Ch. 9 Gravity; 11th edition
Review Questions p. 166

4. State Newton's law of universal gravitation in words. Then do the same with one equation.
Ans. The attractive force of gravity between two objects in directly proportional to the mass of the objects and inversely proportional to the their separation distance squared.

$F = \gamma \frac{m_1 m_2}{d^2}$; where $\gamma = 6.67 \text{ X } 10^{-11} \frac{Nm^2}{kg^2}$ Just remember that this is a small number.

6. What is the magnitude of the gravitational force between the earth and a 1 kilogram object?
Ans. Weight = mg = 1 kg(10 m/s/s)= 10 newtons.
7. What is the magnitude of the gravitational force between the earth and your body?
Ans. This is another way of asking what your weight is. For me the answer is 160 pounds, which equals about 730 newtons in the metric system.

9. How does the force of gravity between two objects change when the distance between them is doubled?
Ans. The force of gravity is inversely proportional to the distance between the two objects. That means if you double the distance between the objects, the force of gravity pulling them together will be $\frac{1}{2^2} = \frac{1}{4}$ of its previous value.

Extra. How does the force of gravity between two objects depend on their masses?
Ans. The force of gravity is directly proportional to the mass of each object. That means if you double the mass of one of the objects, you will double the force of gravity on the object.

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3, What would be the path of the moon if somehow all gravitational forces on it vanished to zero?
Ans. The moon would move in a straight line at constant speed. It would not be a satellite of the Earth.

10. A friend says that the International Space Station in orbit because it is beyond the pull of Earth's gravity. Correct your friend's ignorance.
Ans. Ask about this one in class for + 2 points.

14. The earth and the moon are attracted to each other by gravitational force. Does the more massive earth attract the less massive moon with a force that is greater, smaller or the same as the force with which the moon attracts the earth?
Ans. The forces are equal in magnitude and opposite in direction(Newton's 3rd law).

25. Is gravitational force acting on a person who falls off a cliff? On an astronaut inside an orbiting space station?
Ans. Gravity would still be acting on you. The sensation of having weight requires that you be in contact with something that doesn't have the same acceleration that you do. Both you and the space station are accelerating down at the same rate.

Ch. 9 Exercises continued; 11th edition

28. If you were in a freely falling elevator and you dropped a pencil, you would see the pencil hovering. Is the pencil falling? Explain.

Ans. Yes, the pencil is falling with the same acceleration and velocity that you are. Because you and the pencil are always falling at the same rate, it never reaches your feet. This is very similar to cars on the highway. If they are all going at the same speed in the same direction then they keep their same position, just as they would if they were all at rest.

34. If the mass to the earth somehow increased, with all other factors remaining the same, would your weight also increase?
Ans. Yes. The force of gravity is directly proportional to the mass of the objects involved. Increasing the mass of one of the objects increases the force of gravity pulling the objects together.

$$F = \gamma \frac{m_1 m_2}{d^2}$$

Extra: What are the magnitude and direction of the gravitational force that acts on a man who weights 700 newtons at the surface of the earth?
Ans. Magnitude= 700 newtons; Direction is toward the center of the earth.

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4. Find the change in the force of gravity between two planets when the distance between them is decreased by a factor of five.
Ans. If the distances is 1/5 of the original separation , the new force is 25 times the original force. Ask in class if you don't understand this.

Extra. The value of 'g' at the earth's surface is approximately 10 m/s^2. What is the value of 'g' at a distance from the earth's center that is 4 times the earth's radius?

Ans. $10/16 = 5/8$ m/s^2
If you don't know why I divided by 16, ask in class. Thanks.