1. Which type of bond involves the transfer of electrons from one atom to another?
   A. Hydrogen bond  
   B. Ionic bond  
   C. Metallic bond  
   D. Covalent bond

2. Ethene (C\textsubscript{2}H\textsubscript{4}) and cyclohexane (C\textsubscript{6}H\textsubscript{12}) have the same
   A. molecular formula.  
   B. empirical formula.  
   C. structural formula.  
   D. molar mass.

3. In which pair are both compounds correctly classified?
   A. N\textsubscript{2}O\textsubscript{4}, ionic compound; LiCl, molecular compound  
   B. CH\textsubscript{4}, ionic compound; CuS, ionic compound  
   C. C\textsubscript{6}H\textsubscript{12}O\textsubscript{6}, molecular compound; Fe\textsubscript{2}O\textsubscript{3}, molecular compound  
   D. SF\textsubscript{6}, molecular compound; ScF\textsubscript{3}, ionic compound

4. What is the formula of aluminum sulfate?
   A. Al\textsubscript{2}(SO\textsubscript{4})\textsubscript{3}  
   B. Al\textsubscript{3}(SO\textsubscript{4})\textsubscript{2}  
   C. Al\textsubscript{2}(SO\textsubscript{3})\textsubscript{3}  
   D. Al\textsubscript{3}S\textsubscript{3}O\textsubscript{9}

5. What is the chemical name of Mn(CO\textsubscript{3})\textsubscript{2}?
   A. magnesium carbonate  
   B. manganese(II) carbonate  
   C. manganese(IV) carbonate  
   D. manganese carbonate

6. What is the name of S\textsubscript{2}F\textsubscript{10}?
   A. sulfur fluoride  
   B. diselenium decafluoride  
   C. sulfur(V) fluoride  
   D. disulfur decafluoride

7. Aspirin is acetylsalicylic acid (C\textsubscript{9}H\textsubscript{8}O\textsubscript{4}). What is the molar mass of acetylsalicylic acid?
   A. 169.15 g/mol  
   B. 191.26 g/mol  
   C. 180.16 g/mol  
   D. 168.14 g/mol
8. How many molecules are present in 25.0 g of CH₃OH?
   A. 4.85 × 10²⁶ molecules       C. 7.77 × 10²³ molecules
   B. 4.70 × 10²³ molecules       D. 1.56 × 10²⁵ molecules

9. What is the mass percent composition of mercury in methylmercury(II) chloride, HgCH₃Cl?
   A. 68.64%                    C. 23.27%
   B. 96.45%                    D. 79.89%

10. What mass of oxygen is in 15.8 g of Al(NO₂)₃?
    A. 5.93 g                     C. 15.4 g
    B. 9.19 g                     D. 6.98 g

11. A compound decomposes into 165 g of carbon, 27.8 g of hydrogen, and 220.2 g of oxygen. What is the empirical formula of the compound?
    A. CH₂O              C. CHO₂
    B. CH₃O             D. C₂HO

12. A compound has the empirical formula CH and a molar mass of 78.11 g/mol. What is its molecular formula?
    A. C₆H₁₂                 C. C₅H₅
    B. C₆H₆                 D. C₇H₇
13. What is the sum of the stoichiometric coefficients, \( d + e + f \), when the chemical equation below is balanced with the lowest set of whole number coefficients?

\[
a \text{Ca}_3(\text{PO}_4)_2(s) + b \text{SiO}_2(s) + c \text{C}(s) \rightarrow d \text{CaSiO}_3(l) + e \text{CO(g)} + f \text{P}_4(\text{g})
\]

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>A.</td>
<td>12</td>
<td>C.</td>
</tr>
<tr>
<td>B.</td>
<td>17</td>
<td>D.</td>
</tr>
</tbody>
</table>

14. Given the chemical equation

\[
\text{CaCl}_2(aq) + 2 \text{NaOH(aq)} \rightarrow \text{Ca(OH)}_2(aq) + 2 \text{NaCl(aq)},
\]

how many moles of NaCl are formed from the complete reaction of 2 moles of CaCl\(_2\) with excess NaOH?

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>A.</td>
<td>16</td>
<td>C.</td>
</tr>
<tr>
<td>B.</td>
<td>2</td>
<td>D.</td>
</tr>
</tbody>
</table>

15. A strip of zinc metal with a mass of 2.00 g is placed in an aqueous solution containing 2.50 g of silver nitrate, causing the following reaction to occur:

\[
\text{Zn(s)} + 2 \text{AgNO}_3(aq) \rightarrow 2 \text{Ag(s)} + \text{Zn(NO}_3)_2(aq)
\]

How much silver metal will form?

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<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>A.</td>
<td>1.23 g</td>
<td>C.</td>
</tr>
<tr>
<td>B.</td>
<td>1.59 g</td>
<td>D.</td>
</tr>
</tbody>
</table>

16. A reaction of 15 g of \( \text{N}_2 \) with excess \( \text{H}_2 \) produces 12 g of \( \text{NH}_3 \). What is the percent yield of the reaction?

\[
\text{N}_2(g) + 3 \text{H}_2(g) \rightarrow 2 \text{NH}_3(g)
\]

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<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>66%</td>
<td>C.</td>
</tr>
<tr>
<td>B.</td>
<td>32%</td>
<td>D.</td>
</tr>
</tbody>
</table>
17. How many grams of \((\text{NH}_4)_2\text{SO}_4\) are needed to prepare 200.0 mL of a 1.27 M solution?

A. 49.3 g  
B. 0.324 g  
C. 304 g  
D. 33.6 g

18. What volume of 2.00 M HCl must be used to prepare 500.0 mL of 0.350 M HCl?

A. 28.6 mL  
B. 35.0 mL  
C. 14.0 mL  
D. 87.5 mL

19. Which of these compounds is the most soluble in water?

A. KOH  
B. Co(OH)\(_2\)  
C. AgOH  
D. Fe(OH)\(_2\)

20. Give the net ionic equation for the reaction (if any) that occurs when aqueous solutions of H\(_2\)SO\(_4\) and KOH are mixed.

A. \(\text{H}^+(aq) + \text{OH}^-(aq) \rightarrow \text{H}_2\text{O}(l)\)  
B. \(\text{H}_2\text{SO}_4(aq) + \text{OH}^-(aq) \rightarrow \text{H}_2\text{O}(l) + \text{SO}_4^{2-}(aq)\)  
C. \(2 \text{K}^+(aq) + \text{SO}_4^{2-}(aq) \rightarrow \text{K}_2\text{SO}_4(s)\)  
D. No reaction

21. The titration of a 50.00 mL sample of a HNO\(_3\) solution of unknown concentration requires 67.25 mL of a 0.1245 M Ba(OH)\(_2\) solution to reach the equivalence point. What is the concentration of the unknown HNO\(_3\) solution?

A. 0.8372 M  
B. 0.1681 M  
C. 0.3349 M  
D. 0.4628 M

22. What is the oxidation number of phosphorus in P\(_2\)Br\(_4\)?

A. +2  
B. +4  
C. −2  
D. −4
23. Which one of the following is a redox reaction?

A. \( \text{H}_2\text{SO}_4(aq) + \text{Ca(OH)}_2(aq) \rightarrow \text{CaSO}_4(s) + 2\text{H}_2\text{O(l)} \)
B. \( \text{Pb(NO}_3)_2(aq) + \text{Na}_2\text{SO}_4(aq) \rightarrow 2 \text{NaNO}_3(aq) + \text{PbSO}_4(s) \)
C. \( 2 \text{H}_2(g) + \text{O}_2(g) \rightarrow 2 \text{H}_2\text{O(l)} \)
D. \( \text{HBr(aq) + NaOH(aq) \rightarrow NaBr(aq) + H}_2\text{O(l)} \)

24. Convert 1,180 mmHg to kPa (1 atm = 101.325 kPa).

A. 1.57 kPa  
C. 1.18 kPa
B. 1.57 \times 10^2 \text{ kPa}  
D. 0.118 kPa

25. A red and a blue balloon are each filled with 2.0 L of \( \text{H}_2 \) gas at 15 °C. The red balloon is submersed 30 m below the ocean’s surface in 15 °C water. The blue balloon is submersed in liquid nitrogen at -195.8 °C. The volume of both balloons decreases. Which statement describes the reasons for the decrease in volume?

A. The red balloon demonstrates the inverse relationship between volume and pressure; the blue balloon demonstrates the direct relationship between volume and temperature.
B. The red balloon demonstrates the inverse relationship between volume and pressure; the blue balloon demonstrates the direct relationship between volume and moles of a gas.
C. The red balloon demonstrates the direct relationship between volume and pressure according; the blue balloon demonstrates the inverse relationship between volume and temperature.
D. The red balloon demonstrates the inverse relationship between volume and moles of a gas; the blue balloon demonstrates the direct relationship between volume and temperature.

26. Which of the following statements is true about ideal gases?

A. Ideal gases do not exhibit intermolecular attractions between individual gas atoms or molecules in a gaseous mixture.
B. Ideal gas molecules are broken into individual atoms after colliding with one another in a gaseous mixture.
C. Ideal gases combine to form larger molecules after colliding with one another in a gaseous mixture.
D. All gases behave as ideal gases.
27. What mass of CO$_2$(g) exerts a pressure of 455 mmHg at 25 °C in a 5.00 L vessel?

<table>
<thead>
<tr>
<th>Option</th>
<th>Mass (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>8.87 g</td>
</tr>
<tr>
<td>B.</td>
<td>0.0583 g</td>
</tr>
<tr>
<td>C.</td>
<td>1.08 g</td>
</tr>
<tr>
<td>D.</td>
<td>5.39 g</td>
</tr>
</tbody>
</table>

28. A 0.500 mol sample of gas has a density of 1.05 g/L at 23.0 °C and 1.50 atm. What is the mass of the sample?

<table>
<thead>
<tr>
<th>Option</th>
<th>Mass (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>0.665 g</td>
</tr>
<tr>
<td>B.</td>
<td>66.7 g</td>
</tr>
<tr>
<td>C.</td>
<td>8.51 g</td>
</tr>
<tr>
<td>D.</td>
<td>34.5 g</td>
</tr>
</tbody>
</table>

29. A gas sample in a container at a fixed volume and temperature contains 0.50 mol N$_2$, 0.25 mol O$_2$ and an unknown amount of He. The total pressure is 825 torr while the partial pressure of N$_2$ is 317 torr and of O$_2$ is 159 torr. How many moles of He are in the container?

<table>
<thead>
<tr>
<th>Option</th>
<th>Moles</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>6.0</td>
</tr>
<tr>
<td>B.</td>
<td>0.83</td>
</tr>
<tr>
<td>C.</td>
<td>0.55</td>
</tr>
<tr>
<td>D.</td>
<td>1.1</td>
</tr>
</tbody>
</table>

30. The following reaction was conducted in a 2.00 L evacuated chamber at 25.0 °C:

\[
\text{Na}_2\text{CO}_3(aq) + 2 \text{HCl}(aq) \rightarrow 2 \text{NaCl}(aq) + \text{H}_2\text{O}(l) + \text{CO}_2(g)
\]

If the final pressure in the chamber was 2.45 atm, how many moles of HCl were used in the reaction, assuming that all of the HCl was converted to products? (Neglect the vapor pressure of water.)

<table>
<thead>
<tr>
<th>Option</th>
<th>Moles</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>0.278</td>
</tr>
<tr>
<td>B.</td>
<td>0.523</td>
</tr>
<tr>
<td>C.</td>
<td>0.164</td>
</tr>
<tr>
<td>D.</td>
<td>0.401</td>
</tr>
</tbody>
</table>
Answer Key:

1. B
2. B
3. D
4. A
5. C
6. D
7. C
8. B
9. D
10. B
11. A
12. B
13. B
14. C
15. B
16. A
17. D
18. D
19. A
20. A
21. C
22. A
23. C
24. B
25. A
26. A
27. D
28. C
29. C
30. D