Physics U6 Circular Motion Worksheet #1 Name: _____

1. A 1500 kg car travels around a corner with radius of 68 m at 85 km/hr. → 23.61̄ m/s

a) Calculate the centripetal acceleration of the car and the net force required.

$$a_c = \frac{v^2}{R} = \frac{(23.61)^2}{68} = 8.20 \text{ m/s}^2.$$

$$F_c = ma_c = (1500)(8.2) = 12{,}300 \text{ N}$$

b) In this case the centripetal force is the force of friction. Calculate the coefficient of friction needed in this case.

$$F_f = \mu F_g \rightarrow 12{,}300 = \mu\ 14{,}700$$

$$\mu = 0.837$$

2. A rollercoaster does a loop de loop at 70 km/hr. If the **diameter** of the loop is 25 m calculate the centripetal acceleration.

→ 19.4̄ m/s → r = 12.5 m.

$$a_c = \frac{v^2}{R} = \frac{(19.4)^2}{12.5} = 30.24 \text{ m/s}^2 \text{ approx. } 3g.$$

3. Convert RPM (revolutions per min) to RPS (revolutions per second) Then find the period.

a) 3500 rpm = 3500 revolution/1 mins = 58.3 revolutions/sec = 58.3 Hz (frequency)

$$\text{period} = T = \frac{1}{f} = \frac{1}{58.3} = 0.0172 \text{ sec.}$$

b) What is the period of a hard disc that spins at 4200 rpm?

$$4200 \text{rpm} = 70 \text{ rps} = 70 \text{ Hz.}$$

$$T = \frac{1}{f} = \frac{1}{70 \text{ Hz}} = 0.0143 \text{ sec.}$$

4. Calculate the centripetal acceleration of the outer rim of a 7.5 cm hard drive spinning at 7000 rpm. How many "g" is this?

$0.075\,m = r$

$7000\ rpm = 116.\bar{6}\ r/sec = 116.\bar{6}\ Hz$

$T = \frac{1}{f} = 0.008571\ sec.$

$a_c = \frac{4\pi^2 R}{T^2} = \frac{4\pi^2(0.075)}{(0.008571)^2} = 40{,}304\ m/s^2.$

about 4000 g

5. Find the centripetal force needed to accelerate a (wet) pair of jeans (2.4 kg) around your 40 cm radius dryer if the dryer spins at 4 Hz. (4 times per second) — $T = 1/f = 1/4 = 0.25\ sec.$

$F = ma_c = (2.4)a_c$

$= (2.4)(252.66)$

$F_c = 606\ N$

$a_c = \frac{4\pi^2 R}{T^2} = \frac{4\pi^2(.4)}{(.25)^2} = 253\ m/s^2.$

6. a) Find the centripetal acceleration of the moon around the Earth. Your data sheet will tell you the period of the moon and its distance from the Earth.

$a_c = \frac{4\pi^2 R}{T^2} = \frac{4\pi^2(3.84\times10^8)}{(2.36\times10^6)^2} = 0.002721\ m/s^2.$

b) Find the force needed to cause this acceleration

$F_c = ma_c = (7.35\times10^{22})(0.002721\ m/s^2)$

$= 2.0\times10^{20}\ N.$