UNIT B: Gas Laws - Review Booklet

Name: ____________________________

P_1 V_1 V_2 P_2

1) At a pressure of 95.0 kPa a sample of gas has a volume of 415.0 mL. What is the volume of the gas at 110 kPa?

$$P_1V_1 = P_2V_2$$

$$V_2 = \frac{P_1V_1}{P_2} = \frac{(95.0\,kPa)(415.0\,mL)}{(110\,kPa)} = \boxed{358\,mL}$$

2) A sample of oxygen has a volume of 15. 0L at 125 kPa. What will the volume of the oxygen gas be at a pressure of 75 kPa?

$$P_1V_1 = P_2V_2$$

$$V_2 = \frac{P_1V_1}{P_2} = \frac{(125\,kPa)(15.0\,L)}{(75\,kPa)} = \boxed{25\,L}$$

3) A sample of gas has a volume of 1.73 L at a pressure of 860 mmHg. What must the pressure be on this sample for the volume to change to 2.40 L?

$$P_1V_1 = P_2V_2$$

$$P_2 = \frac{P_1V_1}{V_2} = \frac{(860\,mmHg)(1.73\,L)}{(2.40\,L)} = \boxed{620\,mmHg}$$

4) A sample of oxygen has a volume of 315ml at STP. What is the volume of the gas at 35°C?

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad V_2 = \frac{V_1T_2}{T_1} = \frac{(315\,mL)(308\,K)}{(273.15\,K)} = 3.6 \times 10^2\,mL$$

$$\boxed{= 0.36\,L}$$

5) At 23°C, a sample of hydrogen gas has a volume of 29.00 L. To what temperature must this gas be heated to change the volume to 64.00 L?

$$T_2 = \frac{T_1V_2}{V_1} = \frac{(296\,K)(64.00\,L)}{29.00\,L} = 653\,K$$

$$\boxed{6.5 \times 10^2\,K}$$

6) 27.5 L of chlorine gas at 109 kPa and 23°C is changed to 84.0kPa and 40.0°C. What is the new volume?

$$V_2 = \frac{P_1V_1T_2}{T_1P_2} = \frac{(109)(27.5)(313.2)}{(296)(84.0)}$$

$$= \boxed{38\,L}$$

7) A gas sample has a volume of 35.0 L at 790 mmHg and 22.0°c, What is the volume at STP ~~(745 mmHg)~~?

$$V_2 = \frac{P_1 V_1 T_2}{T_1 P_2} = \frac{(790)(35.0)(273.15)}{(295.15)(760.00)} = \boxed{33.7\,L}$$

8) A sample of fluorine gas with a volume of 45.0 L at STP is changed to 117 kPa and 30.0°C. What is the new volume of the gas?

$$V_2 = \frac{P_1 V_1 T_2}{T_1 P_2} = \frac{(101.325)(45.0)(303.15)}{(273.15)(117)} = \boxed{43.3\,L}$$

9) Find the molar mass of the following molecules:

a) NO_3^- $M = (14.01) + 3(16.00) = \boxed{62.01\ g/mol}$ b) CH_3COOH $M = 2(12.01) + 4(1.01) + 2(16) = 60.06\ g/mol$ c) $PbSO_4$ $M = (207.2) + (32.07) + 4(16)$ $= \boxed{303.27\ g/mol}$	d) $Al_2(SO_4)_3$ $M = 2(26.98) + 3(32.07) + 12(16)$ $= \boxed{342.17\ g/mol}$ e) $(NH_4)_3PO_4$ $M = 3(14.01) + 12(1.01) + 30.97 + 4(16.00)$ $\boxed{M = 149.12\ g/mol}$

10) Find the molar mass of the following molecules:

a) 0.705 mol of CO_2 at STP $M = 12.01 + 2(16)$ $\boxed{= 44.01\ g/mol}$	b) 18.4 mol of $Ni(OH)_2$ $M = 58.69 + 2(16) + 2(1.01)$ $\boxed{= 92.71\ g/mol}$

11) Calculate the number of moles of the following:

a) 0.115 kg of CuS $n = \frac{m}{M} = \frac{115\,g}{95.62\,g/mol} = 1.20\,mol$	b) 4046 mg of Au at STP $n = \frac{m}{M} = \frac{4.046\,g}{196.97\,g/mol} = 0.02054\,mol$ $\boxed{= 20.54\,mmol}$

12) Calculate the volume of 28.897 g of butane gas C_4H_{10} at 21.000°C and 134.000 kPa?

$PV=nRT$

$$V = \frac{nRT}{P} = \frac{(0.497\,mol)(8.314)(294.150K)}{134.000kPa}$$

$$n = \frac{m}{M} = \frac{28.897g}{58.14g/mol}$$

$$\boxed{V = 9.0709\,L}$$

13) What is the molar mass of 0.475 g of an ideal gas that has a volume of 450 ml at 175 kPa and 15.0°C.

$PV=nRT$

$$n = \frac{PV}{RT} = \frac{(175kPa)(0.450L)}{(8.314)(288.15K)} = 0.0329\,mol$$

$$M = \frac{m}{n} = \frac{0.475g}{0.0329\,mol}$$

$$\boxed{= 14.5\,g/mol}$$

14) Explain how you change Celsius to Kelvin.

Add 273.15 to any Celsius temperature to get Kelvin.

15) Explain the difference between SATP and STP.

SATP	STP
100.00kPa	101.325kPa
25.00°C	0.00°C

16) Describe the difference between real and ideal gases

Real Gases	Ideal Gases
- each molecule has volume	- move in straight lines.
- elastic collisions	- Volume can be "0"
- each molecule has mass.	- Can't change state.
	- no LDFs (attractive forces)

17) Explain the Kinetic Molecular Theory and its applications to this unit.

* Every thing is made of molecules
* Molecules are always moving
* There are forces of attraction and repulsion between molecules.

Gas Laws are directly influenced by the KMT. We use ideal gases to see the effect of changes applied to a system.