Physics U6 Circular Motion Worksheet #2 Name: ______________________

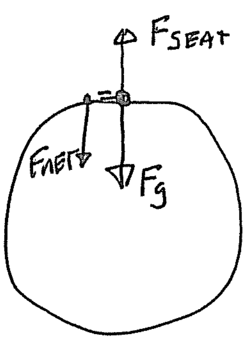
1. A 70 kg person is riding on a ferris wheel. The period of the ferris wheel is 18 seconds and the radius is 9 m.

a) Calculate the centripetal acceleration.

$$a_c = \frac{4\pi^2 R}{T^2} = \frac{4\pi^2 (9)}{(18)^2} = 1.097\ m/s^2.$$

b) Find the force from the seat at the top of the ferris wheel.

- Include a freebody diagram in your working.



$$F_{NET} = ma_c = (70)(1.097) = 76.764\ N.$$

$$F_g = mg = 686\ N$$

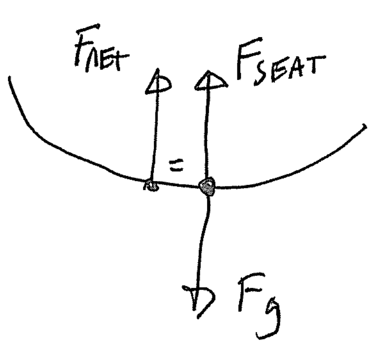
$$F_{NET} = F_g - F_{SEAT}$$

$$76.764 = 686 - F_{SEAT}$$

$$F_{SEAT} = 609.\ N$$

c) Find the force at the bottom of the ferris wheel.

- Include a freebody diagram in your working.



$$F_{NET} = F_{SEAT} - F_g$$

$$F_{SEAT} = F_{NET} + F_g$$

$$= 762.7$$

$$F_{SEAT} = 763\ N$$

2. A 1400 kg car rounds a 35 m radius corner at 45 km/hr. → 12.5 m/s

a) Calculate the centripetal acceleration of the car.

$$a_c = \frac{v^2}{R} = \frac{(12.5)^2}{35} = 4.46 \text{ m/s}^2$$

b) Calculate the friction force needed to produce this acceleration

$$F_f = F_{NET} = m a_c = (1400)(4.46) = 6250 \text{ N}$$

c) Calculate the coefficient of friction needed.

$$F_f = \mu F_\perp = \mu F_g$$

$$6250 = \mu (1400 \times 9.8)$$

$$\boxed{\mu = 0.456}$$

Also notice:

$$F_f = F_{NET}$$

$$\mu F_g = m a_c$$

$$\mu m g = m a_c$$

$$\mu g = a_c$$

$$\mu = \frac{a_c}{g}$$

125 m/s

3. A jet is travelling at 450 km/hr and does a loop with a radius of 350 m.

a) Find the centripetal acceleration of the jet. $a_c = \frac{V^2}{R}$

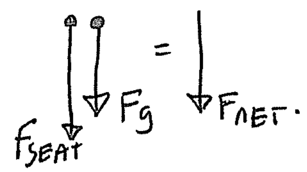
$$a_c = \frac{(125)^2}{350} = 44.6 \text{ m/s}^2.$$

b) How many "g" is this?

$$\frac{44.6}{9.8} = 4.56\ g.$$

c) Find the force on the 55 kg pilot from the seat at the top of the loop.

seat is push down!



$F_{NET} = F_g + F_{SEAT}.$

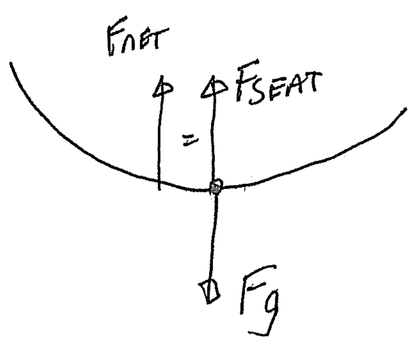
$F_{SEAT} = F_{NET} - F_g$

$= (55)(44.6) - (55)(9.8)$

$= 2455 - 539$

$F_{SEAT} = 1916\ N$

d) Find the force on the pilot from the seat at the bottom of the loop.



$F_{NET} = F_{SEAT} - F_g$

$F_{SEAT} = F_{NET} + F_g$

$= 2455 + 539.$

$F_{SEAT} = 2994\ N$

4. A jet is travelling at Mach 1.5 (510 m/s). The pilot can only pull 6 "g"s. What is the smallest radius loop the jet can pull?

$a_c = \frac{V^2}{R}$

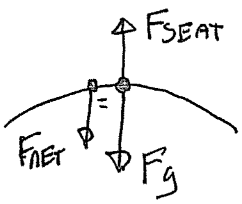
$6 \times 9.8 = \frac{(510)^2}{R}$

$R = 4423\text{ m}$

→ max $a_c = 6 \times 9.8$

note: this simplistic solution only looks @ a_c not the forces from the seat which are higher @ bottom.

5. a) You are driving in a 1200kg car at 45 km/hr. There is a hump in the road with a radius of 35m radius. Calculate the force from the seat on a 65 kg driver at the top of the hump.



12.5 m/s

$a_c = \frac{V^2}{R} = \frac{(12.5)^2}{35} = 4.46\text{ m/s}^2$

$F_{NET} = (65)(4.46) = 290\text{ N}$

$F_{NET} = F_g - F_{SEAT}$

$F_{SEAT} = F_g - F_{NET}$

$= 637 - 290$

$F_{SEAT} = 347\text{ N}$

b) What is the force from the seat if you are standing still?

$F_g = F_{SEAT} = 637\text{ N}$

c) What is the maximum speed you can hit the hump before you become air borne in the car?

(Hint: What is the maximum Fc available?)

$F_{SEAT} = 0$ @ max speed.

$F_c = F_g = 637\text{ N}$ or $a_c = 9.8\text{ m/s}^2 = \frac{V^2}{35}$

$V^2 = (9.8)(35)$

$V = 18.5\text{ m/s}$

$= 67\text{ km/hr}$