1. Find the strength of gravitational field on Saturn. The mass of Saturn is approximately 5.683×10^{26}kg and its radius is 58 232 km. Assume that Saturn is a perfect sphere and its mass is distributed throughout the entire planet.

$r = 58\,232 \text{ km}$
$= 58\,232\,000 \text{ m}$
$= 5.8232 \times 10^{7} \text{ m}$

$$g = \frac{Gm_S}{r_S^2}$$
$$= \frac{(6.67 \times 10^{-11})(5.683 \times 10^{26})}{(5.8232 \times 10^{7})^2}$$
$$= 11.2 \text{ N/kg}$$

2. How does the strength of the gravitational field of Saturn compare to the strength of the gravitational field of planet Earth? ($m_E = 5.98 \times 10^{24}$kg, $r_E = 6.38 \times 10^{6}$m)

$g_E = 9.8 \text{ N/kg}$

$g_S = 11.2 \text{ N/kg}$

$$g = \frac{(6.67 \times 10^{-11})(5.98 \times 10^{24})}{(6.38 \times 10^{6})^2}$$
$$g = 9.8 \text{ N/kg}$$

$$\frac{g_S}{g_E} = \frac{11.2}{9.8} = 1.14$$

∴ the gravitational field of Saturn is 1.14 times stronger than the gravitational field of Earth.

3. a)Newton's Law of Universal Gravitation states that all objects exert an attractive force on all other objects. Why don't you feel gravitational attraction from objects around you?

- the mass of the objects is negligible when compared to the mass of the Earth
- objects create very weak gravitational fields around them, but the effects of this weak gravity often cancel out, depending on the position

$m_1 = \frac{588}{9.8} = 60kg$

b) Provided that your weight is 588 N and you are standing 0.5 m away from a 35.0-kg bookshelf, is there a gravitational force between you and the bookshelf? If yes, find its magnitude. If not, explain why.

$F_g = \frac{G m_1 m_2}{r^2}$

$= \frac{(6.67 \times 10^{-11})(60)(35)}{(0.5)^2}$

$= 5.6 \times 10^{-7} N$

4. a) What is the acceleration due to gravity on Saturn?

$g = 11.2 \frac{m}{s^2}$

b) What would be the weight of a 70-kg person on Saturn?

Weight : $(70)(11.2) = 784 N$

c) How does the weight of the person on Saturn compare to the weight of the person when they are on Earth?

$W_S = 784$

$W_E = (70)(9.8) = 686$

$\frac{W_S}{W_E} = \frac{784}{686} = 1.14$

The weight on Saturn is 1.14 greater than on Earth because

5. a) Find the gravitational force experienced by a 100-kg object that is on the Moon's surface.

(m_M=7.34x10^{22}kg, r_M=1.71x10^{6}m)

$$F_g = \frac{(6.67\times10^{-11})(7.34\times10^{22})(100)}{(1.71\times10^{6})^2}$$

$$= 169.4\ N$$

b)What is the acceleration due to gravity on the Moon?

$$g = 1.69\ \frac{m}{s^2}$$

6. What is the gravitational attraction between Moon and Earth if their surfaces are separated on average by 3.76x10^{8}m?

$$r = r_E + r_m + 3.76\times10^8$$

$$= (6.38\times10^6) + (1.71\times10^6) + (3.76\times10^8)$$

$$= 3.841\times10^8\ m$$

$$F_g = \frac{(6.67\times10^{-11})(5.98\times10^{24})(7.34\times10^{22})}{(3.841\times10^8)^2}$$

$$F_g = 1.98\times10^{20}\ N$$

7. Find the mass of an object that orbits the Earth 320 km and experiences gravitational pull of 686 N [towards the center of the Earth].

$r = r_E + 320\,000$

$r = 6.38 \times 10^6 + 320\,000$

$r = 6.7 \times 10^6 \text{ m}$

$F_g = \frac{G m_1 m_2}{r^2}$

$F_g r^2 = G m_1 m_2$

$\frac{F_g r^2}{G m_1} = m_2$

$m_2 = \frac{(686)(6.7 \times 10^6)^2}{(6.67 \times 10^{-11})(5.98 \times 10^{24})}$

$m_2 = \frac{3.079454 \times 10^{16}}{3.98866 \times 10^{14}}$

$m_2 \doteq 77.2 \text{ kg}$