Seminary exercise Nr. 2
Field of gravitation

For all exercises, let assume the following values:

- gravitational constant $G = 6.67 \cdot 10^{-11} m^3 kg^{-1} s^{-2}$
- Earth radius $r_E = 6.37 \cdot 10^6 m$
- Earth mass $m_E = 5.97 \cdot 10^{24} kg$

1. What is the intensity of the gravitational field at the Earth's surface?
2. At what altitude above the Earth's surface would the gravitational acceleration be $4.6 m s^{-2}$?
3. Four mass particles, each of mass m , form a square with an edge length of d . What gravitational force (magnitude and direction) acts to the fifth mass particle of mass m placed in the center of the square? What is the gravitational field intensity at the same point?
4. A space rocket is in a circular orbit at the altitude of $400 km$ above the Earth's surface. What is the magnitude of the centripetal acceleration acting to the rocket? At what speed it is moving? What is the period of the orbit?
5. Calculate the angular and linear speeds of a projectile moving horizontally near the Earth's surface.
6. What linear speed must an Earth satellite have to be in a circular orbit at an altitude of $160 km$ above Earth's surface? What is the period of revolution?
7. Show that the gravitational force is a conservative force (select an appropriate example to show it).
8. Define the term "Potential energy" of gravitational field. Using the Newton's law of gravitation, show the change in potential energy for a small mass body falling down from the altitude of $100 m$ to the Earth's surface.
9. Four mass particles, each of mass m form a square with an edge length of d . What is the potential of the gravitational field in the center of the square?
10. Determine the orbit altitude for a geostationary satellite. (It is also called a fixed satellite, because its position is fixed above the same place on the Earth's surface)
11. Determine the orbit altitude for a GPS satellite (the orbital period of a GPS satellite is $12 h$).
12. What is the escape speed on the Earth?