Universal Gravitation

1) An 8.0 kg ball is separated from a 6.0 kg ball by 2.0 m. What is the gravitational force of attraction between them?

2) Two satellites of equal mass are put 30 m apart. A gravitational force of 2.0×10^{-7} N acts between them. What is the mass of each satellite?

3) The force of gravity on the average person is about 700 N at the Earth's surface.
   a) The mass of that person.
   a) The weight on that person if they were 10 times that distance from the centre of the Earth.

4) Calculate the gravitational field and determine weight in each case.
   a) A 75 kg astronaut located at Earth's surface
   b) A 75 kg astronaut located 3 Earth radii from the center
   c) A 75 kg astronaut located 10 Earth radii from the center
   d) A 75 kg astronaut located 20 km from Earth's surface.

5) Calculate the force of gravity on a 1.0×10^5 kg space station situated at each of the following locations. ($R_{Earth} = 6.38 \times 10^6$ m ; $M_{Earth} = 5.98 \times 10^{24}$ kg)
   a) on the Earth's surface
   b) 128 000 km from the centre of the Earth.
   c) 384 000 km from the centre of the Earth (about the distance to the moon)
   d) 1.5×10^8 km from the centre of the Earth (about the distance to the sun)

6) The distance from the centre of the Earth to the North Pole is 6356 km and the distance from the centre of the Earth to the equator is 6378 km.
   a) What is your weight if you are at the North Pole?
   b) What is your weight if you are on the equator?
   c) What is the percent difference between your weight on the equator and your weight at the North Pole?
   d) What is the percent difference between your mass on the equator and your weight at the North Pole?

7) A 60 kg person weighs 588 N on Earth's surface.
   a) Calculate g on Earth from this information.
   b) What would the person weigh on a planet where $g = 4.5$ m/s²?
   c) What is the person's mass on this new planet?

8) Mars has a radius of 3390 km and a mass of 6.39×10^{23} kg.
   a) What is the gravitational field strength on Mars?
   b) How much would you weigh on Mars?

9) A planet has a mass of 2.5×10^{24} kg and radius 4.2×10^{6} m.
   a) Compute g on the surface of this planet.
   b) How much would a 90 kg astronaut weigh there?

10) A space rock is dropped near the surface of a planet the same size of Earth but of a different mass. It reaches a speed of 15 m/s in 5.0 s. What is the mass of the planet?

11) A man jumps on the surface of the moon with an initial velocity of 3.2 m/s upwards. How high does he jump? ($R_{Moon} = 1.74 \times 10^{6}$ m ; $M_{Moon} = 7.35 \times 10^{22}$ kg)

12) At what height above Earth's surface will an astronaut's weight be **one-half** of their weight on Earth? Given: $M_E = 5.98 \times 10^{24}$ kg, $R_E = 6.38 \times 10^{6}$ m