PART A: PRACTICE COMMON.
Choose the best answer. You may use a scientific calculator – no graphing calculators allowed.

1. A substance that is formed when two or more chemical elements are chemically bonded together is called a(n) _____.
   a. Molecule
   b. Compound
   c. Homogeneous mixture
   d. Element

2. LiBr(aq) is an example of a(n) _____.
   a. Solution
   b. Solute
   c. Compound
   d. Molecule

3. Choose the element.
   a. O₂
   b. Ammonium
   c. AuS
   d. 2OH⁻

4. Which particle diagram(s) represent(s) a mixture of two elements?
   a. A only
   b. B only
   c. A and B
   d. B and C

5. Which particle diagram(s) represent(s) a mixture of two elements?
   a. A only
   b. B only
   c. A and B
   d. B and C

4. Identify the homogeneous mixture below:
   a. salt and pepper
   b. simple syrup
   c. Italian salad dressing
   d. concrete

5. If you made 200 mL of Li₂SO₄(aq), the solute used to make this solution is _____.
   a. water
   b. Li₂SO₄
   c. isopropyl
   d. benzene

6. What is the electron configuration of a neutral atom of Sulfur?
   a. [Ne]3p⁶
   b. 1s²2s²3s²2p⁶3p²
   c. 1s²2s²2p⁴
   d. 1s²2s²2p⁶3s²3p⁴
7. What is the electron configuration of sulfide?
   a. $1s^22s^22p^63s^23p^4$
   b. $1s^22s^22p^63s^23p^6$
   c. $1s^22s^22p^63s^23p^5$
   d. $1s^22s^22p^63s^23p^44s^1$

8. What is the electron configuration of Al$^{3+}$?
   a. $1s^22s^22p^6$
   b. [Ne]$3s^23p^1$
   c. $1s^22s^22p^63s^23p^3$
   d. [Ar]

9. Which element has one unpaired electron in the 4s sublevel?
   a. K
   b. Ca
   c. Cl
   d. Na

10. Which atom/ion has the electron configuration $1s^22s^22p^63s^23p^6$?
    a. P$^6^-$
    b. F$^-$
    c. Ca$^{2+}$
    d. Al$^{3+}$

11. How many valence electrons are present in an atom with the following electron configuration:
    $1s^22s^22p^63s^23p^6$?
    a. 2
    b. 4
    c. 6
    d. 8

12. A neutral element with the electron configuration $1s^22s^22p^63s^23p^5$ would most likely form which ion?
    a. 3+
    b. 3-
    c. 1+
    d. 1-

13. Select the list of atoms that are arranged in order of decreasing atomic radius.
    a. C, N, O, F
    b. S, As, Sn, Tl
    c. As, P, S, Se
    d. Sb, Bi, N, As

14. Select the list of atoms that are arranged in order of decreasing ionization energy.
    a. F, O, S, Cl
    b. Ca, Sr, Ba, Ra
    c. Po, Te, Se, S
    d. Mg, Al, Si, Cl

15. Choose the correct relationship concerning ionic/atomic radius.
    a. P < P$^{3+}$
    b. Cd < Cd$^{2+}$
    c. Si < Si$^{4+}$
    d. S > S$^{2-}$

16. What is the correct chemical formula for chromium (VI) phosphate?
    a. Cr$_3$PO$_4$
    b. Cr(PO$_4$)$_2$
    c. Cr$_3$(PO$_4$)$_4$
    d. Cr(PO$_4$)$_3$

17. What is the correct chemical formula for nickel (II) hypochlorite?
    a. Ni(ClO)$_2$
    b. Ni$_2$(ClO)$_4$
    c. Ni$_2$ClO
    d. Ni$_2$ClO$_2$

18. Au$_3$PO$_4$ is
    a. gold (I) phosphate
    b. gold (III) phosphate
    c. gold phosphate
    d. trigold monophosphate
19. Vanadium (IV) sulfide is _____.
   a. V$_2$S
   b. V$_4$S
   c. V(SO$_3$)$_2$
   d. V$_2$S

20. If Co(NO$_2$)$_3$ is cobalt (III) nitrite, what is the chemical formula for iron (III) nitrite?
   a. Fe$_3$NO$_2$
   b. Fe(NO$_2$)$_3$
   c. Fe$_3$NO$_3$
   d. Fe$_3$(NO$_2$)$_3$

21. Which formula correctly represents the composition of gold (II) nitride?
   a. AuN$_3$
   b. AuN
   c. Ag$_3$N
   d. Au$_3$N

22. Given the equation representing a reaction:
   HA (aq) + COH (aq) → H$_2$O (l) + CA (aq)

   What kind of reaction is represented by this equation?
   a. synthesis
   b. precipitation
   c. decomposition
   d. acid/base neutralization

23. Given the word equation:
   ethanol vapor + oxygen gas → carbon dioxide + water

   Which type of chemical reaction is represented by this equation?
   a. combustion
   b. double replacement
   c. decomposition
   d. synthesis

24. Given the unbalanced equation:
   _____Fe + _____HC$_2$H$_3$O$_2$ → _____Fe(C$_3$H$_5$O$_2$)$_3$ + _____H$_2$

   When the equation is balanced using the smallest whole-number coefficients, what is the coefficient of Fe?
   a. 1
   b. 2
   c. 3
   d. 6

25. Acid/base and precipitation reactions occur ______.
   a. in solution
   b. in the gaseous phase
   c. in the liquid phase.
   d. slowly.
26. Given the unbalanced equation:

\[ \_\_\text{FeS} + \_\_\text{O}_2 \rightarrow \_\_\text{Fe}_2\text{O}_3 + \_\_\text{SO}_2 \]

When the equation is balanced using the smallest whole-number coefficients, what is the coefficient of \( \text{O}_2 \)?

a. 2  

b. 6  

c. 7  

d. 14

27. What is the proper Lewis structure of ammonia, \( \text{NH}_3 \)?

a. H\( \cdot \)N\( \cdot \)H  

b. H\( \cdot \)H\( \cdot \)H  

c. H\( \cdot \)N\( \cdot \)H  

d. none of these structures are correct

28. In the Lewis structure for \( \text{CF}_4 \), the central atom has ____.

a. two double bonds and no lone pairs  

b. one single bond and three lone pairs  

c. three single bonds and one lone pair  

d. four single bonds and no lone pairs

29. From the balanced equation below, how many moles of water will be produced if 3.57 moles of carbon monoxide is completely reacted?

\[ 8 \text{ CO} + 17 \text{ H}_2 \rightarrow \text{C}_8\text{H}_{18} + 8 \text{ H}_2\text{O} \]

a. 1.79 mol \( \text{H}_2\text{O} \)  

b. 3.57 mol \( \text{H}_2\text{O} \)  

c. 7.14 mol \( \text{H}_2\text{O} \)  

d. none of the above
30. Determine the number of moles of water that reacts with 5.125 moles of PCl₅.

\[ \text{PCl}_5 + 4 \text{H}_2\text{O} \rightarrow \text{H}_3\text{PO}_4 + 5 \text{HCl} \]

a. 1.281 mol H₂O  
   b. 5.125 mol H₂O  
   c. 10.25 mol H₂O  
   d. 20.50 mol H₂O

\[
\frac{5.125 \text{ mol PCl}_5 \times 4 \text{ mol H}_2\text{O}}{1 \text{ mol PCl}_5} = 20.50 \text{ mol H}_2\text{O}
\]

31. Given the balanced equation below:

\[ \text{Ba}_3\text{N}_2 + 6 \text{H}_2\text{O} \rightarrow 3 \text{ Ba(OH)}_2 + 2 \text{ NH}_3 \]

If 126 g of barium nitride is reacted in excess water, how many grams of barium hydroxide will be produced?

a. 147.2 g Ba(OH)₂  
   b. 378.0 g Ba(OH)₂  
   c. 439.92 g Ba(OH)₂  
   d. 525.0 g Ba(OH)₂

\[
\frac{126 \text{ g Ba}_3\text{N}_2}{1 \text{ mol Ba}_3\text{N}_2} \times \frac{1 \text{ mol Ba(OH)}_2}{3 \text{ mol Ba}_3\text{N}_2} \times \frac{171.34 \text{ g Ba(OH)}_2}{1 \text{ mol Ba(OH)}_2} = 147.198 \text{ g Ba(OH)}_2
\]

32. Given the balanced equation below:

\[ 2 \text{ As} + 6 \text{NaOH} \rightarrow 2 \text{ Na}_3\text{AsO}_3 + 3 \text{ H}_2 \]

If 0.568 mol of arsenic is reacted, how many grams of hydrogen will be produced?

a. 0.763 g H₂  
   b. 0.859 g H₂  
   c. 1.72 g H₂  
   d. 2.70 g H₂

33. In a reaction mixing solutions of lithium nitrate and iron (II) chloride, what will the precipitate be (if any)?

   a. lithium chloride (s)  
   b. iron (II) nitrate (s)  
   c. iron (II) lithium (s)  
   d. there is no precipitate

34. Which of the following substances will completely dissociate in water?

   a. calcium chloride  
   b. sodium sulfate  
   c. calcium carbonate  
   d. iron (III) sulfate
35. Given the available reactants, how many times did the reaction run to completion?
   a. 2
   b. 3
   c. 5
   d. cannot be determined w/given info

36. What is the excess reactant?
   a. As
   b. H₂
   c. AsH₃
   d. O₂

**Limiting Reactant: As**

37. Calculate the molarity solution made with 500 mL and 40.0 g of sodium hydroxide
   a. 0.50 M
   b. 1.00 M
   c. 2.00 M
   d. 4.00 M

38. What type of reaction is HCl (aq) + KOH (aq) → KCl (aq) + H₂O (l) ?
   a. acid base
   b. decomposition
   c. precipitation
   d. synthesis

39. What type of reaction is 2 S + 3 O₂ → 2 SO₃ ?
   a. composition
   b. decomposition
   c. precipitation
   d. single replacement

40. What type of reaction is 2 Mg + O₂ → 2 MgO + energy
   a. synthesis
   b. decomposition
   c. precipitation
   d. combustion

   *It's both.*

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**PART B: PRACTICE NATIVE EXAM**

**Part One: Multiple Choice.** Choose the best answer and write the capital letter of your answer in the box. (2pts each)

1. The concentration of hydronium ions is $1.02 \times 10^{-4}$ M in a solution. pH = -log[H$_3$O$^+$]
   - A. Solution has a pH of 3.99 and is acidic.
   - B. Solution has a pH of 3.99 and is acidic.
   - C. Solution has a pH of 1.02 and is basic.
   - D. Solution has a pH of 10.01 and is basic.

2. Theoretical yield is determined by
   - A. performing experiments.
   - B. the percentage yield.
   - C. calculations starting with the limiting reactant.
   - D. the actual yield.

3. How many grams of lithium sulfite are needed to prepare 1.00 L of a 1.00 M solution?
   - A. 87.0 g
   - B. 103 g
   - C. 93.94 g
   - D. 109.94 g

4. The total amount of reactants consumed and product made is restricted by the
   - A. limiting reactant.
   - B. limiting product.
   - C. excess reactant.
   - D. excess product.

5. In a bond between oxygen and hydrogen, electrons spend more time around the oxygen atom. This bond is
   - A. nonpolar.
   - B. polar.
   - C. ionic.
   - D. dipolar.

6. Calcium's valence electrons orbit the nucleus in a(n) ______ ______ shape.
   - A. horseshoe
   - B. cloverleaf
   - C. dumbbell
   - D. spherical

7. The theoretical yield of a product made by a chemical reaction is usually
   - A. less than the actual yield.
   - B. greater than the percentage yield.
   - C. greater than the experimental yield.
   - D. equal to the actual yield.

**Part Two: Short Answer**

8. Listed below are the successive ionization energies in kJ/mol for an element, which element in Period 2 do you expect this data to match? (2pts)
   \[
   \begin{array}{cccc}
   IE_1 & = & 899 & \quad IE_2 = 1,757 & \quad IE_3 = 14,845 & \quad IE_4 = 21,000 \\
   \end{array}
   \]
   Answer: **Beryllium**

9. Which is bigger – Ca or Ca$^{2+}$? Why? (2pts) **Ca** is bigger. **Ca$^{2+}$** is smaller because there are more protons than electrons so the e$^-$ are pulled in closer.

10. Define dissociate (related to Chem) (2pts) **Ions in soluble ionic compounds separate from one another in solution and interact with water molecules.**

11. Define heterogeneous mixture (2pts) **Any physical mixture that is not uniform in composition.**

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12. Define electronegativity. (2pts) **tendency of an element to attract a bonding pair of electrons**

14. Differences in **electronegativity** will determine if a bond is ionic, polar, or nonpolar. (1pt)

13. A chemical reaction is described in the equation below.

\[ \text{Reactants} \rightarrow \text{Products + heat + light} \]

Is this chemical change endothermic or exothermic? (2pts) **exothermic**

15. Write out a **complete ionic equation** for the precipitation reaction between iron (III) nitrate and sodium hydroxide. Label the spectator ions. (10pts)

\[ \text{Fe(NO}_3\text{)}_3 \text{(aq) + 3NaOH(aq) \rightarrow 3NaNO}_3\text{(aq) + Fe(OH)}_3\text{(s)} \]

\[ \text{Fe}^{3+} \text{(aq) + 3NO}_3^- \text{(aq) + 3Na}^+ \text{(aq) + 3OH}^- \text{(aq) \rightarrow 3Na}^+ \text{(aq) + 3NO}_3^- \text{(aq) + Fe(OH)}_3\text{(s)} \]

16. Draw a complete electron box diagram for a neutral atom of potassium. (6pts)

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**Part Three: Calculations.** Show all work including setup and formulas, units, unrounded answers, and rounded final answers. Final answers must have correct significant digits, units, and be circled or boxed.

17. 615.2 mL of 3.1 M zinc (II) nitrate was added to a 2.000 L volumetric flask. Distilled water was then added to the calibration mark. What is the concentration of this final dilute solution? (5pts)

\[
3.1 \text{M} \cdot 0.6152 \text{L} = M_2 \cdot 2.000 \text{L} \\
M_2 = 0.95356 \\
0.95 \text{M}
\]

18. 52 mL of a 3.1 M HI solution were mixed with 78.2 mL of a 4.3 M KOH solution according to the following equation:

\[ \text{HI (aq) + KOH (aq) \rightarrow KI (aq) + H}_2\text{O (l)} \]

The excess reactant is **KOH** and **0.18** moles remain in the mixture after the reaction. (5pts)

**HI:** \[ 3.1 \text{M} = \frac{x \text{mol}}{0.052 \text{L}} \]

\[ \text{mol} = 0.1612 \text{/l} \]

**KOH:** \[ 4.3 \text{M} = \frac{x \text{mol}}{0.0782 \text{L}} \]

\[ \text{mol} = 0.3362 \text{/l} \]