Chemistry 101 – Unit 7
Answers to Practice Problems

Part A. $\mathbf{Cu_2S + O_2 \rightarrow 2\ Cu + SO_2}$

1. When 10.2 moles of Cu_2S react with oxygen, how many moles of Cu are formed?

   Given: **10.2 mol Cu_2S**

   Wanted: **moles Cu**

   Path: **moles Cu_2S → moles Cu**

   Factors: $\frac{\mathbf{2\ moles\ Cu}}{\mathbf{1\ mole\ Cu_2S}}$

   $$\mathbf{10.2\ mol\ Cu_2S \times \frac{2\ moles\ Cu}{1\ mole\ Cu_2S} = 20.4\ moles\ Cu}$$

2. How many moles of O_2 are needed to react with 24.7 moles of Cu_2S?

   Given: **24.7 mol Cu_2S**

   Wanted: **moles O_2**

   Path: **moles Cu_2S → moles O_2**

   Factors: $\frac{\mathbf{1\ mole\ O_2}}{\mathbf{1\ mole\ Cu_2S}}$

   $$\mathbf{24.7\ moles\ Cu_2S \times \frac{1\ mole\ O_2}{1\ mole\ Cu_2S} = 24.7\ moles\ O_2}$$

3. If 15.3 mol Cu are formed, how many moles of SO_2 are produced?

   Given: **15.3 mole Cu**

   Wanted: **moles SO_2**

   Path: **moles Cu → moles SO_2**

   Factors: $\frac{\mathbf{1\ mole\ SO_2}}{\mathbf{2\ moles\ Cu}}$

   $$\mathbf{15.3\ mole\ Cu \times \frac{1\ mole\ SO_2}{2\ moles\ Cu} = 7.65\ mole\ SO_2}$$

$$\mathbf{Cu_2S + O_2 \rightarrow 2\,Cu + SO_2}$$

4. When 18.2 g Cu_2S react with oxygen, how many moles of SO_2 are formed?

   Given: **18.2 g Cu_2S**

   Wanted: **moles SO_2**

   Path: **g Cu_2S → moles Cu_2S → moles SO_2**

   Factors: $\frac{\textbf{1 mole } Cu_2S}{\textbf{159.17 g}}$ $\frac{\textbf{1 mole } SO_2}{\textbf{1 mole } Cu_2S}$

   $$\textbf{18.2 g } Cu_2S \times \frac{\textbf{1 mole } Cu_2S}{\textbf{159.17 g}} \times \frac{\textbf{1 mole } SO_2}{\textbf{1 mole } Cu_2S} = \textbf{0.114 moles}$$

5. How many moles Cu are formed when 34.9 g O_2 react with Cu_2S?

   Given: **34.9 g O_2**

   Wanted: **moles Cu**

   Path: **g O_2 → moles O_2 → moles Cu**

   Factors: $\frac{\textbf{1 mole } O_2}{\textbf{32.00 g}}$ $\frac{\textbf{2 moles Cu}}{\textbf{1 mole } O_2}$

   $$\textbf{34.9 g } O_2 \times \frac{\textbf{1 mole } O_2}{\textbf{32.00 g}} \times \frac{\textbf{2 moles Cu}}{\textbf{1 mole } O_2} = \textbf{2.18 moles}$$

6. If 9.8 moles of Cu_2S react with oxygen, how many grams of Cu are formed?

   Given: **9.8 moles Cu_2S**

   Wanted: **g Cu**

   Path: **mole Cu_2S → moles Cu → g Cu**

   Factors: $\frac{\textbf{2 moles Cu}}{\textbf{1 mole } Cu_2S}$ $\frac{\textbf{63.55 g}}{\textbf{1 mole Cu}}$

   $$\textbf{9.8 moles Cu2S} \times \frac{\textbf{2 moles Cu}}{\textbf{1 mole } Cu_2S} \times \frac{\textbf{63.55 g Cu}}{\textbf{1 mole Cu}} = \textbf{1.2 x } 10^3 \textbf{ g}$$

$$\mathbf{Cu_2S + O_2 \rightarrow 2\ Cu + SO_2}$$

7. When 4.33 moles O_2 react with Cu_2S, how many grams of SO_2 are formed?

Given: **4.33 mol O_2**

Wanted: **g SO_2**

Path: **moles O_2 → moles SO_2 → g SO_2**

Factors: $\frac{\textbf{1 mole } SO_2}{\textbf{1 mole } O_2}$ $\frac{\textbf{64.07 g } SO_2}{\textbf{1 mole}}$

$$\textbf{4.33 g O2 x } \frac{\textbf{1 mole } SO_2}{\textbf{1 mole } O_2} \textbf{ x } \frac{\textbf{64.7 g } SO_2}{\textbf{1 mole } SO_2} \textbf{ = 277 g}$$

8. When 42.7 g Cu_2S react with oxygen, how many grams of Cu are produced?

Given: **42.7 g Cu_2S**

Wanted: **g Cu**

Path: **g Cu_2S → moles Cu_2S → moles Cu → g Cu**

Factors: $\frac{\textbf{1 mole } Cu_2S}{\textbf{159.17 g } Cu_2S}$ $\frac{\textbf{2 moles Cu}}{\textbf{1 mole } Cu_2S}$ $\frac{\textbf{63.55 g Cu}}{\textbf{1 mole Cu}}$

$$\textbf{42.7 g } Cu_2S \textbf{ x } \frac{\textbf{1 mole } Cu_2S}{\textbf{159.17 g}} \textbf{ x } \frac{\textbf{2 moles Cu}}{\textbf{1 mole } Cu_2S} \textbf{ x } \frac{\textbf{63.55 g}}{\textbf{1 mole Cu}} \textbf{ = 34.1 g}$$

9. When 60.8 g Cu_2S react with oxygen, how many grams of SO_2 are produced?

Given: **60.8 g Cu_2S**

Wanted: **g SO_2**

Path: **g Cu_2S → moles Cu_2S → moles SO_2 → g SO_2**

Factors: $\frac{\textbf{1 mole } Cu_2S}{\textbf{159.17 g}}$ $\frac{\textbf{1 mole } SO_2}{\textbf{1 mole } Cu_2S}$ $\frac{\textbf{64.07 g } SO_2}{\textbf{1 mole } SO_2}$

$$\textbf{60.8 g } Cu_2S \textbf{ x } \frac{\textbf{1 mole } Cu_2S}{\textbf{159.17 g}} \textbf{ x } \frac{\textbf{1 mole } SO_2}{\textbf{1 mole } Cu_2S} \textbf{ x } \frac{\textbf{64.07 g}}{\textbf{1 mole } SO_2} \textbf{ = 24.5 g}$$

$$\mathbf{Cu_2S + O_2 \rightarrow 2\,Cu + SO_2}$$

10. How many grams of O_2 are required to react with 38.9 g Cu_2S?

Given: **38.9 g Cu_2S**

Wanted: **g O_2**

Path: **g Cu_2S → moles Cu_2S → moles O_2 → g O_2**

Factors: $\frac{\text{1 mole}}{\text{159.17 g } Cu_2S}$ $\frac{\text{1 mole } O_2}{\text{1 mole } Cu_2S}$ $\frac{\text{32.00 g } O_2}{\text{1 mole } O_2}$

$$\text{38.9 g } Cu_2S \times \frac{\text{1 mole}}{\text{159.17 } Cu_2S} \times \frac{\text{1 mole } O_2}{\text{1 mole } Cu_2S} \times \frac{\text{32.00 g } O_2}{\text{1 mole } O_2} = \text{7.92 g}$$

11. Calculate the theoretical yield of Cu when 53.2 g Cu_2S react with oxygen.

Given: **53.2 g Cu_2S**

Wanted: **yield Cu (g)**

Path: **g Cu_2S → moles Cu_2S → moles Cu → g Cu**

Factors: $\frac{\text{1 mole } Cu_2S}{\text{159.17 g}}$ $\frac{\text{2 moles Cu}}{\text{1 mole } Cu_2S}$ $\frac{\text{63.55 g Cu}}{\text{1 mole}}$

$$\text{53.2 g } Cu_2S \times \frac{\text{1 mole } Cu_2S}{\text{159.17 g } Cu_2S} \times \frac{\text{2 moles Cu}}{\text{1 mole } Cu_2S} \times \frac{\text{63.55 g}}{\text{1 mole Cu}} = \text{42.5 g}$$

12. What is the % yield in question # 11 if only 33.4 g Cu was obtained?

Given: **33.4 g Cu actual; 42.6 g Cu theoretical (from #11)**

Wanted: **% yield**

Equation: **% Yield = (actual / theoretical) x 100**

$$\text{\% Yield} = \frac{\text{33.4 g Cu}}{\text{42.5 g Cu}} \times 100 = 78.6$$

$$\mathbf{Cu_2S + O_2 \rightarrow 2\ Cu + SO_2}$$

13. Calculate the theoretical yield of copper when 85.0 g O_2 react with Cu_2S.

Given: **85.0 g O_2**

Wanted: **g Cu**

Path: **g O_2 → mole O_2 → mole Cu → g Cu**

Factors: $\frac{\textbf{1 mole } O_2}{\textbf{32.00 g}}$ $\frac{\textbf{2 moles Cu}}{\textbf{1 mole } O_2}$ $\frac{\textbf{63.55 g}}{\textbf{1 mole Cu}}$

$$\textbf{85.0 g O2} \times \frac{\textbf{1 mole O2}}{\textbf{32.00 g}} \times \frac{\textbf{2 moles Cu}}{\textbf{1 mole } O_2} \times \frac{\textbf{63.55 g}}{\textbf{1 mole Cu}} = \textbf{338 g}$$

14. If 231 grams Cu are obtained in # 13, what is the % yield?

Given: **231 g Cu actual; 338 g Cu theoretical**

Wanted: **% yield**

Equation: **% Yield = (actual / theoretical) x 100**

$$\textbf{\% Yield} = \frac{\textbf{231 g Cu}}{\textbf{338 g Cu}} \times 100 = \textbf{68.3}$$

15. If 29.8 g Cu were obtained in the laboratory when the theoretical yield was 36.5 g Cu, what is the % yield for the reaction?

Given: **29.8 g Cu actual; 36.5 g Cu theoretical**

Wanted: **% yield**

Equation: **% Yield = (actual / theoretical) x 100**

$$\textbf{\% Yield} = \frac{\textbf{29.8 g Cu}}{\textbf{36.5 g Cu}} \times 100 = \textbf{81.6}$$

Part B. **$2\ Al + 6\ HBr \rightarrow 2\ AlBr_3 + 3\ H_2$**

16. When 14.7 moles Al react with HBr, how many moles H_2 are formed?

Given: **14.7 mole Al**

Wanted: **moles H_2**

Path: **moles Al → moles H_2**

Factors: $\frac{\textbf{3 moles } H_2}{\textbf{2 moles Al}}$

$$\textbf{14.7 moles Al} \times \frac{\textbf{3 moles } H_2}{\textbf{2 moles Al}} = \textbf{22.1 moles H2}$$

17. How many moles of HBr are needed to react with 4.40 mol Al?

Given: **4.40 mol Al**

Wanted: **moles HBr**

Path: **moles Al → mole HBr**

Factors: $\frac{\textbf{6 moles HBr}}{\textbf{2 moles Al}}$

$$\textbf{4.40 moles} \times \frac{\textbf{6 moles HBr}}{\textbf{2 moles Al}} = \textbf{13.2 moles HBr}$$

18. When 9.25 moles HBr react with Al, how many moles $AlBr_3$ are formed?

Given: **9.25 moles HBr**

Wanted: **moles $AlBr_3$**

Path: **moles HBr → moles $AlBr_3$**

Factors: $\frac{\textbf{2 moles } AlBr_3}{\textbf{6 moles HBr}}$

$$\textbf{9.25 moles HBr} \times \frac{\textbf{2 moles } AlBr_3}{\textbf{6 moles HBr}} = \textbf{3.08 moles}$$

$$\mathbf{2\ Al\ +\ 6\ HBr\ \rightarrow\ 2\ AlBr_3\ +\ 3\ H_2}$$

19. When 6.88 moles HBr react with Al, how many moles H_2 are formed?

Given: **6.88 moles HBr**

Wanted: **moles H_2**

Path: **moles HBr $\rightarrow$ moles H_2**

Factors: $\frac{\mathbf{3\ moles\ H_2}}{\mathbf{6\ moles\ HBr}}$

$$\mathbf{6.88\ moles\ HBr\ x\ \frac{3\ moles\ H_2}{6\ moles\ HBr}\ =\ 3.44\ moles}$$

20. When 15.6 moles Al react with HBr, how many grams of $AlBr_3$ are formed?

Given: **15.6 mol Al**

Wanted: **g $AlBr_3$**

Path: **mol Al $\rightarrow$ mole $AlBr_3$ $\rightarrow$ g $AlBr_3$**

Factors: $\frac{\mathbf{2\ moles\ AlBr_3}}{\mathbf{2\ moles\ Al}}$ $\frac{\mathbf{266.71\ g\ AlBr_3}}{\mathbf{1\ mole\ AlBr266.71}}$

$$\mathbf{15.6\ moles\ Al\ x\ \frac{2\ moles\ AlBr_3}{2\ moles\ Al}\ x\ \frac{266.71\ g\ AlBr_3}{1\ mole\ AlBr_3}\ =\ 4.16\ x\ 10^3\ g}$$

21. When 85.2 g HBr react with Al, how many moles of H_2 are produced?

Given: **85.2 g HBr**

Wanted: **mol H_2**

Path: **g HBr $\rightarrow$ mole HBr $\rightarrow$ mole H_2**

Factors: $\frac{\mathbf{1\ mole\ HBr}}{\mathbf{80.92\ g\ HBr}}$ $\frac{\mathbf{3\ moles\ H_2}}{\mathbf{6\ moles\ HBr}}$

$$\mathbf{85.2\ g\ HBr\ x\ \frac{1\ mole\ HBr}{80.92\ g\ HBr}\ x\ \frac{3\ moles\ H_2}{6\ moles\ HBr}\ =\ 0.526\ moles}$$

$$\mathbf{2\ Al + 6\ HBr \rightarrow 2\ AlBr_3 + 3\ H_2}$$

22. When 10.0 moles HBr react with Al, how many grams of H_2 are formed?

Given: **10.0 mol HBr**

Wanted: **g H_2**

Path: **mol HBr → mol H_2 → g H_2**

Factors: $\frac{\mathbf{3\ mole\ H_2}}{\mathbf{6\ mole\ HBr}}$ $\frac{\mathbf{2.016\ g\ H_2}}{\mathbf{1\ mole\ H_2}}$

$$\mathbf{10.0\ mole\ HBr \times \frac{3\ mole\ H_2}{6\ mole\ HBr} \times \frac{2.016\ g}{1\ mole\ H_2} = 10.1\ g}$$

23. How many moles HBr are required to react with 72.8 g of Al?

Given: **72.8 g Al**

Wanted: **moles HBr**

Path: **g Al → moles Al → moles HBr**

Factors: $\frac{\mathbf{1\ mole\ Al}}{\mathbf{26.98\ g\ Al}}$ $\frac{\mathbf{6\ moles\ HBr}}{\mathbf{2\ moles\ Al}}$

$$\mathbf{72.8\ g\ Al \times \frac{1\ mole\ Al}{26.98\ g\ Al} \times \frac{6\ moles\ HBr}{2\ moles\ Al} = 8.09\ moles}$$

24. How many grams of $AlBr_3$ can be formed when 95.3 g Al react with HBr?

Given: **95.3 g Al**

Wanted: **g $AlBr_3$**

Path: **g Al → mol Al → mol $AlBr_3$ → g $AlBr_3$**

Factors: $\frac{\mathbf{1\ mole\ Al}}{\mathbf{26.98\ g\ Al}}$ $\frac{\mathbf{2\ mole\ AlBr_3}}{\mathbf{2\ mole\ Al}}$ $\frac{\mathbf{266.71\ g\ AlBr_3}}{\mathbf{1\ mole\ AlBr_3}}$

$$\mathbf{95.3\ g\ Al \times \frac{1\ mole\ Al}{26.98\ g\ Al} \times \frac{2\ mole\ AlBr_3}{2\ mole\ Al} \times \frac{266.71\ g\ AlBr_3}{1\ mole\ AlBr_3} = 942\ g}$$

$$\mathbf{2\ Al\ +\ 6\ HBr\ \rightarrow\ 2\ AlBr_3\ +\ 3\ H_2}$$

25. How many grams of HBr are needed to react with 48.2 g Al?

Given: **48.2 g Al**

Wanted: **g HBr**

Path: **g Al → mol Al → mol HBr → g HBr**

Factors: $\frac{\mathbf{1\ mole\ Al}}{\mathbf{26.98\ g\ Al}}$ $\frac{\mathbf{6\ mole\ HBr}}{\mathbf{2\ mole\ Al}}$ $\frac{\mathbf{80.92\ g\ HBr}}{\mathbf{1\ mole\ HBr}}$

$$\mathbf{48.2\ g\ Al\ x\ \frac{1\ mole\ Al}{26.98\ g\ Al}\ x\ \frac{6\ mole\ HBr}{2\ mole\ Al}\ x\ \frac{80.92\ g\ HBr}{1\ mole\ HBr}\ =\ 434\ g}$$

26. When 235 g HBr react with Al, how many grams of H_2 are produced?

Given: **235 g HBr**

Wanted: **g H_2**

Path: **g HBr → mol HBr → mol H_2 → g H_2**

Factors: $\frac{\mathbf{1\ mole\ HBr}}{\mathbf{80.92\ g\ HBr}}$ $\frac{\mathbf{3\ mole\ H_2}}{\mathbf{6\ mole\ HBr}}$ $\frac{\mathbf{2.016\ g\ H_2}}{\mathbf{1\ mole\ H_2}}$

$$\mathbf{235\ g\ HBr\ x\ \frac{1\ mole\ HBr}{80.92\ g\ HBr}\ x\ \frac{3\ mole\ H_2}{6\ mole\ HBr}\ x\ \frac{2.016\ g\ H_2}{1\ mole\ H_2}\ =\ 2.93\ g}$$

27. To form 65.0 g $AlBr_3$, how many grams of Al must react with HBr?

Given: **65.0 g $AlBr_3$**

Wanted: **g Al**

Path: **g $AlBr_3$ → mol $AlBr_3$ → mol Al → g Al**

Factors: $\frac{\mathbf{1\ mole\ AlBr_3}}{\mathbf{266.71\ g\ AlBr_3}}$ $\frac{\mathbf{2\ mole\ Al}}{\mathbf{2\ mole\ AlBr_3}}$ $\frac{\mathbf{26.98\ g\ Al}}{\mathbf{1\ mole\ Al}}$

$$\mathbf{65.0\ g\ AlBr_3\ x\ \frac{1\ mole\ AlBr_3}{266.71\ g\ AlBr_3}\ x\ \frac{2\ mole\ Al}{2\ mole\ AlBr_3}\ x\ \frac{26.98\ g\ Al}{1\ mole\ Al}\ =\ 6.58\ g}$$

$$\mathbf{2\ Al + 6\ HBr \rightarrow 2\ AlBr_3 + 3\ H_2}$$

28. Calculate the theoretical yield of $AlBr_3$ when 20.0 g Al react with HBr.

Given: **20.0 g Al**

Wanted: **g $AlBr_3$**

Path: **g Al → mol Al → mol $AlBr_3$ → g $AlBr_3$**

Factors: $\frac{\textbf{1 mole Al}}{\textbf{26.98 g Al}}$ $\frac{\textbf{2 mole AlBr}_3}{\textbf{2 mole Al}}$ $\frac{\textbf{266.71 AlBr}_3}{\textbf{1 mole AlBr}_3}$

$$\textbf{20.0 g Al} \times \frac{\textbf{1 mole Al}}{\textbf{26.98 g Al}} \times \frac{\textbf{2 mole AlBr}_3}{\textbf{2 mole Al}} \times \frac{\textbf{266.71 g AlBr}_3}{\textbf{1 mole AlBr}_3} = \textbf{198 g}$$

29. If 175 g $AlBr_3$ are obtained in # 28, what is the % yield?

Given: **175 g actual; 198 g theoretical (#28)**

Wanted: **% yield**

Equation: **% Yield = (actual / theoretical) x 100**

$$\textbf{\% Yield} = \frac{\textbf{175 g}}{\textbf{198 g}} \times 100 = \textbf{88.4 \%}$$

30. Calculate the theoretical yield of H_2 when 30.0 g Al react with HBr.

Given: **30.0 g Al**

Wanted: **g H_2**

Path: **g Al → mol Al → mol H_2 → g H_2**

Factors: $\frac{\textbf{1 mole Al}}{\textbf{26.98 g Al}}$ $\frac{\textbf{3 mole H}_2}{\textbf{2 mole Al}}$ $\frac{\textbf{2.016 g H}_2}{\textbf{1 mole H}_2}$

$$\textbf{30.0 g Al} \times \frac{\textbf{1 mole Al}}{\textbf{26.98 g Al}} \times \frac{\textbf{3 mole H}_2}{\textbf{2 mole Al}} \times \frac{\textbf{2.016 g H}_2}{\textbf{1 mole H}_2} = \textbf{3.36 g}$$

31. If 3.08 g of H_2 are obtained in #30, what is the % yield?

Given: **3.08 g H_2 actual; 3.36 g theoretical (#30)**

Wanted: **% yield**

Equation: **% Yield = (actual / theoretical) x 100**

$$\textbf{\% Yield} = \frac{\textbf{3.08 g}}{\textbf{3.36 g}} \times 100 = \textbf{91.7 \%}$$