NAME: KEY

Universal Gravitation Review

1. The earth exerts a gravitational force of 8000 N on a satellite.
   a. What force does the satellite exert on the earth? 8000 N!
   b. Which has a greater acceleration? satellite, b/c less mass
   c. Why doesn't the satellite crash into the earth?
   b/c it is moving so that it ends up going around in circle.

2. What two masses and one distance determine your weight on earth?

   Your mass
   Earth's mass
   Radius of earth

3. Calculate the force of attraction between a 500 kg mass and a 700 kg mass that are 30 cm apart.

$$F_g = \frac{(6.67\times10^{-11})(500)(700)}{(.3)^2} = \boxed{2.59\times10^{-4}\ N}$$

4. What would a 75 kg person weigh on a planet with a mass of 2.5 x 10^{24} kg and a radius of 3.6 x 10^{6} m?

$$F_g = \frac{(6.67\times10^{-11})(75)(2.5\times10^{24})}{(3.6\times10^{6})^2} = \boxed{965\ N}$$

5. The force of attraction between two identical masses is 2.3 x 10^{-7} N. The masses are 1.3 meters apart. What is the mass of each?

$$2.3\times10^{-7} = \frac{(6.67\times10^{-11})\,m^2}{(1.3)^2} \Rightarrow m^2 = 5828$$

$$\boxed{m = 76.3\ kg}$$

6. What is the acceleration due to gravity at a height of 9.6 x 10^6 m above the surface of the earth?

weight = Force of gravity

$$mg = G\frac{mM}{d^2}$$

So $d = 9.6\times10^6 + 6.4\times10^6 = 16\times10^6$

$$\cancel{m}g = \frac{(6.67\times10^{-11})\cancel{m}(6\times10^{24})}{(16\times10^6)^2}$$

$$\boxed{g = 1.56\ m/s^2}$$

7. Mary weighs 450 N on the surface of the earth.
   a. What is the force of attraction between Mary and the earth?
   450 N
   b. What is the direction of the force?
   To the center of the earth
   c. If Mary climbed to the top of a mountain, would her weight change? Explain.
   Technically, yes, b/c she is a little further from the center of the earth.
   d. Would her mass be different on top of the mountain?
   NO - mass doesn't depend on location.

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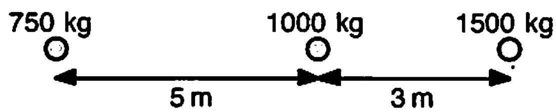
8. Two masses are placed a certain distance apart and the gravitational force between them is 500 N. What is the new force if
   a. one mass is doubled? 1000 N (twice)
   b. both masses are doubled? 2000 N (4 x)
   c. the distance between the masses tripled? $\frac{1}{9} \rightarrow = 55.6$ N
   d. both masses are doubled and the distance is doubled?
   $\frac{2 \cdot 2}{2^2} = 1 = 500$ N

9. Find the net force on the mass 1500 kg mass (the one on the right.)



Two forces acting on the 1500 kg mass, both pulling it to left. So add them:

$F_1 = \frac{(6.67 \times 10^{-11})(1000)(1500)}{3^2} = 1.11 \times 10^{-5}$ N

$F_2 = \frac{(6.67 \times 10^{-11})(750)(1500)}{(8)^2} = 1.17 \times 10^{-6}$ N

$F_1 + F_2 = \boxed{1.23 \times 10^{-5} \text{ N}}$

10. In problem number 9, could you change any of the masses so that the net force on the 1500 kg mass would be zero? Explain.

No, b/c both are pulling 1500 kg to left. Would need a mass to the right of 1500 kg to cancel out.

11. Why did Newton use the adjective "universal" to describe his theory of gravity?

b/c he said all matter was attracted to all matter

12. A 2000 kg satellite in a circular orbit around the earth moves with a constant speed. The radius of the orbit is 12.8 x 10^6 meters.
   a. Is the satellite accelerating? Explain.

   Yes. Moving in a circle

   b. What is the net force acting on the satellite?

   Net Force is gravity, so $F_g = \frac{(6.67 \times 10^{-11})(2000)(6 \times 10^{24})}{(12.8 \times 10^6)^2} = \boxed{4885 \text{ N}}$

   c. How fast is the satellite moving?

   $F_g = F_c$ so $4885 = \frac{(2000)v^2}{12.8 \times 10^6}$ $v^2 = 31{,}264{,}000$ $\boxed{v = 5591 \text{ m/s}}$

   d. What is the period of the satellite's motion?

   $v = \frac{2\pi r}{T}$ $5591 = \frac{2\pi(12.8 \times 10^6)}{T}$ $\boxed{T = 28{,}750 \text{ s} \approx 8 \text{ hours}}$

   e. Did you really need to know the mass of the satellite in order to calculate its period?

   Nope. It would have canceled out. (Look at steps b and c)