Gas Laws – Applications

density & MW

1) Calculate the density of methane gas, CH_4, in g/L at 25°C and 0.978 atm.

$$d = \frac{MP}{RT} = \frac{16.04\,g}{mol} \times \frac{0.978\,atm}{0.0821\,\frac{L\,atm}{mol\,K} \times 298\,K}$$

$25°C + 273 = 298\,K$

$CH_4 = 16.04\,g/mol$

$$= \boxed{0.641\,g/L\ CH_4}$$

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2) Calculate the molecular mass of a liquid that, when vaporized at 100°C and 755 Torr yields 185 mL of vapor that has a mass of 0.523 g.

$$M = \frac{mRT}{PV}$$

(M: molar mass g/mol; m: mass)

$T = 100°C + 273 = 373\,K$

$P = 755\,torr \times \frac{1\,atm}{760\,torr} = 0.9934\,atm$

$V = 185\,mL \times \frac{1\,L}{1000\,L} = 0.185\,L$

$$M = \frac{0.523\,g \times 0.0821\,\frac{L\,atm}{mol\,K} \times 373\,K}{0.9934\,atm \times 0.185\,L} = \boxed{87.1\,g/mol}$$

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3) Under what pressure must O_2 be maintained to have a density of 1.50 g/L at 25°C? $25 + 273 = 298$

$$d = \frac{MP}{RT} \qquad P = \frac{dRT}{M} = \frac{1.50\,g}{L} \times \frac{0.0821\,\frac{L\,atm}{mol\,K} \times 298\,K}{32\,g/mol}$$

$O_2 = 16 \times 2 = 32\,g/mol$

$$= \boxed{1.15\,atm}$$