Physics 12 U6 Gravitation Worksheet #1

Solutions

Name: _____

$$F_g = \frac{GMM}{R^2} \qquad F_g = mg$$

1. A word that we use instead of "the force of gravity on an object"
   weight
2. The metric units for mass Kg
3. The metric units for force Newton(s) N
4. The metric unit for weight Newton N
5. The force of gravity on 1 kg on Earth 9.8 N
6. Calculate the weight of a 18.8 kg dog.

$F_g = mg = 184N$

7. This one you will need to find out the info on your own.

For either your vehicle or one of your parents vehicles calculate the weight the vehicle. You can either Google the vehicle and look for GVW (gross vehicle weight) which is often listed in pounds in the US or Kg in Canada or you can look in the owners manual or you can look just inside the drivers side door.

Vehicle name and brand _____
GVW _____

Force of gravity on vehicle. _____

8. The "g" in $\mathbf{F_g = mg}$ has two names that describe the two different uses for the number.

The first name is: *gravitational field strength* (in N/kg)

The second one is: acceleration due to gravity. (in m/s^2)

9. The gravitational field strength (g) is not exactly the same everywhere on Earth. The value we use, 9.8 N/kg, is an average.

Find the value of g if at that location the force of gravity on a 0.8 kg mass is 7.8560 N. List your answer to 5 sig figs.

$$F_g = mg \rightarrow g = \frac{F_g}{m} = \frac{7.856}{0.8}$$

g = 9.82 N/kg

$\div 1000$

1 kg = 1000 g

$\times 1000$

10. a) 4 grams = .004 kg

b) 670 grams = .670 kg

c) 1200 grams = 1.2 kg

d) 2.1 kg = 2100 grams

e) 4.5 kg = 4500 grams

f) 0.87 kg = 870 grams

11. a) 12 cm = .12 m

b) 145 cm = 1.45 m

c) 248 m = .248 km

d) 3580 m = 3.58 km

e) 12000 m = 12 km

f) 5.6 km = 5600 m

g) 76 km = 76,000 m

1 m = 100 cm.

1 Km = 1000 m.

12. We can not always use the equation $\mathbf{F_g = mg}$ to calculate the force of gravity. We can only use it if we know the value of "**g**" at that location.

For places where we do not know the value of "**g**" we can instead use the equation

$F_g = GMM/R^2$ – Newton's Universal Law of Gravitation

What is the official name for the constant "G" ? (universal) gravitational constant.

What is the value of "G"? G = 6.67×10^{-11}

13. Calculate the force of gravity between the Sun and the Earth. See data sheet for distance and masses.

- Hint: Looking up the distance is always the tricky one. Look under the Earth section for a radius around sun

- Hint: Do the math step by step the first time and check your values against another student or two. The numbers you are putting in your calculator are in scientific notation and some students struggle with how to properly do this with their calculator.

$$F_g = \frac{GMM}{R^2} = \frac{(6.67 \times 10^{-11})(1.98 \times 10^{30})(5.98 \times 10^{24})}{(1.5 \times 10^{11})^2}$$

$$= 3.51 \times 10^{22}\ N$$

14. Calculate the force of gravity between the Moon and the Earth.
- Hint: you need to look under the Moon section to find the correct distance.

$$F_g = \frac{GMM}{R^2} = \frac{(6.67 \times 10^{-11})(5.98 \times 10^{24})(7.35 \times 10^{22})}{(3.84 \times 10^{8})^2}$$

$$= 1.99 \times 10^{20}\ N$$

15. Calculate the force of gravity on a 480 kg satellite that is **700 km above the surface of the Earth**.

- Hint, calculate R carefully.

R = 6.38×10^6 m + 700,000 m = 7.08×10^6 m.

$$F_g = \frac{GMm}{R^2} = \frac{(6.67 \times 10^{-11})(480)(5.98 \times 10^{24})}{(7.08 \times 10^6)^2}$$

$$= 3820\ N$$

F_g = _____

16. Calculate the force of gravity between two people with a mass of 70 kg that are 2 m apart. This demonstrates that the force of gravity between "normal" size objects is quite small.

$$F_g = \frac{GMm}{R^2}$$

$$= \frac{(6.67 \times 10^{-11})(70)(70)}{(2)^2} = 8.2 \times 10^{-8}$$

= less than 1/millionth of a Newton.

17. Calculate the weight of a 122 kg motorbike on the surface of the Earth using both methods listed below

a) $F_g = mg = (9.8)(122) = 1195.6\ N$

b) $F_g = GMM/R^2 = \dfrac{(6.67\times10^{-11})(122)(5.98\times10^{24})}{(6.38\times10^{6})^2}$

$= 1195\ N$

19. Using the equation below solve for gravitation field strength (g) on the surface of an asteroid with a mass of 4.68×10^6 kg and a radius of 5 km. 5000m.

It is obvious that $F_g = F_g$ or that $mg = GMM/R^2$

Note that m and M both represent the same thing, mass.

$F_g = F_g$

$mg = GMM/R^2$

$g = GM/R^2$ ↘

$$g = \frac{(6.67\times10^{-11})(4.68\times10^{6})}{(5000)^2}$$

$g = 1.25\times10^{-11}$ (weak, basically no gravitational field.)

20. a) Fill in the following table assuming the following . . .

mass 1 = 2×10^9 kg mass 2 = 40,000 kg

look G up on your formula sheet

a)

Distance	Force of gravity
10 m	
20 m	
30 m	
40 m	
50 m	
60 m	
70 m	

Show your working here,

a) $F_g = \frac{GmM}{R^2} = \frac{(6.67 \times 10^{-11})(2 \times 10^9)(40{,}000)}{(10)^2} = \frac{5336}{100} = 53.4\,N$

b) $F_g = \frac{5336}{(20)^2} =$

Show your working here,

b) Create a graph

- plot Force of gravity on the y axis
- plot distance on the x axis
- draw a smooth curved line through your points