Chapter 14 – Quiz #5 KEY

Solve the following problems.

Remember the following KEY POINTS:

- **Make sure all temperature units in any gas law use the Kelvin scale.**
- **Isolate the unknown on one side of the equation BEFORE you plug in your numbers.**
- **Include units with all numbers!**
- **Put a box around your final answer. Don't forget about SF!**

1. A balloon is inflated in a room at 27°C and has an initial volume of 3.00 liters. Then, the balloon is heated to a temperature of 66°C. What is its new volume in liters if the atmospheric pressure is held constant? What is the name of the gas law you will use?

Charles Law $V_1 / T_1 = V_2 / T_2$

$T_1 = 27^o C + 273 = 300. K$

$V_1 = 3.00 L$

$T_2 = 66^o C + 273 = 339 K$

$V_2 = ?$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Therefore, $V_1 T_2 = T_1 V_2$

So, $V_2 = V_1 T_2 / T_1$

$V_2 = (3.00 L)(339K) / 300. K$

$V_2 = 3.39 L$ (3 SF)

2. A gas with a volume of 2.5 liters at a pressure of 159 kPa expands to a volume of 15.2 liters. What is the pressure in the container if the temperature is held constant? What is the name of the gas law you will use?

Boyle's Law $P_1V_1 = P_2V_2$

V_1 = 2.5 L

P_1 = 159 kPa

V_2 = 15.2 L

P_2 = ?

$P_1 V_1 = P_2 V_2$

Therefore, $P_1 V_1 / V_2 = P_2$

(159 kPa)(2.5 L) / 15.2 L = P_2

26.15 kPa = P_2

26 kPa = P_2 (2 SF)

3. As the temperature in a pressure cooker rose from 303 K to 401 K, the pressure rose to 1.36 atmospheres. What was the original pressure in the cooker, assuming that the volume remained constant? What is the name of the gas law you will use?

Gay-Lussac's Law $P_1 / T_1 = P_2 / T_2$

P_1 = ?

P_2 = 1.36 atm

T_1 = 303 K

T_2 = 401 K

$P_1 = T_1 P_2 / T_2$

P_1 = (303 K) (1.36 atm) / 401 K

P_1 = 1.03 atm (3 SF)

4. What volume of gas is present at 388 K and 2.15 atmospheres if the same sample of gas initially occupied 0.51 L at 261 K and 4.03 atmospheres? What is the name of the gas law you will use?

Combined gas law $P_1 V_1 / T_1 = P_2 V_2 / T_2$

V_1 = .51 L

T_1 = 261 K

P_1 = 4.03 atm

V_2 = ?

$T_2 = 388$ K

$P_2 = 2.15$ atm

$P_1 V_1 T_2 = T_1 P_2 V_2$ and so…
$V_2 = P_1 V_1 T_2 / T_1 P_2$

$V_2 =$ (4.03 atm) (.51 L) (388 K) / (261 K) (2.15 atm)

$V_2 = 1.4$ L (2 SF)

5. A sample of gas is found to occupy 2.950 L at 26.0 ^oC and 750.0 mm Hg. How many moles of the gas are present? What is the name of the gas law you will use?
1 atm = 760 mm Hg
R = 0.08206 L • atm / mol • K

Ideal Gas Law PV = nRT
so…
PV / RT = n

V = 2.950 L

T = 26.0 ^oC + 273 = 299 K

P = 750.0 mm Hg * 1 atm / 760 mm Hg = .987 atm

PV / RT = n

n = (.987 atm) (2.950 L) / [(0.08206 L • atm / mol • K) (299 K)]

n = .119 mole of gas

6. In a reaction between nitrogen and hydrogen to produce ammonia (NH_3), what volume of hydrogen is needed to produce 15 L of ammonia (assuming constant temperature and pressure)?

First, write and balance the equation.

$1 N_2 + 3 H_2 \rightarrow 2 NH_3$

15.0 L NH_3 * $\frac{\text{3 volumes } H_2}{\text{2 volumes } NH_3}$ = 22.5 L

7. In the same reaction in #6 above, if 2.00 L of nitrogen completely reacts at 1.00 atm and 25 ^oC, how many grams of ammonia are produced?
R = 0.08206 L • atm / mol • K

$1\ N_2 + 3\ H_2 \rightarrow 2\ NH_3$

2.00 L N_2 * $\frac{2 \text{ volumes } NH_3}{1 \text{ volume } N_2}$ = 4.00 L NH_3

PV = nRT
So…

PV / RT = n

T = 25 ^oC + 273 = 298 K

P = 1.00 atm

V = 4.00 L (from above)

n = (1.00 atm) (4.00 L) / [(.08206 L • atm / mol • K) (298 K)]

n = .163 mole NH_3

.163 mole NH_3 * $\frac{17.04 \text{ g}}{1 \text{ mole } NH_3}$ = 2.79 g NH_3 (3 SF)