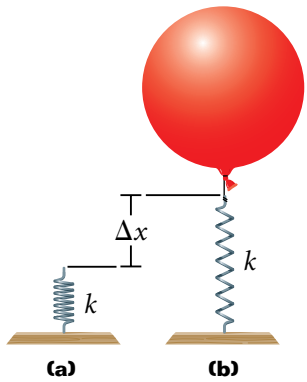
31. A light spring with a spring constant of 90.0 N/m rests vertically on a table, as shown in **(a)** below. A 2.00 g balloon is filled with helium (0°C and 1 atm pressure) to a volume of 5.00 m^3 and connected to the spring, causing the spring to stretch, as shown in **(b)**. How much does the spring stretch when the system is in equilibrium? (Hint: See **Table 1** for the density of helium. The magnitude of the spring force equals $k\Delta x$.)



32. The aorta in an average adult has a cross-sectional area of 2.0 cm^2.

a. Calculate the flow rate (in grams per second) of blood ($\rho = 1.0$ g/cm^3) in the aorta if the flow speed is 42 cm/s.

b. Assume that the aorta branches to form a large number of capillaries with a combined cross-sectional area of 3.0×10^3 cm^2. What is the flow speed in the capillaries?

33. A 1.0 kg hollow ball with a radius of 0.10 m is filled with air and is released from rest at the bottom of a 2.0 m deep pool of water. How high above the surface of the water does the ball rise? Disregard friction and the ball's motion when the ball is only partially submerged.

34. In testing a new material for shielding spacecraft, 150 ball bearings each moving at a supersonic speed of 400.0 m/s collide head-on and elastically with the material during a 1.00 min interval. If the ball bearings each have a mass of 8.0 g and the area of the tested material is 0.75 m^2, what is the pressure exerted on the material?

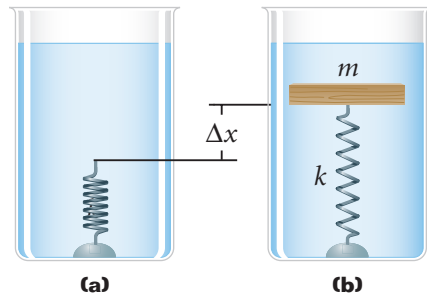
35. A thin, rigid, spherical shell with a mass of 4.00 kg and diameter of 0.200 m is filled with helium (adding negligible mass) at 0°C and 1 atm pressure. It is then released from rest on the bottom of a pool of water that is 4.00 m deep.

a. Determine the upward acceleration of the shell.

b. How long will it take for the top of the shell to reach the surface? Disregard frictional effects.

36. A student claims that if the strength of Earth's gravity doubled, people would be unable to float on water. Do you agree or disagree with this statement? Why?

37. A light spring with a spring constant of 16.0 N/m rests vertically on the bottom of a large beaker of water, as shown in **(a)** below. A 5.00×10^{-3} kg block of wood with a density of 650.0 kg/m^3 is connected to the spring, and the mass-spring system is allowed to come to static equilibrium, as shown in **(b)** below. How much does the spring stretch?



38. Astronauts sometimes train underwater to simulate conditions in space. Explain why.

39. Explain why balloonists use helium instead of air in balloons.