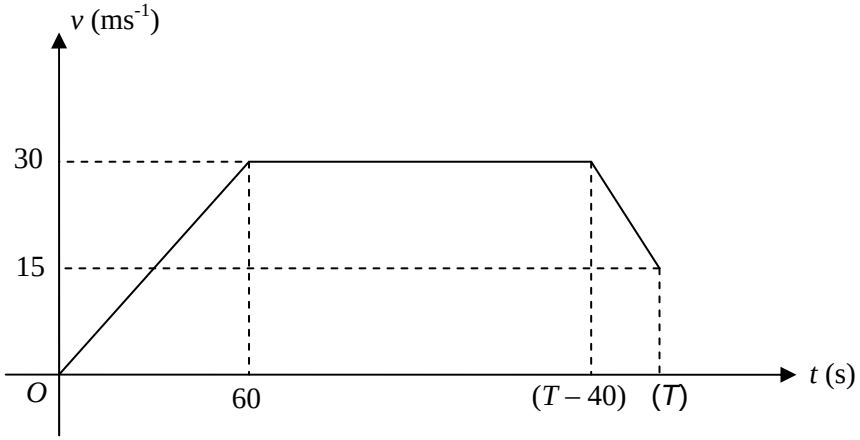
M1

1. (a)



v-*t* graph and (0, 0) to (60, 30) M1

(60, 30) to (?, 30) A1

(?, 30) to (?, 15) A1

All labels and units; all correct A1

(b) acceleration = $\frac{30 - 0}{60}$ M1

= $\underline{0.5\ ms^{-1}}$ A1

distance = $0.5 \times 60 \times 30$ any correct method M1

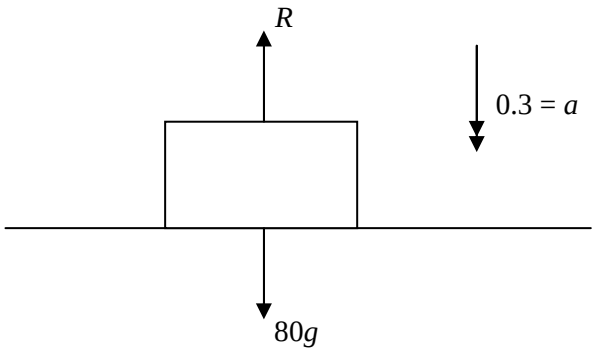
= $\underline{900\ m}$ A1

(c) Total area under graph = 24×1000 M1

$900 + (T - 40 - 60) \times 30 + 0.5 \times 40\ (30 + 15) = 24000$ A1 A1

Total time = T = $\underline{840\ s}$ A1

2. (a)

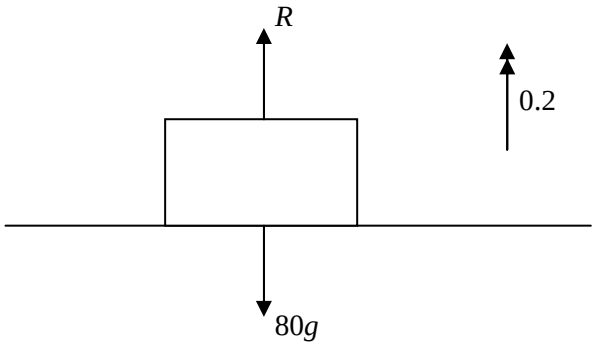


N2L applied to trunk dim. correct, R and 80g opposing M1

$80g - R = 80 \times 0.3$ A1

$R =$ <u>760 N</u> cao A1

(b)



N2L applied to trunk dim. correct, R and 80g opposing M1

$R - 80g = 80 \times 0.2$ A1

R = <u>800 N</u> cao A1

(c) $R = 80g$ since $a = 0$

$=$ <u>784 N</u> B1

3. (a) Using $v = u + at$ with $u = 0$, $t = 0.8$, $a = (+)\ 9.8$ (downwards positive) M1

$v = 0 + 9.8 \times 0.8$ A1

$v = \underline{7.84\ \text{ms}^{-1}}$ A1

(b) Using $v^2 = u^2 + 2as$ with $u = u$, $s = 0.9$, $v = 0$ (upwards positive) M1

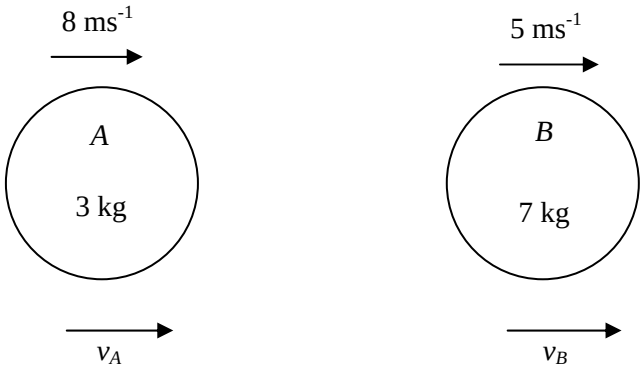
$0 = u^2 - 2 \times 9.8 \times 0.9$ A1

$u = \underline{4.2\ \text{ms}^{-1}}$ A1

Coefficient of restitution $= \dfrac{4 \cdot 2}{7 \cdot 84} = \left(\dfrac{15}{28}\right)$ M1

$= \underline{0.536}$ (to 3 sig figs) ft u, v A1

4. (a)



Conservation of momentum M1

$3 \times 8 + 7 \times 5 = 3v_A + 7v_B$ A1

Restitution M1

$v_B - v_A = -0.4(5 - 8)$ A1

$-7\,v_A + 7v_B = 8.4$

$3\,v_A + 7v_B = 59$

Subtract $10\,v_A = 50\ 6$ m1

$v_A = \underline{5.06\ \text{ms}^{-1}}$ cao A1

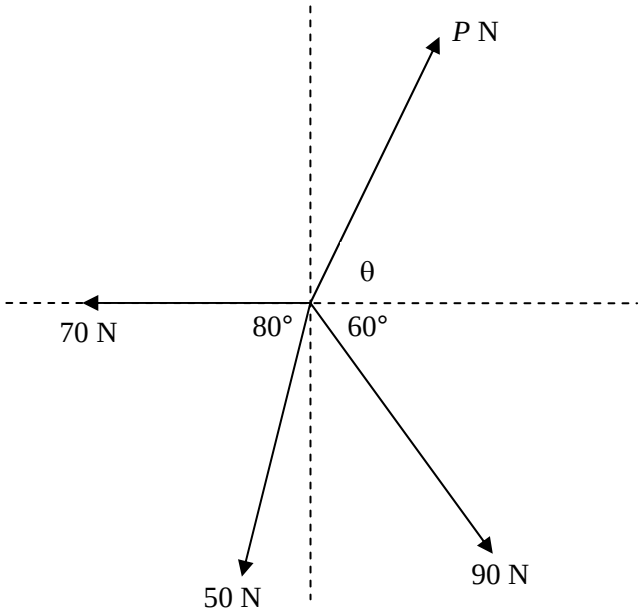
$v_B = \underline{6.26\ \text{ms}^{-1}}$ cao A1

(b) Impulse required = change in momentum of B used M1

$= 7(6.26 - 5)$

$= \underline{8.82\ \text{Ns}}$ ft $v_B > 5$ A1

5.



Resolve in direction parallel to 70 N ($\rightarrow$) all forces M1

$P\cos\theta + 90\cos60° = 70 + 50\cos80°$ A1

$P\cos\theta = 33{\cdot}6824$

Resolve in direction perpendicular to 70 N ($\uparrow$) all forces M1

$P\sin\theta = 90\sin60° + 50\sin80°$ A1

$P\sin\theta = 127.1827$

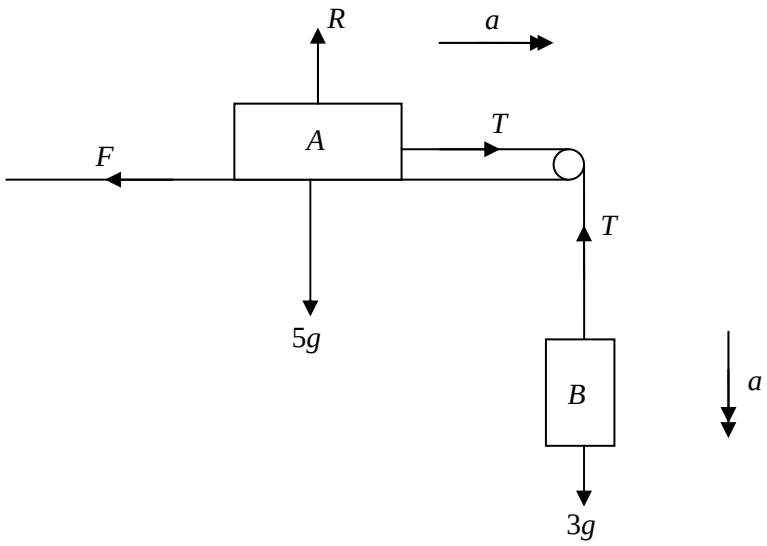
$P = \sqrt{33\cdot6824^2 + 127\cdot1827^2}$ M1

$P = \underline{131.6\text{ N}}$ ft A1

$\theta = \tan^{-1}\left(\frac{127\cdot1827}{33\cdot6824}\right)$ M1

$\theta = \underline{75.2°}$ ft A1

6. (a)



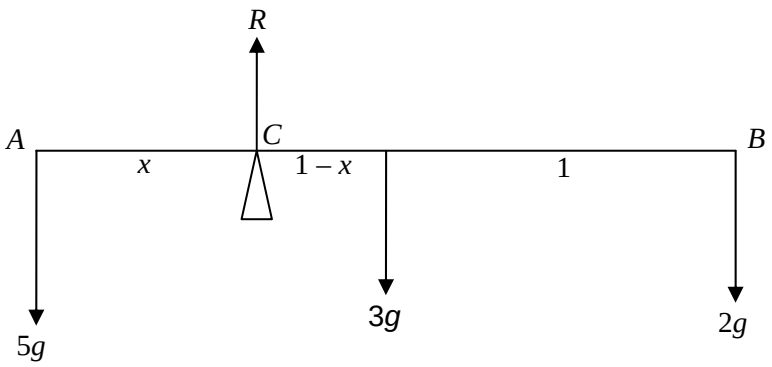
At A, resolve vertically	$R = 5g$	si	B1
Limiting friction $= \mu R = 0.4 \times 5g$		si	B1
	$F = 19.6$ N		
N2L applied to B			M1
	$3g - T = 3a$		A1
N2L applied to A			M1
	$T - F = 5a$	ft F	A1
Adding	$8a = 3 \times 9.8 - 19.6$		m1
	$a = \underline{1.225 \text{ ms}^{-2}}$	cao	A1
	$T = \underline{25.725 \text{ N}}$	cao	A1

(b) Least value of μ is given by $a = 0$ M1

$3g - 5\mu g = 0$ m1

least $\mu = \underline{0.6}$ cao A1

7.



Resolve vertically M1

$R = 5g + 3g + 2g$

$= 10g$

$= \underline{98\text{ N}}$ A1

Moments about C all forces M1

$5gx = 3g(1 - x) + 2g(2 - x)$ B1 A1

$5x = 3 - 3x + 4 - 2x$

$10x = 7$

$x = \underline{0.7}$ A1

8. (a)

	Area	from *AD*	from *AB*	
ABCD	120	5	6	B1
Circle	9π	4	7	B1
Lamina	$120 - 9\pi$	x	y	B1

Moments from *AD* M1

$120 \times 5 = 9\pi \times 4 + (120 - 9\pi) \times x$ A1

$x = \underline{5.308 \text{ cm}}$ cao A1

Moments from *AB* M1

$120 \times 6 = 9\pi \times 7 + (120 - 9\pi) \times y$ A1

$y = \underline{5.692 \text{ cm}}$ cao A1

(b) Required angle = $\theta = \tan^{-1}\left(\frac{y}{x}\right)$ M1

$\theta = \tan^{-1}\left(\frac{5 \cdot 692}{5 \cdot 308}\right)$ ft x, y A1

$\theta = \underline{47.0°}$ ft x, y A1

(c) *DP* = $\underline{5.308 \text{ cm}}$ ft x B1