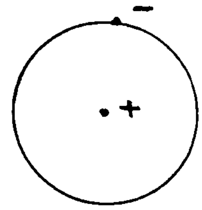
Additional Exercises *Answer on a separate sheet of paper*

A-1: Halley's Comet orbits the sun about every 75 years due to the gravitational force the sun provides. Compare the gravitational force between Halley's Comet and the sun when the comet is at aphelion (its greatest distance from the sun) and d is about 4.5×10^{12} m to the force at perihelion (or closest approach), where d is about 5.0×10^{10} m.

A-2: In Exercise A-1, what is the comet's acceleration a) at aphelion? b) at perihelion? ($M_S = 1.99 \times 10^{30}$ kg)

A-3: An early planetary model of the hydrogen atom consisted of a 1.67×10^{-27}-kg proton in the nucleus and a 9.11×10^{-31}-kg electron in orbit around it at a distance of 5.0×10^{-11} m. In this model, what is the gravitational force between a proton and an electron?



A-4: At what height above Earth would a 400.0-kg weather satellite have to orbit in order to experience a gravitational force half as strong as that on the surface of Earth?

A-5: It is said that people often behave in unusual ways during a full moon. a) Calculate the gravitational force that the moon would exert on a 50.0-kg student in your physics class. The moon is 3.84×10^{8} m from Earth and has a mass of 7.35×10^{22} kg. b) Does the moon attract the student with a force that is greater than, less than, or the same as the force with which the student attracts the moon?

A-6: The tiny planet Mercury has a radius of 2400 km and a mass of 3.3×10^{23} kg. a) What would be the gravitational acceleration of an astronaut standing on the surface of Mercury? b) Compare the motion of a ball dropped on the surface of Mercury to that of a ball dropped on Earth.

A-7: The acceleration due to gravity on Venus is 0.89 that of Earth. a) If the radius of Venus is 6.05×10^{6} m, what is Venus' mass? b) How does this compare to Earth's mass? c) If you were on a diet and had to "weigh in," would you rather stand on a scale on Venus or on Earth in order to appear as if you had lost the most weight?

A-8: The planet Mars has a mass that is 0.11 times Earth's mass and a radius that is 0.54 times Earth's radius. a) How much would a 60.0-kg astronaut weigh if she were to stand on the surface of Mars? b) Although Mercury is much smaller than Mars, it has almost the same gravitational acceleration. Describe how you might explain this phenomenon.

A-9: On October 26, 2000, the NEAR Shoemaker spacecraft swooped within 3 miles of the asteroid Eros, taking images and collecting data from a distance closer than any spacecraft has ever come to an asteroid. Eros has a mass of 6.69×10^{15} kg. The strange potato-like shape of Eros makes its diameter difficult to determine. If the NEAR spacecraft is orbiting a distance of 18 300 m from Eros' center of mass, what gravitational acceleration does Eros provide on NEAR?

A-10: Find the NEAR spacecraft's escape speed from Eros, using the information given in A-9.

A-11: NASA has announced that a mission to Mars to return rock samples to Earth could come as early as 2011. If NASA landed a 360.-kg spacecraft on the surface of Mars a) what would be the weight of the spacecraft on the planet's surface b) what escape speed would be needed for the craft to leave the planet and head back to Earth with its rock samples. ($M_m = 6.42 \times 10^{23}$ kg, $d_M = 3.39 \times 10^{6}$ m)

A1. $1/8100$
A3. 4.1×10^{-47} N
A5. a) 1.66×10^{-3} N
A7. a) 4.9×10^{23} kg
A9. $1.33 \times 10^{-9}\ \mathrm{m/s^2}$
A11. a) 1340 N
b) 3560 m/s