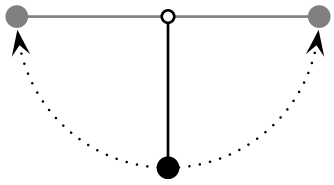
Solve any three problems out of four:

1. Consider a pendulum made of a steel ball on a 1.8 m string. The pendulum swings in a semicircle: when the the string becomes horizontal, the ball stops and swings back.



   Calculate the speed of the ball at the lowest point of its swing.

2. A can contains 3.6 liters of water (0.95 gallon).
   (a) What is the molecular weight of water?
   (b) How many H_2O molecules are there in the can?

3. An air bubble leaks out of some junk on a bottom of a lake, 10 meters below the surface. The bubble rises to the surface and eventually bursts. For simplicity, assume that the air in the bubble has constant temperature during this process.
   (a) What is the water pressure at the bottom of the lake?
   (b) At the bottom, the bubble has volume $V_{\text{bot}} = 1$ cm^3. What is its volume V_{sur} just before it bursts at the surface?

4. The Sun emits approximately $4 \cdot 10^{26}$ watts of light and other radiation. The source of this tremendous power is nuclear fusion of hydrogen into helium; in the process, 0.8% of hydrogen's mass is converted into energy. How much hydrogen does the Sun fuse to helium in one second?

For your information:
$g = 9.8$ m/s$^2 \approx 10$ m/s^2; 1 atm = 101.3 kPa $\approx 10^5$ Pa; ρ(water) = 1 g/cm^3 = 1 kg/L; atomic weight of hydrogen is 1, of oxygen — 16; Avogadro's number $N_A = 6.022 \cdot 10^{23} \approx 6 \cdot 10^{23}$ molecules per mol; $c = 3 \cdot 10^8$ m/s. For simplicity, use approximate values.