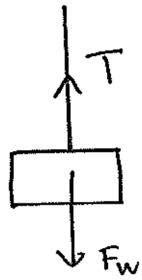
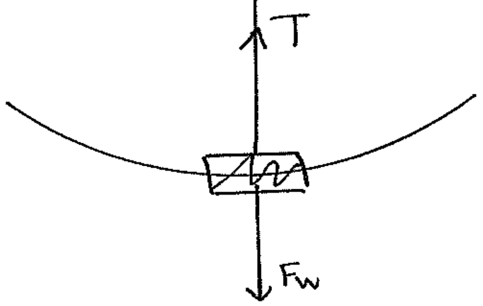
Set 3 Circular MOTION

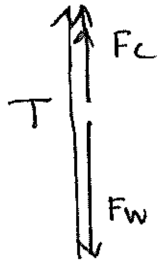
14) when the brick is stationary

$T = F_W$

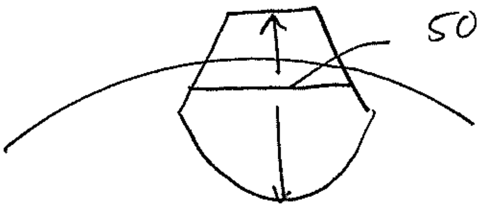


When moving in a circle tension will increase since it must balance the weight force and provide F_c.





15) a)



weight of plastic bucket 500g
weight of water in bucket 20 L = 20 kg } Note mass Not a factor.

Minimum speed when $F_W = F_c$

$$\frac{\cancel{m}v^2}{r} = \cancel{20.5} \times 9.8$$

Estimate radius of Circle = 50 + 75 cm
= 1.25 m diameter

$$v^2 = r \times 9.8$$

$$v = \sqrt{rg}.$$

$$= \sqrt{0.65 \times 9.8}$$

$$= 2.53 \, ms^{-1}$$

b) water will not fall out if it experiences a Reaction force from the bottom of the bucket.

c) No. Potential energy will be converted to kinetic energy so speed will increase at bottom of curve.

Set 3

16). $r = 1600m.$

a) $F_W = F_c$

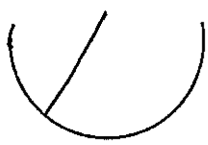
$\frac{mv^2}{r} = mg$

$v = \sqrt{rg}$

$= \sqrt{800 \times 9.8}$

$= \underline{88.5 \ ms^{-1}}$

$r = 800m.$



b)

$E_{k \ bottom} = E_{k \ Top} + mgl$

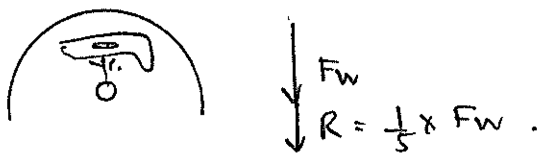
$\frac{1}{2}mv^2 = \frac{1}{2}m \times 88.5^2 + m \times 9.8 \times 1600$

$v^2 = 7{,}832.2 + 31360$

$v^2 = 3.92 \times 10^4$

$v = \underline{198 \ ms^{-1}}$

17) $r = 650m$



$R = \frac{1}{5} \times mg$

$F_c = R + F_w$

$\frac{mv^2}{r} = \frac{6}{5} \times m \times 9.8$

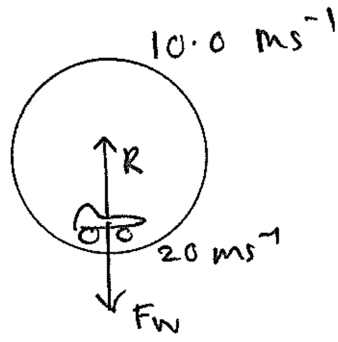
$v^2 = \frac{6}{5} \times 9.8 \times 650$

$v^2 = 7.644 \times 10^3$

$v = \underline{87.4 \ ms^{-1}}$

Set 3

18/ $M_{car} = 2.00$ kg



Lowest Point.

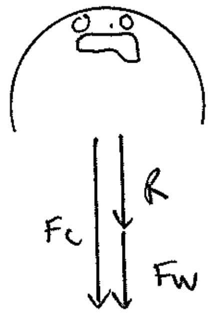
$R = mg + \frac{mv^2}{r}$

$= 2 \times 9.8 + \frac{2 \times 20^2}{5.0}$

$= 19.6 + 160$

$= \underline{179.6 \text{ N}}$ upwards

Highest Point



$F_w = 19.6$ N

$F_c = \frac{mv^2}{r} = \frac{2.00 \times 10^2}{5.0} = 40$ N

$R = 40 - 19.6$

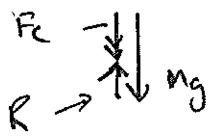
$= \underline{20.4 \text{ N}}$ down.

19/ a) $\frac{\cancel{M}v^2}{r} = \cancel{M}g$ when we feel weightless.

$r = \frac{v^2}{g} = \frac{14^2}{9.8} = \underline{20.0 \text{ m}}$

b) Faster than 14.0 ms^{-1}.
Centripetal force must increase
so reaction force on the passengers
through the wheels of the car would increase.

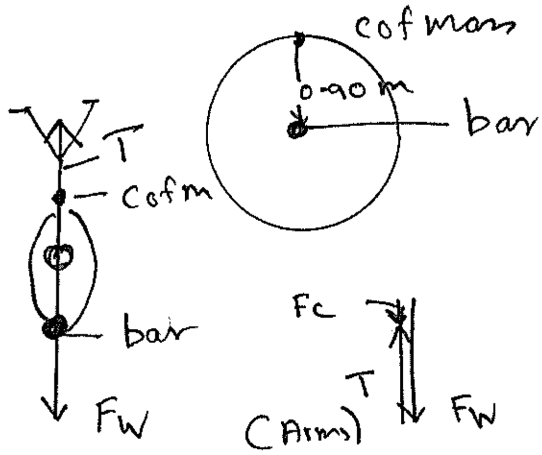
c) Slower than 14.0 ms^{-1}.
Centripetal force has decreased $F_c = \frac{mv^2}{r}$



and is less than Fw. Therefore
seat belts must provide an upward force
on the passengers.

Set 3 Circular Motion

20/ $m = 40 \text{ kg}$

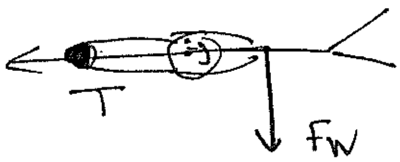


a) V at highest point $= 1.00 \text{ ms}^{-1}$

$$F_c = \frac{mv^2}{r} = \frac{40 \times 1^2}{0.9} = 44.4 \text{ N}$$

$$F_W = 40 \times 9.8 = 392 \text{ N}$$

Note tension in the arms balances most of the weight.



b) When level with bar. Loss in E_p increases E_K.

$$E_{K \text{ (level)}} = E_{K \text{ Top}} + mgL \text{ Loss of Ep.}$$

$$\frac{1}{2} \cancel{m} v^2 = \frac{1}{2} \cancel{m} \times 1^2 + \cancel{m} \times 9.8 \times 0.9$$

$$v^2 = 1 + (2 \times 9.8 \times 0.9)$$

$$v^2 = 18.64$$

$$v = 4.32 \text{ ms}^{-1}$$

b) $$E_{K \text{ bottom}} = E_{K \text{ Top}} + mgL \text{ (Loss of Ep)}$$

$$\frac{1}{2} \cancel{m} v^2 = \frac{1}{2} \cancel{m} 1^2 + \cancel{m} \times 9.8 \times 1.8$$

$$v^2 = 1 + 35.28$$

$$v^2 = 36.28$$

$$v = 6.023 \text{ ms}^{-1}$$

$$F_c = \frac{mv^2}{r} = \frac{40 \times 36.28}{0.9} = 1{,}612.4 \text{ N}$$

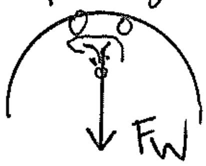
Force in Arms $= T = 1612.4 \text{ N} + 40 \times 9.8$

$= 1612.4 + 392$

$\equiv 2.00 \times 10^3 \text{ N}$

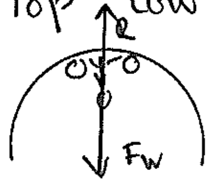
Stowa set 3

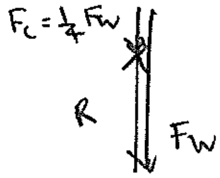
Q 21) a) Top High speed



$F_W = F_C$

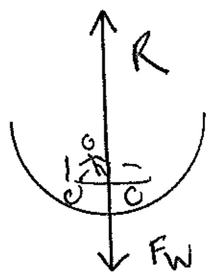
Top low speed ($\frac{1}{2}$ high speed)





$F_C = \frac{1}{4} \cdot F_W$

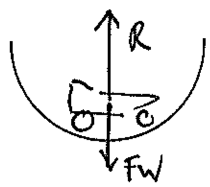
Bottom High speed

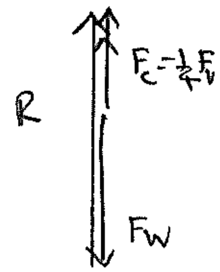


$F_C = F_W$

$\therefore R = 2 \times F_W$

Bottom low speed





$F_C = \frac{1}{4} F_W$

$R = \frac{5}{4} \times F_W$.

b) At high speed

$\frac{mv^2}{r} = mg$

$v = \sqrt{rg}$

$= \sqrt{3.6 \times 9.8}$

$v = 5.94 \, ms^{-1}$

c) mass passenger = 60 kg. At high speed at top $R = 0$ since passenger feels weightless. $F_C = F_W$.

At Bottom $R = 2 \times m \times g$

$= 2 \times 60 \times 9.8$

$= 1.18 \times 10^3$ N up

d) low speed Top

$R = \frac{3}{4} \times 60 \times 9.8$

$= 441$ N (provided by seat belts upwards)

low speed bottom.

$R = \frac{5}{4} \times 60 \times 9.8$

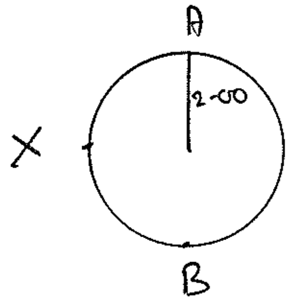
$= 735$ N upwards

Set 3 Circular Motion

Q22) $M_{stone} = 2.50$ kg

$r = 2.00$ m

$V_X = 10.4\ ms^{-1}$.



$E_K = E_{K_X} + \text{Loss of } E_p$

At B:

$\frac{1}{2} \cdot 2.5 \times V_B^2 = \frac{1}{2} \times 2.50 \times 10.4^2 + 2.50 \times 9.8 \times 2.00$

$V_B^2 = 108.16 + 39.2$

$V_B^2 = 1.4736 \times 10^2$

$V_B = 12.1\ ms^{-1}$

At A

$\frac{1}{2} m V_A^2 = \frac{1}{2} m \times 10.4^2 - m \times 9.8 \times 2.0$

$V_A^2 = 108.16 - 39.2$

$V_A^2 = 68.96$

$V_A = 8.30\ ms^{-1}$

b) $T_B = mg + \frac{mv^2}{r}$

$= 9.8 \times 2.50 + \frac{2.5 \times 12.1^2}{2.0}$

$= 24.5 + 183.01$

$= 207.5$ N up.

$T_A = F_c - mg$

$= 86.1 - 24.5$

$= 61.6$ N down

F_c at A $= \frac{mv^2}{r}$

$= \frac{2.5 \times 8.3^2}{2.0}$

$= 86.1$ N

c) Breaks at B. Since tension will be greatest at this point.