NAME Key for kPa PER ______

GAS LAWS

Remember: 1 atm = 101.3 kPa = 1 atm = 760 mmHg   R = ~~0.0821~~ 8.314 L·~~atm/mol·K~~ kPa/mol·k

1) Define each of the three main variables for a gas.

P - Force of gas collisions per unit area of container

T - ave. kinetic Energy of gas particles   V = space the gas takes up

2) If temperature is increased while volume is held constant, what will happen to the pressure of a gas?

P. will also increase

3) If the temperature is held constant while the pressure on a gas is increased, what will happen to the volume?

volume will decrease

4) If volume and temperature are held constant, what will happen to the pressure when more gas is added to the container?

Pressure increases

Ideal Gas Law:

5) Write the Ideal Gas Law. What units does each part of the law need to have? (Hint: Look at the units of R, the constant)

$PV = nRT$

P = atm/kPa   T = Kelvin

V = Liters $R = \frac{(atm/kPa) \cdot L}{mol \cdot Kelvin}$

n = moles

6) 2.3 moles of hydrogen gas are in a 250. mL container. If the pressure in the container is 1.4 atm, what is the temperature of the gas?

$V = \frac{250\,mL}{1000} = 0.250\,L$ $P = 1.4\,atm \cdot 101.3\,kPa = 141.82\,kPa$

$(141.82\,kPa)(0.250\,L) = (2.3\,mol)(8.314)(T)$

$T = 1.85\,K$

7) A 1.5 L container has a pressure of 120 kPa at a temperature of 25 °C. How many moles of gas are in the container?

$T = 25 + 273 = 298\,K$

$120\,kPa\,(1.5\,L) = n(8.314)(298\,K)$

$n = 0.073$ moles

8) If 0.57 grams of carbon dioxide is placed in a 250 milliliter container at 40 °C, what will be the pressure of the container?

$V = 0.250\,L$ $T = 40 + 273 = 313\,K$

$n = \frac{0.57\,g\,CO_2}{} \cdot \frac{1\,mol\,CO_2}{44\,g\,CO_2} = 0.013\,mol$

$P(0.250\,L) = 0.013\,mol\,(8.314)(313\,K)$

$P = 135\,kPa$

$V = 3.5\,L$

9) 3.4 grams of oxygen gas is mixed with 5.6 grams of hydrogen gas in a 3.5 liter container at 256 K. What is the total pressure in the container?

$n = \frac{3.4g\,O_2}{} \Big| \frac{1\,mol\,O_2}{32g\,O_2} = 0.106$

$+$

$\frac{5.6g\,H_2}{} \Big| \frac{1\,mol\,H_2}{2.02g\,H_2} = 2.77\,mol$

$\} \; 2.88\,mol$

$P(3.5L) = (2.88\,mol)\,8.314\,(256\,K)$

$P = 1751\,kPa$

Combined Gas Laws:

10) Write out the combined gas law used when any of the big three variables are <u>changing</u> in a gas problem.

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

11) While temperature MUST be in Kelvin for these problems, the units for volume and pressure don't matter. Why is this?

Kelvin measures kinetic energy - only one that has basis of true zero, but 0°C can happen - div. by 0 is not good!

12) A gas in a rigid, metal container at 38 °C and 134 kPa is cooled to 25 °C. What is the pressure in the cooled container? $T_1 = 311K$ $T_2 = 298K$ P_2

$$\frac{134\,kPa}{311\,K} = \frac{P_2}{298\,K}$$

$P_2 = 128\,KPa$

13) The pressure of a 1.0 L flexible container is decreased from 1.5 atm to .85 atm while the temperature is held constant. What is the new volume of the container? V_1

$1.5\,atm = P_1 \rightarrow 151.95\,kPa$

$P_2 = 86.1\,kPa$

$(151.95\,kPa)(1.0L) = (86.1\,kPa)\,V_2$

$1.76L = V_2$

14) If a sample of gas in a 0.55 L balloon is heated from 135 K to 255 K while pressure is kept at ~~105 kPa~~ constant, what will happen to the volume of the balloon? V_1 T_1 T_2 V_2

$$\frac{0.55L}{135K} = \frac{V_2}{255K}$$

$V_2 = 1.04L$

15) A 1.4 L sample of NO gas at 23 °C and 1.2 atm is heated to 45 °C while the volume increases to 1.6 L. What is the new pressure of the gas? V_1 P_1 $T_1 = 296K$ V_2 $T_2 = 318K$ P_2

$1.2\,atm \times \frac{101.3\,kPa}{1\,atm} = 121.56\,kPa$

$$\frac{(121.56\,kPa)(1.4L)}{296K} = \frac{P_2(1.6L)}{318K}$$

$P_2 = 114.3\,KPa$