

Extra Practice Problems for Circular Motion and Gravity

1 sticker if you do all 4 problems, 1 more sticker if you can solve the challenge problem ☺

1. Your pig (mass 532 grams) is flying in a circle with a radius of 1.4 meters.
 a. If he goes around 5 times in 15 seconds, what is his speed? (2.93 m/s)

$$v = \frac{2\pi r}{T}$$

$$T = 15/5 = 3 \text{ sec}$$

$$r = 1.4 \text{ m}$$

$$v = \frac{2\pi(1.4)}{3 \text{ sec}} = \boxed{2.93 \text{ m/s}}$$

- b. What is the centripetal force acting on him? (3.27 N)

$$F_c = \frac{mv^2}{r} = \frac{(0.532 \text{ kg})(2.93 \text{ m/s})^2}{1.4 \text{ m}} = \boxed{F_c = 3.26 \text{ N}}$$

2. Calculate the force of attraction between you (mass 63 kg) and your large cat (44 pounds) if you are 1.2 meters apart. (5.84×10^{-8} N)



$$F_g = \frac{Gm_1m_2}{r^2} = \frac{G(63 \text{ kg})(20 \text{ kg})}{1.2 \text{ m}^2} = \boxed{5.84 \times 10^{-8} \text{ N}}$$

$\div 2.2 = 20 \text{ kg}$
 $r = 1.2 \text{ m}$

3. How far away from the center of the earth (r) would you (100 kg) need to go in order for the acceleration due to gravity to be equal to 4.9 m/s^2 ? What would your weight be there? ($9.02 \times 10^6 \text{ m}$, 490 N)

$$g = \frac{GM}{r^2}$$

$$4.9 \frac{\text{m}}{\text{s}^2} = \frac{G(5.98 \times 10^{24} \text{ kg})}{r^2}$$

$$r^2 = 8.14 \times 10^{13} \quad | \quad r = 9.02 \times 10^6 \text{ m}$$

weight: $F_g = m \cdot g = (100)(4.9) = \boxed{490 \text{ N}}$

4. A satellite for AT&T is orbiting at 820,000 m above the surface of the earth. Calculate how fast it is traveling. (Hint: You will need to find g at that altitude first.) (7,450 m/s)

Find gravity

$$r = 820,000 + 6.37 \times 10^6 \text{ m} = 7.19 \times 10^6 \text{ m}$$

$$g = \frac{GM}{r^2} = \frac{G(5.98 \times 10^{24} \text{ kg})}{(7.19 \times 10^6)^2} = 7.72 \frac{\text{m}}{\text{s}^2}$$

Find velocity

$$g = \frac{v^2}{r}$$

$$7.72 = \frac{v^2}{7.19 \times 10^6 \text{ m}}$$

$$v = \boxed{7448 \text{ m/s}}$$

CHALLENGE PROBLEM

There will not be one like this on your quiz. Yes, it is solvable. ☺

In our video clip from a while back it said the Vomit Comet is actually free-falling around the earth at 17,000 miles per hour. Calculate how many meters they must be at above the earth's surface in miles. (335 miles) HINT: set your 2 equations for g equal to each other

$$\frac{v^2}{r} = \frac{GM}{r^2}$$

$$v^2 = \frac{GM}{r}$$

Yes, there is a cat in the Vomit Comet below.

