Final Exam Practice Questions

Name:_____

Part I

1. Draw the Bohr Model of Fluorine -19.

2. Complete the following table.

Hyphen notation	Element	# of Protons	Mass #	# of Electrons	Atomic Number	# of Neutrons	Isotope, Ion, or Neutral
H-1	Hydrogen	1	1	1	1	0	neutral
C-14	Carbon	6	14	6	6	8	neutral
K⁺-39	Potassium	19	39	18	19	20	ion
Li-7	Lithium	3	7	3	3	4	neutral
Cl-37	Chlorine	17	37	18	17	20	Ion, isotope

3. Name the following:

Co_3N_2 _____cobalt (II) nitride_____

$FeCl_3$ _____iron (III) chloride_____

PbO _____lead (II) oxide_____

SiF_4 _____silicon tetrafluoride_____

P_4S_5 _____tetraphosphorus pentasulfide_____

CO _____carbon monoxide_____

4. Write the formulas for the following:

diboron hexahydride _____B_2H_6_____

nitrogen tribromide _____NBr_3_____

diphosphorus pentoxide _____P_2O_5_____

vanadium (V) phosphate _____$V_3(PO_4)_5$_____

lead (II) sulfite _____$PbSO_3$_____

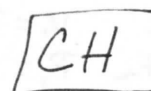copper (I) carbonate _____Cu_2CO_3_____

5. Put the following elements in order from <u>largest to smallest</u> according to the specified trend.

a) Electronegativity – P, Ga, O, Ba

O, P, Ga, Ba

b) Ionization Energy – Cl, Mg, Si, Sr

Cl, Si, Mg, Sr

c) Atomic Radii – C, Rb, F, Na

Rb, Na, C, F

6. What is the empirical formula for a compound that is 92.3% C and 7.7% H?

$$\frac{92.3 g}{} \Big| \frac{1 mol C}{12 g} = \frac{7.7 mol C}{7.7} = 1 mol C \qquad \frac{7.7 g}{} \Big| \frac{1 mol H}{1 g} = \frac{7.7 mol H}{7.7} = 1 mol H$$

$\boxed{CH}$

7. What is the empirical formula for a compound that has 36.5 g of sodium, 25.4 g of sulfur, and 38.1 g of oxygen?
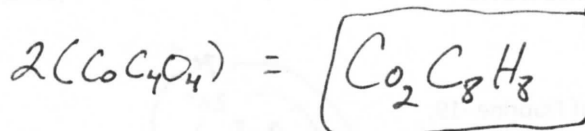
$$\frac{36.5 g Na}{} \Big| \frac{1 mol Na}{23 g} = \frac{1.59 mol Na}{.791} = 2 mol Na$$

$$\frac{25.4 g S}{} \Big| \frac{1 mol S}{32.1 g} = \frac{.791 mol S}{.791} = 1 mol S$$

$$\frac{38.1 g O}{} \Big| \frac{1 mol O}{16 g} = \frac{2.38 mol O}{.791} = 3 mol O$$

$\boxed{Na_2SO_3}$
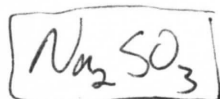
8. What is the molecular formula for a compound with an empirical formula of CoC_4O_4 and the molecular weight 341.94 g/mol?

$$n = \frac{341.94}{170.9} = 2 \qquad 2(CoC_4O_4) = \boxed{Co_2C_8H_8}$$

9. Given a 44.8 L sample of O_2 gas at STP, calculate the number of moles.

$$\frac{1\,mol}{22.4L} = \frac{x}{44.8L} \qquad x = \boxed{2\,mol\,O_2}$$

10. Label the following equations as either: *single replacement, double replacement, neutralization, synthesis, decomposition,* or *combustion.*

    a. $H_2 + Cl_2 \rightarrow HCl$ Syn
    b. $Al + Fe_2O_3 \rightarrow$ SR
    c. $Ba(ClO_3)_2 \rightarrow BaCl_2 + O_2$ Decomp
    d. Iron (III) oxide + magnesium → magnesium oxide + iron   SR
    e. Hydrochloric acid + sodium hydroxide → sodium chloride + water   Neutralization
    f. $CH_4 + O_2 \rightarrow CO_2 + H_2O$ Combustion

10. Predict the products.

    a. $Zn + O_2 \rightarrow$ $2Zn + O_2 \rightarrow 2ZnO$

    b. $Mg + CaCl_2 \rightarrow$ No Rxn

    c. $Na_2CO_3 \rightarrow$ $Na_2CO_3 \rightarrow Na_2O + CO_2$

    d. $NH_4Cl + AgNO_3 \rightarrow$ $NH_4Cl_{(aq)} + AgNO_{3\,(aq)} \rightarrow AgCl_{(s)} + NH_4NO_{3\,(aq)}$

    e. $Cu + FeSO_4 \rightarrow$ No Rxn

11. Balance.

    a) $\underline{3}\,NO_2 + \underline{}\,H_2O \rightarrow \underline{2}\,HNO_3 + \underline{}\,NO$
    b) $\underline{4}\,Fe + \underline{3}\,O_2 \rightarrow \underline{2}\,Fe_2O_3$
    c) $\underline{2}\,Al + \underline{3}\,F_2 \rightarrow \underline{2}\,AlF_3$

12. Some chlorine gas is collected over water with a pressure of 153.5 kPa. The total pressure of the sample is 156.5 kPa. What is the pressure of the water vapor?

$$P_T = P_1 + P_2 = 156.5\,kPa = 153.5\,kPa + P_{H_2O}$$
$$P_{H_2O} = \boxed{3.0\,kPa}$$

13. A scientist has a sample of gas collected several days ago. The final volume of the gas is 392 mL at a pressure of 0.977 atm and a temperature of 21°C. Its initial temperature was 13°C and had a pressure of 0.992 atm. What was the initial volume of the gas?

$V_2 = .392L \qquad V_1 = ?$
$P_2 = .977\,atm \qquad P_1 = .992\,atm$
$T_2 = 294K \qquad T_1 = 286K$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad V_1 = \frac{P_2V_2T_1}{T_2P_1} = \frac{(.977\,atm)(.392L)(286K)}{(294K)(.992\,atm)} = \boxed{.376L}$$

14. What is the volume (in liters) of a gas with the pressure of 0.980 atm, a temperature of 68°C, and 0.120 mol?

$$PV = nRT \qquad V = \frac{nRT}{P} = \frac{(.12\,mol)(0.0821\,\frac{L\cdot atm}{mol\,K})(341K)}{.980\,atm}$$
$$= \boxed{3.43L}$$

Final Exam Review Questions

Name:_____

Part II

c, b 1. Which of the following is NOT part of Dalton's model of the atom?
- a. The atom is unchanged in chemical reactions.
- b. The atom is invisible.
- c. The atom has most of its mass in the center.
- d. The atom is indivisible.

C 2. Which of the following statements was NOT part of Dalton's hypothesis on the structure of matter?
- a. All matter is made up of atoms.
- b. Atoms of the same element are identical.
- c. Atoms are made of protons and electrons
- d. Atoms unite in definite ratios to form compounds.

a 3. In Rutherford's experiment very few positively charged alpha particles
- a. Were slightly deflected as they passed through the metal
- b. Were used to bombard a cathode plate
- c. Collided with electrons
- d. Were used to bombard thin metal foil

b 4. In Rutherford's experiment, most of the particles
- a. Bounced back
- b. Passed through the foil
- c. Were absorbed by the foil
- d. Combined with the foil

a 5. Because most particles fired at metal foil passed straight through, Rutherford concluded that
- a. Atoms were mostly empty space
- b. Atoms contained no charged particles
- c. Electron formed the nucleus
- d. Atoms were indivisible

6. What mass of pure mercury would one need to fill a container with a volume of 5.0 mL?

$$D = \frac{m}{V} \qquad 5.1\,g/mL = \frac{m}{5.0\,mL} \qquad m = \boxed{25.5\,g}$$

7. Which block is more dense? Explain.

B	Mass = 500 g

A	Mass = 500 g

A — Same mass in a smaller volume

8. Write the equation for a reaction between aqueous iron III chloride and aqueous silver nitrate. Predict the products and include state symbols for all species. [HINT: Use Solubility Rules]

$$FeCl_{3\,(aq)} + 3AgNO_{3\,(aq)} \longrightarrow 3AgCl_{(s)} + Fe(NO_3)_{3\,(aq)}$$
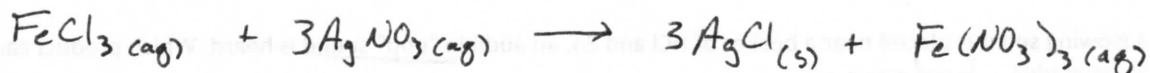
9. A quantity of CO_2 gas occupies a volume of 624 L at a pressure of 1.40 atm. If the CO_2 is pumped into a gas cylinder that has a volume of 80.0 L, what pressure will the CO_2 exert on the cylinder?

$$V_1 = 624L \qquad V_2 = 80L \qquad P_1V_1 = P_2V_2 \qquad P_2 = \frac{P_1V_1}{V_2} = \frac{(624L)(1.40\,atm)}{80L} = \boxed{10.92\,atm}$$
$$P_1 = 1.40\,atm \qquad P_2 = ?$$

10. What is the total pressure of a gas sample made of oxygen, nitrogen, and carbon dioxide? The partial pressure of oxygen is 716.2 mmHg, nitrogen is 22.5 mmHg, and carbon dioxide is 28.1 mmHg.

$$P_T = 716.2\,mmHg + 22.5\,mmHg + 28.1\,mmHg = \boxed{766.8\,mmHg}$$

11. There is a ___direct___ relationship between vapor pressure and temperature. As the temperature goes up, the vapor pressure goes ___up___.

12. How does a cation's size compare to the size of its parent atom? ___cation is smaller___

13. How does an anion's size compare to the size of its parent atom? ___anion is bigger___

14. List the group number for each of the following:

    alkali metals   ___1___

    alkaline earth metals   ___2___

    halogens   ___17___

    noble gases   ___18___

15. Identify the element:

    $1s^1$ ___H___ $1s^2 2s^2 2p^6 3s^2 3p^5$ ___Cl___

    $[He]2s^1$ ___Li___ $[Ar]4s^2 3d^8$ ___Ni___

16. Draw the electrons for the orbital notation of PHOSPHORUS.

    $1s$ [↑↓] $2s$ [↑↓] $2p$ [↑↓] [↑↓] [↑↓] $3s$ [↑↓] $3p$ [↑] [↑] [↑]

    * Aufbau Principle
    * Hund's Rule

17. What is the empirical formula for a compound that has 36.5 g of sodium, 25.4 g of sulfur, and 38.1 g of oxygen?

    $Na_2 SO_3$
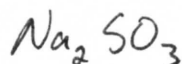
18. Determine the percent composition of nitrogen in $(NH_4)_2 CO_3$.

 $$\frac{(2 \times 14)}{96} = \boxed{29\% \ N}$$

19. A student heats a substance in a test tube. A <u>glowing splint is</u> placed over the opening to the test tube and it reignites. What is one possible product created by the heating of this substance? ___oxygen___

20. During a demonstration a teacher <u>extinguishes a burning splint</u> by placing it near a beaker containing baking soda and vinegar. What did this reaction produce that extinguished the flame? ___carbon dioxide___

21. When a glowing splint is placed near a beaker of HCl and Zn, an audible "pop" <u>sound</u> is heard. Which product caused this sound to be made? ___hydrogen___

22. Identify the major intermolecular force in each compound.

    a. Ammonia   ___H-Bond___
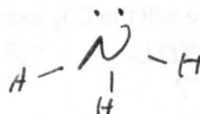
    b. CH_2F_2 ___London Dispersion___

    c. Oxygen   ___London Dispersion___

    d. carbon dioxide   ___London Dispersion___

Final Exam Practice Questions

Name:_____

Part III

1.   Dipole-dipole forces are considered the most important forces in polar substances because the London dispersion for
- (a) act only in nonpolar substances.
- b. are usually much weaker than the dipole-dipole forces.
- c. are too unpredictable.
- d. act only in solids.

2.   The strong forces of attraction between the positive and negative regions of molecules are called
- (a) dipole-dipole forces.
- b. London forces.
- c. lattice forces.
- d. orbital forces.

3.   The intermolecular attraction between a hydrogen atom bonded to a strongly electronegative atom and the unshare pair of electrons on another strongly electronegative atom is called
- a. electron affinity.
- b. covalent bonding.
- (c) hydrogen bonding.
- d. electronegativity.

4.   The weak intermolecular forces resulting from instantaneous and induced dipoles are called
- (a.) London dispersion forces.
- b. dipole-dipole forces.
- c. hydrogen forces.
- d. polar covalent bonding.

5.   The following molecules contain polar bonds. The only nonpolar molecule is
- a. HCl.
- b. H_2O.
- (c.) CO_2.
- d. NH_3.

6.   Iodine monochloride (ICl) has a higher boiling point than bromine (Br_2) partly because iodine monochloride is a(n)
- a. nonpolar molecule.
- b. ion.
- c. crystal.
- (d.) polar molecule.

7. The intermolecular forces in between particles are:
- a. less effective in solids than in liquids.
- b. more effective in gases than in solids.
- c. equally effective in gases and in liquids.
- (d.) more effective in liquids than in gases.

8. Complete the table

Compound	Name	Electron Dot Structure	Bonding Pairs, Lone Pairs	Shape	Bond Angle	Polar or Nonpolar
O_2	oxygen	:O=O:	1 BP, 0 BP	linear	180°	Nonpolar
CCl_4	carbon tetrachloride	Cl–C–Cl (Cl, Cl)	4 BP, 0 LP	tetrahedral	109.5°	Nonpolar
NH_3	ammonia	H–N–H (H)	3 BP, 1 LP	trigonal pyramidal	<109.5°	Polar
CS_2	carbon disulfide	S=C=S	2 BP, 0 LP	linear	180°	Nonpolar

9. 2.50 moles of ethanol are mixed with 2.90 liters of solution. What is the molarity of the resulting solution?

$$M = \frac{mol}{L} = \frac{2.50\,mol}{2.90\,L} = \boxed{0.862\,M}$$

10. What is the molarity of a solution containing 14.2g of HCL dissolved in enough water to make 150.0 ml of solution?

$$\frac{14.2g\,HCl}{.15L}\bigg|\frac{1\,mol}{36.5g\,HCl} = \boxed{2.59\,M}$$

11. How many grams of NaOH must be added to water in order to make 750.0 ml of a 12.0 M solution?

$$\frac{12\,mol}{1\,L} = \frac{x\,mol}{.75\,L} \qquad x = \frac{9\,mol\,NaOH}{}\bigg|\frac{40g}{1\,mol\,NaOH} = \boxed{360g\,NaOH}$$

12. Characterize if (a) acid or (b) base or (c) both
   a. electrolytes ___C___
   b. Ammonia dissolves in water it forms a(n) _b_
   c. Compound that gains a proton ___b___
   d. Compound that loses a proton ___a___
   e. Cu(OH)$_2$ is a ___b___
   f. H$_2$SO$_4$ ___a___

13. Distinguish between (a) acid (b) base
   a. Proton acceptor theory ___b___
   b. Compounds that donate a hydrogen ion ___a___
   c. Conjugate acid forms ___b___
   d. Conjugate base forms ___a___

14. How many grams of HCl must be added to water in order to make 12.0 L of 0.250 M HCl.

$$\frac{.25\,mol}{1\,L} = \frac{x\,mol}{12\,L} \qquad x = \frac{3\,mol\,HCl}{}\bigg|\frac{36.5g\,HCl}{1\,mol} = \boxed{109.5g\,HCl}$$

15. Using M$_1$V$_1$ = M$_2$V$_2$. Determine the volume of 0.250 M HCl that can be made using 150.0 ml of 1.00 M HCl stock solut

$$(1.00M)(150\,mL) = (.25M)M_2$$
$$M_2 = \boxed{600\,mL}$$

16. Use pH scale to identify acids and bases. Circle correct ans.
   a. pH = 3.5   (acid) or base
   b. pOH = 6.5   acid or (base)
   c. pOH = 2.5   acid or (base)
   d. pH = 10.5   acid or (base)

17. Interpret pH scale in terms of the exponential nature of pH values in terms of concentrations. Determine the hydron ion concentration give the pH.
   a. pH = 3.0 $[H_3O^+] = 10^{-pH} = \boxed{.001\,M}$
   b. pH = 10.0 $\boxed{10^{-10}\,M}$
   c. pH = 6.5 $\boxed{10^{-6.5}\,M}$

18. Determine the concentration of 25 mL of HCl that required 32.0 mL of 0.1 M NaOH to neutralize the acid at its endpoint.

$$M_A(25\,mL) = (0.1M)(32\,mL)$$
$$M_A = \boxed{0.128\,m}$$

Final Exam Practice Questions

Name:_____

Part IV
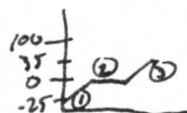
1. How much heat is necessary to raise the temperature of 30 g of water from 10 C to 75 C?

$$q = mc\Delta t = (30g)(4.18 \, J/g°c)(65°C) = \boxed{8151 J}$$

2. How many joules of heat does it take to vaporize 3.5 g of water?

$$q = mH_v = (3.5g)(2260 \, J/g) = \boxed{7910 \, J}$$

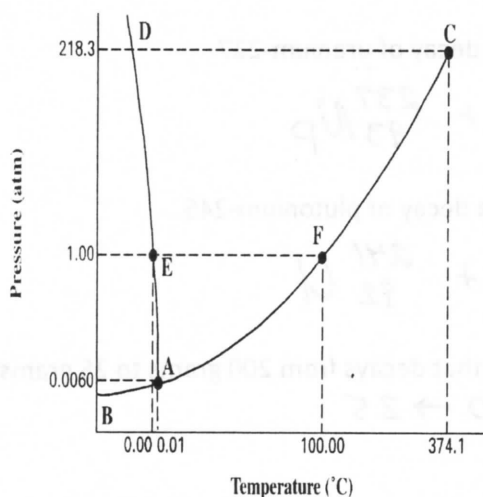3. How much heat is needed to raise the temperature of 25 g of ice at -25 C to water at 35 C?

$$q_1 = (25g)(2.05 \, J/g°c)(25°C) = 1281.25J$$
$$q_2 = (25g)(334 \, J/g) = 8350 J$$
$$q_3 = (25g)(4.18 \, J/g°c)(35°C) = 3657.5J$$

$$q_T = \boxed{13288.75J}$$

Temperature (°C)

4. What point is the triple point? Why is it the triple point? __0.0060 atm + 0.01 °C, all three phases coexist__

5. What is the critical pressure and temperature of water? __218.3 atm + 374.1 °C__

6. What letter represents the melting point of H_2O? __E__

7. What is the normal boiling point of H_2O? __F__

8. What temperature is it impossible to liquefy this substance no matter what the pressure? What is this point called?
   __C, critical point__

9. At what letter does sublimation occur? __B__

10. Solve for enthalpy and activation energy for the following graphs.

(A) $\Delta H = -50J$ $E_A = 150J$

(C) $\Delta H = 100J$ $E_A = 150J$

(B) $\Delta H = 50J$ $E_A = 100J$

(D) $\Delta H = -100J$ $E_A = 50J$

Answer the following questions using A, B, C and D from the graphs above. More than one letter can be used.

11. shows the greatest activation energy for the forward reaction __A, C__
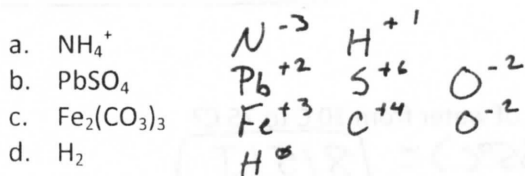12. shows the greatest activation energy for the reverse reaction __A__
13. heat is being absorbed __B, C__
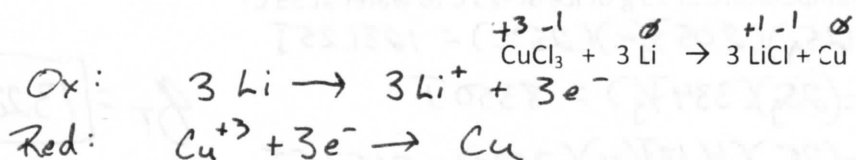14. heat is being released __A, D__
15. shows the greatest ΔH __C, D__
16. shows the greatest activation energy __A, C__

17. Determine the oxidation number for each atom in the following:

    a. NH_4^+ N^{-3} H^{+1}
    b. $PbSO_4$ Pb^{+2} S^{+6} O^{-2}
    c. $Fe_2(CO_3)_3$ Fe^{+3} C^{+4} O^{-2}
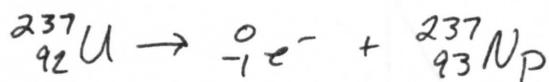   d. H_2 H^{0}

18. Oxidation is the ___loss___ of electrons. Reduction is the ___gain___ of electrons.

19. For the following equation, identify the element being oxidized and the element being reduced. Write the half reactions.

$$\overset{+3 \; -1}{CuCl_3} + 3 \overset{0}{Li} \rightarrow 3 \overset{+1\;-1}{LiCl} + \overset{0}{Cu}$$

Ox: $3 Li \rightarrow 3 Li^+ + 3e^-$

Red: $Cu^{+3} + 3e^- \rightarrow Cu$

20. Write the equation for the beta decay of uranium-237.

$$^{237}_{92}U \rightarrow {}^{0}_{-1}e^- + {}^{237}_{93}Np$$

21. Write the equation for the alpha decay of plutonium-245.

$$^{245}_{94}Pu \rightarrow {}^{4}_{2}He + {}^{241}_{92}U$$
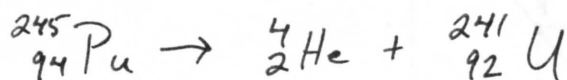
22. What is the half life of a sample that decays from 200 grams to 25 grams in 36 minutes?

$200 \rightarrow 100 \rightarrow 50 \rightarrow 25$

$\boxed{12 min}$

23. The half-life of iodine-131 is approximately 8 days. How much of an original sample will be left after 24 days?

$\frac{24}{8} = 3$ half-lives

$100\% \rightarrow 50\% \rightarrow 25\% \rightarrow \boxed{12.5\%}$