

Jan 2006 m1.

1. i) (P) R(↓) $0.3g - T = 0.3a$ (1) m0

Q R(↑) $T - 0.4g = 0.4a$ (2) m0

(1) + (2) $-0.1g = 0.7a$ m0

$a = -1.4 \text{ ms}^{-2}$ A0

ii) $v = u + at$ $v = 0, u = 2.8, a = -1.4$

$0 = 2.8 + -1.4 \times t$ m0

$t = \frac{-2.8}{-1.4} = 2 \text{ s}$ A0 but up and down so $2 \text{ s} \times 2 = 4 \text{ s}$ A0

2. i) R(→) $T \sin \alpha = 0.08 \times 1.25$ m0

$T \sin \alpha = 0.1$ (1) A0

ii) R(↑) $T \cos \alpha = 0.08g$ (2) m0

(1) ÷ (2) $\tan \alpha = \frac{0.1}{0.08g} = 0.128$ m0

$\alpha = 7.27^\circ$ A0

sub into (2) $T \cos 7.27 = 0.08g \cdot m0$

$T = 0.790 \text{ N}$ A0

3. i) $v = 7.2t - 0.45t^2$

$a = \frac{dv}{dt} = 7.2 - 0.9t$ A0 = 0

$0.9t = 7.2$ m0

$t = 8 \text{ s}$ A0

ii) $v = 7.2 \times 8 - 0.45 \times 8^2$ m0

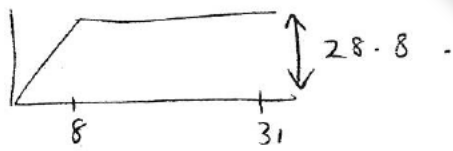
$v = 28.8 \text{ ms}^{-1}$

iii) $S = \int v dt$ from $t=0$ to $t=8$ m0

$S = \int_0^8 7.2t - 0.45t^2 dt$ m0

$S = 3.6t^2 - 0.15t^3$

$S = 3.6 \times 8^2 - 0.15 \times 8^3 = 153.6$ A0 ($t=0 \rightarrow 8$)

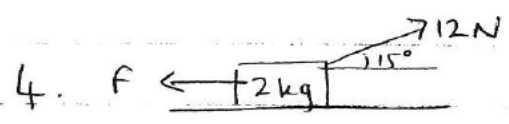


From 8s \rightarrow 31s

$$31 - 8 = 23s$$

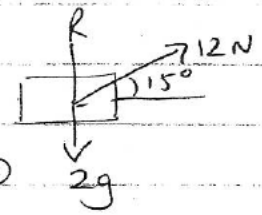
$$23 \times 28.8 = 662.4 \text{ m}$$

$$662.4 + 153.6 = \underline{\underline{816 \text{ m}}}$$

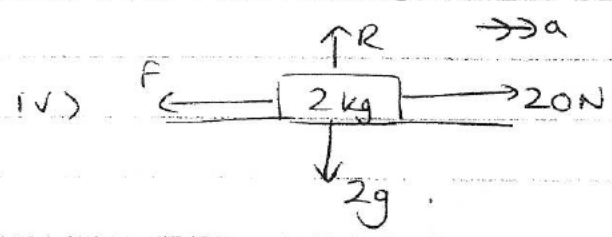


i) $R(\rightarrow) F = 12 \cos 15^\circ \text{ m}$
 $F = \underline{\underline{11.6 \text{ N}}}$

ii) $R(\uparrow)$
 $2g = R + 12 \sin 15^\circ \text{ m}$
 $R = \underline{\underline{16.5 \text{ N}}}$



iii) $F = \mu R \text{ m}$
 $\mu = \frac{11.6}{16.5} = \underline{\underline{0.703}}$



$R(\rightarrow) 20 - F = 2a \text{ m}$

$R(\uparrow) R = 2g \text{ m}$

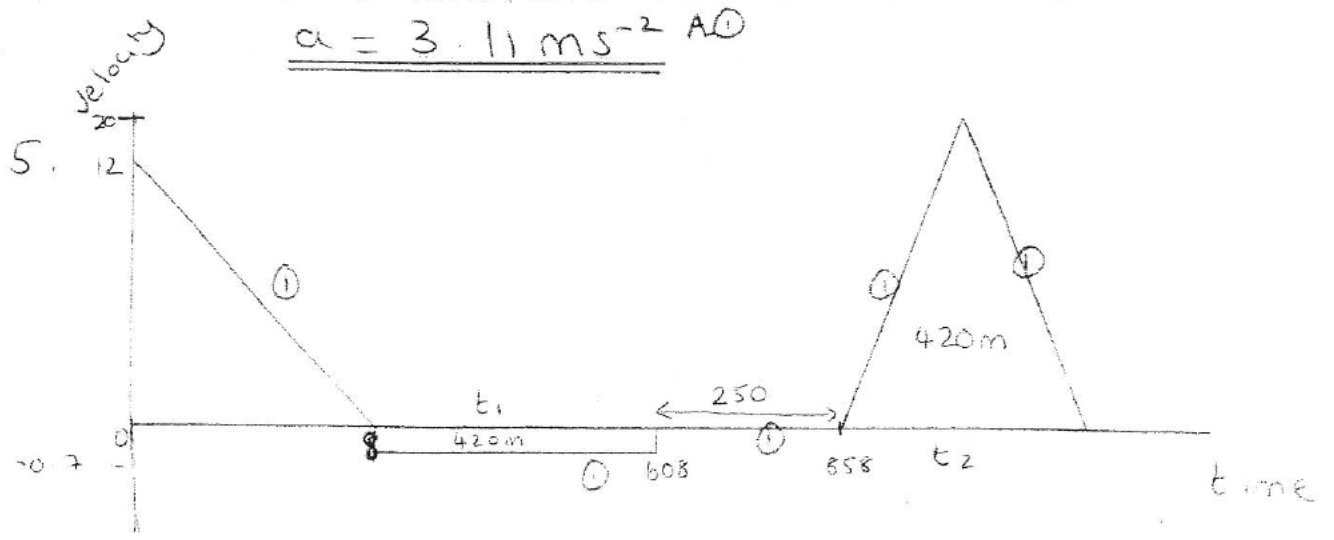
$F = \mu R \text{ m}$

$20 - 2a = 0.703 \times 2g \text{ m}$

$2a = 6.2212$

$a = 3.1106$

$\underline{\underline{a = 3.11 \text{ ms}^{-2}}}$



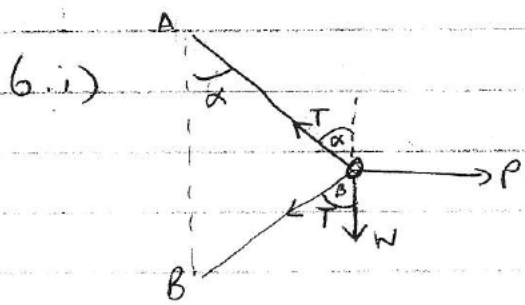
ii) $v = u + at$
 $0 = 12 + a \times 8$
 $a = \frac{-12}{8} = -1.5 \text{ ms}^{-2} \text{ A1} \therefore \text{decel of } 1.5 \text{ ms}^{-2}$

iii) $T = 8s + t_1 + 250 + t_2$

$t_1 = \frac{420}{0.7} = \underline{600s} \text{ M1}$

$t_2 = \frac{420}{\frac{1}{2} \times 20} = \underline{42s} \text{ M1}$

$T = 8 + 600 + 250 + 42 = \underline{900s} \text{ A1}$



R(↑) $T \cos \alpha = W + T \cos \beta \text{ M0}$
 $T \cos \alpha > T \cos \beta \text{ M0}$
 $\cos \alpha > \cos \beta$

α acute so less than 90° A1
 \cos is a decreasing function between 0 and 90°

\therefore smaller \cos gets \Rightarrow bigger angle gets.
 $\alpha < \beta$

ii) R(↑) $T \cos \alpha = W + T \cos \beta \text{ M0}$

$0.4^2 - 0.24^2 = Am^2$
 $Am = 0.32$

$0.3^2 - 0.24^2 = Bm^2$
 $Bm = 0.18$

$\cos \alpha = \frac{0.32}{0.4} = 0.8$

$\cos \beta = \frac{0.18}{0.3} = 0.6 \text{ M1}$

$T \times 0.8 = W + T \times 0.6$
 $0.2T = W$


R(→) $14 = T \sin \alpha + T \sin \beta \text{ M0}$ $\sin \alpha = 0.6$
 $14 = T \times 0.6 + T \times 0.8$ $\sin \beta = 0.8 \text{ M0}$

$1.4T = 14$

$T = 10 \text{ N}$ A1

$W = 0.2 \times 10 = \underline{2 \text{ N}}$ A1

iii) a) R will be below A and B. A0

b)  $W = 2T$
 $T = \frac{W}{2} = \frac{2}{2} = 1\text{ N} \cdot \text{A0}$

Need to find s.

7. i) $8 \times 0.15 + 2 \times 0.5 = 0.15 \times 0 + 0.5 \times u \cdot \text{M0}$
 $2.2 = 0.5u$
 $u = 4.4 \text{ ms}^{-1} \cdot \text{A0}$

B: R(\rightarrow) (f=ma) $-0.5g \sin 30^\circ = 0.5a \cdot \text{M0}$

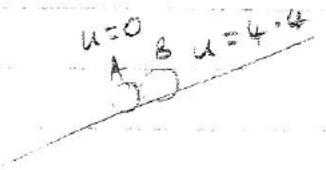
$a = -g \sin 30$
 $a = -4.9 \text{ ms}^{-2} \cdot \text{A0}$

$u = 4.4$, $v = 0$, $a = -4.9$, $s = ?$

$v^2 = u^2 + 2as$
 $0^2 = 4.4^2 + 2 \times -4.9 \times s \cdot \text{M0}$

$s = 1.98 \text{ m} \cdot \text{A0}$ less than $2 \text{ m} \cdot \text{A0}$ \therefore doesn't reach Q.

ii)



time B to get to top part.

$u = 4.4$, $v = 0$, $a = -4.9$

$v = u + at \cdot \text{M0}$

$0 = 4.4 + -4.9 \times t$

$t = 0.8979 \dots \text{ s} \cdot \text{A0}$

time of B from top to P.

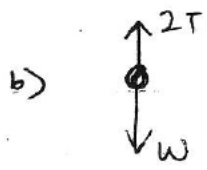
$s = 1.98 + 2 = 3.98 \text{ m}$, $a = 4.9$, $u = 0$.

$s = ut + \frac{1}{2}at^2 \cdot \text{M0}$

$3.98 = 0 \times t + \frac{1}{2} \times 4.9 \times t^2$

$\frac{3.98}{2.45} = t^2$ $t = 1.2745 \dots \text{ s} \cdot \text{A0}$

iii) a) R will be below A and B. A0



$$W = 2T$$

$$T = \frac{W}{2} = \frac{2}{2} = 1 \text{ N} \cdot \text{A0}$$

7: need to find s, M0

$$8 \times 0.15 + 2 \times 0.5 = 0.15 \times 0 + 0.5 \times u \cdot \text{M0}$$

$$2.2 = 0.5u$$

$$u = \underline{\underline{4.4 \text{ ms}^{-1}}} \cdot \text{A0}$$

B: R(→) (F=ma) $-0.5g \sin 30^\circ = 0.5a \cdot \text{M0}$

$$a = -g \sin 30$$

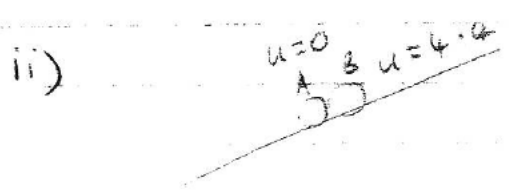
$$a = -4.9 \text{ ms}^{-2} \cdot \text{A0}$$

$u = 4.4$, $v = 0$, $a = -4.9$, $s = ?$

$$v^2 = u^2 + 2as$$

$$0^2 = 4.4^2 + 2 \times -4.9 \times s \cdot \text{M0}$$

$$s = \underline{\underline{1.98 \text{ m}}} \cdot \text{A0} \text{ less than } 2 \text{ m} \cdot \text{A0} \text{ so doesn't reach Q.}$$



time B to get to top part.

$$u = 4.4, v = 0, a = -4.9$$

$$v = u + at \cdot \text{M0}$$

$$0 = 4.4 + -4.9 \times t$$

$$t = 0.8979 \dots \text{ s} \cdot \text{A0}$$

time of B from top to P.

$$s = 1.98 + 2 = 3.98 \text{ m}, a = 4.9, u = 0$$

$$s = ut + \frac{1}{2}at^2 \cdot \text{M0}$$

$$3.98 = 0 \times t + \frac{1}{2} \times 4.9 \times t^2$$

$$\underline{\underline{3.98}} = t^2 \quad t = 1.2745 \dots \text{ s} \cdot \text{A0}$$

Total time B \rightarrow P = $0.898 + 1.27 = 2.17$

Time for A \rightarrow P

$u = 0, s = 2, a = 4.9, t = ?$

$s = ut + \frac{1}{2}at^2$

$2 = 0 \times t + \frac{1}{2} \times 4.9 \times t^2$ (M1)

$t^2 = 0.8163 \dots$

$t = 0.9035 \dots = 0.904$ s.

Time interval = $2.17 - 0.904 = 1.27$ s. (3sf)
A1