Gases Quiz Review **Name** Key

1) Use the Kinetic Molecular Theory to explain why gases...
   a. Spread out to fill the volume of a container.

Molecules of gas feel no attraction or repulsion to hold the particles together, so they are free to spread out randomly throughout the container

   b. Exert pressure on the walls of their container.

All particles are in constant motion, meaning they collide with the walls of the container, resulting in pressure.

2) Which elements form diatomic gases?

H_2, N_2, O_2, F_2, Br_2, Cl_2, I_2

3) Two identical samples of gas are placed in containers of equal volume. Both samples of gas are heated. Explain what you would expect to see happen to pressure and volume in each container if one has flexible walls while the other has rigid walls.

- The increased strength of collisions (particles moving faster) would cause ↑P in the rigid container since the walls can't adjust, ↑V in the flexible container since the walls would expand out.

4) Describe what is happening at the molecular level to cause the following relationships.

a. When the temperature of a gas is increased, the pressure inside its rigid container increases.

↑T = ↑ particle speed = stronger/frequent collisions

Stronger/More collisions with walls = ↑P

b. When the volume of a gas is decreased, the pressure inside its rigid container increases.

↓V = less space for particle motion = more likely to collide w/ walls

More collisions with walls = ↑P

c. When moles of gas are removed from a container with rigid walls, the pressure decreases.

↓n = less particles = less chance of collision with walls

Fewer collisions = ↓P

d. The temperature of a gas inside a container with flexible walls is decreased, causing the volume to decrease.

↓T = slower particles that don't expand as much

Less expansion = ↓ volume

5) As you enjoy a hot sauna, you pour 320.0mL of water onto the stove to steam up the room. Explain why the air suddenly feels "heavier" in the muggy room.

Creates steam: ↑ moles = ↑ pressure

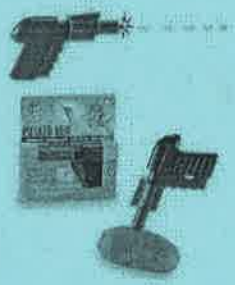
6) If you look at the instructions for cooking food at high altitude, it often tells you to cook it for longer or at a higher temperature than at sea-level. Explain why.

High altitude = thin air (↓ moles gas)

↓n = ↓P

You have to cook longer & at higher temperatures to compensate for ↓n (T & n are indirectly related)

7) Larger potato guns can shoot a spud over 300 yards. Explain how volume and pressure are used to shoot these spud projectiles.



When the trigger is pulled, the volume inside the barrel decreases.

↓V = ↑P

The pressure builds until the piece of potato is shot out of the barrel

8) A 150.0g block of dry ice (CO_2 (s)) is allowed to sublimate (go straight from a solid to a gas) inside of a 1055 L glass container. If the temperature inside the container is 12°C after all of the dry ice been converted into gas, what pressure is inside the container?

$= 273 + 12 = 285\ K$

$$CO_2(s) \rightarrow CO_2(g)$$

$$150.0\ g\ CO_2(s)\left(\frac{1\ mol\ CO_2(s)}{44.01\ g}\right)\left(\frac{1\ mol\ CO_2(g)}{1\ mol\ CO_2(s)}\right) = 3.408\ mol\ CO_2$$

$$PV = nRT$$

$$P(1055\ L) = (3.408\ mol)\left(0.0821\ \frac{atm \cdot L}{mol \cdot K}\right)(285\ K)$$

$$P = 0.07559\ atm = \boxed{0.076\ atm}$$

9) Tom Brady needs to reduce the pressure in his footballs before the big game. If the 1.87L ball is inflated by officials to 0.851 atm at room temperature (298K)...

a. How many moles of gas are in the regulation football?

$$PV = nRT$$

$$(0.851\ atm)(1.87\ L) = n\left(0.0821\ \frac{atm \cdot L}{mol \cdot K}\right)(298\ K)$$

$$n = \boxed{0.0650\ mol\ gas}$$

b. The game is in Green Bay, where the forecast at game time is 0.00°C. How many moles of gas will Tom have to remove from the ball if he wants a nice, soft 0.714 atm ball once its outside?

$= 273\ K$

$$\frac{P_1}{n_1 T_1} = \frac{P_2}{n_2 T_2}$$

$$\frac{0.851\ atm}{(0.0650\ mol)(298\ K)} = \frac{0.714\ atm}{n_2\ (273\ K)}$$

$$n_2 = 0.0595\ mol\ gas$$

$$n_1 - n_2 = 0.0650 - 0.0595 = \boxed{0.00547\ mol\ removed}$$

c. At STP, what volume of air should he let out from the football to remove the moles calculated in (b)?

$$0.00547\ mol\ gas\left(\frac{22.4\ L}{1\ mol}\right) = \boxed{0.123\ L}$$

10) A bottle of hydrogen peroxide in your cabinet decomposes into water and oxygen gas over time.

a. The 500.0mL hydrogen peroxide solution has a molarity of 0.88M, if complete decomposition occurs, how many moles of gas will be produced inside the container?

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

$$0.500\ L_{H_2O_2}\left(\frac{0.88\ mol\ H_2O_2}{1\ L}\right)\left(\frac{1\ mol\ O_2}{2\ mol\ H_2O_2}\right) = \boxed{0.22\ mol\ O_2}$$

b. If the bottle has a 0.0050L pocket of air between the solution and the bottle cap, determine the pressure inside the bottle due to the oxygen gas product, at room temperature (298K).

$$PV = nRT$$

$$P(0.0050\ L) = (0.22\ mol)\left(0.0821\ \frac{atm \cdot L}{mol \cdot K}\right)(298\ K)$$

$$P = 1076\ atm$$

$$= \boxed{1100\ atm}$$

c. If you squeeze the bottle and reduce the empty space to 0.0030L, what would be the new pressure inside the air space?

$$\frac{P_1V_1}{nRT} = \frac{P_2V_2}{nRT}$$

$$P_1V_1 = P_2V_2$$

$$(1076\ atm)(0.0050\ L) = P_2(0.0030\ L)$$

$$P_2 = 1794\ atm$$

$$= \boxed{1800\ atm}$$

11) You take a 3.05g antacid tablet ($CaCO_3$) to help with excess stomach acid (HCl).

a. How many moles of gas will be produced in your stomach?

$$CaCO_3\,(s) + 2HCl\,(aq) = CaCl_2\,(aq) + H_2O\,(l) + CO_2(g)$$

$$3.05\text{ g } CaCO_3 \left(\frac{1\text{ mol } CaCO_3}{100.09\text{ g}}\right)\left(\frac{1\text{ mol } CO_2}{1\text{ mol } CaCO_3}\right) = \boxed{0.0305\text{ mol } CO_2}$$

b. Explain why people tend to burp after taking antacids. Support with a calculation of pressure if your body is 37°C and your stomach has a volume of 0.850L when empty.

CO_2 gas is produced in the digestive tract, which is released as a burp as pressure builds

$$PV = nRT$$

$$P(0.850\text{ L}) = (0.0305\text{ mol})\left(0.0821\ \frac{\text{atm}\cdot\text{L}}{\text{mol}\cdot\text{K}}\right)(310\text{ K})$$

$$\boxed{P = 0.91\text{ atm}}$$