

Exercise 5.4

Gas Stoichiometry

Name: _____

Date: _____ Per: _____

1. A 2.50-L container is filled with 175 g argon.
- a. If the pressure is 10.0 atm, what is the temperature?

- b. If the temperature is 225 K, what is the pressure?

2. Air bags are activated when a severe impact causes a steel ball to compress a spring and electrically ignite a detonator cap. This causes sodium azide (NaN_3) to decompose explosively according to the following reaction: $2\text{NaN}_3(\text{s}) \rightarrow 2\text{Na}(\text{s}) + 3\text{N}_2(\text{g})$. What mass of $\text{NaN}_3(\text{s})$ must be reacted to inflate an air bag to 70.0 L at **STP**? Hint: N_2 is what is filling the air bag.

3. A 15.0 L rigid container was charged with 0.500 atm of krypton gas and 1.50 atm of chlorine gas at 350°C. The krypton and chlorine react to form krypton tetrachloride. What mass of krypton tetrachloride can be produced assuming 100% yield?

4. Consider the reaction between 50.0 mL liquid methanol, CH_3OH (density = 0.850 g/mL) and 22.8 L O_2 at 27°C and a pressure of 2.00 atm. The products of the reaction are $\text{CO}_2(\text{g})$ and $\text{H}_2\text{O}(\text{g})$. Calculate the number of moles of H_2O formed if the reaction goes to completion.

5. Hydrogen cyanide is prepared commercially by the reaction of methane, $\text{CH}_4(\text{g})$, ammonia, $\text{NH}_3(\text{g})$, and oxygen, $\text{O}_2(\text{g})$ at high temperature. The other product is gaseous water.
- a. Write a chemical equation for the reaction.

- b. What volume of $\text{HCN}(\text{g})$ can be obtained from the reaction of 20.0 L $\text{CH}_4(\text{g})$, 20.0 L $\text{NH}_3(\text{g})$, and 20.0 L $\text{O}_2(\text{g})$? The volumes of all gases are measured at the same temperature and pressure.

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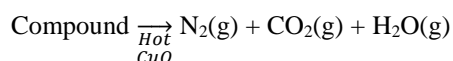
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6. An unknown diatomic gas has a density of 3.164 g/L at STP. What is the identity of the gas?

7. Uranium hexafluoride is a solid at room temperature, but it boils at 56°C. Determine the density of uranium hexafluoride at 60.°C and 745 torr.

8. The nitrogen content of organic compounds can be determined by the Dumas method. The compound in question is first reacted by passage over hot CuO(s):



The product gas is then passed through a concentrated solution of KOH to remove the CO₂. After passage through the KOH solution the gas contains N₂ and is saturated with water vapor. In a given experiment a 0.253 g sample of a compound produced 31.8 mL N₂ saturated with water vapor at 25°C and 726 torr. What is the mass percent of nitrogen in the compound? (The vapor pressure of water at 25°C is 23.8 torr.)

9. A 2.00 L sample of O₂(g) was collected over water at a total pressure of 785 torr and 25°C. When the O₂(g) was dried (water vapor removed), the gas had a volume of 1.94 L at 25°C and 785 torr. Calculate the vapor pressure of water at 25°C.

10. Hydrogen and nitrogen gases were combined in a 4.00 L flask. If 0.750 g of hydrogen and 2.50 g of nitrogen are placed in the flask and it is heated to 325°C what is the final pressure after the reaction below has occurred?

