

1. You swing a 1kg ball in a circle of radius 2m at 10 m/s.

a. What force does this take? **ANSWERS:** 50 N

$$F = m a$$

$$F = m v^2/r = (1) (10^2)/2 = \mathbf{50\ N}$$

b. How many g's does the object experience? **ANSWERS:** 5.1 g's

$$F = m v^2/r$$

$$a = v^2/r = (10)^2/2 = 50\ \text{m/s}^2$$

$$\# \text{ g's} = a / 9.8 = \mathbf{5.1}$$

c. What velocity must you swing it at to experience 10g's? **ANSWERS:** 14 m/s

$$\# \text{ g's} = a / 9.8$$

$$10 = a / 9.8 \quad \text{therefore: } a = 98\ \text{m/s}^2$$

$$98 = v^2 / r$$

$$v = \mathbf{14\ m/s}$$

d. What would be the force needed to hold it in part c? **ANSWERS:** 98 N

$$F = m v^2/r$$

$$F = (1) (14)^2 / 2 = \mathbf{98\ N}$$

e. What is the frequency of the object in part c? **ANSWERS:** 1.1 Hz

$$v = 2 \pi r / T$$

$$= 2 \pi r f \quad f = v / (2 \pi r) = 14 / (2 \pi \cdot 2) = \mathbf{1.1\ Hz}$$

f. How long does 1 revolution take in part c? **ANSWERS:** 0.9 s

$$T = 1 / f = 1 / 1.1 = \mathbf{0.9\ s}$$

2. You have 5,000N of friction available between your tires and the road as you turn on an off-ramp with radius 100m.  
Your car's mass is 1200 kg.

- a. What is the max speed you can travel in the corner? **ANSWERS:** 20.4 m/s

$$F = m a$$

$$F = m v^2/r$$

$$5000 = (1200) (v^2)/100 \quad \mathbf{v = 20.4 \text{ m/s}}$$

- b. How fast if the friction doubles? **ANSWERS:** 28.9 m/s

$$F = m v^2/r$$

$$10,000 = (1200) (v^2)/100 \quad \mathbf{v = 28.9 \text{ m/s}}$$

- c. How fast if the friction is reduced to ½? **ANSWERS:** 14.4m/s

$$F = m v^2/r$$

$$2500 = (1200) (v^2)/100 \quad \mathbf{v = 14.4 \text{ m/s}}$$

- d. How fast if the mass of the car doubles in part (a)? **ANSWERS:** 20.4 m/s

$$F = m v^2/r$$

If the mass of the car doubles, so will the friction ( $F=uFn$ )...

$$2 \times 5,000 = (2 \times 1200) (v^2)/100 \quad \mathbf{v = 20.4 \text{ m/s}}$$

- e. How fast if drive a truck that weighs twice as much as the car in part (a)? **ANSWERS:** 20.4 m/s

Same problem as part (d). twice the weight is twice the mass.

3. A circus stunt rider enters a 6m radius loop traveling at 10 m/s. If they're total mass is 100 kg...

a. What is the acceleration of the rider? **ANSWERS:** 16.7 m/s<sup>2</sup>

$$F = m v^2 / r$$

$$a = v^2 / r = (10)^2 / 6 = \mathbf{16.7 \text{ m/s}^2}$$

b. How many g's does the rider feel? **ANSWERS:** 1.7 g's

$$\# \text{ g's} = a / 9.8 = \mathbf{1.7}$$

c. If the loop will break at a force of 4000N, how fast can the rider travel before breaks? **ANSWERS:** 15.5 m/s

$$F = m v^2 / r$$

$$4000 = 100 (v)^2 / 6$$

$$v = \mathbf{15.5 \text{ m/s}}$$