Exam 1 review key

1. Which of the following is a weak electrolyte?
   a. HCl
   b. CH₃COOH
   c. NaOH
   d. HNO₃

2. Give the formula for the following compounds.
   a. Lithium sulfate \( \text{Li}_2\text{SO}_4 \)
   b. Beryllium phosphide \( \text{Be}_3\text{P}_2 \)
   c. Dinitrogen monoxide \( \text{N}_2\text{O} \)

3. Name the following compounds.
   a. \( \text{FeSO}_3 \) Iron(III) sulfite
   b. \( \text{K}_2\text{S} \) Potassium sulfide
   c. \( \text{P}_2\text{O}_5 \) Diphosphorus pentoxide

4. Write the molecular equation for the compound.

\[
\text{C}_6\text{H}_{10}\text{N}_2\text{O}_2
\]

5. Classify each as an acid or base. Which are strong and which are weak?
   a. \( \text{H}_2\text{S} \) weak acid
   b. \( \text{NH}_2\text{OH} \) weak base
   c. \( \text{NH}_4^+ \) weak acid
   d. \( \text{H}_2\text{SO}_4 \) strong acid
   e. \( \text{Ca(OH)}_2 \) strong base

6. What ions will be present in aqueous solution?
   a. \( \text{CaCO}_3 \) \( \text{Ca}^{2+} \text{CO}_3^{2-} \)
   b. \( \text{LiNO}_3 \) \( \text{Li}^+ \text{NO}_3^- \)
   c. \( \text{KBr} \) \( \text{K}^+ \text{Br}^- \)
7. Identify the two new compounds that would form if each of the compounds were to react. Identify the products as soluble or insoluble.

<table>
<thead>
<tr>
<th></th>
<th>KBr</th>
<th>Na₂CO₃</th>
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<tbody>
<tr>
<td>AgNO₃</td>
<td>AgBr + KNO₃</td>
<td>NaNO₃ + Ag₂CO₃</td>
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<tr>
<td>BaCl₂</td>
<td>KCl + BaBr₂.</td>
<td>NaCl + BaCO₃</td>
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8. What mass of magnesium has the same volume as 20.0 g of copper? Density of Mg = 1.74 g/mL. Density of Cu = 8.02 g/mL.

\[
\frac{d = \frac{m}{V}}{8.02 \text{ g/mL} = \frac{20.0 \text{ g}}{V}} \Rightarrow V = 2.49 \text{ mL} = \text{volume of Mg}
\]

\[
d_{\text{Mg}} = \frac{m_{\text{Mg}}}{V_{\text{Mg}}} \Rightarrow 1.74 \text{ g/mL} = \frac{m_{\text{Mg}}}{2.49 \text{ mL}}
\]

\[
\Rightarrow m_{\text{Mg}} = 4.33 \text{ g}
\]

9. Which length is the largest?
   a. 6.7 m
   b. 8.9 x 10⁻⁴ km
   c. 7.3 x 10⁻¹⁰ nm
   d. 5.4 x 10⁻⁷ mm

10. Give the following answer to the correct number of significant figures.
    \((23.5 - 21.3) / 1.58 = 1.4\)

11. Identify the alkali metal that is in the 5th period of the periodic table.
    \(Rb\)

12. Identify element X.
    a) \(^{63}_{29}X\) Cu
    b) \(^{118}_{47}X\) Ag
    c) \(^{200}_{80}X\) Hg
    d) \(^{39}_{19}X\) K
13. Which of the following will form a covalent bond?
   a. Nitrogen and oxygen
   b. Calcium and sulfur
   c. Zinc and chlorine
   d. Potassium and bromine

14. Balance the equation.
   \[ \underline{3} \text{Cu} + \underline{8} \text{HNO}_3 \rightarrow \underline{3} \text{Cu(NO}_3)_2 + \underline{2} \text{NO} + \underline{4} \text{H}_2\text{O} \]

15. Write the total ionic and net ionic equation for the following reaction.
   \[ 3(\text{NH}_4)_2\text{S(aq)} + 2\text{FeCl}_3(\text{aq}) \rightarrow 6\text{NH}_4\text{Cl(aq)} + \text{Fe}_2\text{S}_3(\text{s}) \]
   Total: \[ 18\text{NH}_4^+ + 3\text{S}^{2-} + 6\text{Fe}^{3+} + 6\text{Cl}^- \rightarrow 6\text{NH}_4^+ + \text{Fe}_2\text{S}_3(\text{s}) \]
   Net: \[ 3\text{S}^{2-} + 2\text{Fe}^{3+} \rightarrow \text{Fe}_2\text{S}_3(\text{s}) \]

16. Determine the empirical formula of methane given that 6.0 g of methane can be decomposed into 4.5 g C and 1.5 g H.
   
   \[ \frac{4.5 \text{ g C}}{12 \text{ g/mol}} \times \frac{1 \text{ mol}}{} = 0.375 \text{ mol C} \]
   
   \[ \frac{1.5 \text{ g H}}{1.0 \text{ g/mol}} = 1.5 \text{ mol H} \]
   
   Ratio: \( \frac{H}{C} = \frac{1.5}{0.375} = 4 \)
   
   \[ C = 0.375 \times \frac{1 \text{ mol}}{0.375} = 1 \]

17. The solubility of KNO₃ is 31.6 g/100 g H₂O. Suppose that you have 625 g of KNO₃. What is the minimum volume of water you would need to dissolve it all (assume that the density of water is 1.0 g/mL)?
   
   \[ \frac{625 \text{ g KNO}_3}{31.6 \text{ g KNO}_3} \times \frac{1 \text{ mL}}{1.0 \text{ g H}_2\text{O}} = 1977.8 \text{ mL} \]

18. What's the molar mass of AgNO₃?

   \[ \frac{169.879 \text{ g/mol}}{1} \]
   
   \[ A\text{g} = 107.879 \text{ g/mol} \]
   
   \[ N = 14.9 \text{ g/mol} \]
   
   \[ D_3 = 169 \text{ g/mol} \times 3 \]
   
   \[ 169.879 \text{ g/mol} \]
19. Rubidium has two naturally occurring isotopes, $^{85}\text{Rb}$ (relative mass 84.9118 amu) and $^{87}\text{Rb}$ (relative mass 86.9092 amu). If rubidium has an average atomic mass of 85.47 amu, what is the abundance of each isotope (in percent)?

\[ 84.9118x + 86.9092(1-x) = 85.47 \]
\[ 84.9118x + 86.9092 - 86.9092x = 85.47 \]
\[ -1.9174x = -1.4392 \]
\[ x = 0.75 = 75\% \text{ for } ^{85}\text{Rb} \]

20. A chemist requires a 2.5 M sodium hydroxide (NaOH) aqueous solution for a series of reactions. The only solution available is 4.0 M NaOH. What volume of 4.0 M NaOH must be diluted to obtain 5.0 L of 2.5 M NaOH solution?

\[ V_1 \cdot M_1 = V_2 \cdot M_2 \]
\[ V_1 = \frac{M_2 \cdot V_2}{M_1} = \frac{(2.5)(5.0)}{4.0} \]
\[ V_1 = 3.125 \text{ L} \]

21. Which one of the following is an alkene?

\[ \text{a.} \quad \text{b.} \quad \text{c.} \quad \text{d.} \]

22. Automotive air bags inflate when sodium azide decomposes explosively to its constituent elements:

\[ 2\text{NaN}_3(s) \rightarrow 2\text{Na}(s) + 3\text{N}_2(g) \]

How many moles of sodium azide are required to produce 18 moles of nitrogen?

\[ 2 \text{ moles of NaN}_3 = 3 \text{ moles of N}_2 \]
\[ x = 18 \text{ moles of N}_2 \]
\[ x = \frac{18 \times 2}{3} \]
Extra problems key (Spring 2019 exam 1)

2. Which of the following is one of the SI base units?
   a. °C (Celsius)
   b. lb (pound)
   c. m (meter)
   d. in (inch)

3. Which of the following is the lowest temperature?
   a. 0 K
   b. 0°C
   c. 0°F
   d. the values above all represent the same temperature

4. The distance between the nuclei of a Na⁺ and a Cl⁻ ion in solid NaCl is 278 pm. What is the distance in nanometers (nm)?
   a. $2.78 \times 10^{-1} \text{ nm}$
   b. $2.78 \times 10^{-9} \text{ nm}$
   c. $278 \times 10^{-10} \text{ nm}$
   d. $5.56 \times 10^{-10} \text{ nm}$

5. What is the speed in m/s (meter per second) of a car traveling at 70 miles per hour?
   (1 mile = 1.609 km)
   a. 31.3 m/s
   b. 112.6 m/s
   c. 404.5 m/s
   d. $3.19 \times 10^{-4} \text{ m/s}$

6. Report the answer to the following equation to the correct number of significant figures:
   $4.1080 \div (8.51 - 2.0139) = $
   a. 0.63237943
   b. 0.632
   c. 0.63238
   d. 0.6
7. Liquid aluminum has a density of \(d = 2.375\ \text{g/cm}^3\) at the melting point. What would be the mass of 0.33 L of liquid aluminum at the melting point?
   a. 0.78 kg
   b. 40 kg
   c. 0.33 kg
   d. 1.8 kg

8. One of the natural oxygen isotopes is \(^{17}\text{O}\). Which combination of protons, neutrons, and electrons is correct for this isotope?
   a. 9, 8, 9
   b. 17, 17, 17
   c. 8, 9, 8
   d. 8, 8, 9

9. The combustion of vanadium with oxygen results in an oxide which has the molar mass of 181.8 g/mol (atomic masses of vanadium and oxygen are 50.9 and 16.0 g/mol, respectively). What is the formula of the expected oxide?
   a. \(\text{VO}_{2+} = \text{V}_2\text{O}_3\)
   b. \(\text{VO}_{1.5} = \text{V}_2\text{O}_3\)
   c. \(\text{VO}_2\)
   d. \(\text{VO}\)

10. Which of the following formulas represents a ketone?
   a. 
   b. 
   c. 
   d. 

11. Carbon forms a compound with hydrogen called methane, \(\text{CH}_4\). Which element, \(X\), do you expect to form a compound with the molecular formula \(\text{XH}_4\)?
   a. \(X = \text{P}\)
   b. \(X = \text{Si}\)
   c. \(X = \text{O}\)
   d. \(X = \text{I}\)
12. The typical charge on a stable ion of magnesium, potassium, and fluorine in salts is:
   a. +1, +2, +3
   b. +2, +3, –4
   c. –2, –3, +1
   d. +2, +1, –1

13. Which statement is correct?
   a. Hydrogen is an alkali metal.
   b. Fluorine is a halogen.
   c. Silicon is a metal.
   d. Chlorine is a metallic noble gas element.

14. What is the correct systematic name of Al₂O₃?
   a. Aluminum oxide(VI)
   b. Aluminum(III) oxide
   c. Aluminum oxide
   d. Aluminum trioxide

15. Ascorbic acid (vitamin C) is an important constituent of our daily diet. Calculate the molar mass of ascorbic acid.
   \[H = 1.01 \text{ g/mol, } C = 12.0 \text{ g/mol, } O = 16.0 \text{ g/mol}\]
   a. 168 g/mol
   b. 173 g/mol
   c. 176 g/mol
   d. 180 g/mol

16. Which one of the following compounds is NOT an electrolyte in aqueous solution? All species are soluble.
   a. H₂SO₄
   b. NaCl
   c. C₂H₅OH
   d. H₃PO₄

17. When the following chemical reaction equation is correctly balanced, the stoichiometric coefficient for O₂(g) is:
   \[1\text{ C₃H₇O₆(s)} + \text{ O}_2(g) \rightarrow \text{ CO}_2(g) + \text{ H}_2\text{O(l)}\]
   a. 4
   b. 2
   c. 6
   d. 1
18. Consider the reaction of iron with sulfuric acid:

\[ \text{Fe}(s) + \text{H}_2\text{SO}_4(aq) \rightarrow \text{FeSO}_4(aq) + \text{H}_2(g) \]

Which of the following is the correct net ionic reaction equation for this reaction?

a. \( \text{Fe}(s) + \text{H}_2\text{SO}_4(aq) \rightarrow \text{FeSO}_4(aq) + \text{H}_2(g) \)

b. \( \text{Fe}(s) + 2\text{H}^+(aq) + \text{SO}_4^{2-}(aq) \rightarrow \text{Fe}^{2+}(aq) + \text{SO}_4^{2-}(aq) + \text{H}_2(g) \)

c. \( \text{Fe}(s) + 2\text{H}^+(aq) \rightarrow \text{Fe}^{2+}(aq) + \text{H}_2(g) \)

d. \( 2\text{H}^+(aq) \rightarrow \text{H}_2(g) \)

19. What happens when an aqueous solution of \( \text{Fe(NO}_3)_2 \) is reacted with an aqueous solution of \( \text{Na}_3(\text{PO}_4) \)?

a. Both \( \text{Fe}_3(\text{PO}_4)_2 \) and \( \text{NaNO}_3 \) precipitate out of the solution

b. \( \text{Fe}_3(\text{PO}_4)_2 \) precipitates out of the solution

c. \( \text{Na}_3(\text{PO}_4) \) precipitates out of the solution

d. Nothing – all species remain in solution.

20. What is the mass of 1 mole of borax = sodium tetraborate decahydrate, \( \text{Na}_2\text{B}_4\text{O}_7\cdot10\text{H}_2\text{O} \)?

a. 142.1 g

b. 201.2 g

c. 221.4 g

d. 381.4 g

21. How many moles does 5 kg of glucose, \( \text{C}_6\text{H}_12\text{O}_6 \), contain?

a. 1 mol

b. 5.55 mol

c. 27.75 mol

d. 180.12 mol

22. A compound, which is obtained by dehydration of malonic acid, consists of carbon and oxygen. It was analyzed and found to be 52.94% carbon and 47.06% oxygen by mass. Determine the empirical formula of the compound. The ratio of carbon to oxygen atoms is:

a. 1:1

b. 3:2

c. 2:3

d. 1:2
23. Polyethylene, PE, is an important everyday polymer. Which one of the following is the monomer from which PE is produced?

   a. CH₂
   b. C₂H₄
   c. C₃H₆
   d. C₂H₆

24. A chemist requires a 2.0 M potassium hydroxide (KOH) aqueous solution for a series of reactions. The only solution available is 5.0 M KOH. What volume of 5.0 M KOH must be diluted to obtain 10.0 L of 2.0 M KOH solution?

   a. 3.6 × 10⁻¹ L
   b. 7.2 × 10⁻¹ L
   c. 4.0 L
   d. 2.3 L

25. Which one of the following is a carboxylic acid?

   a. ![Carboxylic Acid](image)
   b. ![Other Compound](image)
   c. ![Other Compound](image)
   d. ![Other Compound](image)

26. Which of the following compounds is a strong base:

   a. NH₃
   b. CH₃OH
   c. KOH
   d. CH₃COOH