ment is usually lower than that of an irregular packing of atoms. However, when the atoms are not given the opportunity to arrange themselves in an orderly manner, by inhibiting their mobility during solidification, an *amorphous* material may be formed. This is the case, for example, in the formation of soot. In other cases, the molecules may be extremely long and irregular in shape, so that an orderly arrangement may not be obtained easily, as in the case of polymers. In some materials, such as glass, the solid state corresponds to a *supercooled liquid* in which the molecular arrangement of the liquid state is frozen in. Due to the high viscosity of the liquid, crystals do not have time to grow under normal conditions, and an amorphous material is formed. Upon annealing, such glassy materials may crystallize (*devitrify*), as observed in the case of quartz.

In the remaining chapters we shall have ample opportunity to indicate the importance of the regular or irregular stacking of atoms on the properties of materials.

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Problems

1.1 Given that one gram molecule of a gas at 0°C and a pressure of 760 mm mercury occupies a volume of 22.414 liters, and assuming Avogadro's number is 6.025×10^{23}, compute the number of molecules per m^3 in a gas at 0°C and 760 mm mercury (Loschmidt's number).

1.2 A residual pressure of 10^{-10} mm mercury in a vacuum tube is considered very good vacuum; estimate the number of gas molecules per m^3 in such a tube at room temperature.

1.3 According to the kinetic theory of gases, the average kinetic energy of a gas molecule at an absolute temperature T is equal to $(3/2)kT$, where k is Boltzmann's constant. What is the average energy, expressed in electron volts, at room temperature ($T = 300$°K)? If the gas is hydrogen, what is the order of magnitude of the velocity of the molecules at $T = 300$°K?