

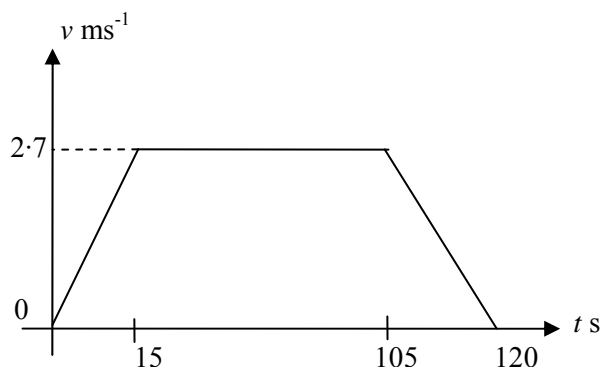
Mathematics M1

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
 $v = \underline{17.5 \text{ (ms}^{-1}\text{)}}$ 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
 $t = \frac{11}{7}$ cao A1

2.

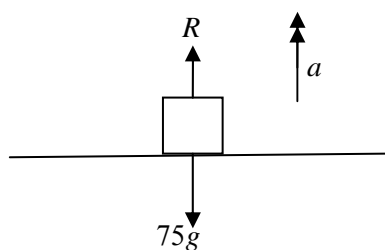
(a)



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
 = $\underline{283.5 \text{ (m)}}$ any correct value for an area B1
 cao A1

(c)

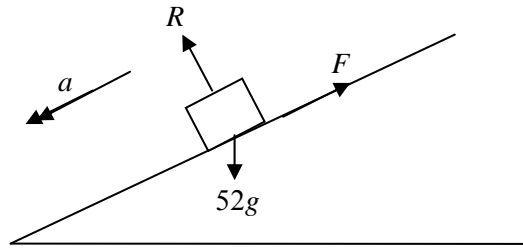


$$a = \frac{2.7}{15} = (0.18) \quad \text{B1}$$

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

$$R = 75(9.8 + 0.18) \\ = \underline{748.5 \text{ (N)}} \quad \text{ft } a \text{ A1}$$

3.



$\sin\alpha = \frac{5}{13}$ $\cos\alpha = \frac{12}{13}$
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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

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

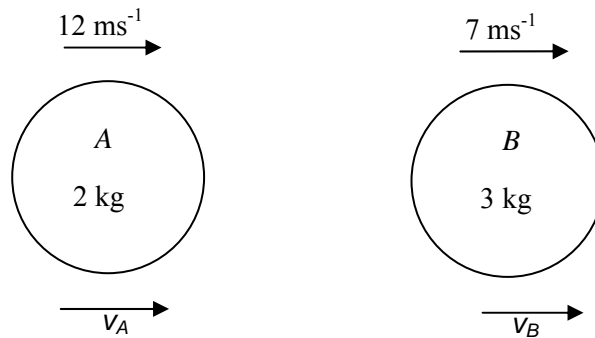
Apply N2L to object down slope Dim correct, all forces M1

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

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

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

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

$$5v_A = 36$$

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

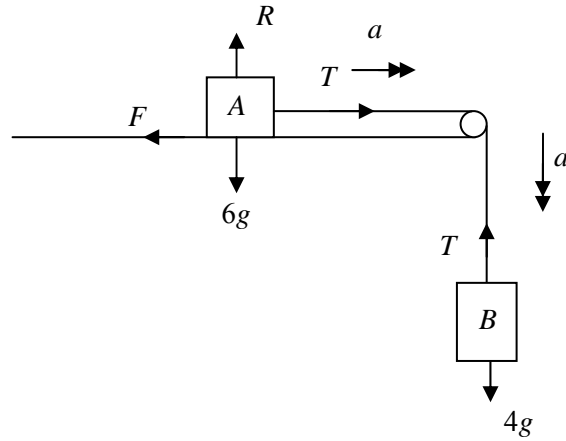
$$v_B = \underline{10.2 \text{ (ms}^{-1}\text{)}} \quad \text{cao A1}$$

(b) Use of Impulse = change in momentum M1

$$I = 3(10.2 - 7)$$

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

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

attempt to solve equations simultaneously m1
 $4g - 2.4g = 10a$
 $a = \frac{0.16g}{1} = \underline{1.568 \text{ (ms}^{-2}\text{)}}$ cao A1
 $T = \underline{32.928 \text{ (N)}}$ 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
 $Y = 12 - 5\sqrt{3} \sin 60^\circ - 3\sqrt{2} \sin 45^\circ$ A1
 $Y = 1.5$

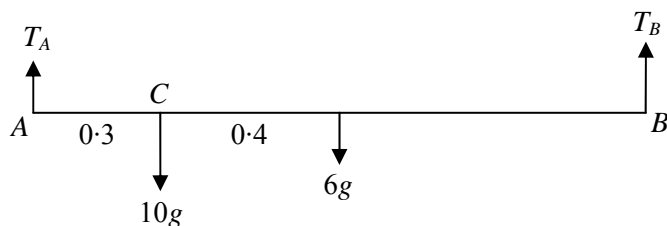
Attempt to resolve in perpendicular direction M1
 $X = 5\sqrt{3} \cos 60^\circ - 3\sqrt{2} \cos 45^\circ$ A1
 $X = 1.33$

Resultant $R = \sqrt{(1.5)^2 + 1.33^2}$ M1
 $= \underline{2.0048 \text{ (N)}}$ ft A1

$\theta = \tan^{-1}\left(\frac{1.33}{1.50}\right) = 41.6^\circ$ 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
 $T_B = \underline{50.4 \text{ (N)}}$ cao A1
 Resolve vertically dim correct, all forces oe M1
 $T_A + T_B = 16g$ A1
 $T_A = \underline{106.4 \text{ (N)}}$ 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
 $10.8 = 4.5a$
 $a = \underline{2.4}$ cao A1
 $u = \underline{13}$ 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
 $89x = 80 \times 4 + 9 \times 3$ ft A1
 $x = \underline{3.90 \text{ (cm)}}$ cao A1

Moments about AB M1
 $89y = 80 \times 5 + 9 \times 3$ ft A1
 $y = \underline{4.80 \text{ (cm)}}$ cao A1

(b) $\theta = \tan^{-1}\left(\frac{x}{10 - y}\right)$ correct triangle M1
 $= \tan^{-1}\left(\frac{3.9}{10 - 4.8}\right)$ ft A1
 $= \underline{36.9^\circ}$