P.62

5. The particles of solids and liquids are joined relatively strongly by forces of attraction that make them virtually incompressible. In a gas, the particles move independently of each other and are spaced far apart.

8. On the one hand, the temperature of a substance corresponds to the degree of agitation of its particles: the higher the temperature, the greater the speed of the particles. On the other hand, the kinetic energy of the particles varies in proportion to the square of their velocity. Thus, the mean kinetic energy of the particles increases when the temperature rises.

9. Curve 3 shows the highest gas temperature because the mean kinetic energy of the gas particles (the top of the curve) of this curve is the greatest (the farthest to the right).

10. *b)* Gas particles are not attracted to each other, because there is no force of attraction or repulsion between them.

P.68

1. Compressibility. Water entering the ballasts compresses the air in them. Conversely, when the water is pumped out of the ballasts, the air expands to fill the free space.

2. Gases must be kept away from heat sources and must be handled with care. The particles of gas occupy all the available space and move continuously in all directions, striking the walls of the container. An increase in temperature increases the velocity of the particles, which increases the pressure on the container walls, thus increasing the risk of an explosion. In addition, if a container of compressed gas is damaged, the gas will seek to escape and the container may explode.

6. In diffusion, a gas mixes gradually with another gas in a container until the particles of the two gases are uniformly distributed throughout the available space. In effusion, a gas escapes from a container through one or many small openings in the surface of the container.

   Examples: The effusion of air from a bicycle tire causes it to need to be re-inflated regularly. Diffusion allows the fragrance of a perfume to spread throughout a room even if there is only one bottle of perfume in the room.

7. NH_3, HF, CO, NO_2, HI.
   (compare Molar masses)

8. $$\frac{v_{CO_2}}{v_x} = \sqrt{\frac{M_x}{M_{CO_2}}}$$

$$\sqrt{M_x} = \sqrt{M_{CO_2}} \cdot \frac{v_{CO_2}}{v_x}$$

$$= \sqrt{44.009\ \text{g/mol}} \cdot \frac{32.0\ \text{mL/min}}{43.0\ \text{mL/min}}$$

$$M_x = 44.009\ \text{g/mol} \cdot \left(\frac{32.0\ \cancel{\text{mL/min}}}{43.0\ \cancel{\text{mL/min}}}\right)^2 = 24.4\ \text{g/mol}$$

Answer: The molar mass of the unknown gas is 24.4 g/mol.

9. $$\frac{t_{N_2}}{t_x} = \sqrt{\frac{M_x}{M_{N_2}}}$$

$$\sqrt{M_x} = \sqrt{M_{N_2}} \cdot \frac{t_{N_2}}{t_x}$$

$$\sqrt{M_x} = \sqrt{28.014\ \text{g/mol}} \cdot \frac{84\ \cancel{\text{s}}}{192\ \cancel{\text{s}}}$$

$$M_x = 28.014\ \text{g/mol} \cdot (0.4375)^2 = 5.36\text{g/mol}$$

Answer: The molar mass of the unknown gas is 5.4 g/mol.

10. Curve 1 represents the gas with the greatest mass because the most probable velocity (the top of the curve) is smaller (the farthest to the left). At the same temperature, the particles of a gas with high mass move more slowly than those of a gas with lower mass.