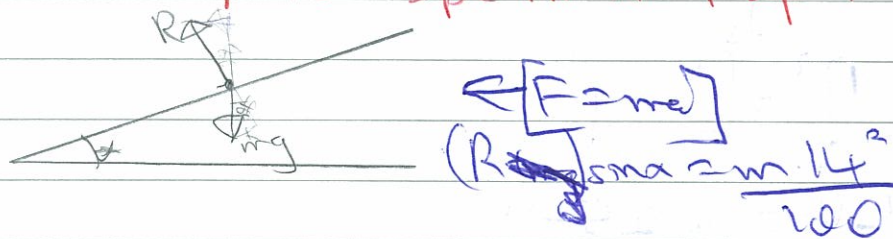


M3 - Specimen Paper

1-



$$\uparrow R = mg \cos \alpha \quad \textcircled{1}$$

$$s_{max} = \frac{1.96m}{R} \quad \textcircled{1}$$

① m ②:

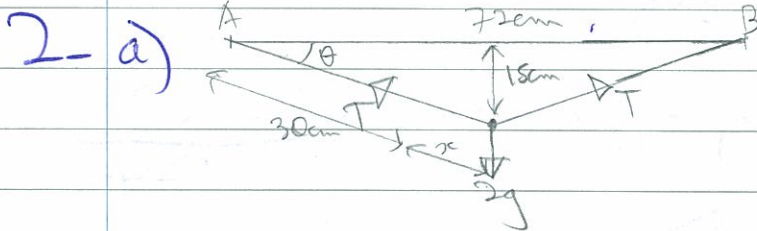
$$s_{max} = 1.96m$$

$$1.96 = mg \cos \alpha$$

$$0.14 = \sin 2\alpha$$

$$2\alpha = 23.6$$

$$\alpha = 11.8^\circ \text{ (1dp)}$$



$$(30+x)^2 = 15^2 + 36^2$$

$$(30+x)^2 = 225 + 1296$$

$$(30+x)^2 = 1521$$

$$30+x = 39$$

$$T = \frac{1}{2}x = \frac{9}{30} \times 39 = 0.3 \times 39$$

$$x = 9 \text{ cm}$$

$$2g = 2 \times T \times \frac{15}{39}$$

$$T = \frac{39g}{15}$$

$$T = 0.3 \times 39$$

$$\frac{39g}{15} = 0.3 \times 39$$

$$\lambda = 84.9 \text{ N (1dp)}$$

b) No turning effect

3.  $\rightarrow [F=ma]$

$$-2x^{-2} = m \frac{v dv}{dx}$$

$$\int_1^x -2x^{-2} dx = \int_3^{15} 0.5 v dv$$

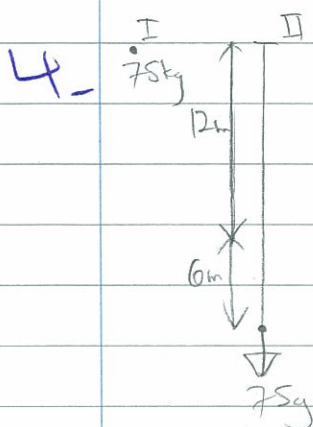
$$-4 \int_1^x x^{-2} dx = \int_3^{1.5} v dv$$

$$-4 \left[ -x^{-1} \right]_1^x = \left[ \frac{1}{2} v^2 \right]_3^{1.5}$$

$$4x^{-1} - 4 = 1.125 - 4.5$$

$$\frac{4}{x} = 0.625$$

$$x = 6.4 \text{ m}$$



a)  $m v_{II}^2 = m E_{II} + W D$

$$75g \times 18 = \frac{\lambda \times 6^2}{24}$$

$$\lambda = \frac{24 \times 75g \times 18^3}{6 \cdot 6} = 8820 \text{ N}$$

b)  $\frac{8820 + 36}{24} = 75g + \frac{1}{2} \times 75 \times v^2 + \frac{8820 \times 25}{24}$

~~$v^2 = 88.2$~~

~~$v^2 = 88.2$~~

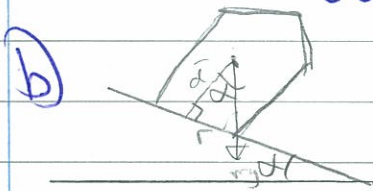
$v = 9.39 \text{ ms}^{-1} (3 \text{ sf})$

5 a)  $\frac{1}{2} \cdot \pi r^2 \cdot r + (r + \frac{1}{4}h) \cdot \frac{1}{3} \pi r^2 h = (\pi r^2 \cdot r + \frac{1}{3} \pi r^2 h) d$

$$3r^2 + 2hr + \frac{1}{2}h^2 = (6r + 2h) d$$

$$6r^2 + 4rh + h^2 = (12r + 4h) d$$

$$d = \frac{6r^2 + 4rh + h^2}{4(3r + h)}$$

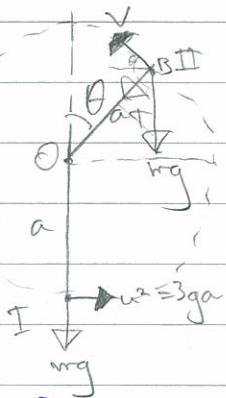


$$\frac{6r^2 + 4rh + h^2}{4(3r + h)} = \frac{6r^2 + 8r^2 + 4r^2}{12r^2 + 8r^2} = \frac{9}{10}$$

$$\alpha = 4.8^\circ$$



6-a)



$$mE_I = mE_{II}$$

$$\frac{1}{2} m \cdot 3ga = \frac{1}{2} m v^2 + mg(a + a \cos \theta)$$

$$3ga = v^2 + 2ga + 2ga \cos \theta$$

$$v^2 = ga - 2ga \cos \theta$$

$$[F = ma]$$

$$T + mg \cos \theta = \frac{mv^2}{a}$$

$$mg \cos \theta = \frac{m}{a} (ga - 2ga \cos \theta)$$

$$g \cos \theta = g - 2g \cos \theta$$

$$\cos \theta = \frac{g}{3g} = \frac{1}{3}$$

b)  $\frac{1}{2} m v^2 = mgh + \frac{1}{2} m v^2$ ,  $h =$  greatest height above B

$$\frac{1}{2} ga - ga \cos \theta = gh + \frac{1}{2} \left( \frac{1}{3} ga - \frac{2}{3} ga \cdot \frac{1}{3} \right)$$

$$\frac{1}{2} a - \frac{1}{3} a = h + \frac{1}{2} \cdot \frac{1}{27} a^2$$

$$h = \frac{4a}{27}$$

7-a)  $T = mg$   
 $T = \frac{\lambda x}{l}$

$$mg = \frac{6mg}{a} x$$

$$l = \frac{a}{6}$$

b)  $[F = ma]$

$$mg - T = m \frac{d^2 x}{dt^2}$$

$$mg - \frac{6mg}{a} \left( \frac{a}{6} + x \right) = m \frac{d^2 x}{dt^2}$$

$$g - g - \frac{6gx}{a} = \frac{d^2 x}{dt^2}$$

$$\frac{d^2 x}{dt^2} = -\frac{6g}{a} x$$

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{\sqrt{\frac{6g}{a}}} = 2\pi \sqrt{\frac{a}{6g}}$$

$$c) v_{\max} = \omega a = \sqrt{\frac{6g}{a}} \times \frac{1}{3}a = \frac{1}{3} \sqrt{6g} \cdot \frac{a}{\sqrt{a}} = \frac{1}{3} \sqrt{6ga}$$

$$d) x = a \cos \omega t$$

$$x = \frac{1}{3} a \cos \left( \sqrt{\frac{6g}{a}} t \right)$$

$$-\frac{1}{6}a = \frac{1}{3} a \cos \sqrt{\frac{6g}{a}} t$$

$$-\frac{1}{2} = \cos \sqrt{\frac{6g}{a}} t$$

$$\sqrt{\frac{6g}{a}} t = \frac{2\pi}{3}$$

$$t = \frac{2\pi}{3} \sqrt{\frac{a}{6g}} \text{ s}$$