Week 18 - Gases Sample Free Response (Pre-AP Chemistry)

Write your response in the space provided following each question. Examples and equations may be included in your responses where appropriate. For calculations, clearly show the method used and the steps involved in arriving at your answers. You must show your work to receive credit for your answer. Pay attention to significant figures.

1. A sample of hydrogen gas, H_2 (g), is placed inside a 1.50 L container initially at 2.00 atm and 25°C. Use these measurements as the initial values in all the questions below.

(a) If the temperature is held constant and the volume changes to 2.50 L, what would be the new pressure of this hydrogen gas?

$P_1V_1 = P_2V_2$

$(2.00\text{atm})(1.50\text{L}) = P_2(2.50\text{L})$

1pt

$P_2 = 1.2\text{atm}$

(b) If the temperature is increased to 100°C and the volume changes to 0.75 L, what would be the new pressure of this hydrogen gas?

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $\quad \frac{(2.00\text{atm})(1.50\text{L})}{298\text{K}} = \frac{P_2(0.75\text{L})}{373\text{K}}$

1pt

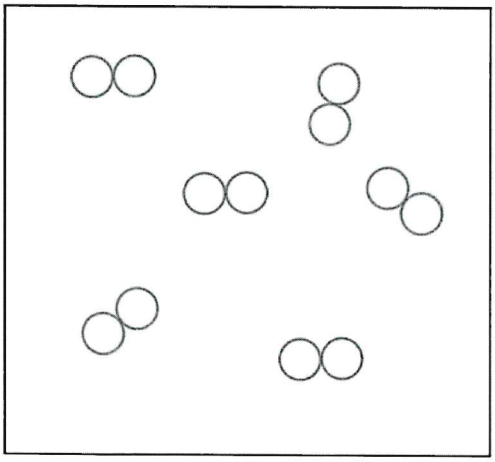
$P_2 = 5.01\text{atm}$

(c) If the volume of the container is held constant, explain why the measured pressure would increase if the temperature is increased using particle-level reasoning.

1pt Any KE or speed → If temp is increased, the average kinetic energy of the particles increases as well as the speed of the particles.

1pt Increase frequency of collisions → If the average KE + speed of the particles increases, the particles will have more collisions and higher force collisions, resulting in greater pressure

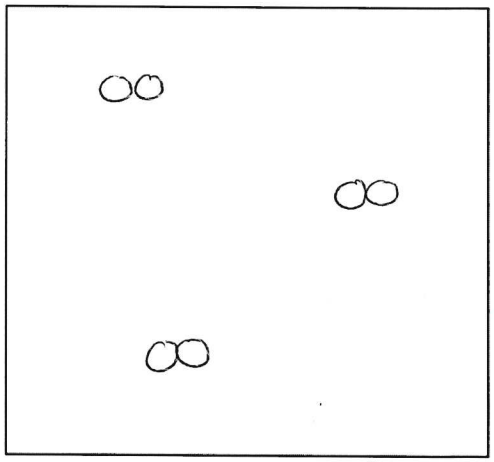
(d) The initial values of hydrogen gas, H_2 (g) (1.50 L container initially at 2.00 atm and 25°C) are shown below in a particle diagram labeled Container 1. Draw the particle level diagram of what H_2 (g) would look like in a 1.50 L container at 1.00 atm and 25°C in Container 2 below.



Container 1

1.5L 2.00atm

25°C



Container 2

1.5L 1.00atm

25°C

← 1pt

3 particles spread out 1pt

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2. A 0.800 gram sample of He gas is placed in a 0.500 L container at 298 K.

(a) How many moles of helium gas are placed inside the container?

1PT → $0.800\text{g He} \div \frac{4\text{g}}{\text{mol}} = 0.200\text{ mol He}$

(b) What will be the measured gas pressure inside the container?

$PV = nRT$

$P(0.500\text{L}) = (0.200\text{mol})\left(0.0820\text{L}\frac{\text{atm}}{\text{mol K}}\right)(298\text{K})$

1PT → (consistency)

$P = 9.78\text{ atm}$

(c) Oxygen gas, O_2 (g), has a molar mass that is 8 times greater than helium, He (g). A student proposed that a sample of oxygen gas at the measured pressure you calculated in part (b) and a temperature of 298 K in a 0.500 L container will be heavier than the sample of He because there are more particles of the oxygen gas as compared to the helium particles. Support or refute this student's proposal with evidence.

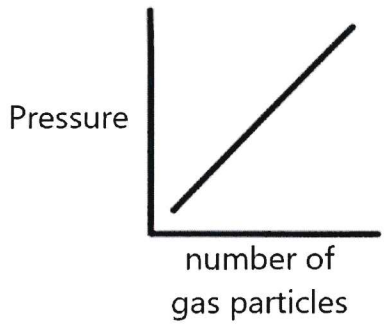
REFUTE

IF TEMP IS SAME, VOL IS SAME, PRESSURE IS SAME, THEN THE # OF MOLES IS THE SAME.

1PT # of moles same →

IF THE # OF MOLES IS THE SAME, THAN THE # OF PARTICLES IS THE SAME (6.02×10^{23} PARTICLES / 1 MOLE)

(d) Another student predicts that the following graph shows the mathematical relationship between the number of gas particles and its pressure. Do you agree or disagree with the student's prediction? Use particle-level reasoning to support or refute this prediction.



1PT

- AGREE
- IF THE # OF PARTICLES INCREASES THEN THE # OF PARTICLES COLLISIONS WILL INCREASE. INCREASING THE PRESSURE

$PV = nRT$

$P = n$