Chapter 3 & 4 Review **Name:**

1) Under proper conditions, ammonia, NH_3, and oxygen, O_2, react to form nitrogen and water. How many moles of oxygen would be consumed for each mole of nitrogen formed?

(A) 0.67
(B) 0.75
(C) 1.5
(D) 3.0

2) A compound is analyzed and found to consist of 50.4% Ce, 15.1% N, and 34.5% O by mass. What is the correct empirical (simplest) formula for the compound?

(A) $Ce_2(NO_3)_2$
(B) $Ce_2(NO_2)_3$
(C) $Ce(NO_3)_2$
(D) $Ce(NO_2)_3$

3) Analysis of a quantity of a compound shows that it contains 0.110 mol of C, 0.055 mol of N, and 0.165 mol of 0. Its molecular weight is about 260. How many atoms of carbon are there in the empirical formula for the compound and how many in the molecular formula?

(A) Empirical - 1. molecular - 3
(B) Empirical - 2, molecular - 2
(C) Empirical - 2. molecular - 6
(D) Empirical - 3, molecular - 2

4) The correct molecular formula of a compound that has an empirical formula C_3H_4O and a molecular mass of 168 grams/mole is

(A) C_3H_4O
(B) $C_6H_8O_2$
(C) $C_8H_8O_4$
(D) $C_9H_{12}O_3$

5) Iron(III) oxide can be reduced with carbon monoxide to form metallic iron as described by the unbalanced chemical equation

$Fe_2O_3 + CO \text{ ---> } Fe + CO_2$

The number of moles of CO required to form one mole of Fe from its oxide is

(A) 1
(B) 1.5
(C) 2
(D) 3

6) The net ionic equation for the precipitation reaction that occurs when aqueous solutions of $AgNO_3$ and K_2CrO_4 are mixed is

(A) $K^+ + NO^{3-} \text{ ---> } KNO_{3(s)}$
(B) $Ag^+ + CrO^{4-} \text{ ---> } AgCrO_{4(s)}$
(C) $K_2^+ + NO_3^- \text{ ---> } K_2NO_{3(s)}$
(D) $2Ag^+ + CrO_4^{2-}$ ---> $Ag_2CrO_{4(s)}$

7) In the oxidation-reduction reaction

$Sn^{4+} + 2\ Fe^{2+} \text{ ---> } 2\ Fe^{3+} + Sn^{2+}$

(A) Sn^{4+} is the oxidizing agent and Fe^{2+} is the reducing agent.
(B) Sn^{4+} is the reducing agent and Fe^{2+} is the oxidizing agent.
(C) Sn^{4+} is the reducing agent and Fe^{3+} is the oxidizing agent.
(D) Fe^{3+} is the oxidizing agent and Sn^{2+} is the reducing agent.

8) Consider the unbalanced equation

__ Fe^{2+} + __ MnO_4^- + __ H^+ ---> __ Mn^{2+} + __ Fe^{3+} + __ H_2O

When properly balanced with the simplest set of whole number coefficients, the sum of the coefficients in the balanced equation is

(A) 12
(B) 18
(C) 22
(D) 24

9) Sodium nitrate, heated in the presence of an excess of hydrogen, forms water according to the two-step process

$2\ NaNO_3$ ---> $2\ NaNO_2 + O_2$

$2\ H_2 + O_2$ ---> $2\ H_2O$

How many grams of sodium nitrate are required to form 9 grams of water?

(A) 21.3
(B) 42.5
(C) 69.0
(D) 85.0

10) Which quantity of nickel has the largest mass?

(A) one mole
(B) 6.02×10^{23} atoms
(C) 58.7 grams
(D) All of the above

11) A car traveling at 10 miles per hour emits about 0.15 kg of carbon monoxide (CO) gas per mile. How many moles of CO are emitted per mile under theses conditions?

(A) 1.5×10^{-1}
(B) 5.4
(C) 9.4
(D) 12.5

12) A sample of a compound contains 0.100 g of hydrogen and 4.20 g of nitrogen. The simplest formula for the compound is

(A) HN_2
(B) HN_3
(C) NH_3
(D) NH_2

13) If the hydrocarbon C_2H_4 is burned in oxygen gas, carbon dioxide and water are formed as described by the unbalanced chemical equation

$C_2H_4 + O_2$ ----> $CO_2 + H_2O$

When this equation is balanced properly, we predict that one mole of C_2H_4 will

(A) react with one mole of O_2
(B) form two moles of CO_2.
(C) form three moles of water.
(D) react with four moles of O_2.

14) Methanol (CH_3OH), also called methyl alcohol, is the simplest alcohol. It is used as a fuel in race cars and is a potential replacement for gasoline. Write the balanced equation for the combustion of methanol with oxygen to produce carbon dioxide and water. **$2CH_3OH + 3O_2$ --> $2CO_2 + 4H_2O$**

15) Using the equation from problem 13, how much water will be produced if 50.0 g of methanol is burned? **56.3g H_2O**

16) Aluminum metal reacts with iron(II) nitrate to produce aluminum nitrate and iron metal, if 40.0 g of aluminum reacts with 300.0 g of iron(II) nitrate how much of the product that contains aluminum will be produced? **236.9g $Al(NO_3)_3$**

17) Hexane C_6H_{12}, burns in the presence of oxygen to produce carbon dioxide and water. How many grams of each product will be produced by 6.05 moles of hexane. How many moles of oxygen gas are needed for this reaction? **1.60e3 gCO_2 653g H_2O, 54.5mol O_2**

18) The explosive TNT is composed of 37.0% carbon, 2.20% hydrogen, 18.5% nitrogen, and 42.3% oxygen. What is the empirical formula of TNT? The molar mass of TNT is 227 g/mole. What is the true molecular formula of TNT? **$C_7H_5N_3O_6$,**

19) A 25.0g sample of carbon is reacted with hydrogen gas to produce a hydrocarbon compound that massed 35.4g. What is the empirical formula of the compound formed. I f the true molar mass was determined to be 70g, what is the true molecular formula20) **CH_5, C_4H_{20}**

Write balanced equations for the following reactions:
a) calcium carbonate decomposes to form calcium oxide and carbon dioxide
$CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$

b) potassium bromide reacts with chlorine gas to produce potassium chloride and bromine gas
$2KBr_{(s)} + Cl_{2(g)} \rightarrow 2KCl_{(s)} + Br_{2(g)}$

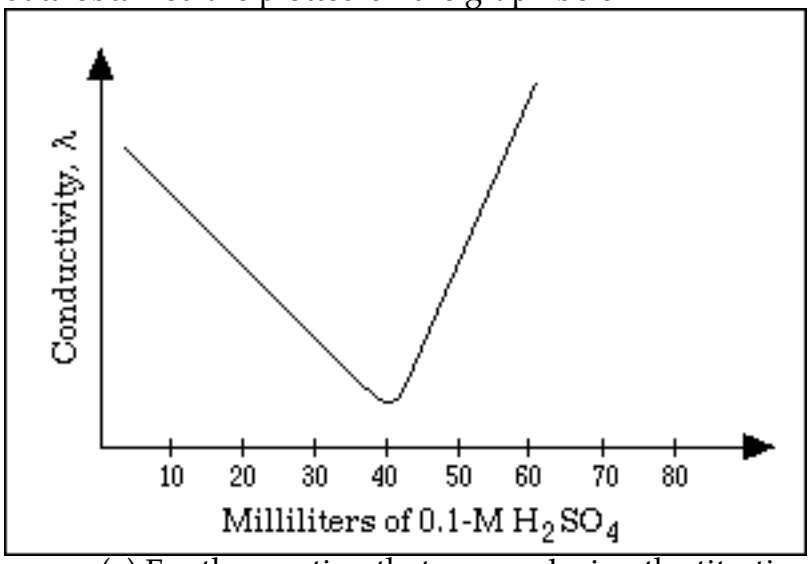
c) tin metal reacts with oxygen gas to form tin(IV) oxide
$Sn_{(s)} + O_{2(g)} \rightarrow SnO_{2(s)}$

20) Three samples of magnesium(II) sulfate hydrate were heated and the following results were obtained.

	(Sample No. 1)	(Sample No. 2)	(Sample No. 3)
TIME HEATED	10 min.	20 min.	30 min.
Mass of hydrate	1.762 g	1.351 g	1.097 g
Mass heated salt	1.006 g	0.660 g	0.538 g
Mass water lost	0.756 g	0.691 g	0.559 g

(A) Calculate the percentage of the water that was originally present in each sample. **1-42.9%, 2-51.2%, 3-51.0%**
(B) What percentage of water should be reported for the magnesium sulfate hydrate? Why? **51.1%, average of trials of 2&3, trial one most likely not heated enough and should not be included.**
(C) How can you tell when you have heated a sample long enough? **The change in the % of water in different samples should be very small. In trials 1&2 there is a large difference in the % of H_2O. In trials 2&3 the difference is much small, so we can assume we have driven off all the water.**
(D) calculate the number of moles of water per mole of magnesium sulfate in the hydrate. **6.95 mole H_2O : 1 mole $MgSO_4$ or $MgSO_4 \cdot 7H_2O$**

21) A solution of barium hydroxide is titrated with 0.1-M sulfuric acid and the electrical conductivity of the solution is measured as the titration proceeds. The data obtained are plotted on the graph below.



(a) For the reaction that occurs during the titration described above, write a balanced net ionic equation.

$Ba^{2+} + 2OH^- + 2H^+ + SO_4^{-2}$ --> $BaSO_4 + 2H_2O$

(b) Explain why the conductivity decreases, passes through a minimum, and then increases as the volume of H_2SO_4 added to the barium hydroxide is increased.

Before any sulfuric acid is added the solution has a lot of barium and hydroxide ions, this allows the solution to conduct electricity.

(c) Calculate the number of moles of barium hydroxide originally present in the solution that is titrated.

0.040L•0.1M=0.004mol

(d) Explain why the conductivity does not fall to zero at the equivalence point of this titration.

While at the equivalence point all of the barium hydroxide and sulfuric acid have reacted the products still provide some ions. While barium sulfate is generally insoluble, some of the barium sulfate will break apart producing ions that will conduct electricity.

22) For each of the following three reactions, in part (i) write a BALANCED equation and in part (ii) answer the question about the reaction. In part (i), coefficients should be in terms of lowest whole numbers. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solutions as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction.

A.i) Iron (III) ions are reduced by chloride ions. *$2Fe^{3+} + 2Cl^-$ --> $2Fe^{2+} + Cl_2$*

A.ii) Is this a REDOX reaction? Explain.

Yes there are electrons transferred from the chlorine to the iron.

B.i) Hydrogen sulfide gas is bubbled through a solution of silver ions.
$H_2S + 2Ag^+ \rightarrow Ag_2S + 2H^+$
B.ii) What would be the expected pH of the resulting solution? Explain. *The formation of hydrogen ipons would make the solution acidic.*

C.i) Magnesium metal is added to dilute hydrochloric acid.
$Mg + 2H^+ \rightarrow H_2 + Mg^{2+}$
C.ii) What might one expect to observe? *The formation of bubbles.*

D.i) Cesium metal is burned in air. $2Cs + O_2 \rightarrow 2CsO$
D.ii) If the product of this reaction were to be dissolved in water, what would the pH be, acidic or basic? Explain *Alkali metal oxides react with water to produce hydroxides so the solution would be basic.*

E.i) Aluminum metal is added to a solution of copper (II) nitrate.
$2Al + 3Cu^{2+} \rightarrow 2Al^{3+} + 3Cu$
E.ii) What color change might one observe?
Copper ions are blue in solution, so the blue color would fade as the copper ions are consumed.

F.i) Magnesium nitrate solution is mixed with potassium hydroxide solution.
$Mg^{2+} + 2OH^- \rightarrow Mg(OH)_2$
F.ii) What might one observe? *The formation of a white solid.*

G.i) A solution of ethanoic (acetic) acid is added to a solution of barium hydroxide. $CH_3COOH + OH^- \rightarrow H_2O + CH_3COO^-$
G.ii) Explain why a mixture of equal volumes of equimolar solutions of ethanoic acid and barium hydroxide is basic. *The acetate ion is a weak base and reacts with water to form hydroxide ions.*

H.i) Zinc metal is placed in a solution of copper(II) sulfate.
$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$
H.ii) Describe the change in color of the solution that occurs as the reaction proceeds. *The solution would change from blue to clear.*

I.i) Hexane is combusted in air. $2C_6H_{14} + 19O_2 \rightarrow 12CO_2 + 14H_2O$
I.ii) When one molecule of hexane is completely combusted, how many molecules of products are formed? *6 molecules of carbon dioxide and 7 molecules of water for a total of 13 molecules.*