Unit 10 Review & Summary

Equations from Unit 10 = Circled equations are the ones that are given on the reference tables or by me.

$PV = nRT$	$MM = \frac{gRT}{PV}$	$D = \frac{MM\,P}{R\,T}$
$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$	$P_1V_1 = P_2V_2$	$\frac{V_1}{T_1} = \frac{V_2}{T_2}$
$\frac{P_1}{T_1} = \frac{P_2}{T_2}$	$P_{total} = P_{gas1} + P_{gas2} + \ldots$	
$\frac{\text{rate A}}{\text{rate B}} = \sqrt{\frac{MMB}{MMA}}$	$P_{gasx} = \frac{\text{moles x}}{\text{total moles}} \cdot P_{total}$	

1. Convert the following temperatures.

(A) 104 °C to K 104 + 273 = 377 K **(B) -3 °C to K** -3 + 273 = 270 K

(C) 67 K to °C 67 − 273 = −206 °C **(D) 1671 K to °C** 1671 − 273 = 1398 °C

2. Convert the following pressures.

(A) 635 torr to atm $\frac{635\text{ torr}}{760\text{ torr}} \times \frac{1\text{ atm}}{} = 0.836\text{ atm}$ **(B) 104.2 kPa to mm Hg** $\frac{104.2\text{ kPa}}{101.3\text{ kPa}} \times \frac{760\text{ mm Hg}}{} = 781.8\text{ mm Hg}$

(C) 1.45 atm to kPa $\frac{1.45\text{ atm}}{1\text{ atm}} \times \frac{101.3\text{ kPa}}{} = 147\text{ kPa}$

3. Nitrogen effuses 1.194 times faster than a gas that is added to light bulbs. What is the molecular mass of this unknown gas?

gas A = lighter gas = N_2

gas B = heavier gas = unknown

$$\frac{\text{rate A}}{\text{rate B}} = \sqrt{\frac{\text{MMB}}{\text{MMA}}} \qquad \frac{1.194}{1} = \sqrt{\frac{x}{28.0}}$$

$$\frac{1.425636}{1} = \frac{x}{28.0}$$

$$x = \boxed{39.92 \text{ g/mole}}$$

4. (A) What is the molecular mass of a 0.2500 g sample of a gas at 99.8°C and 0.9131 atm in a 100.0 cm^3 container?

(B) What is the gas in the container?

$$MM = \frac{gRT}{PV}$$

g = 0.2500

R = 0.0821

T = 99.8 + 273 = 372.8

P = 0.9131

V = 0.1000

MM = $\boxed{83.80 \text{ g/mole}}$

$\boxed{\text{krypton}}$

5. A small 2.00 L fire extinguisher has an internal pressure of 506.6 kPa at 25°C. What volume of methyl bromide, the fire extinguisher's main ingredient , is needed to fill an empty fire extinguisher at standard pressure if the temperature remains constant?

$P_1 = 506.6$ kPa $P_2 = 101.3$ kPa

$V_1 = 2.00$ L $V_2 = ??$

$$506.6 \cdot 2.00 = 101.3 \cdot x$$

$$x = \boxed{10.0 \text{ L}}$$

6. If 45.0 g of propane gas burns completely in the following reaction:

$$C_3H_{8(g)} + 5\ O_{2(g)} \rightarrow 3\ CO_{2(g)} + 4\ H_2O_{(g)}$$

then how many liters of carbon dioxide gas will be released if the system is at STP?

$$45.0 \text{ g } C_3H_8 \left| \frac{1 \text{ mole}}{44.0 \text{ g}} \right. = 1.023 \text{ moles } C_3H_8$$

$$\frac{1.023 \text{ moles } C_3H_8}{1} = \frac{x \text{ moles } CO_2}{3} \qquad x = 3.069 \text{ moles } CO_2$$

$$3.069 \text{ moles } CO_2 \left| \frac{22.4 \text{ L}}{1 \text{ mole}} \right. = \boxed{68.7 \text{ L } CO_2}$$

7. Air in a closed cylinder is heated from 25°C to 36°C. If the initial pressure is 3.80 atm, what is the final pressure?

$P_1 = 3.80$ atm $P_2 = ??$

$T_1 = 25 + 273 = 298$ $T_2 = 36 + 273 = 309$

$$\frac{3.80}{298} = \frac{x}{309} \qquad x = \boxed{3.94 \text{ atm}}$$

8. At what temperature Celsius will 19.4 g of molecular oxygen, O_2, exert a pressure of 1820 mm Hg in a 5.12 L cylinder?

$$n = \frac{19.4\text{ g}}{32.0\text{ g}} \left| \frac{1\text{ mole}}{} \right. = 0.606\text{ moles}$$

$$P = \frac{1820\text{ mmHg}}{760\text{ mmHg}} \left| \frac{1\text{ atm}}{} \right. = 2.39\text{ atm}$$

$V = 5.12$ L

$PV = nRT$

$2.39 \cdot 5.12 = 0.606 \cdot 0.0821 \cdot T$

$T = 246$ K

-273

$= -27^\circ C$

9. To what temperature must 32.0 ft^3 of a gas at 2.0 °C be heated for it to occupy 1.00×10^2 ft^3 at the same pressure? (ft^3 is a unit of volume)

$V_1 = 32.0$

$T_1 = 2 + 273 = 275$

$V_2 = 1.00 \times 10^2$

$T_2 = ??$

$$\frac{32.0}{275} = \frac{100}{x}$$

$T_2 = 859$ K

10. Determine the molar mass of a gas that has a density of 2.18 g/L at 66°C and 720 mm Hg.

$$D = \frac{MM\ P}{R\ T} \qquad MM = \frac{D\ R\ T}{P}$$

$$MM = \frac{2.18 \cdot 0.0821 \cdot 339}{0.947}$$

$MM = 64.1$ g/mole

11. A 3.10 mL bubble of methane gas forms at the bottom of a bog where the temperature is 12°C and the pressure is 8.5 atm. The bubble rises to the surface where the temperature is 35°C and the pressure is 1.18 atm. What is the new volume of the methane bubble? $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$ $\frac{8.5 * 3.10}{285} = \frac{1.18 * x}{308}$

$x = 24.1$ mL

12. A mixture of 2.00 moles of H_2, 2.00 moles of NH_3, 4.00 moles of CO_2 and 5.00 moles of N_2 exerts a total pressure of 800. torr. What is the partial pressure of each gas?

$PH_2 = \frac{2.00 \text{ moles}}{13.00 \text{ moles}} \cdot 800 =$ 123 torr

$PNH_3 =$ 123 torr

$PCO_2 = \frac{4.00 \text{ moles}}{13.00 \text{ moles}} \cdot 800 =$ 246 torr

$PN_2 = \frac{5.00 \text{ moles}}{13.00 \text{ moles}} \cdot 800 =$ 308 torr

13. For the reaction $2\ H_{2(g)} + O_{2(g)} \rightarrow 2\ H_2O_{(g)}$, how many liters of water can be made from 5.0 L of oxygen gas and an excess of hydrogen? $\frac{5.0 \text{ L } O_2}{1} = \frac{x \text{ L } H_2O}{2}$ $x =$ 10. L H_2O