

# AP CHEMISTRY

## TOPIC 3: GASES, PART B-I EXAMPLE PROBLEMS

Day 37:

- Gas Density
- Gas Molar Mass

$$n = \frac{m}{M} = \frac{\text{mass}}{\text{Molar mass}} = \frac{\text{grams}}{\frac{\text{grams}}{\text{mol}}} = \frac{\text{grams (mol)}}{\text{grams}}$$

1) What is the density of  $C_8H_{18}$  vapor at 2.25 atm and 342 °C?

$$PV = nRT$$

$$PV = \frac{m}{M}RT$$

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$$P = \frac{mRT}{MV}$$

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$$\frac{PM}{RT} = \frac{m}{V} = \text{density}$$

$$C_8H_{18} = (8)(12.01 \text{ g mol}^{-1}) + (18)(1.008 \text{ g mol}^{-1}) = 114.224 \text{ g mol}^{-1}$$

$$\frac{PM}{RT} = \frac{m}{V} = \frac{(2.25 \text{ atm})(114.224 \text{ g})(\text{mol} \cdot \text{K})}{(0.0821 \text{ atm} \cdot \text{L})(\text{mol})(615 \text{ K})} = 5.09 \frac{\text{g}}{\text{L}}$$

2) Calculate the molar mass of a gas if it has a density of 8.35 g L<sup>-1</sup> at 122 °C and 1589 torr.

$$PV = nRT$$

$$PV = \frac{m}{M}RT$$

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$$M = \frac{mRT}{PV} = \left(\frac{m}{V}\right)\left(\frac{RT}{P}\right)$$

$$122^{\circ}\text{C} + 273 = 395 \text{ K}$$

$$\frac{1589 \text{ torr}}{760 \text{ torr}} \times \frac{1 \text{ atm}}{1 \text{ atm}} = 2.090789474 \text{ atm}$$

$$M = \left(\frac{m}{V}\right)\left(\frac{RT}{P}\right) = \left(\frac{8.35 \text{ g}}{\text{L}}\right)\left(\frac{(0.0821 \text{ atm} \cdot \text{L})(395 \text{ K})}{(2.09 \text{ atm})(\text{mol} \cdot \text{K})}\right) = 130. \frac{\text{g}}{\text{mol}}$$