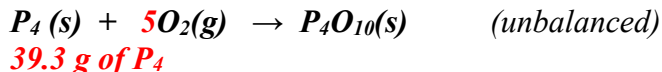
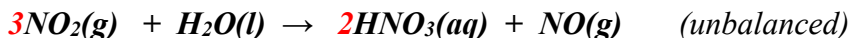


**Worksheet 21 Solutions Gas law and Reaction Stoichiometry**

1. How many grams of phosphorus react with 35.5 L of O<sub>2</sub> at STP to form tetraphosphorus decoxide?



2. The industrial synthesis of nitric acid involves the reaction of nitrogen dioxide gas with water:



How many moles of nitric acid can be prepared using 450 L of NO<sub>2</sub> at a pressure of 5.00 atm and a temperature of 295 K?

**61.9 moles of HNO<sub>3</sub>(aq)**

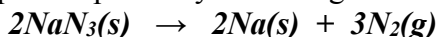
3. In the first step in the industrial process of making nitric acid, ammonia reacts with oxygen at 850°C and 5.00 atm in the presence of a suitable catalyst. The following reaction occurs:



How many litres of NH<sub>3</sub>(g) at 850°C and 5.00 atm are required to react with 1.00 mol of O<sub>2</sub>(g) in this reaction?

**14.8 L**

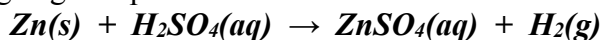
4. Air bags are activated when a severe impact causes a steel ball to compress a spring and electrically ignite a detonator cap. This causes sodium azide (NaN<sub>3</sub>) to decompose explosively according to the following reaction:



What mass of NaN<sub>3</sub>(s) must be reacted to inflate an air bag to 70.0 L at STP?

**135 g of NaN<sub>3</sub>**

5. Hydrogen gas is produced when zinc reacts with sulfuric acid:



If 159 mL of wet H<sub>2</sub> is collected over water at 25°C and a barometric pressure of 738 torr, how many grams of Zn have been consumed?

**0.400 g**

6. Small quantities of oxygen gas are sometimes generated in the laboratory by heating KClO<sub>3</sub> in the presence of MnO<sub>2</sub> as a catalyst:



What volume of O<sub>2</sub> is collected over water at 20°C by reaction of 0.3570 g of KClO<sub>3</sub> if the barometric pressure is 742 torr?

**108 mL**

7. How many grams of phosphine (PH<sub>3</sub>) can form when 37.5 g of phosphorus and 83.0 L of hydrogen gas react at STP?



**41.2 g PH<sub>3</sub>**

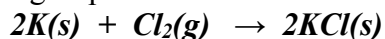
8. Consider the reaction between 60.0 mL of liquid methyl alcohol, CH<sub>3</sub>OH (density = 0.850 g/mL), and 22.8 L of O<sub>2</sub> at 27°C and a pressure of 2.00 atm. The

**Worksheet 21 Solutions Gas law and Reaction Stoichiometry**

products of the reaction are CO<sub>2</sub> (g) and H<sub>2</sub>O (g). Calculate the number of moles of H<sub>2</sub>O formed if the reaction goes to completion.

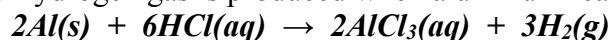
**2.47 moles of H<sub>2</sub>O**

9. The alkali metals react with the halogens to form ionic metal halides. What mass of potassium chloride forms when 5.25 L of chlorine gas at 0.950 atm and 293 K reacts with 17.0 g of potassium?



**30.9 g KCl (s)**

10. Hydrogen gas is produced when aluminum reacts with hydrochloric acid:



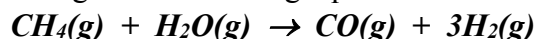
What volume of hydrogen gas is collected over water at 35°C by reaction of 0.6470 g of aluminum if the atmospheric pressure is 742 torr?

**0.987 L**

11. Consider the reaction between 75.0 mL of liquid ethanol, C<sub>2</sub>H<sub>5</sub>OH (density = 0.789 g/mL), and 32.5 L of O<sub>2</sub> at 27°C and a pressure of 2.50 atm. The products of the reaction are CO<sub>2</sub> (g) and H<sub>2</sub>O (g). If the reaction produces 45.0 g of H<sub>2</sub>O (g), what is the percent yield?

**75.6%**

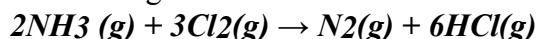
12. Hydrogen gas (a potential future fuel) can be formed by the reaction of methane with water according to the following equation:



In a particular reaction, 25.5 L of methane gas (measured at a pressure of 732 torr and a temperature of 25°C) is mixed with 22.8 L of water vapor (measured at a pressure of 702 torr and a temperature of 12.5 °C). The reaction produces 26.2 L of hydrogen gas measured at STP. What is the percent yield of the reaction?

**43.4 %**

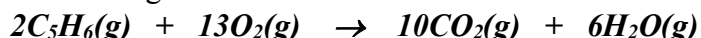
13. Consider the following reaction:



19.8 L of NH<sub>3</sub> gas (measured at STP) is mixed with 26.8 L of wet Cl<sub>2</sub> (measured at a pressure of 722 torr and a temperature of 35.0 °C). The reaction produces 6.81 g of N<sub>2</sub>. What is the percent yield of the reaction?

**76.9 %**

14. Consider the following reaction:



10.8 L of C<sub>5</sub>H<sub>6</sub> gas (measured at STP) is mixed with 26.8 L of wet O<sub>2</sub> (measured at a pressure of 0.968 atm and a temperature of 45.0 °C). The reaction produces 5.00 g of H<sub>2</sub>O(g). What is the *percent yield* of the reaction?

**67.0 %**