Fall Examination Study Questions

1. (Chapter 1) How many significant figures are there in the following numbers or answers?
   a) 10.2   b) 0.0030   c) 3.1×10^5 d) $6.382 + 1.2 = ?$ e) $8.0 \times 10.0 = ?$

2. (Chapter 1) Identify the following properties as physical or chemical properties:
   a) Copper is shiny and orange.
   b) Potassium reacts explosively with fluorine gas to produce potassium fluoride.
   c) Oxygen is a gas at room temperature.
   d) Sodium oxide has a very high melting point.
   e) Sodium chloride dissolves readily in water.

3. (Chapter 2) For each of the following compounds indicate whether it is ionic or covalent and give the correct formula. For the covalent compound(s), is the formula an empirical formula?
   a) dinitrogen pentoxide   b) magnesium nitrate   c) silver(I)oxide   d) potassium hydroxide

4. (Chapter 3) Rust is 52.3% Fe, 44.9% O and 2.8% H.
   a) Find the empirical (simplest) formula for rust.
   b) Rust is an ionic compound. What two ions are present in rust?
   c) Write a balanced equation for the formation of rust from iron(III)oxide and water.

5. (Chapter 2) Name the following compounds:
   a) $PbCl_2$ b) Cu_2SO_4 c) CS_2 d) HF   e) $NaClO_3$

6. (Chapter 3) Perform the following calculations about barium hydroxide.
   a) Determine the mass percentage of each element in barium hydroxide.
   b) Determine the number of moles of oxygen in 49.7 grams of barium hydroxide.

7. (Chap 3 & 6) For the reaction, $3\ CO(g) + 7\ H_2(g) \rightarrow C_3H_8(g) + 3\ H_2O(l)$ determine:
   a) the mass of C_3H_8 produced when 3.66 moles of H_2 are used up.
   b) the mass of water produced from 144 *milligrams* of H_2.
   c) the number of *molecules* of C_3H_8 produced from 8.0 moles of carbon monoxide.
   d) the mass of propane formed if 28.0 grams of H_2 are combined with 126 grams of CO.

8. (Chapter 4) What mass of sodium nitrate is needed to make 157 ml of a 3.00 M sodium nitrate solution?

9. (Chapter 4) Silver nitrate and calcium chloride react to form a precipitate.
   a) Write a balanced formula equation for this reaction.
   b) What volume of a 0.120 M calcium chloride solution is needed to react with an excess of aqueous silver nitrate to form 2.89 grams of the precipitate?
   c) If only 2.11 grams of precipitate are formed in (*b*), what is the percent yield of precipitate?

10. (Chap 4) List one example each of a) strong acid, b) weak acid, c) strong base, d) weak base

11. (Chapter 7) Give the ground state electron configuration for the following atoms or ions:
    a) Ar
    b) Ca^{2+}
    c) Y
    d) F^-

12. (Chapter 7) Which element . . . . . ?
    a) has an outer electron configuration of $3s^2$?
    b) is the least electronegative element in Period 3?
    c) has the smallest atomic radius in Group 14?

13. (Chapter 7) Give possible values for the 4 quantum numbers for a $4f$ electron.

14. (Chapter 8) Draw Lewis structures for the following molecules:
    a) CH_3Cl
    b) N_2
    c) C_2H_4O
    d) H_2SO_4

15. (Chapter 22) Draw structures for each of the following compounds:
    a) acetic acid b) an aromatic alcohol c) 3-ethyl, 2,3-dimethylhexane d) an isomer of (c)

16. (Chapter 22) Draw the polyester made from
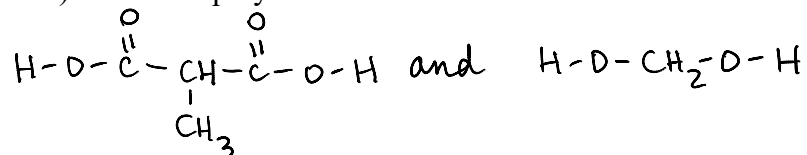
17. (Chapter 8 & 9) For each of the following molecules, indicate the geometry and indicate whether the molecule is polar or nonpolar. (b & c have extended octets)
    a) CH_2Cl_2
    b) SCl_4
    c) XeF_4
    d) NH_3

18. (Chapter 2 & 4) Decide whether a precipitate will form when the following solutions are mixed. If a precipitate forms, give the name and formula of the precipitate.
    a) sodium sulfate and barium chloride
    b) ammonium sulfide and strontium nitrate
    c) lithium carbonate and cobalt(III) chloride

19. (Chapter 4) For each of the net reactions in **Question 18**, write both a balanced formula equation and a net ionic equation for the reaction.

20. (Chapter 3) A sample of aluminum is heated in air and completely converted to aluminum oxide. Use the data below to calculate the empirical formula of aluminum oxide.
    Mass of crucible   = 29.00 g
    Mass of crucible + aluminum (before heating) = 30.62 g
    Mass of crucible + oxide (after heating)   = 32.06 g
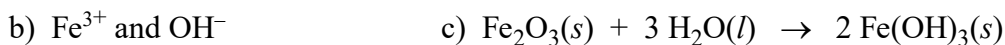
Answers to Fall Examination Study Questions

1. a) 3   b) 2   c) 2   d) 2 (answer is 7.6)   e) 2

2. a) physical   b) chemical   c) physical   d) physical   e) physical

3. a) covalent, empirical, N_2O_5 b) ionic, $Mg(NO_3)_2$ c) ionic, Ag_2O d) ionic, KOH

4. a) In 100 g of the compound:

$$52.3 \text{ g Fe x } \frac{1 \, mol \, Fe}{55.8 \, g \, Fe} = 0.937 \text{ mol Fe} \qquad 0.937/0.937 = 1 \qquad FeO_3H_3 =$$

$$44.9 \text{ g O x } \frac{1 \, mol \, O}{16.0 \, g \, O} = 2.81 \text{ mol O} \qquad 2.81/0.937 = 3 \qquad Fe(OH)_3$$

$$2.8 \text{ g H x } \frac{1 \, mol \, H}{1.0 \, g \, H} = 2.8 \text{ moles H} \qquad 2.8/0.937 = 3$$

   b) Fe^{3+} and OH^- c) $Fe_2O_3(s) + 3 H_2O(l) \rightarrow 2 Fe(OH)_3(s)$

5. a) lead(II) chloride   b) copper(I) sulfate   c) carbon disulfide   d) hydrofluoric acid
   e) sodium chlorate

6. a) $Ba(OH)_2$ = 1 mole Ba = 137.34 g Ba   137.34/171.36 = **80.1% Ba**
                   2 mole O = 32.00 g O   32.0/171.36 = **18.7% O**
                   2 mole H = 2.016 g H   2.016/171.36 = **1.18% H**

   b) $49.7 \text{ g } Ba(OH)_2 \text{ x } \dfrac{1 \, mol \, Ba(OH)_2}{171.3 \, g \, Ba(OH)_2} x \dfrac{2 \, mol \, O}{1 \, mol \, Ba(OH)_2} = 0.580 \text{ moles O}$

7. a) $3.66 \text{ mol } H_2 \times \dfrac{1 \, mol \, C_3H_8}{7 \, mol \, H_2} \times \dfrac{44.0 \, g \, C_3H_8}{1 \, mol \, C_3H_8} = 23.0 \text{ g } C_3H_8$

   b) $144 \text{ mg } H_2 \times \dfrac{1 \, g \, H_2}{1000 \, mg \, H_2} \times \dfrac{1 \, mol \, H_2}{2.016 \, g \, H_2} \times \dfrac{3 \, mol \, H_2O}{7 \, mol \, H_2} x \dfrac{18.0 \, g \, H_2O}{1 \, mol \, H_2O} = 0.551 \text{ g } H_2O$

   c) $8.0 \text{ moles CO} \times \dfrac{1 \, mol \, C_3H_8}{3 \, mol \, CO} \times \dfrac{6.02 \, x \, 10^{23} \, molecules}{1 \, mol \, C_3H_8} = 16.0 \text{ x } 10^{23} = 1.6 \text{ x } 10^{24} \text{ molecules}$

   d) limiting reactant problem:

   $$28.0 \text{ g } H_2 \text{ x } \frac{1 \, mol \, H_2}{2.016 \, g \, H_2} \times \frac{1 \, mol \, C_3H_8}{7 \, mol \, H_2} \times \frac{44.0 \, g \, C_3H_8}{1 \, mol \, C_3H_8} = 88.0 \text{ g } C_3H_8$$

   $$126 \text{ g CO x } \frac{1 \, mol \, CO}{28.0 \, g \, CO} \times \frac{1 \, mol \, C_3H_8}{3 \, mol \, CO} \times \frac{44.0 \, g \, C_3H_8}{1 \, mol \, C_3H_8} = 66.0 \text{ g } C_3H_8, \; 66.0 \text{ g } C_3H_8$$

8. $157 \text{ ml x } \dfrac{3 \, mol \, NaNO_3}{1000 \, ml} x \dfrac{85.0 \, g \, NaNO_3}{1 \, mol \, NaNO_3} = 40.0 \text{ g } NaNO_3$

9. a) $2\ AgNO_3(aq)\ +\ CaCl_2(aq)\ \rightarrow\ 2\ AgCl(s)\ +\ Ca(NO_3)_2(aq)$
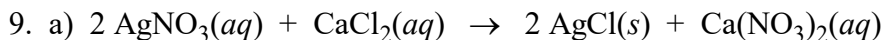
   b) $2.89\ g\ AgCl\ \times\ \dfrac{1\ mol\ AgCl}{143.3\ g\ AgCl}\ \times\ \dfrac{1\ mol\ CaCl_2}{2\ mol\ AgCl}\ \times\ \dfrac{1000\ ml}{0.120\ mol\ CaCl_2}\ =\ 84.0\ mL$
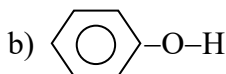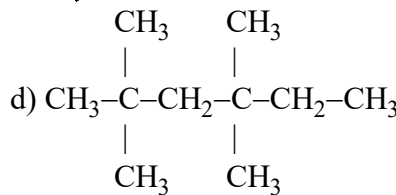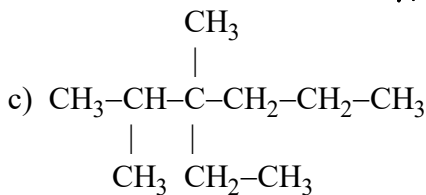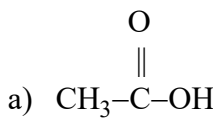
   c) % yield $=$ experimental yield/theoretic yield x 100% $=$ 2.11/2.89 x 100% $=$ **73.0%**

10. a) HCl, HNO_3　　b) HNO_2, HF, CH_3COOH　　c) $NaOH$, $LiOH$　　　d) NH_3, NO_2^-

11. a) $1s^2 2s^2 2p^6 3s^2 3p^6$　b) $1s^2 2s^2 2p^6 3s^2 3p^6$　c) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^1$　d) $1s^2 2s^2 2p^6$

12. a) Mg (period 3, Group 2)　　　b) Na　　　　c) C

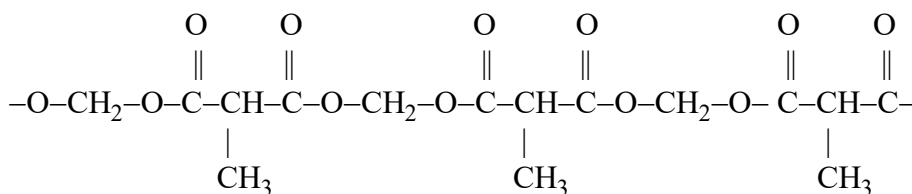13. $n = 4$, $l = 3$, $m_l = 3, 2, 1, 0, -1, -2,$ or -3, $m_s = +\frac{1}{2}$ or $-\frac{1}{2}$
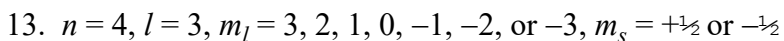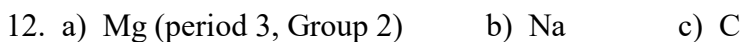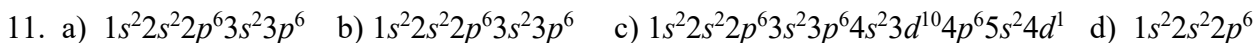
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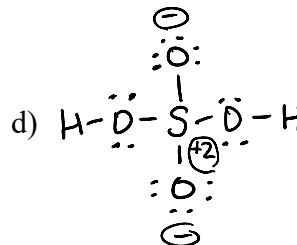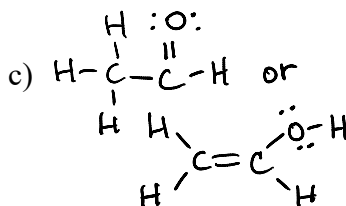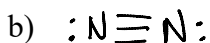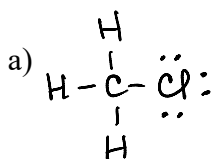
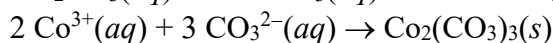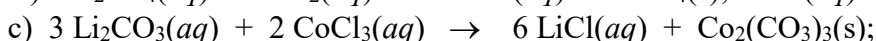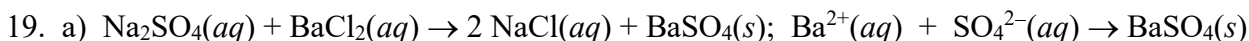
15.

16.

17. a) tetrahedral, polar　　　　　　　b) see-saw, polar
   c) square planar, nonpolar　　　　　d) trigonal pyramid, polar

18. a) barium sulfate, $BaSO_4$　　　b) no reaction　　　c) cobalt(III) carbonate, $Co_2(CO_3)_3$

19. a) $Na_2SO_4(aq) + BaCl_2(aq) \rightarrow 2\ NaCl(aq) + BaSO_4(s)$; $\ Ba^{2+}(aq)\ +\ SO_4^{2-}(aq) \rightarrow BaSO_4(s)$
   c) $3\ Li_2CO_3(aq)\ +\ 2\ CoCl_3(aq)\ \rightarrow\ 6\ LiCl(aq)\ +\ Co_2(CO_3)_3(s)$;
      $2\ Co^{3+}(aq) + 3\ CO_3^{2-}(aq) \rightarrow Co_2(CO_3)_3(s)$

20. Mass of Al $=$ 30.62 g - 29.00 g $=$ 1.62 g Al;　Mass of O $=$ 32.06 g - 30.62 g $=$ 1.44 g O

   $1.62\ g\ Al\ \times\ \dfrac{1\ mol\ Al}{27.0\ g\ Al}\ =\ 0.0600\ mol\ Al$　　0.0600/0.0600 $=$ 1 x 2 $=$ 2

   $1.44\ g\ O\ \times\ \dfrac{1\ mol\ O}{16.0\ g\ O}\ =\ 0.0900\ mole\ O$　　0.0900/0.0600 $=$ 1.5 x 2 $=$ 3　　Al_2O_3