Mathematics M1

Notes: cao = correct answer only, oe = or equivalent, si = seen or implied,
ft = follow through
(c) = candidate's value acceptable

1. (a) Use of $v^2 = u^2 + 2as$ with $u = (\pm)2.1$, $a = (\pm)9.8$, $s = (\pm)15.4$ M1

$v^2 = 2.1^2 + 2 \times 9.8 \times 15.4$ A1

$v = \underline{17.5 \text{ (ms}^{-1})}$ cao A1

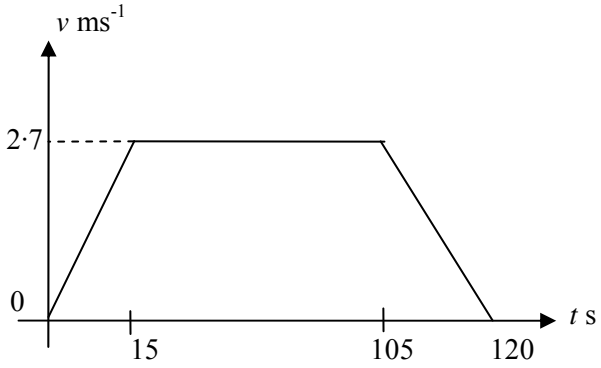
(b) Use of $v = u + at$ with $v = 17.5$(c), $a = (\pm)9.8$, $u = (\pm)2.1$ oe M1

$17.5 = 2.1 + 9.8t$ A1

$t = \dfrac{11}{7}$ cao A1

2.

(a)

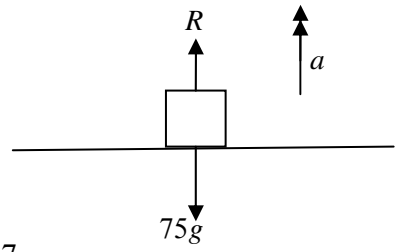


attempt at v-t graph with one correct section and axes M1
second correct section A1
completely correct graph with labels A1

(b) Distance = $0.5(90 + 120) \times 2.7$ attempt to calculate total area M1
any correct value for an area B1

$= \underline{283.5 \text{ (m)}}$ cao A1

(c)



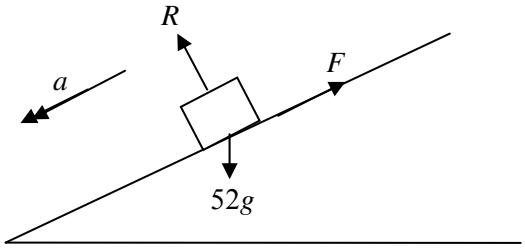
$a = \dfrac{2.7}{15} = (0{\cdot}18)$ B1

Apply N2L to woman $R - 75g = 75a$ all forces, dim correct M1
correct equation A1

$R = 75(9.8 + 0.18)$

$= \underline{748.5 \text{ (N)}}$ ft a A1

3.



$\sin\alpha = \frac{5}{13}$

$\cos\alpha = \frac{12}{13}$

Resolve perpendicular to plane M1

$R = 52g\cos\alpha$

Use of $F = \mu R$ m1

$= 0.2 \times 52 \times 9.8 \times \frac{12}{13}$ si A1

$= \underline{94.08 \text{ (N)}}$

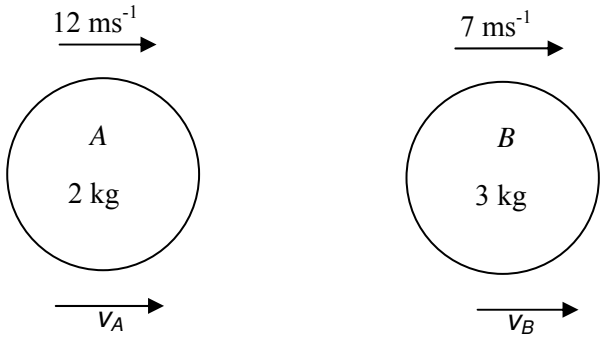
Apply N2L to object down slope Dim correct, all forces M1

$52g\sin\alpha - F = 52a$ A1

$52 \times 9.8 \times \frac{5}{13} - 94.08 = 52a$

$a = \underline{1.96 \text{ (ms}^{-2}\text{)}}$ cao A1

4.



(a) attempt at conservation of momentum equation M1

$2 \times 12 + 3 \times 7 = 2v_A + 3v_B$ A1

$2v_A + 3v_B = 45$

attempt at restitution equation M1

$v_B - v_A = -0.6(7 - 12)$ A1

$-3v_A + 3v_B = 9$

attempt to solve simultaneously dep. Both M's m1

$5\ v_A = 36$

$v_A = \underline{7.2 \text{ (ms}^{-1}\text{)}}$ cao A1

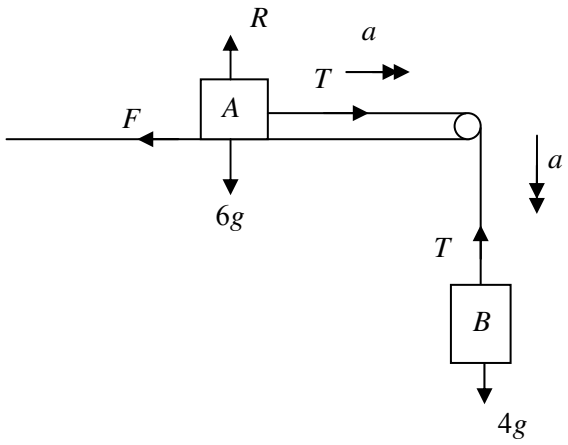
$v_B = \underline{10.2 \text{ (ms}^{-1}\text{)}}$ cao A1

(b) Use of Impulse = change in momentum M1

$I = 3(10.2 - 7)$

$= \underline{9.6 \text{ (Ns)}}$ ft sensible results only A1

5.



(a) Apply N2L to *B/A* M1

$4g - T = 4a$ A1

Apply N2l to other particle M1

$T - F = 6a$ A1

Resolve vertically, particle *A*

$R = 6g$ si B1

$F = \mu R = 0.4 \times 6g = 2.4g$ B1

attempt to solve equations simultaneously m1

$4g - 2.4g = 10a$

$a = \underline{0.16g} = \underline{1.568\ (ms^{-2})}$ cao A1

$T = \underline{32.928\ (N)}$ cao A1

(b) Light strings enable the assumption that tension is constant throughout the string to be used. B1

6. Attempt to resolve in direction of 12 N force M1

$Y = 12 - 5\sqrt{3} \sin 60° - 3\sqrt{2} \sin 45°$ A1

$Y = 1.5$

Attempt to resolve in perpendicular direction M1

$X = 5\sqrt{3} \cos 60° - 3\sqrt{2} \cos 45°$ A1

$X = 1.33$

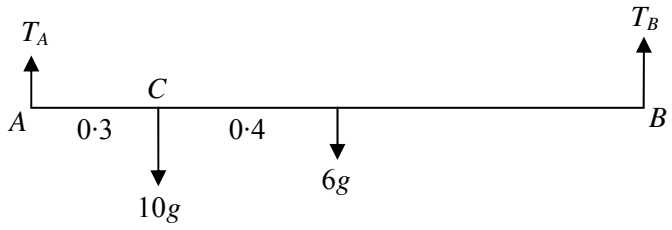
Resultant $R = \sqrt{(1.5)^2 + 1.33^2}$ M1

$= \underline{2.(0048)\ (N)}$ ft A1

$\theta = \tan^{-1}\left(\frac{1.33}{1.50}\right) = 41.6°$ M1

Dir of *R* is 41.6° to the right with the 12 N force ft A1

7.



Moments about A	dim. correct equation, all forces	M1
	any correct moment	B1
$1.4\,T_B = 0.7 \times 6g + 0.3 \times 10g$		A1
$T_B =$ <u>50.4 (N)</u>	cao	A1
Resolve vertically dim correct, all forces	oe	M1
$T_A + T_B = 16g$		A1
$T_A =$ <u>106.4 (N)</u>	ft T_B	A1

8.

Use of $s = ut + 0.5at^2$ with $s = 95$, $t = 5$	M1
$95 = 5u + 0.5 \times a \times 25$	A1
Use of $v = u + at$ with $t = 7$. $v = 29.8$	M1
$29.8 = u + 7a$	A1
attempt to solve simultaneously	m1
$10.8 = 4.5a$	
$a =$ <u>2.4</u> cao	A1
$u =$ <u>13</u> cao	A1

9. (a)

Lamina	Area	from AD	from AB
$ABCD$	80	4	5
XYZ	9	3	3
Decoration	89	x	y

one correct pair of distances B1
all four correct B1
correct areas B1

Moments about AD		M1
$89\,x = 80 \times 4 + 9 \times 3$	ft	A1
$x =$ <u>3.90 (cm)</u>	cao	A1
Moments about AB		M1
$89y = 80 \times 5 + 9 \times 3$	ft	A1
$y =$ <u>4.80 (cm)</u>	cao	A1

(b) $\theta = \tan^{-1}\left(\dfrac{x}{10 - y}\right)$ correct triangle M1

$= \tan^{-1}\left(\dfrac{3.9}{10 - 4.8}\right)$ ft A1

$=$ <u>36.9°</u>