Gravity, Part 1

Some useful numbers for this sheet. $G = 6.67 \times 10^{-11}\ N \cdot m^2/kg^2$

Mass of Earth: 6×10^{24} kg
Radius of Earth: 6.4×10^{6} m
Mass of Moon: 7.4×10^{22} kg
Radius of Moon: 1.74×10^{6} m

Distance Earth-Moon: 3.8×10^{8} m
Distance Earth-Sun: 1.5×10^{11} m

Conceptual Questions

1. What is Newton's Theory of Universal Gravitation? (Words and equation.)

2. Why does he call it universal?

3. What does the "d" represent in the equation?

4. What is "G?" (Words and number.)

5. If you get farther away from the earth, what happens to:
   a. the force of gravity acting on you?

   b. the acceleration due to gravity acting on you?

   c. your weight?

5. Why do we only notice the gravitational attraction to the earth, and not to the people and objects around us?

6. If you are standing on the earth, what is the distance between you and the earth, at least as far as universal gravitation is concerned?

Calculations

1. a. Calculate the gravitational force between the earth and the moon.

   b. Which experiences the greater force – the earth or the moon?

   c. Which experiences the greater acceleration – the earth or the moon?

   d. Why doesn't the moon crash into the earth?

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2. a. What is gravitational force between two people (60 kg and 75 kg) who are 1 meter apart.

   b. Compared to other every day forces, how large is this attraction?

   c. Is it even noticable?

3. Calculate the gravitational force between you (m = 65 kg) and the earth.

4. If you were somehow floating in space 6.4×10^6 m above the surface of the earth, what would be the gravitational force on you? (Still use 65 kg)

5. There is a gravitational force of 100 N between two objects. What would be the gravitational force if
   a. the distance between them were doubled.

   b. the distance between them were halved.

   c. the distance between them were tripled.

   d. if the mass of one of the objects doubled.

   e. if the mass of both of the objects doubled.

   f. if the mass of one of the objects were halved.

   g. if the size of one of the objects were doubled (and the mass stayed the same.)

   h. if the size of both of the objects were doubled (and the mass stayed the same.)

Answers: 1. a) 2.05 x 10^{20} N b) the same c) the moon d) because it moves really fast in a nearly circular orbit; its acceleration is changing its direction of travel. 2. a) 3 x 10^{-7} N b) really, really small c) not a bit 3) 635 N 4) 159 N 5. a) 25 N b) 400 N c) 11.1 N d) 200 N e) 400 N f) 50 N g) 100 N h) 100 N