

Key

1. Ammonia gas, NH_3 , reacts with hydrogen chloride gas, HCl , to produce a white solid ammonium chloride, NH_4Cl . Calculate the mass of HCl that reacts with 0.3520 g of NH_3 ?



$$\text{g NH}_3 \rightarrow \text{mol NH}_3 \rightarrow \text{mol HCl} \rightarrow \text{g HCl}$$

$$0.3520 \text{ g NH}_3 \cdot \frac{1 \text{ mol NH}_3}{17.04 \text{ g NH}_3} = 0.020657 \text{ mol NH}_3$$

$$0.020657 \text{ mol NH}_3 \cdot \frac{1 \text{ mol HCl}}{1 \text{ mol NH}_3} = 0.020657 \text{ mol HCl}$$

$$0.020657 \text{ mol HCl} \cdot \frac{36.46 \text{ g HCl}}{1 \text{ mol HCl}} = \underline{0.7532 \text{ g HCl}}$$

2. Hydrogen fluoride acid reacts with a solution of magnesium hydroxide $\text{Mg}(\text{OH})_2$ to give magnesium fluoride and water. What mass of H_2O products 6.50 g of MgF_2 ?



$$\text{g MgF}_2 \rightarrow \text{mol MgF}_2 \rightarrow \text{mol H}_2\text{O} \rightarrow \text{g H}_2\text{O}$$

$$6.50 \text{ g MgF}_2 \cdot \frac{1 \text{ mol MgF}_2}{62.30 \text{ g MgF}_2} = 0.1043 \text{ mol MgF}_2$$

$$0.1043 \text{ mol MgF}_2 \cdot \frac{2 \text{ mol H}_2\text{O}}{1 \text{ mol MgF}_2} = 0.2086 \text{ mol H}_2\text{O}$$

$$0.2086 \text{ mol H}_2\text{O} \cdot \frac{18.02 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = \underline{3.76 \text{ g H}_2\text{O}}$$

3. 6.82 g of zinc metal reacts with copper (II) chloride to produce copper metal and zinc (II) chloride. Calculate the mass of elemental copper produced and the mass of zinc chloride produced.



$$6.82 \text{ g Zn} \cdot \frac{1 \text{ mol Zn}}{65.41 \text{ g Zn}} \cdot \frac{1 \text{ mol Cu}}{1 \text{ mol Zn}} \cdot \frac{63.55 \text{ g Cu}}{1 \text{ mol Cu}} = \underline{\underline{6.63 \text{ g Cu}}}$$



$$6.82 \text{ g Zn} \cdot \frac{1 \text{ mol Zn}}{65.41 \text{ g Zn}} \cdot \frac{1 \text{ mol ZnCl}_2}{1 \text{ mol Zn}} \cdot \frac{136.30 \text{ g ZnCl}_2}{1 \text{ mol ZnCl}_2} = \underline{\underline{14.2 \text{ g ZnCl}_2}}$$

4. What mass of ammonia, NH₃, is formed when 2.55 g of Li₃N reacts with water, H₂O, to produce lithium hydroxide, LiOH, and ammonia, NH₃.



$$2.55 \text{ g Li}_3\text{N} \cdot \frac{1 \text{ mol Li}_3\text{N}}{34.83 \text{ g Li}_3\text{N}} \cdot \frac{1 \text{ mol NH}_3}{1 \text{ mol Li}_3\text{N}} \cdot \frac{17.03 \text{ g NH}_3}{1 \text{ mol NH}_3} = 1.25 \text{ g NH}_3$$

5. Sulfuric acid (H_2SO_4) reacts with potassium hydroxide to give potassium sulfate (K_2SO_4) and water. What mass of KOH reacts with 3.75 g of H_2SO_4 ? What is the mass of K_2SO_4 obtained?



$$3.75 \text{ g } \cancel{\text{H}_2\text{SO}_4} \cdot \frac{1 \text{ mol } \cancel{\text{H}_2\text{SO}_4}}{98.08 \text{ g } \cancel{\text{H}_2\text{SO}_4}} \cdot \frac{2 \text{ mol KOH}}{1 \text{ mol } \cancel{\text{H}_2\text{SO}_4}} \cdot \frac{56.11 \text{ g KOH}}{1 \text{ mol KOH}} = \underline{\underline{4.29 \text{ g KOH}}}$$



$$3.75 \text{ g } \cancel{\text{H}_2\text{SO}_4} \cdot \frac{1 \text{ mol } \cancel{\text{H}_2\text{SO}_4}}{98.08 \text{ g } \cancel{\text{H}_2\text{SO}_4}} \cdot \frac{1 \text{ mol } \cancel{\text{K}_2\text{SO}_4}}{1 \text{ mol } \cancel{\text{H}_2\text{SO}_4}} \cdot \frac{174.26 \text{ g K}_2\text{SO}_4}{1 \text{ mol } \cancel{\text{K}_2\text{SO}_4}} = \underline{\underline{6.66 \text{ g K}_2\text{SO}_4}}$$

6. Hydrofluoric acid (HF) reacts with a solution of calcium hydroxide ($\text{Ca}(\text{OH})_2$) to give calcium fluoride and water. What mass of H_2O must react to produce 4.50 g of CaF_2 ?



$$4.50 \text{ g } \cancel{\text{CaF}_2} \cdot \frac{1 \text{ mol } \cancel{\text{CaF}_2}}{78.07 \text{ g } \cancel{\text{CaF}_2}} \cdot \frac{2 \text{ mol H}_2\text{O}}{1 \text{ mol } \cancel{\text{CaF}_2}} \cdot \frac{18.01 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = \underline{\underline{2.08 \text{ g H}_2\text{O}}}$$

7. When iron (Fe) reacts with chlorine (Cl₂), iron (III) chloride is formed. If you would like to make 1.50 g of iron (III) chloride, what masses of chlorine and iron must react?

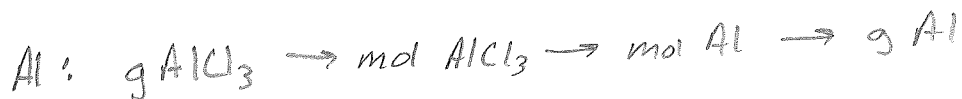


$$1.50 \text{ g FeCl}_3 \cdot \frac{1 \text{ mol FeCl}_3}{162.20 \text{ g FeCl}_3} \cdot \frac{2 \text{ mol Fe}}{2 \text{ mol FeCl}_3} \cdot \frac{55.84 \text{ g Fe}}{1 \text{ mol Fe}} = \underline{\underline{0.517 \text{ g Fe}}}$$

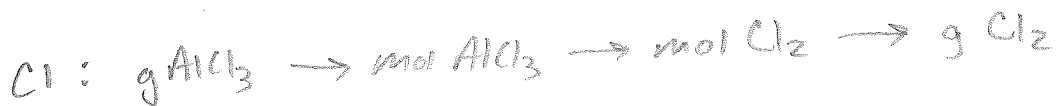


$$1.50 \text{ g FeCl}_3 \cdot \frac{1 \text{ mol FeCl}_3}{162.20 \text{ g FeCl}_3} \cdot \frac{3 \text{ mol Cl}_2}{2 \text{ mol FeCl}_3} \cdot \frac{70.90 \text{ g Cl}_2}{1 \text{ mol Cl}_2} = \underline{\underline{0.984 \text{ g Cl}_2}}$$

8. When aluminum (Al) reacts with chlorine (Cl₂), aluminum chloride is formed. If you would like to make 275 g of aluminum chloride, what masses of aluminum and chlorine must react?



$$275 \text{ g AlCl}_3 \cdot \frac{1 \text{ mol AlCl}_3}{133.34 \text{ g AlCl}_3} \cdot \frac{2 \text{ mol Al}}{2 \text{ mol AlCl}_3} \cdot \frac{26.98 \text{ g Al}}{1 \text{ mol Al}} = \underline{\underline{55.6 \text{ g Al}}}$$



$$275 \text{ g AlCl}_3 \cdot \frac{1 \text{ mol AlCl}_3}{133.34 \text{ g AlCl}_3} \cdot \frac{3 \text{ mol Cl}_2}{2 \text{ mol AlCl}_3} \cdot \frac{70.90 \text{ g Cl}_2}{1 \text{ mol Cl}_2} = \underline{\underline{219 \text{ g Cl}_2}}$$

9. When hydrogen reacts with oxygen, water is formed. If you would like to make 525 g of water, What masses of hydrogen and oxygen must react? Remember that hydrogen and oxygen are diatomic elements.



$$\text{H}_2: \text{g H}_2\text{O} \rightarrow \text{mol H}_2\text{O} \rightarrow \text{mol H}_2 \rightarrow \text{g H}_2$$

$$525 \text{ g H}_2\text{O} \cdot \frac{1 \text{ mol H}_2\text{O}}{18.02 \text{ g H}_2\text{O}} \cdot \frac{2 \text{ mol H}_2}{2 \text{ mol H}_2\text{O}} \cdot \frac{2.02 \text{ g H}_2}{1 \text{ mol H}_2} = \underline{\underline{58.9 \text{ g H}_2}}$$

$$\text{O}_2: \text{g H}_2\text{O} \rightarrow \text{mol H}_2\text{O} \rightarrow \text{mol H}_2 \rightarrow \text{g H}_2$$

$$525 \text{ g H}_2\text{O} \cdot \frac{1 \text{ mol H}_2\text{O}}{18.02 \text{ g H}_2\text{O}} \cdot \frac{1 \text{ mol O}_2}{2 \text{ mol H}_2\text{O}} \cdot \frac{32.00 \text{ g O}_2}{1 \text{ mol O}_2} = \underline{\underline{466 \text{ g O}_2}}$$

10. When nitrogen reacts with oxygen, dinitrogen monoxide (N_2O) is formed. If you would like to make 3.55 g of N_2O , what masses of nitrogen and oxygen must react? Remember that nitrogen and oxygen are diatomic elements.



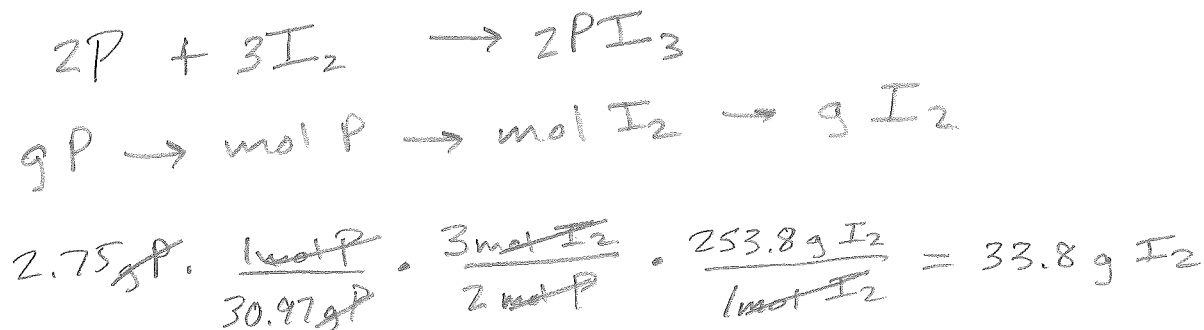
$$\text{N}_2: \text{g N}_2\text{O} \rightarrow \text{mol N}_2\text{O} \rightarrow \text{mol N}_2 \rightarrow \text{g N}_2$$

$$3.55 \text{ g N}_2\text{O} \cdot \frac{1 \text{ mol N}_2\text{O}}{44.01 \text{ g N}_2\text{O}} \cdot \frac{2 \text{ mol N}_2}{2 \text{ mol N}_2\text{O}} \cdot \frac{28.01 \text{ g N}_2}{1 \text{ mol N}_2} = \underline{\underline{2.26 \text{ g N}_2}}$$

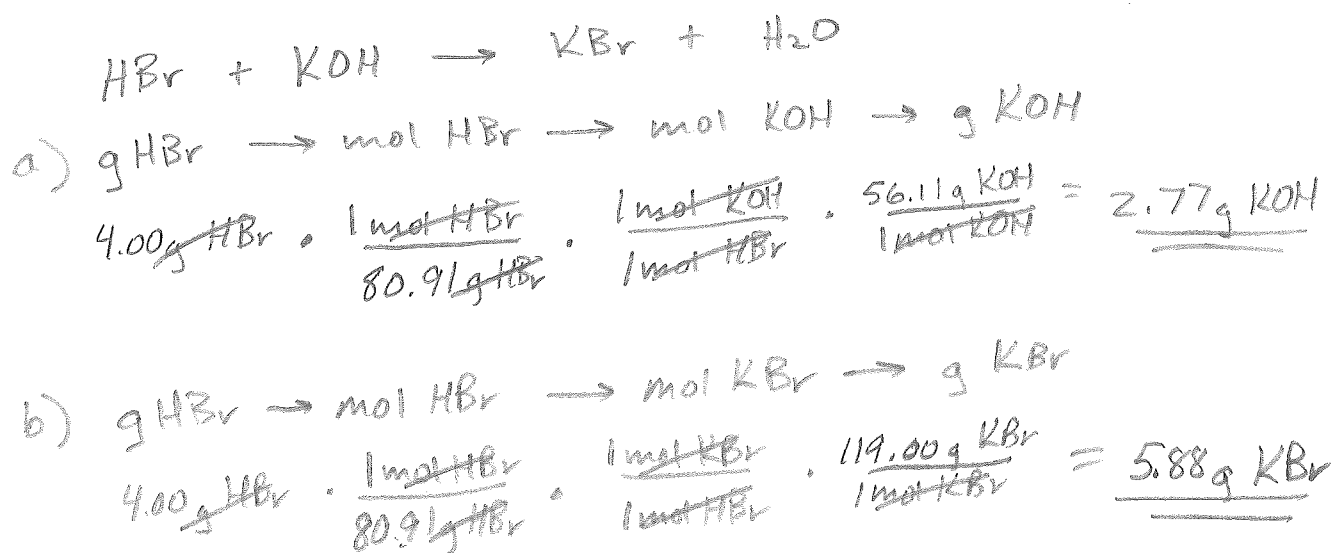
$$\text{O}_2: \text{g N}_2\text{O} \rightarrow \text{mol N}_2\text{O} \rightarrow \text{mol O}_2 \rightarrow \text{g O}_2$$

$$3.55 \text{ g N}_2\text{O} \cdot \frac{1 \text{ mol N}_2\text{O}}{44.01 \text{ g N}_2\text{O}} \cdot \frac{1 \text{ mol O}_2}{2 \text{ mol N}_2\text{O}} \cdot \frac{32.00 \text{ g O}_2}{1 \text{ mol O}_2} = \underline{\underline{1.29 \text{ g O}_2}}$$

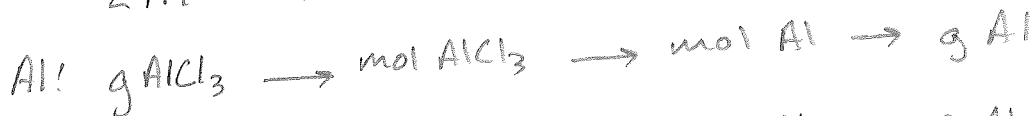
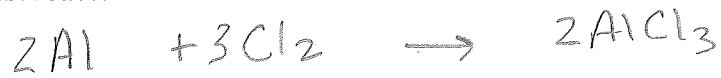
11. Phosphorous reacts with iodine, I_2 , to produce a white solid phosphorous tri iodide PI_3 . Calculate the mass of I_2 that reacts with 2.75g of P.



12. Hydrobromide acid, HBr, reacts with a solution of potassium hydroxide to give potassium bromide and water. What mass of KOH reacts with 4.00 g of HBr? What is the mass of KBr obtained?



13. When Aluminum (Al) reacts with chlorine (Cl₂), aluminum chloride is formed. If you would like to make 25.50 g of aluminum chloride, what masses of aluminum and chlorine must react?



$$25.50 \text{ g AlCl}_3 \cdot \frac{1 \text{ mol AlCl}_3}{133.34 \text{ g AlCl}_3} \cdot \frac{2 \text{ mol Al}}{2 \text{ mol AlCl}_3} \cdot \frac{26.98 \text{ g Al}}{1 \text{ mol Al}} = \underline{5.16 \text{ g Al}}$$

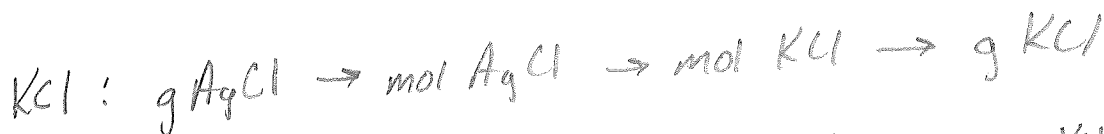


$$25.50 \text{ g AlCl}_3 \cdot \frac{1 \text{ mol AlCl}_3}{133.34 \text{ g AlCl}_3} \cdot \frac{3 \text{ mol Cl}_2}{2 \text{ mol AlCl}_3} \cdot \frac{70.90 \text{ g Cl}_2}{1 \text{ mol Cl}_2} = \underline{20.34 \text{ g Cl}_2}$$

14. Silver (I) nitrate (AgNO₃) reacts with potassium chloride to produce potassium nitrate and silver (I) chloride. If 1.13 g of silver (I) chloride is produced, what masses of silver (I) nitrate and potassium chloride must have reacted?



$$1.13 \text{ g AgCl} \cdot \frac{1 \text{ mol AgCl}}{143.32 \text{ g AgCl}} \cdot \frac{1 \text{ mol AgNO}_3}{1 \text{ mol AgCl}} \cdot \frac{169.87 \text{ g AgNO}_3}{1 \text{ mol AgNO}_3} = \underline{1.34 \text{ g AgNO}_3}$$



$$1.13 \text{ g AgCl} \cdot \frac{1 \text{ mol AgCl}}{143.32 \text{ g AgCl}} \cdot \frac{1 \text{ mol KCl}}{1 \text{ mol AgCl}} \cdot \frac{74.55 \text{ g KCl}}{1 \text{ mol KCl}} = \underline{0.588 \text{ g KCl}}$$