Gravity

1. What would be the weight of an 80 *kg* astronaut standing on the surface of a spherical, iron asteroid of radius 100 *m*? The density of iron is 7.87 g/cm^3, and the gravitational constant $G = 6.67 \cdot 10^{-11} m^3 kg^{-1} s^{-2}$.

2. SOHO (the space observatory of the Sun) is located at the point where the gravity forces coming from the Earth and the Sun compensate each other. Find the distance of that specific point from the Earth. (see also *http://sohowww.nascom.nasa.gov* with plenty of interesting photos and films about the activity of the Sun) .

3. Find the speed of the Earth's satellite moving along a circular orbit as a function of its radius *r*. Consider two limiting cases: $r = R_E$ (the radius of the Earth), and $r \to \infty$. Assume that $R_E = 6000 km$, and $g = 9.81 m/s^2$ (on the Earth's surface).

4. A satellite on a geostationary orbit (*geosynchronous satellite*) see e.g. *http://en.wikipedia.org/wiki/Geostationary* , is at such a height above the Earth's surface that it remains always above the same point on. Estimate the radius of the orbit of such satellite. Given are: $R_E = 6000 km$, $g = 9.81 m/s^2$. The period of the Earth's daily rotation $T = 24h$.

5. Find the acceleration of gravity at an altitude of 1000 *km*. Express the result by *g* constant.

6. Use the Newton's law of gravitation to estimate the mass of the Sun. The average distance between the Earth and the Sun $r_{ES} = 1.5 \cdot 10^{11} m$, the period of the orbital motion of the Earth around the Sun $T = 365\, days$, assume also $R_E = 6000 km$, $g = 9.81 m/s^2$.

7. Similarly as in the problem above estimate the mass of our planet using the following data: the distance between the Earth and the Moon $r_{EM} = 3.86 \cdot 10^5 km$, the period of the Moon circular motion around the Earth $T = 27\, days$, and the gravitational constant $G = 6.67 \cdot 10^{-11} m^3 kg^{-1} s^{-2}$.

8. Assuming that the Earth is a perfect solid sphere having a constant density (homogenous distribution of mass) find the dependence of the gravity force *inside* the planet as a function of its radius. Use all the necessary data from the problems above.

P. Scharoch & M. Mulak