

Newton's Law of Universal Gravitation

Solve the following problems

Einstein famously said that "Gravitation is not responsible for people falling in love."

1. (Serway, p. 264, #18) What would be the gravitational force between a 50 kg girl and a 60 kg boy sitting 2.5 meters apart?
2. What is the gravitational force between me, mass 100 kg, and the planet Jupiter? Jupiter's mass is 1.9×10^{27} kg, and is 6.29×10^{11} meters away from me.
3. Two satellites of equal mass are orbiting Earth 50 m apart. If the gravitational force between them is 1.5×10^{-7} N, find the mass of each.
4. The moon of mass 7.35×10^{22} kg orbits the Earth. If the force of attraction between them is 1.9×10^{20} N, how far away is the Moon?
5. What is the force of gravitation between a proton (mass of 1.67×10^{-27} kg) and an electron (mass 9.11×10^{-31} kg) in a hydrogen atom if they are 1×10^{-10} meter apart?
6. Calculate g at a point 6.37×10^6 m above the earth's surface.

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Chapter 7: Rotational motion

13. (Giancoli, p 141, # 31) Calculate the effective value of g , the acceleration of gravity, at (a) 3200 m, and (b) 3200 km, above the Earth's surface.
14. (Giancoli, p 141, # 33) A typical white-dwarf star, which once was an average star like our Sun but is now in the last stage of its evolution, is the size of our Moon but has the mass of our Sun. What is the surface gravity on this star?
15. (Giancoli, p 141, # 36) Every few hundred years most of the planets line up on the same side of the Sun. Calculate the total force on the Earth due to Venus, Jupiter, and Saturn, assuming all four planets are in a line (Remember Venus is between the Sun and Earth). The masses are $M_V = 0.815M_E$, $M_J = 318M_E$, $M_S = 95.1M_E$, and their mean distances from the Sun are 108, 150, 778, and 1430 million km, respectively. What fraction of the Sun's force on the Earth is this?
16. (Giancoli, p 141, #30) You are explaining why astronauts feel weightless while orbiting in the space shuttle. Your friends respond that they thought gravity was just a lot weaker up there. Convince them and yourself that it isn't so by calculating the acceleration of gravity 250 km above the Earth's surface in terms of g .