1. During a solar eclipse, the Moon, the Earth, and the Sun all lie on the same line, with the Moon between the Earth and the Sun. (a) What force is exerted by the Sun on the Moon? (b) What force is exerted by the Earth on the Moon? (c) What force is exerted by the Sun on the Earth? (d) Compare the answers to parts (a) and (b). Why doesn’t the Sun capture the Moon away from the Earth?

(a) The Sun-Earth distance is 1.496 × 1011 m and the Earth-Moon distance is 3.84 × 108 m, so the distance from the Sun to the Moon during a solar eclipse is

1.496 × 1011 m − 3.84 × 108 m = 1.492 × 1011 m

The mass of the Sun, Earth, and Moon are





and 

We have



(b) 

(c) 

(d) 

1. Use Kepler’s third law to determine how many days it takes a spacecraft to travel in an elliptical orbit from a point 6 670 km from the Earth’s center to the Moon, 385 000 km from the Earth’s center.

For an object in orbit about Earth, Kepler’s third law gives the relation between the orbital period *T* and the average radius of the orbit (“semimajor axis”) as



We assume that the two given distances in the problem statements are the perigee and apogee, respectively.

Thus, if the average radius is



The period (time for a round trip from Earth to the Moon) would be



The time for a one-way trip from Earth to the Moon is then



1. (a) What is the minimum speed, relative to the Sun, necessary for a spacecraft to escape the solar system if it starts at the Earth’s orbit? (b) Voyager 1 achieved a maximum speed of 125 000 km/h on its way to photograph Jupiter. Beyond what distance from the Sun is this speed sufficient to escape the solar system?

(a) The escape velocity from the solar system, starting at Earth’s orbit, is given by



(b) Let *x* represent the variable distance from the Sun. Then,



If  then



Note that at or beyond the orbit of Mars, 125 000 km/h is sufficient for escape.

Chapter-14

1. What must be the contact area between a suction cup (completely evacuated) and a ceiling if the cup is to support the weight of an 80.0-kg student



When the cup barely supports the student, the normal force of the ceiling is zero and the cup is in equilibrium.



1. A plastic sphere floats in water with 50.0% of its volume submerged. This same sphere floats in glycerin with 40.0% of its volume submerged. Determine the densities of (a) the glycerin and (b) the sphere.

(a) The buoyant force of glycerin supports the weight of the sphere which is supported by the buoyant force of water.





(b) The buoyant force from the water supports the weight of the sphere:







1. Water flowing through a garden hose of diameter 2.74 cm fills a 25-L bucket in 1.50 min. (a) What is the speed of the water leaving the end of the hose? (b) A nozzle is now attached to the end of the hose. If the nozzle diameter is one-third the diameter of the hose, what is the speed of the water leaving the nozzle?

Ans : (a) The cross-sectional area of the hose is



and the volume flow rate (volume per unit time) is

*A*v = 25.0 L/1.50 min

Thus,



(b)  or 

Then from the equation of continuity, , we find



1. To an order of magnitude, how many helium-filled toy balloons would be required to lift you? Because helium is an irreplaceable resource, develop a theoretical answer rather than an experimental answer. In your solution, state what physical quantities you take as data and the values you measure or estimate for them

Consider spherical balloons of radius 12.5 cm containing helium at STP and immersed in air at 0°C and 1 atm. If the rubber envelope has mass 5.00 g, the upward force on each is



If your weight (including harness, strings, and submarine sandwich) is



you need this many balloons:



**Chapter-15**

1. A 0.60-kg block attached to a spring with force constant 130 N/m is free to move on a frictionless, horizontal surface as in Figure 15.1. The block is released from rest when the spring is stretched 0.13 m. At the instant the block is released, find (a) the force on the block and (b) its acceleration

(a) Taking to the right as positive, the spring force acting on the block at the instant of release is



(b) At this instant, the acceleration is



or 

1. A simple pendulum makes 120 complete oscillations in 3.00 min at a location where g 5 9.80 m/s2. Find (a) the period of the pendulum and (b) its length

The period of a pendulum is the time for one complete oscillation and is given by  where  is the length of the pendulum.

(a) 

(b) The length of the pendulum is

