

(a) Place the following gases in order of increasing average molecular speed at 25°C: CO, SF6, H2S, Cl2, HI. (Type your answer using the format SF6 for SF6.)

slowest

<

<

<

<

fastest

(b) Calculate the rms speed of CO at 95.0°C.

m/s

### Solution

(a) Average molecular speed of a gas is directly proportional to its absolute temperature and inversely proportional to its molar mass:

$$v_{\text{rms}} = \sqrt{3RT/M}$$

The gases considered in the task are at the same temperature, then their average molecular speeds depend on their molecular masses. As this proportion is inverse then the more the molecular mass of a gas the less its average molecular speed.

Find molecular masses of gases:

$$M(\text{CO}) = 12.01 + 16.00 = 28.01 \text{ (g/mol)}$$

$$M(\text{SF}_6) = 32.07 + 19.00 \cdot 6 = 146.07 \text{ (g/mol)}$$

$$M(\text{H}_2\text{S}) = 1.01 \cdot 2 + 32.07 = 34.09 \text{ (g/mol)}$$

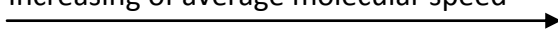
$$M(\text{Cl}_2) = 35.45 \cdot 2 = 70.9 \text{ (g/mol)}$$

$$M(\text{HI}) = 1.01 + 126.90 = 127.91 \text{ (g/mol)}$$

$$M(\text{SF}_6) > M(\text{HI}) > M(\text{Cl}_2) > M(\text{H}_2\text{S}) > M(\text{CO})$$

$$\text{SF}_6 < \text{HI} < \text{Cl}_2 < \text{H}_2\text{S} < \text{CO}$$

Increasing of average molecular speed



(b)  $v_{\text{rms}} = \sqrt{3RT/M}$ .

$$R = 8.314 \text{ kg} \cdot \text{m}^2 / \text{s}^2 \cdot \text{mol} \cdot \text{K}$$

$$T = 95 + 273.15 = 368.15 \text{ K}$$

$$M(\text{CO}) = 28.01 \cdot 10^{-3} \text{ kg/mol}$$

$$v_{\text{rms}} = \sqrt{3 \cdot 8.314 \cdot 368.15 / 28.01 \cdot 10^{-3}} = 572.6 \text{ m/s}$$

**Answer:**

(a)  $\text{SF}_6 < \text{HI} < \text{Cl}_2 < \text{H}_2\text{S} < \text{CO}$

(b) 572.6 m/s

Answer provided by AssignmentExpert.com