Mathematics M1

1. *(a)* Using $v^2 = u^2 + 2as$ with $v = 20$, $u = 12$, $s = 1000$ M1

$20^2 = 12^2 + 2 \times 1000a$ A1

$a = \dfrac{20^2 - 12^2}{2 \times 1000} = 0.128$ ms^{-1} convincing A1

(b) Using $s = 0.5(v + u)t$ with $s = 1000$, $u = 12$, $v = 20$ M1

$1000 = 0.5(12 + 20)t$ A1

$t = 62.5$ *s* A1

(c) Using $v = u + at$ with $u = 12$, $a = 0.128$, $t = 25$ M1

$v = 12 + 0.128 \times 25$ A1

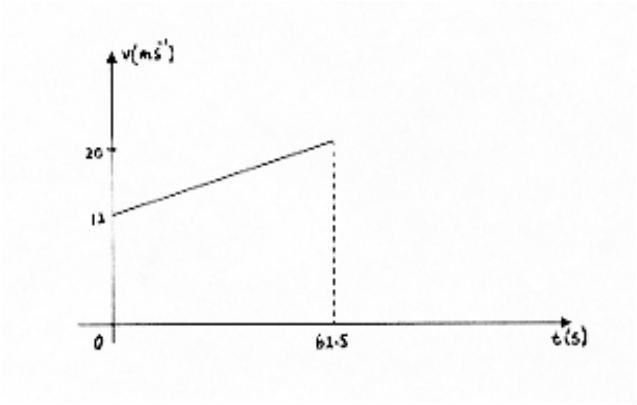
$= 15.2$ ms^{-1} A1

(d) Using $s = ut + 0.5at^2$ with $u = 12$, $t = 30$, $a = 0.128$ M1

$s = 12 \times 30 + 0.5 \times 0.128 \times 30^2$ A1

$= 417.6$ m A1

(e) M1 A1



2. Using $v^2 = u^2 + 2as$ with $u = 0$, $a = (-)9.8$, $s = 3.6$ M1

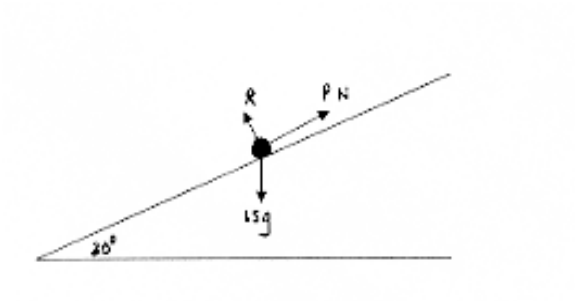
$v^2 = 2 \times 9.8 \times 3.6$ A1

$v = 8.4$ ms^{-1} A1

Therefore speed after rebound $= 0.3 \times 8.4$ M1

$= 2.52$ ms^{-1} ft v A1

3.



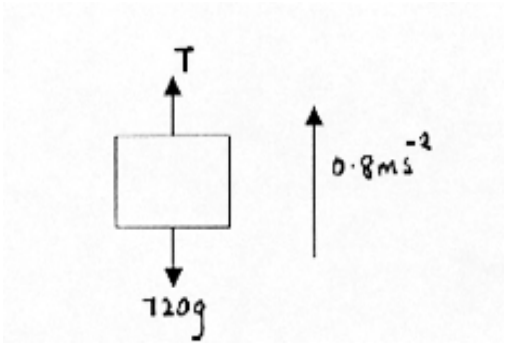
(a) Resolve perpendicular to plane

R = 15 *g* cos30°			B1
F = 0.2 ×15 *g* cos30°		ft R	B1
= 29.4 cos30°			
N2L parallel to plane		dim. correct	M1
15 *g* sin30°- F – P = 15*a*			A1
15*a* = 147 sin30°- 29.4 cos30° - 12			A1
a = 2.4 ms^{-2}		cao	A1

(b) On the point of sliding up, friction acts downwards.

P = 15 *g* sin30° + F		M1 A1
= 98.96 N		A1

4. *(a)*

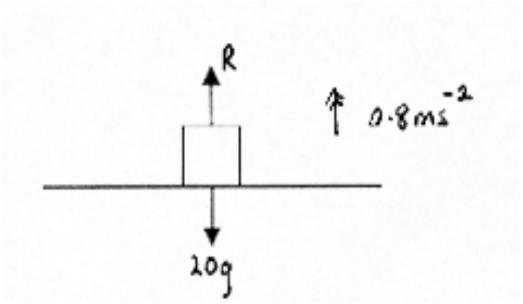


N2L $T - 720g = 720a$ M1 A1

$T = 720 \times 9.8 - 720 \times 0.8$

$= 7632$ N A1

(b)

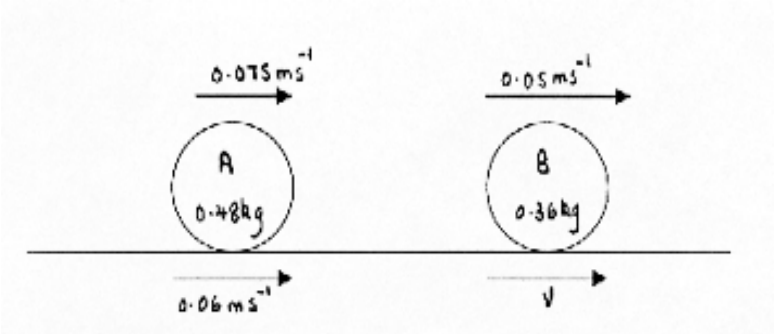


$R - 20g = 20 \times 0.8$ M1A1

$R = 20(9.8 + 0.8)$

$= 212$ N A1

5.



(a) Conservation of momentum M1

$0.48 \times 0.075 + 0.36 \times 0.05 = 0.48 \times 0.06 + 0.36v$ A1

$0.054 = 0.0288 + 0.36v$

$v = 0.07 \text{ ms}^{-1}$ A1

(b) Restitution M1

$0.07 - 0.06 = -e(0.05 - 0.075)$ ft v A1

$0.01 = 0.025e$

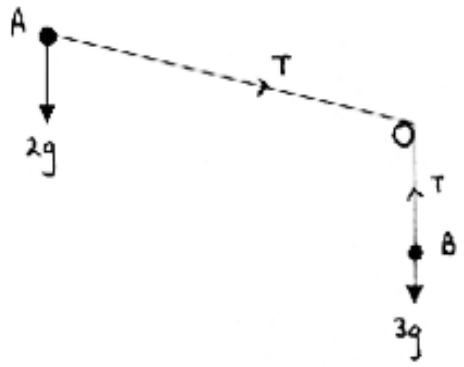
$e = 0.4$ A1

(c) Impulse on B = change in momentum for B

$I = 0.36(0.07 - 0.05)$ M1

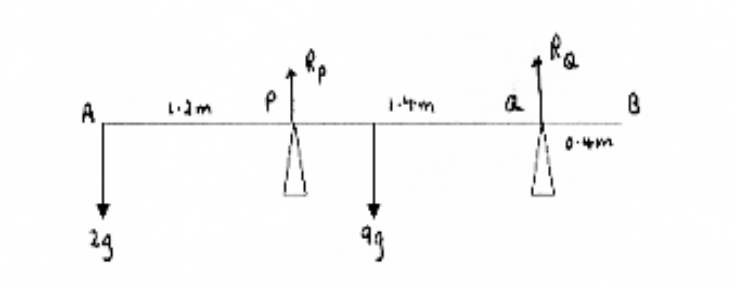
$= 0.0072$ (Ns) ft v A1

6.



N2l applied to *B*		dim. correct	M1
	$3g - T = 3a$		A1
N2L applied to *A*		dim. correct	M1
	$T + 2g\sin30° = 2a$		A1
Solving	$3g + g = 5a$		m1
	$a = 0.8g$		
	$= 7.84\ \text{ms}^{-2}$	cao	A1
	$T = 3(g - a)$		
	$= 3(9.8 - 7.84)$		
	$= 5.88$ N	cao	A1

7.



(a) Moments about *P* M1

$2g \times 1.2 = 9g \times 0.3 - R_Q \times 1.4$ B1 A1

$1.4\,R_Q = 2.7g - 2.4g$

$= 0.3g$

$R_Q = \dfrac{0.3 \times 9.8}{1.4}$

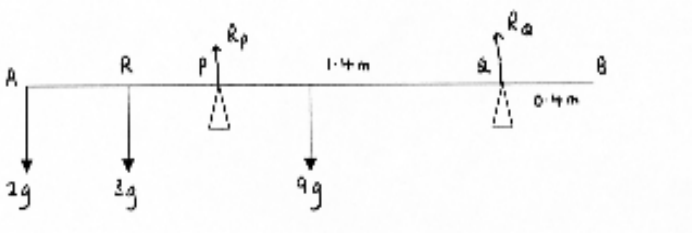
$= 2.1$ N cao A1

$R_P + R_Q = 11g$ M1 A1

$R_P = 11g - 2.1$

$= 105\ 7$ N cao A1

(b)



$R_Q = 0$ B1

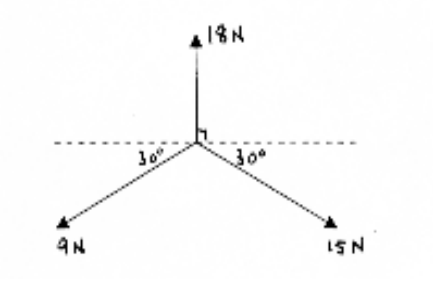
Moments about *P*

$3g(1.2 - x) = 9g \times 0.3 - 2g \times 1.2$ B1

$1.2 - x = 0.9 - 0.8$

$x = 1.1$m cao B1

8.



Resolve in 18 N direction M1

Y = 18 – 15 sin30°°° – 9 sin 30 A1

= 18 – 7.5 – 4.5

= 6 N

Resolve in direction perpendicular to 18 N M1

X = 15 sin60 – 9 sin60° A1

$= 6 \times \frac{\sqrt{3}}{2}$

$= 3\sqrt{3}$ N

Therefore resultant $= \sqrt{6^2 + (3\sqrt{3})^2}$ m1

$= \sqrt{63}$ ft X, Ys.i. A1

Angle between 18 N force and resultant = θ $= \tan^{-1}\left(\frac{3\sqrt{3}}{6}\right)$ oe m1

= 40.9° ft X,Y A1

9.*(a)*

	Mass	from *DE*	from *DB*		
rectangle	8	2	1	si	B1
triangle	9	5	2	si	B1
lamina	17	x	y	si	B1

Moments about *AB* M1

$17\ x = 8 \times 2 + 9 \times 5$ A1

$x = \dfrac{61}{17} = 3.588$ cao A1

Moments about *BC* M1

$17\ y = 8 \times 1 + 9 \times 2$ A1

$y = \dfrac{26}{61} = 1.529$ cao A1

(c) $\theta = \tan^{-1}\left(\dfrac{26}{61}\right)$ M1

$= 23.08°$ ft x, y A1