Unit 9: Gas Laws and Gas Stoichiometry

Pre-AP Chemistry Free Response Review #2

Directions: The suggested time is about 15 minutes for answering the constructed response section of the chemistry test. The parts within a question may not have equal weight. For calculations, show all your work in the spaces provided after each part. Pay particular attention to the proper use of units. Be sure your final answer is rounded to the correct number of significant figures. Make sure your work is legible. Illegible work will receive a grade of zero.

Question 1 [10 POINTS]

$$2\ H_2O_2(aq) \rightarrow 2\ H_2O(l) + O_2(g)$$

An aqueous solution containing 0.4969 g H_2O_2 decomposes completely according to the reaction represented above. The $O_2(g)$ produced is collected in an inverted graduated tube over water at 23.4°C and has a volume of 182.4 mL when the water levels (or height of the water) inside and outside of the tube are the same. The atmospheric pressure in the lab is 762.6 torr.

A. Calculate the number of moles of $O_2(g)$ produced in the reaction. **[2 POINTS]**

$$0.4969\ g\ H_2O_2 \left| \frac{1\ mol\ H_2O_2}{34.016\ g\ H_2O_2} \right| \frac{1\ mol\ O_2}{2\ mol\ H_2O_2} = \boxed{0.007304\ mol\ O_2}$$

or $7.304 \times 10^{-3}\ mol\ O_2$

B. Calculate the number of molecules of $O_2(g)$ produced in the reaction. **[2 POINTS]**

$$7.304\text{E-}3\ mol\ O_2 \times \frac{6.022\text{E}23\ molec.\ O_2}{1\ mol\ O_2} = \boxed{4.398 \times 10^{21}\ molec.\ O_2}$$

C. Calculate the partial pressure, in torr, of $O_2(g)$ in the gas-collection tube. **[2 POINTS]**

$PV = nRT$ (not at STP!)

$$P = \frac{nRT}{V} = \frac{(7.304\text{E-}3)(62.36)(23.4+273)}{0.1824} = \boxed{740.2\ torr}$$

↑ L!

$\left(182.4\ mL \times \frac{1\ L}{1000\ mL}\right)$

D. Calculate the vapor pressure of water at 23.4°C (in torr). **[2 POINTS]**

$P_T = P_{O_2} + P_{H_2O}$

$P_{H_2O} = P_T - P_{O_2} = 762.6 - 740.2 = \boxed{22.4 \text{ torr}}$

E. Identify whether the average kinetic energy of the $O_2(g)$ molecules in the gas collection tube is greater than, less than, or equal to the average kinetic energy of the $H_2O(g)$ molecules. Justify your answer. **[1 POINT]**

Same average KE, b/c same T!

F. Identify whether the average velocity of the $O_2(g)$ molecules in the gas collection tube is greater than, less than, or equal to the average velocity of the $H_2O(g)$ molecules. Justify your answer. **[1 POINT]**

$MM(O_2) > MM(H_2O)$, so O_2 molec. will have ↓ velocity than H_2O (since at same T)