

Chemistry 101 – Unit 7
Answers to Practice Problems

Part A. $\text{Cu}_2\text{S} + \text{O}_2 \rightarrow 2 \text{ Cu} + \text{SO}_2$

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:
$$\frac{\text{2 moles Cu}}{1 \text{ mole } \text{Cu}_2\text{S}}$$

$$10.2 \text{ mol } \text{Cu}_2\text{S} \times \frac{\text{2 moles Cu}}{1 \text{ mole } \text{Cu}_2\text{S}} = 20.4 \text{ moles Cu}$$

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:
$$\frac{\text{1 mole } \text{O}_2}{1 \text{ mole } \text{Cu}_2\text{S}}$$

$$24.7 \text{ moles } \text{Cu}_2\text{S} \times \frac{\text{1 mole } \text{O}_2}{1 \text{ mole } \text{Cu}_2\text{S}} = 24.7 \text{ moles } \text{O}_2$$

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

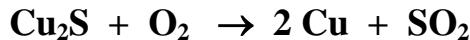
Given: **15.3 mole Cu**

Wanted: **moles SO_2**

Path: **moles Cu → moles SO_2**

Factors:
$$\frac{\text{1 mole } \text{SO}_2}{2 \text{ moles Cu}}$$

$$15.3 \text{ mole Cu} \times \frac{\text{1 mole } \text{SO}_2}{2 \text{ moles Cu}} = 7.65 \text{ mole } \text{SO}_2$$



4. When 18.2 g Cu₂S react with oxygen, how many moles of SO₂ are formed?

Given: **18.2 g Cu₂S**

Wanted: **moles SO₂**

Path: **g Cu₂S → moles Cu₂S → moles SO₂**

Factors: **$\frac{1 \text{ mole Cu}_2\text{S}}{159.17 \text{ g}}$ $\frac{1 \text{ mole SO}_2}{1 \text{ mole Cu}_2\text{S}}$**

$$18.2 \text{ g Cu}_2\text{S} \times \frac{1 \text{ mole Cu}_2\text{S}}{159.17 \text{ g}} \times \frac{1 \text{ mole SO}_2}{1 \text{ mole Cu}_2\text{S}} = 0.114 \text{ moles}$$

5. How many moles Cu are formed when 34.9 g O₂ react with Cu₂S?

Given: **34.9 g O₂**

Wanted: **moles Cu**

Path: **g O₂ → moles O₂ → moles Cu**

Factors: **$\frac{1 \text{ mole O}_2}{32.00 \text{ g}}$ $\frac{2 \text{ moles Cu}}{1 \text{ mole O}_2}$**

$$34.9 \text{ g O}_2 \times \frac{1 \text{ mole O}_2}{32.00 \text{ g}} \times \frac{2 \text{ moles Cu}}{1 \text{ mole O}_2} = 2.18 \text{ moles}$$

6. If 9.8 moles of Cu₂S react with oxygen, how many grams of Cu are formed?

Given: **9.8 moles Cu₂S**

Wanted: **g Cu**

Path: **mole Cu₂S → moles Cu → g Cu**

Factors: **$\frac{2 \text{ moles Cu}}{1 \text{ mole Cu}_2\text{S}}$ $\frac{63.55 \text{ g}}{1 \text{ mole Cu}}$**

$$9.8 \text{ moles Cu}_2\text{S} \times \frac{2 \text{ moles Cu}}{1 \text{ mole Cu}_2\text{S}} \times \frac{63.55 \text{ g Cu}}{1 \text{ mole Cu}} = 1.2 \times 10^3 \text{ g}$$



7. When 4.33 moles O₂ react with Cu₂S, how many grams of SO₂ are formed?

Given: **4.33 mol O₂**

Wanted: **g SO₂**

Path: **moles O₂ → moles SO₂ → g SO₂**

Factors: $\frac{1 \text{ mole SO}_2}{1 \text{ mole O}_2}$ $\frac{64.07 \text{ g SO}_2}{1 \text{ mole}}$

$$4.33 \text{ g O}_2 \times \frac{1 \text{ mole SO}_2}{1 \text{ mole O}_2} \times \frac{64.07 \text{ g SO}_2}{1 \text{ mole}} = 277 \text{ g}$$

8. When 42.7 g Cu₂S react with oxygen, how many grams of Cu are produced?

Given: **42.7 g Cu₂S**

Wanted: **g Cu**

Path: **g Cu₂S → moles Cu₂S → moles Cu → g Cu**

Factors: $\frac{1 \text{ mole Cu}_2\text{S}}{159.17 \text{ g Cu}_2\text{S}}$ $\frac{2 \text{ moles Cu}}{1 \text{ mole Cu}_2\text{S}}$ $\frac{63.55 \text{ g Cu}}{1 \text{ mole Cu}}$

$$42.7 \text{ g Cu}_2\text{S} \times \frac{1 \text{ mole Cu}_2\text{S}}{159.17 \text{ g}} \times \frac{2 \text{ moles Cu}}{1 \text{ mole Cu}_2\text{S}} \times \frac{63.55 \text{ g Cu}}{1 \text{ mole Cu}} = 34.1 \text{ g}$$

9. When 60.8 g Cu₂S react with oxygen, how many grams of SO₂ are produced?

Given: **60.8 g Cu₂S**

Wanted: **g SO₂**

Path: **g Cu₂S → moles Cu₂S → moles SO₂ → g SO₂**

Factors: $\frac{1 \text{ mole Cu}_2\text{S}}{159.17 \text{ g}}$ $\frac{1 \text{ mole SO}_2}{1 \text{ mole Cu}_2\text{S}}$ $\frac{64.07 \text{ g SO}_2}{1 \text{ mole SO}_2}$

$$60.8 \text{ g Cu}_2\text{S} \times \frac{1 \text{ mole Cu}_2\text{S}}{159.17 \text{ g}} \times \frac{1 \text{ mole SO}_2}{1 \text{ mole Cu}_2\text{S}} \times \frac{64.07 \text{ g SO}_2}{1 \text{ mole SO}_2} = 24.5 \text{ g}$$



10. How many grams of O₂ are required to react with 38.9 g Cu₂S?

Given: 38.9 g Cu₂S

Wanted: g O₂

Path: g Cu₂S → moles Cu₂S → moles O₂ → g O₂

Factors: $\frac{1 \text{ mole}}{159.17 \text{ g Cu}_2\text{S}}$ $\frac{1 \text{ mole O}_2}{1 \text{ mole Cu}_2\text{S}}$ $\frac{32.00 \text{ g O}_2}{1 \text{ mole O}_2}$

$$38.9 \text{ g Cu}_2\text{S} \times \frac{1 \text{ mole}}{159.17 \text{ g Cu}_2\text{S}} \times \frac{1 \text{ mole O}_2}{1 \text{ mole Cu}_2\text{S}} \times \frac{32.00 \text{ g O}_2}{1 \text{ mole O}_2} = 7.92 \text{ g}$$

11. Calculate the theoretical yield of Cu when 53.2 g Cu₂S react with oxygen.

Given: 53.2 g Cu₂S

Wanted: yield Cu (g)

Path: g Cu₂S → moles Cu₂S → moles Cu → g Cu

Factors: $\frac{1 \text{ mole Cu}_2\text{S}}{159.17 \text{ g}}$ $\frac{2 \text{ moles Cu}}{1 \text{ mole Cu}_2\text{S}}$ $\frac{63.55 \text{ g Cu}}{1 \text{ mole}}$

$$53.2 \text{ g Cu}_2\text{S} \times \frac{1 \text{ mole Cu}_2\text{S}}{159.17 \text{ g Cu}_2\text{S}} \times \frac{2 \text{ moles Cu}}{1 \text{ mole Cu}_2\text{S}} \times \frac{63.55 \text{ g Cu}}{1 \text{ mole}} = 42.5 \text{ g}$$

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

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



13. Calculate the theoretical yield of copper when 85.0 g O₂ react with Cu₂S.

Given: **85.0 g O₂**

Wanted: **g Cu**

Path: **g O₂ → mole O₂ → mole Cu → g Cu**

Factors: **$\frac{1 \text{ mole O}_2}{32.00 \text{ g}}$ $\frac{2 \text{ moles Cu}}{1 \text{ mole O}_2}$ $\frac{63.55 \text{ g}}{1 \text{ mole Cu}}$**

$$85.0 \text{ g O}_2 \times \frac{1 \text{ mole O}_2}{32.00 \text{ g}} \times \frac{2 \text{ moles Cu}}{1 \text{ mole O}_2} \times \frac{63.55 \text{ g}}{1 \text{ mole Cu}} = 338 \text{ g}$$

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) × 100**

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

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) × 100**

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



16. When 14.7 moles Al react with HBr, how many moles H₂ are formed?

Given: **14.7 mole Al**

Wanted: **moles H₂**

Path: **moles Al → moles H₂**

Factors: **$\frac{3 \text{ moles H}_2}{2 \text{ moles Al}}$**

$$14.7 \text{ moles Al} \times \frac{3 \text{ moles H}_2}{2 \text{ moles Al}} = 22.1 \text{ moles H}_2$$

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: **$\frac{6 \text{ moles HBr}}{2 \text{ moles Al}}$**

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

18. When 9.25 moles HBr react with Al, how many moles AlBr₃ are formed?

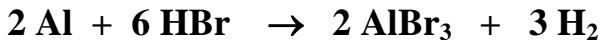
Given: **9.25 moles HBr**

Wanted: **moles AlBr₃**

Path: **moles HBr → moles AlBr₃**

Factors: **$\frac{2 \text{ moles AlBr}_3}{6 \text{ moles HBr}}$**

$$9.25 \text{ moles HBr} \times \frac{2 \text{ moles AlBr}_3}{6 \text{ moles HBr}} = 3.08 \text{ moles}$$



19. When 6.88 moles HBr react with Al, how many moles H₂ are formed?

Given: **6.88 moles HBr**

Wanted: **moles H₂**

Path: **moles HBr → moles H₂**

Factors: $\frac{3 \text{ moles H}_2}{6 \text{ moles HBr}}$

$$6.88 \text{ moles HBr} \times \frac{3 \text{ moles H}_2}{6 \text{ moles HBr}} = 3.44 \text{ moles}$$

20. When 15.6 moles Al react with HBr, how many grams of AlBr₃ are formed?

Given: **15.6 mol Al**

Wanted: **g AlBr₃**

Path: **mol Al → mole AlBr₃ → g AlBr₃**

Factors: $\frac{2 \text{ moles AlBr}_3}{2 \text{ moles Al}} \quad \frac{266.71 \text{ g AlBr}_3}{1 \text{ mole AlBr}_3}$

$$15.6 \text{ moles Al} \times \frac{2 \text{ moles AlBr}_3}{2 \text{ moles Al}} \times \frac{266.71 \text{ g AlBr}_3}{1 \text{ mole AlBr}_3} = 4.16 \times 10^3 \text{ g}$$

21. When 85.2 g HBr react with Al, how many moles of H₂ are produced?

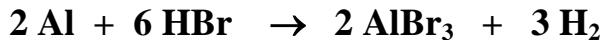
Given: **85.2 g HBr**

Wanted: **mol H₂**

Path: **g HBr → mole HBr → mole H₂**

Factors: $\frac{1 \text{ mole HBr}}{80.92 \text{ g HBr}} \quad \frac{3 \text{ moles H}_2}{6 \text{ moles HBr}}$

$$85.2 \text{ g HBr} \times \frac{1 \text{ mole HBr}}{80.92 \text{ g HBr}} \times \frac{3 \text{ moles H}_2}{6 \text{ moles HBr}} = 0.526 \text{ moles}$$



22. When 10.0 moles HBr react with Al, how many grams of H₂ are formed?

Given: **10.0 mol HBr**

Wanted: **g H₂**

Path: **mol HBr → mol H₂ → g H₂**

Factors: $\frac{3 \text{ mole H}_2}{6 \text{ mole HBr}} \quad \frac{2.016 \text{ g H}_2}{1 \text{ mole H}_2}$

$$10.0 \text{ mole HBr} \times \frac{3 \text{ mole H}_2}{6 \text{ mole HBr}} \times \frac{2.016 \text{ g}}{1 \text{ mole H}_2} = 10.1 \text{ g}$$

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: $\frac{1 \text{ mole Al}}{26.98 \text{ g Al}} \quad \frac{6 \text{ moles HBr}}{2 \text{ moles Al}}$

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

24. How many grams of AlBr₃ can be formed when 95.3 g Al react with HBr?

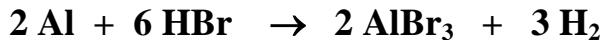
Given: **95.3 g Al**

Wanted: **g AlBr₃**

Path: **g Al → mol Al → mol AlBr₃ → g AlBr₃**

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

$$95.3 \text{ g Al} \times \frac{1 \text{ mole Al}}{26.98 \text{ g Al}} \times \frac{2 \text{ mole AlBr}_3}{2 \text{ mole Al}} \times \frac{266.71 \text{ g AlBr}_3}{1 \text{ mole AlBr}_3} = 942 \text{ g}$$



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: **$\frac{1 \text{ mole Al}}{26.98 \text{ g Al}}$ $\frac{6 \text{ mole HBr}}{2 \text{ mole Al}}$ $\frac{80.92 \text{ g HBr}}{1 \text{ mole HBr}}$**

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

26. When 235 g HBr react with Al, how many grams of H₂ are produced?

Given: **235 g HBr**

Wanted: **g H₂**

Path: **g HBr → mol HBr → mol H₂ → g H₂**

Factors: **$\frac{1 \text{ mole HBr}}{80.92 \text{ g HBr}}$ $\frac{3 \text{ mole H}_2}{6 \text{ mole HBr}}$ $\frac{2.016 \text{ g H}_2}{1 \text{ mole H}_2}$**

$$235 \text{ g HBr} \times \frac{1 \text{ mole HBr}}{80.92 \text{ g HBr}} \times \frac{3 \text{ mole H}_2}{6 \text{ mole HBr}} \times \frac{2.016 \text{ g H}_2}{1 \text{ mole H}_2} = 2.93 \text{ g}$$

27. To form 65.0 g AlBr₃, how many grams of Al must react with HBr?

Given: **65.0 g AlBr₃**

Wanted: **g Al**

Path: **g AlBr₃ → mol AlBr₃ → mol Al → g Al**

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

$$65.0 \text{ g AlBr}_3 \times \frac{1 \text{ mole AlBr}_3}{266.71 \text{ g AlBr}_3} \times \frac{2 \text{ mole Al}}{2 \text{ mole AlBr}_3} \times \frac{26.98 \text{ g Al}}{1 \text{ mole Al}} = 6.58 \text{ g}$$



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 \rightarrow mol Al \rightarrow mol AlBr_3 \rightarrow g AlBr_3

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

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

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) \times 100

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

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 \rightarrow mol Al \rightarrow mol H_2 \rightarrow g H_2

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

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

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) \times 100

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