$R \sin \alpha + F \cos \alpha = T$		A1
$14 \times 0.6 + 0.4 \times 14 \times 0.8 = T$	elimination of variable	m1
$T = \underline{12.88 \text{ N}}$	cao	A1

7.



Moments about Y	all forces	M1
$0.3\ R_X = 0.2 \times 8g + 1 \times 5g$		A1 B1
$R_X = 22g$		
$R_X = \underline{215.6\ \text{N}}$	cao	A1
Resolve vertically		M1
$R_Y = R_X + 8g + 5g$		A1
$R_Y = 35g = \underline{343\ \text{N}}$	ft R_X only	A1

8. *(a)*

Particle	mass	from AC	from AB	
P	2m	7.5	0	B1
Q	3m	2.4	4.2	B1
R	5m	0	3.5	B1

(i) Moments about AC — equation — M1

$10\ \bar{x} = 7.5 \times 2 + 2.4 \times 3 + 0 \times 5$ — ft — A1

$10\ \bar{x} = 22.2$

$\bar{x} = \underline{2.22\ \text{cm}}$ — cao — A1

(ii) Moments about AB — M1

$10\ \bar{y} = 0 \times 2 + 4.2 \times 3 + 3.5 \times 5$ — ft — A1

$10\ \bar{y} = 30.1$

$\bar{y} = \underline{3.01\ \text{cm}}$ — cao — A1

(b) $\theta = \tan^{-1}\left(\dfrac{3.01}{8-2.22}\right)$ — ft — M1 A1

$\theta = \underline{27.51^\circ}$ — ft — A1