1. Which formula is an empirical formula?
   A) \( \text{CH}_4 \)  B) \( \text{C}_2\text{H}_4 \)  C) \( \text{C}_3\text{H}_6 \)  D) \( \text{C}_4\text{H}_8 \)

2. Which compound has the same empirical and molecular formula?
   A) \( \text{C}_2\text{H}_4 \)  B) \( \text{C}_3\text{H}_6 \)  C) \( \text{CH}_4 \)  D) \( \text{H}_2\text{O}_2 \)

3. The molecular formula of a compound is represented by \( X_3Y_6 \). What is the empirical formula of this compound?
   A) \( X_3Y \)  B) \( X_2Y \)  C) \( XY_2 \)  D) \( XY_3 \)

4. What is the chemical formula for zinc carbonate?
   A) \( \text{ZnCO}_3 \)  B) \( \text{Zn(CO}_3)_2 \)  C) \( \text{Zn}_2\text{CO}_3 \)  D) \( \text{Zn}_3\text{CO}_2 \)

5. The empirical formula of a compound is \( \text{CH}_2 \). The molecular formula of this compound could be
   A) \( \text{CH}_4 \)  B) \( \text{C}_2\text{H}_2 \)  C) \( \text{C}_2\text{H}_4 \)  D) \( \text{C}_2\text{H}_6 \)

6. The empirical formula of a compound is \( \text{CH}_2 \). The molecular formula of this compound could be
   A) \( \text{CH}_4 \)  B) \( \text{C}_2\text{H}_2 \)  C) \( \text{C}_2\text{H}_4 \)  D) \( \text{C}_3\text{H}_3 \)

7. What is the gram formula mass of \( \text{Ca(OH)}_2 \)?
   A) 29 g  B) 34 g  C) 57 g  D) 74 g

8. The sum of the atomic masses of the atoms in one molecule of \( \text{C}_3\text{H}_6\text{Br}_2 \) is called the
   A) formula mass  B) isotopic mass  C) percent abundance  D) percent composition

9. What is the formula mass of \( \text{Al}_2(\text{SO}_4)_3 \)?
   A) 123  B) 150  C) 214  D) 342

10. The gram-formula mass of a compound is 48 grams. The mass of 1.0 mole of this compound is
    A) 1.0 g  B) 4.8 g  C) 48 g  D) 480 g

11. Which quantity of particles is correctly represented by the formula \( \text{H}_2\text{SO}_4 \)?
    A) 1.0 mole of ions  
    B) 1.0 mole of molecules  
    C) \( 6.0 \times 10^{23} \) ions  
    D) \( 6.0 \times 10^{23} \) atoms

12. Which sample contains a mole of atoms?
    A) 23 g \( \text{Na} \)  B) 24 g \( \text{C} \)  C) 42 g \( \text{Kr} \)  D) 78 g \( \text{K} \)

13. Which sample contains the same number of atoms as a gram of \( \text{He} \)?
    A) 6 g of C  B) 7 g of Li  C) 4 g of O  D) 9 g of F

14. The number of moles of molecules in a 12.0-gram sample of \( \text{Cl}_2 \) is
    A) \( \frac{12.0}{35.5} \) mole  B) \( \frac{12.0}{71.0} \) mole  
    C) 12.0 moles  D) 12.0 × 35.5 moles

15. One mole of \( \text{O}_2 \) has approximately the same mass as one mole of
    A) \( \text{CH}_4 \)  B) \( \text{S} \)  C) \( \text{LiH} \)  D) \( \text{Cl}_2 \)

16. What is the total mass of 2.0 moles of \( \text{H}_2(\text{g}) \)?
    A) 1.0 g  B) 2.0 g  C) 3.0 g  D) 4.0 g

17. What is the total mass of oxygen in 1.00 mole of \( \text{Al}_2(\text{CrO}_4)_3 \)?
    A) 192 g  B) 112 g  C) 64.0 g  D) 48.0 g

18. What is the molecular formula of a compound with an empirical formula of \( \text{CH} \) and a molecular mass of 78?
    A) \( \text{C}_6\text{H}_6 \)  B) \( \text{C}_4\text{H}_{10} \)  C) \( \text{C}_2\text{H}_2 \)  D) \( \text{CH} \)

19. The empirical formula of a compound is \( \text{CH}_3 \). The molecular formula of this compound could be
    A) \( \text{CH}_4 \)  B) \( \text{C}_2\text{H}_4 \)  C) \( \text{C}_2\text{H}_6 \)  D) \( \text{C}_3\text{H}_6 \)

20. Which gas has a density of 1.52 grams per liter at STP?
    A) \( \text{H}_2\text{S} \)  B) \( \text{CH}_4 \)  C) \( \text{NO} \)  D) \( \text{CO} \)

21. What is the density, in grams per liter, of \( \text{N}_2 \) gas at STP?
    A) 28.0  B) 14.0  C) 1.25  D) 0.800

22. In which compound is the percent composition by mass of chlorine equal to 42%?
    A) \( \text{HClO} \) (gram-formula mass = 52 g/mol)  
    B) \( \text{HClO}_2 \) (gram-formula mass = 68 g/mol)  
    C) \( \text{HClO}_3 \) (gram-formula mass = 84 g/mol)  
    D) \( \text{HClO}_4 \) (gram-formula mass = 100. g/mol)

23. A compound contains 46.7% nitrogen and 53.3% oxygen by mass. What is the empirical formula of the compound?
    A) \( \text{NO} \)  B) \( \text{N}_2\text{O} \)  C) \( \text{N}_2\text{O}_3 \)  D) \( \text{N}_2\text{O}_5 \)
24. A compound consists of 25.9% nitrogen and 74.1% oxygen by mass. What is the empirical formula of the compound?

A) NO  B) NO₂  C) N₂O  D) N₂O₅

25. A 60. g sample of LiCl • H₂O is heated in an open crucible until all of the water has been driven off. What is the total mass of LiCl remaining in the crucible?

A) 18 g  B) 24 g  C) 42 g  D) 60 g

26. The percent by mass of water in the hydrate Na₂SO₄•10H₂O is closest to

A) 18%  B) 44%  C) 56%  D) 76%

27. A student obtained the following data to determine the percent by mass of water in a hydrate.

<table>
<thead>
<tr>
<th>Mass of empty crucible + cover</th>
<th>11.70 g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass of crucible + cover + hydrated salt before heating</td>
<td>14.90 g</td>
</tr>
<tr>
<td>Mass of crucible + cover + anhydrous salt after thorough heating</td>
<td>14.53 g</td>
</tr>
</tbody>
</table>

What is the approximate percent by mass of the water in the hydrated salt?

A) 2.5%  B) 12%  C) 88%  D) 98%

28. The percent by mass of nitrogen in Mg(CN)₂ is equal to

A) \( \frac{14}{76} \times 100 \)  B) \( \frac{14}{50} \times 100 \)  C) \( \frac{28}{76} \times 100 \)  D) \( \frac{28}{50} \times 100 \)

29. Which terms identify types of chemical reactions?

A) decomposition and sublimation  B) decomposition and synthesis  C) deposition and sublimation  D) deposition and synthesis

30. Which change results in the formation of different substances?

A) burning of propane  B) melting of NaCl(s)  C) deposition of CO₂(g)  D) solidification of water

31. Which reaction releases the greatest amount of energy per kilogram of reactants?

A) \( \frac{1}{6} \text{Li} + \frac{2}{3} \text{U} \rightarrow \frac{1}{5} \text{Ba} + \frac{9}{36} \text{Kr} + \frac{3}{0} \text{n} \)

B) 2C + H₂ \rightarrow C₂H₂

C) C₆H₆(g) + 5O₂(g) \rightarrow 3CO₂(g) + 4H₂O(ℓ)

D) NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H₂O(ℓ)

32. Given the reaction:

\[ \text{Mg(s)} + 2 \text{AgNO₃(aq)} \rightarrow \text{Mg(NO₃)₂(aq)} + 2 \text{Ag(s)} \]

Which type of reaction is represented?

A) single replacement  B) double replacement  C) synthesis  D) decomposition

33. Which balanced equation represents an oxidation-reduction reaction?

A) BaCl₂ + Na₂SO₄ \rightarrow BaSO₄ + 2NaCl  
B) C + H₂O \rightarrow CO + H₂  
C) CaCO₃ \rightarrow CaO + CO₂  
D) Mg(OH)₂ + 2HNO₃ \rightarrow Mg(NO₃)₂ + 2H₂O

34. In which type of chemical reaction do two or more reactants combine to form one product, only?

A) synthesis  B) decomposition  C) single replacement  D) double replacement

35. Given the balanced equation representing a reaction:

\[ \text{Zn(s)} + \text{H₂SO₄(aq)} \rightarrow \text{ZnSO₄(aq)} + \text{H₂(g)} \]

Which type of reaction is represented by this equation?

A) decomposition  B) double replacement  C) single replacement  D) synthesis

36. Given the balanced equation representing a reaction:

\[ 4\text{Al(s)} + 3\text{O₂(g)} \rightarrow 2\text{Al₂O₃(s)} \]

As the aluminum loses 12 moles of electrons, the oxygen

A) gains 4 moles of electrons  B) gains 12 moles of electrons  C) loses 4 moles of electrons  D) loses 12 moles of electrons
37. Given the unbalanced equation:

\[ \text{Al}_2(\text{SO}_4)_3 + \_ \text{Ca(OH)}_2 \rightarrow \_ \text{Al(OH)}_3 + \_ \text{CaSO}_4 \]

What is the coefficient in front of the CaSO_4 when the equation is completely balanced with the smallest whole-number coefficients?

A) 1  B) 2  C) 3  D) 4

38. When the equation

\[ \_ \text{H}_2 + \_ \text{N}_2 \rightarrow \_ \text{NH}_3 \]

is completely balanced using smallest whole numbers, the sum of all the coefficients will be

A) 6  B) 7  C) 3  D) 12

39. Which equation is correctly balanced?

A) \( \text{Zn} + \text{Ag}^+ \rightarrow \text{Zn}^{2+} + \text{Ag} \)
B) \( \text{Cu} + \text{Au}^{3+} \rightarrow \text{Cu}^{2+} + \text{Au} \)
C) \( \text{Al} + \text{Sn}^{2+} \rightarrow \text{Al}^{3+} + \text{Sn} \)
D) \( \text{Ca} + \text{Mg}^{2+} \rightarrow \text{Ca}^{2+} + \text{Mg} \)

40. Given the incomplete equation:

\[ 4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{X} \]

Which compound is represented by X?

A) \( \text{FeO} \)  B) \( \text{Fe}_2\text{O}_3 \)
C) \( \text{Fe}_3\text{O}_2 \)  D) \( \text{Fe}_3\text{O}_4 \)

41. Given the balanced equation representing a reaction:

\[ 4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O} \]

What is the minimum number of moles of \( \text{O}_2 \) that are needed to completely react with 16 moles of \( \text{NH}_3 \)?

A) 16 mol  B) 20, mol  C) 64 mol  D) 80, mol

42. Given the incomplete equation representing a reaction:

\[ 2\text{Na}(s) + 2\text{H}_2\text{O}(\ell) \rightarrow 2\text{Na}^+(aq) + 2 \_ \_ \_ (aq) + \text{H}_2(g) \]

What is the formula of the missing product?

A) \( \text{O}^{2-} \)  B) \( \text{O}_2 \)  C) \( \text{OH}^- \)  D) \( \text{OH} \)

43. Given the reaction:

\[ 2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2 \]

What is the minimum number of moles of \( \text{O}_2 \) required to produce one mole of \( \text{CO}_2 \)?

A) 1.0  B) 2.0  C) 0.50  D) 0.50

44. Given the reaction:

\[ \text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{H}_2 \]

How many moles of \( \text{H}_2\text{O} \) are needed to exactly react with 2.0 moles of \( \text{Ca} \)?

A) 1.0  B) 2.0  C) 0.50  D) 4.0

45. Given the reaction:

\[ 2\text{C}_2\text{H}_6 + 7\text{O}_2 \rightarrow 4\text{CO}_2 + 6\text{H}_2\text{O} \]

What is the total number of moles of \( \text{CO}_2 \) produced by the complete combustion of 5.0 moles of \( \text{C}_2\text{H}_6 \)?

A) 1.0 mole  B) 2.0 moles  C) 5.0 moles  D) 10, moles
46. Given the reaction:

\[ 6 \text{CO}_2 + 6 \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 \]

What is the total number of moles of water needed to make 2.5 moles of \( \text{C}_6\text{H}_{12}\text{O}_6 \)?

A) 2.5  B) 6.0  C) 12  D) 15

47. What is the total number of nitrogen atoms in 0.25 mole of \( \text{NO}_2 \) gas?

A) \(1.5 \times 10^{23}\)  B) \(6.0 \times 10^{23}\)
C) \(3.0 \times 10^{23}\)  D) \(1.2 \times 10^{24}\)

48. What is the total number of molecules of \( \text{SO}_2 \) in a 0.10-mole sample of \( \text{SO}_2 \)?

A) \(6.0 \times 10^{21}\)  B) \(6.0 \times 10^{22}\)
C) \(6.0 \times 10^{23}\)  D) \(6.0 \times 10^{24}\)

49. What is the total number of molecules of hydrogen in 0.25 mole of hydrogen?

A) \(6.0 \times 10^{23}\)  B) \(4.5 \times 10^{23}\)
C) \(3.0 \times 10^{23}\)  D) \(1.5 \times 10^{23}\)

50. The total quantity of molecules contained in 5.6 liters of an ideal gas at STP is

A) 1.0 mole  B) 0.75 mole
C) 0.50 mole  D) \(0.25\) mole