

**Example(9):** Helium gas diffuses 4 times as fast as an unknown gas. What is the relative molecular mass of the gas? ( $r_{He} = 4$ )

**Solution:** :

$$r_{He} = 4 \times r_{gas}$$

$$M_{He} = 4 \text{ g mol}^{-1}$$

$$\frac{r_{He}}{r_{gas}} = 4$$

$$M_{gas} = ?$$

Using Graham's law of gaseous diffusion,  $\frac{r_{He}}{r_{gas}} = \sqrt{\frac{M_{gas}}{M_{He}}}$

$$4 = \sqrt{\frac{M_{gas}}{4}}$$

$$16 = \frac{M_{gas}}{4}$$

$$M_{gas} = 64 \text{ g mol}^{-1}$$

$$\text{molar mass of the gas} = 64 \text{ g mol}^{-1}$$

$$\text{relative molecular mass} = 64$$

**Check:** The molar mass of gas is inversely proportional to its rate of diffusion. Therefore, the greater value of molar mass of unknown gas is as expected.