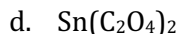
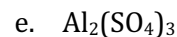


Mole Unit Review

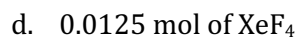
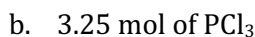
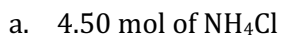
Complete the following questions on a separate sheet of paper. Ensure all work is shown!

1. Calculate the molar mass of each of the following:



$$\text{a. } (2 \times 1.01) + (1 \times 16.00) = \boxed{18.02 \text{ g/mol H}_2\text{O}}$$

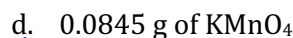
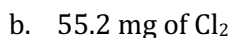
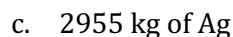
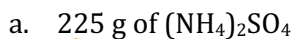
2. Calculate the mass of the following:



$$\text{a. } (1 \times 14.01) + (4 \times 1.01) + (35.45) = 53.50 \text{ g/mol NH}_4\text{Cl}$$

$$4.50 \text{ mol} \times \frac{53.50 \text{ g}}{1 \text{ mol}} = 240.75 \text{ g} \rightarrow \boxed{241 \text{ g NH}_4\text{Cl}}$$

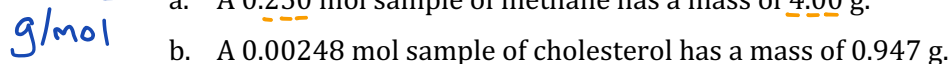
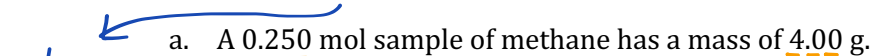
3. Calculate the number of moles in the following:



$$\text{a. } (2 \times 14.01) + (8 \times 1.01) + (32.07) + (4 \times 16.00) = 132.17 \text{ g/mol (NH}_4)_2\text{SO}_4$$

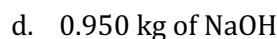
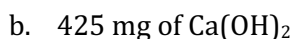
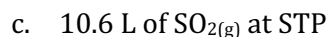
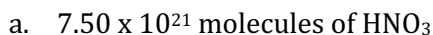
$$225 \text{ g} \times \frac{1 \text{ mol}}{132.17 \text{ g}} = \boxed{1.70 \text{ mol (NH}_4)_2\text{SO}_4}$$

4. Calculate the molar mass of each of the substances mentioned in the following:

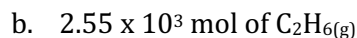
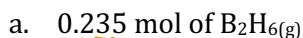


$$\text{a. } \frac{4.00 \text{ g}}{0.250 \text{ mol}} = \boxed{16.0 \text{ g/mol}}$$

5. Calculate the number of moles contained in each of the following:



6. Calculate the volume of the following gases at STP:



$$\text{a. } 0.235 \text{ mol} \times \frac{22.4 \text{ L}}{1 \text{ mol}} = \boxed{5.26 \text{ L B}_2\text{H}_6}$$

7. Calculate the mass of each of the following:

a. 0.125 mol of CO_2 b. 5.48 mol of FeCl_3

$$0.125 \text{ mol} \times \frac{44.01 \text{ g}}{1 \text{ mol}} = \boxed{5.50 \text{ g CO}_2}$$

8. Calculate the mass of 1 mol of each of the following:

a. $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ b. $\text{Cu}_3(\text{OH})_2(\text{CO}_3)_2$

$$1 \text{ mol} \times \frac{381.42 \text{ g}}{1 \text{ mol}} = \boxed{381.42 \text{ g Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}}$$

9. An unknown gas sample contains only one of the compounds SO_3 , CH_4 , NF_3 , or C_2H_2 . If 1 molecule of the gas has a mass of $4.32 \times 10^{-23} \text{ g}$, which type of molecule is contained in the sample?

$$1 \text{ molecule} \times \frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ molecules}} \times \boxed{\text{g}} = 4.32 \times 10^{-23} \text{ g}$$

← try the 4 possibilities

10. How many atoms are contained in 1 molecule of each of the following?

a. $\text{CH}_3\text{CO}_2\text{H}$ b. NH_4Cl c. $(\text{CH}_3)_2\text{CO}$

$$1 \text{ molecule} \times \frac{8 \text{ atoms}}{1 \text{ molecule}} = \boxed{8 \text{ atoms CH}_3\text{CO}_2\text{H}}$$

11. How many atoms are contained in the following?

a. 5 molecules of $\text{C}_6\text{H}_2\text{Cl}_4$
 b. 10 molecules of $\text{Co}(\text{ClO}_4)_2 \cdot 6\text{H}_2\text{O}$

$$5 \text{ molecules} \times \frac{12 \text{ atoms}}{1 \text{ molecule}} = \boxed{60 \text{ atoms C}_6\text{H}_2\text{Cl}_4}$$

12. Find the mass in grams of each of the following:

a. 2×10^6 CO molecules c. 175 N atoms
 b. 1 KOH molecule d. 1.25 L of $\text{NH}_3(\text{g})$ at STP

a./b. molecule \rightarrow mol \rightarrow mass c. atoms \rightarrow mol \rightarrow mass
 d. volume \rightarrow mol \rightarrow mass

13. How many atoms are contained in each of the following?

a. 12 g of H_2O_2 c. 5.0 g of NaCl e. $6.5 \times 10^{-6} \text{ g}$ of Kr
 b. 40.0 g of K d. 125 g of CH_3Cl

$$12 \text{ g} \times \frac{1 \text{ mol}}{34.02 \text{ g}} \times \frac{6.022 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \times \frac{4 \text{ atoms}}{1 \text{ molecule}} = \boxed{8.5 \times 10^{23} \text{ atoms H}_2\text{O}_2}$$

14. What volume at STP is occupied by each of the following?

a. 16.5 g of $\text{AsH}_3(\text{g})$

b. 5.65×10^{22} molecules of $\text{POF}_3(\text{g})$

a. mass \rightarrow mol \rightarrow volume

b. molecule \rightarrow mol \rightarrow volume

15. How many atoms of N are there in 30.0 g of NH_4NO_3 ?

mass \rightarrow mol \rightarrow molecules \rightarrow atoms

16. Calculate the percentage composition of the following:

a. C_2H_6

b. FeCl_3

c. CaCO_3

step 1 - find total molar mass

step 2 - divide $\frac{\text{individual molar mass}}{\text{total molar mass}}$

17. Find the empirical formula for the following compounds:

a. 15.9% B, 84.1% F

c. 46.2% C, 7.69% H, 46.2% O

b. 70.0% Fe, 30.0% O

d. 50.5% C, 5.26% H, 44.2% N

step 1 - convert % \rightarrow g \rightarrow mol

step 2 - divide all by smallest mol

step 3 - ensure all ratios are whole numbers

18. A gas has the empirical formula CH_2 . If 0.850 L of the gas at STP has a mass of 1.59 g, what is the molecular formula?

step 1 - get molar mass (volume \rightarrow mol)
put $\frac{\text{g}}{\text{mol}}$

step 2 - divide molar mass of CH_2 by molar mass found in step 1

19. A compound has an empirical formula C_5H_{11} . If 0.0275 mol of the compound has a mass of 3.91 g, what is the molecular formula of the compound?

step 1 - $\frac{3.91 \text{ g}}{0.0275 \text{ mol}} = \text{molar mass}$

step 2 - divide molar mass of C_5H_{11} by molar mass found in step 1

20. 0.0600 mol of a gas containing carbon and oxygen has a mass of 1.68 g. If the gas is 42.9% C, what is the empirical and molecular formula of the gas?

step 1 - $\frac{1.68 \text{ g}}{0.0600 \text{ mol}} = \text{molar mass}$

step 2 - % \rightarrow g \rightarrow mol

step 3 - get empirical formula

step 4 - divide molar mass of emp. by mass found in step 1

21. Calculate the molar concentration of the following solutions:

- 0.26 mol of HCl in 1.0 L of solution
- 2.8 mol of HNO₃ in 4.0 L of solution
- 25.0 g of NaCl in 250.0 mL of solution

$$M = \frac{\text{mol}}{L}$$

22. How many moles of AlCl₃ are contained in 350.0 mL of 0.250 M AlCl₃?

$$0.3500 L \times \frac{0.250 \text{ mol}}{1 L}$$

23. What volume of 2.8×10^{-2} M NaF contains 0.15 g of NaF?

Step 1 - Mass \rightarrow mol

$$\text{Step 2 - mol} \times \frac{1 L}{2.8 \times 10^{-2} \text{ mol}}$$

24. How many grams of CaCl₂ are contained in 225 mL of 0.0350 M CaCl₂ solution?

$$L \times \frac{\text{mol}}{L} \times \frac{g}{\text{mol}}$$

Mole Unit Review – Answer Key

1. a) 18.02 g/mol H₂O
b) 17.04 g/mol NH₃
c) 169.88 g/mol AgNO₃
d) 294.75 g/mol Sn(C₂O₄)₂
e) 342.17 g/mol Al₂(SO₄)₃
f) 60.06 g/mol CH₃COOH
2. a) 241 g NH₄Cl
b) 446 g PCl₃
c) 0.504 g Na₂HPO₄
d) 2.59 g XeF₄
3. a) 1.70 mol (NH₄)₂SO₄
b) 7.79 x 10⁻⁴ mol Cl₂
c) 2.739 x 10⁴ mol Ag
d) 5.35 x 10⁻⁴ mol KMnO₄
4. a) 16.0 g/mol CH₄
b) 382 g/mol Cholesterol
5. a) 0.0125 mol HNO₃
b) 5.74 x 10⁻³ mol Ca(OH)₂
c) 0.473 mol SO₂
d) 23.8 mol NaOH
6. a) 5.26 L B₂H₆
b) 5.71 x 10⁴ L C₂H₆
7. a) 5.50 g CO₂
b) 889 g FeCl₃
8. a) 381.42 g Na₂B₄O₇·10H₂O
b) 344.69 g Cu₃(OH)₂(CO₃)₂
9. C₂H₂
10. a) 8 atoms of CH₃CO₂H
b) 6 atoms of NH₄Cl
c) 10 atoms of (CH₃)₂CO
11. a) 60 atoms of C₆H₂Cl₄
b) 290 atoms of Co(ClO₄)₂·6H₂O
12. a) 9 x 10⁻¹⁷ g CO
b) 9 x 10⁻²³ g KOH
c) 4.07 x 10⁻²¹ g N
d) 0.95 g NH₃
13. a) 8.5 x 10²³ atoms of H₂O₂
b) 6.16 x 10²³ atoms of K
c) 1.0 x 10²³ atoms of NaCl
d) 7.45 x 10²⁴ atoms CH₃Cl
e) 4.7 x 10¹⁶ atoms of Kr
14. a) 4.74 L AsH₃
b) 2.10 L POF₃
15. 4.51 x 10²³ atoms of N
16. a) 79.85% C, 20.1% H
b) 34.43% Fe, 65.57% Cl
c) 40.04% Ca, 12.00% C, 47.96% O
17. a) BF₃
b) Fe₂O₃
c) C₄H₈O₃
d) C₄H₅N₃
18. C₃H₆
19. C₁₀H₂₂
20. Empirical = CO; Molecular = CO
21. a) 0.26 M HCl
b) 0.70 M HNO₃
c) 1.71 M NaCl
22. 0.0875 mol AlCl₃
23. 0.13 L NaF
24. 0.874 g CaCl₂