NAME _____
DATE _____

CHEMISTRY FINAL REVIEW

UNIT 8 – REACTIONS

1. What is a reaction? What actually occurs in a reaction?
A reaction is a chemical change; atoms rearrange to form new substances.

2. What are the two parts in a reaction?
Reactants and products

3. What is the name of the written form of a reaction?
Chemical Equation

4. Why do chemical equations need to be balanced? What law dictates this?
Law of Conservation of Matter – matter cannot be created or destroyed. This applies to atoms, mass, and energy.

5. What is the name of the number that is used to balance chemical equations?
Coefficients

6. What are the five types of reactions?
Synthesis, Decomposition, Single Replacement, Double Replacement, Combustion.

7. Label the type of reaction and then balance the following chemical equations.

a. **Syn** $4\,Al + 3\,O_2 \rightarrow 2\,Al_2O_3$

b. **DR** $3\,CaBr_2 + 2\,H_3PO_4 \rightarrow 6\,HBr + Ca_3(PO_4)_2$

c. **Comb** $C_4H_8 + 6\,O_2 \rightarrow 4\,CO_2 + 4\,H_2O$

d. **DR** $3\,KNO_3 + FeCl_3 \rightarrow 3\,KCl + Fe(NO_3)_3$

e. **DR** $MgS + 2\,LiHCO_3 \rightarrow Li_2S + Mg(HCO_3)_2$

f. **DR** $2\,KMnO_4 + SrSO_4 \rightarrow K_2SO_4 + Sr(MnO_4)_2$

g. **Syn** $Ca + F_2 \rightarrow CaF_2$

h. **Decomp** $2\,KHCO_3 \rightarrow H_2O + CO_2 + K_2CO_3$

i. **SR** $2\,GaBr_3 + 3\,F_2 \rightarrow 2\,GaF_3 + 3\,Br_2$

j. **DR** $3\,CuSO_4 + 2\,Fe(C_2H_3O_2)_3 \rightarrow 3\,Cu(C_2H_3O_2)_2 + Fe_2(SO_4)_3$

k. **DR** $H_2SO_4 + FeCl_2 \rightarrow 2\,HCl + FeSO_4$

l. **DR** $KOH + AgNO_3 \rightarrow AgOH + KNO_3$

m. **DR** $3\,SrCO_3 + 2\,H_3PO_4 \rightarrow 3\,H_2CO_3 + Sr_3(PO_4)_2$

n. **Comb** $2\,C_3H_6 + 9\,O_2 \rightarrow 6\,H_2O + 6\,CO_2$

UNIT 9 – STOICHIOMETRY

8. What does stoichiometry allow you to calculate?
Stoich allows you to calculate the amounts of other substances in a reaction.

9. What is molar ratio?
Ratio of moles in a reaction determined by the balanced chemical equation.

10. Determine the number of moles of ALL the other reactants and products in the following chemical reactions using the number of moles of the one substance given in the equation. (These are 1-step problems!)
   a. 1.5 moles of HBr $3\ CaBr_2 + 2\ H_3PO_4 \rightarrow 6\ HBr + Ca_3(PO_4)_2$
   0.75 moles $CaBr_2$, 0.50 moles H_3PO_4, 0.25 moles $Ca_3(PO_4)_2$

   b. 2.2 moles CO_2 $C_4H_8 + 6\ O_2 \rightarrow 4\ CO_2 + 4\ H_2O$
   0.55 moles C_4H_8, 3.3 moles O_2, 2.2 moles H_2O

11. Determine the masses of ALL the other reactants and products in the following chemical reactions using the mass of the one substance given in the equation. (These are tricky problems! Think about why you were given two amounts of reactants.)
   a. 200.0 g C_3H_6 and 200.0 g of O_2 $2\ C_3H_6 + 9\ O_2 \rightarrow 6\ H_2O + 6\ CO_2$
   O_2 is the LR, C_3H_6 is in excess. There is 141.5g of C_3H_6 left over and 75.08g H_2O and 183.4g CO_2 produced.

   b. 45.9 g $CuSO_4$ and 67.3 g of $Fe(C_2H_3O_2)_3$
   $3\ CuSO_4 + 2\ Fe(C_2H_3O_2)_3 \rightarrow 3\ Cu(C_2H_3O_2)_2 + Fe_2(SO_4)_3$
   $CuSO_4$ is the LR, $Fe(C_2H_3O_2)_3$ is in excess. There is 22.6 g of $Fe(C_2H_3O_2)_3$ left over and 52.2g $Cu(C_2H_3O_2)_2$ and 38.3g $Fe_2(SO_4)_3$ produced.

   c. 0.82 g $GaBr_3$ and 1.0 g of F_2 $2\ GaBr_3 + 3\ F_2 \rightarrow 2\ GaF_3 + 3\ Br_2$
   $GaBr_3$ is the LR, F_2 is in excess. There is 0.85g of F_2 left over and 0.34g GaF_3 and 0.64g Br_2 produced.

UNIT 10 – BONDING

12. What is a bond?
A bond is a connection between two atoms or ions using electrons that hold the two particles together.

13. What are the 3 main categories of bonds? What is the difference?
Metallic, ionic, and covalent. Metallic bonds are the connections between metallic atoms, ionic bonds are the attractions between two oppositely charged ions, and covalent bonds are the attractions between two nuclei and a pair of electrons.

14. What are the 2 types of covalent bonds? What is the difference?
Polar covalent and nonpolar covalent. Polar covalent is unequal sharing of electrons and nonpolar covalent bonds occur when electrons are shared equally.

15. What is a double bond? Triple bond?
Double bond is a covalent bond that shares two pair of electrons. Triple bond is a covalent bond that shares three pair of electrons.

16. What is the VSEPR Theory? Explain.
Valence Shell Electron Pair Repulsion Theory – Valence electron pairs around a central atom will repel and move as far apart as they can to minimize repulsions. It is used to predict molecular shapes.

17. What are the 5 basic shapes formed by molecules with only bonds surrounding the center atom? (No unbonded electrons)
Linear, Trigonal Planar, Tetrahedron, Trigonal Bipyramid, Octahedron.

18. What are the shapes formed when there are unbonded pairs of electrons around the center atom?
Bent, 117° (Trigonal Planar)
Trigonal Pyramid, Bent 104.5 ° (Tetrahedron)
See-saw, T-Shaped, Linear (Trigonal Bipyramid)
Square Pyramid, Square Planar (Octahedron)

19. Determine the shape formed by the following molecules.
a. SeF_6 **Octahedron**
b. ClF_3 **T-Shaped**
c. AsF_5 **Trigonal Bipyramid**
d. NH_3 **Trigonal Pyramid**
e. BF_3 **Trigonal planar**
f. H_2O **Bent 104.5 °**
g. $SiBr_4$ **Tetrahedron**

20. What is resonance?
Phenomenon that occurs in a molecule with single/double bonds between the same elements. The extra bond will constantly switch between the atoms.

UNIT 11 – GASES

Henry's Law – The amount of a gas that can dissolve in a liquid varies directly with the partial pressure of the gas. So if pressure increases, so does solubility.

21. What does Boyle's Law state? Formula? What 2 factors must be held constant for this law to be true?
Pressure and volume are inversely related to each other when temperature and the number of moles remain constant. $P_1V_1 = P_2V_2$

22. What does Charles' Law state? Formula? What 2 factors must be held constant for this law to be true?
Volume and temperature are directly related to each other when pressure and number of moles are held constant. $V_1/T_1 = V_2/T_2$

23. What does the Combined Gas Law state? Formula? What factor must be held constant for this law to be true?
The combined gas law relates pressure, volume, and temperature of a gas when the number of moles is kept constant. $(P_1V_1)/T_1 = (P_2V_2)/T_2$

24. What is the Ideal Gas Law? Formula?
The Ideal Gas Law relates all factors of one gas in one situation. PV = nRT

25. What is R? What is its value?
R is the Universal Gas Law Constant, its value is 8.31 kPa·L/mol·K or 0.0821 atm·L/mol·K

26. What unit does temperature have to be measured in to solve any gas law problem?
Kelvin

27. How do you convert degrees Celsius into the unit from #26?
Celsius + 273

28. Solve the following problems using the best Gas Law. Remember that standard temperature is 0°C and standard pressure is 1 atm, 101 kPa, 760 mm Hg or 760 torr.
    a. Oxygen gas kept at 45.00°C has a pressure of 105.0 kPa. The pressure is decreased to 90.00 kPa. What temperature will allow this to happen?
    272.6 K
    b. What was the original pressure of Sulfur gas at 35.00°C and 590.0 cm^3 when it is now in a 500.0 cm^3 container with a pressure of 680.0 mm Hg and at 25.00°C?
    595.6 mm Hg
    c. What was the original volume of Hydrogen gas at 15°C if it is now at 23°C and in a 2.0 L container?
    1.9 L
    d. What is the original pressure of a gas in a 1.10 L container if its new volume is 1.35 L with a pressure of 1.05 atm?`
    1.29 atm
    e. What is the new volume of Chlorine gas at STP when it was in a 2.5 L container with a pressure of 720 torr at 33°C?
    2.1 L

UNIT 12 – SOLIDS & LIQUIDS

29. Explain the difference between solids, liquids and gases in terms of molecular spacing?
Solid particles are tightly packed and in position, while liquid particles are close together but are able to move past one another, and gas particles are very far apart.

30. Explain the difference between solids, liquids and gases in terms of Kinetic Energy and IMF?
Solids have a high IMF compared to their low KE, they do move – but it I sin position. Liquids have more KE and less IMF than a solid which allows them to move around but not separate from each other. Gases are very far apart and are constantly moving in a straight line. They have high KE and low IMF.

31. What is Heat of Fusion? Heat of Vaporization?
Heat of Fusion is the amount of heat that is required to completely melt one gram of a solid at the melting point. Heat of Vaporization is the amount of heat required to completely vaporize one gram of a liquid at the boiling point.

32. Why does the temperature of a substance remain the same during a phase change?
The energy is being used to break the IMF of the substance rather than increase the temperature.

33. What is a crystal?
A rigid solid made up of a repeating pattern of atoms.

34. What is a unit cell?
The simplest repeating pattern of atoms in a crystal.

35. What is evaporation? How does evaporation occur?
Evaporation is the process by which a liquid becomes a gas below the boiling point. It occurs when liquid particles at the surface collide and enough energy is transferred in the collision to overcome the IMF and allows that particle to become a gas.

UNIT 13 – IMF

36. What is IMF?
Intermolecular Forces are the attractive forces that occur between molecules.

37. What is the importance of the IMF?
IMF allows for solids and liquids to occur.

38. What are the three types of IMF?
Dispersion forces, Dipole-dipole forces, and Hydrogen bonding.

39. Which is the strongest form of IMF? Why?
Hydrogen bonding is the strongest because it occurs between two dipoles so the attraction is constant and it occurs between molecules that contain a polar covalent bond between Hydrogen and Nitrogen, Oxygen, or Fluorine. This bond is extremely strong since the atoms are very small and allows the bond to be very close causing a greater partial charge.

40. Which is the weakest form of IMF? Why?
Dispersion forces is the weakest form of IMF since it occurs between two momentary dipoles. The force is not constant.

41. What is a dipole?
A dipole is a molecule that has two opposite areas of partial charges due to polar covalent bonds.

42. What is a momentary dipole?
A momentary dipole is a dipole that was formed from a nonpolar molecule due to the constant movement of electrons. At a given moment, the electrons may have arranged themselves closer to one atom causing the partial charge to occur.

UNIT 14 – SOLUTIONS

43. What is a solution?
A solution is another name for a homogeneous mixture.

44. What are the 2 parts to a solution?
Solute and solvent.

45. What is the difference between the 2 parts in #44?
Solute dissolves into the solvent.

46. What is solubility?
Solubility is the ability of a solute to dissolve in a solvent at a given temperature.

47. What are the three descriptions of solutions with respect to solubility?
Saturated, supersaturated, unsaturated.

48. How do you know if a solution is saturated?
You know the solution is saturated if you add more solute and it doesn't dissolve.

49. What types of substances dissolve in each other?
Miscible substances completely dissolve in one another. Polar substances dissolve in polar substances and nonpolar substances dissolve in nonpolar substances.

50. What is a solution with water as the solvent?
Aqueous

51. What is molarity? What is the formula for molarity?
Molarity is a measure of the number of moles of solute per liter of solution.

52. What is the molarity of a 5.0 L solution that contains 2.0 moles of K_2CO_3?
0.40 *M*

53. How many moles of solute are present in 0.500 L of a 1.28 *M* $NaNO_3$ solution?
0.640 moles $NaNO_3$

54. How many liters of solution will contain 1.5 moles of $CaCl_2$ if the solution is 6.0 *M* $CaCl_2$?
0.25 L solution

UNIT 15 – ACIDS & BASES

55. What is an acid?
An acid is a substance that has Hydrogen ions (or hydronium Ions) to donate in reactions.

56. What is a base?
A base is a substance that accepts Hydrogen ions (or Hydronium Ions) in reactions.

57. What are the properties of acids? Bases?
Acids are electrolytes, react with metals to produce Hydrogen gas, sour, turn litmus paper red, is colorless in phenolphthalein, and has pH values less than 7.
Bases are electrolytes, do not react with metals, bitter, slippery, turn litmus paper blue, is pink in phenolphthalein, and has pH values greater than 7.

58. What is a neutral substance?
A neutral substance has equal amounts of acidic and basic character and has a pH value of exactly 7.

59. What is the difference between weak acids and bases and strong acids and bases?
Strong acids and bases dissociate 100% while weak acids and bases dissociate less than 10%.

60. List the strong acids.
Hydrochloric Acid – HCl, Hydrobromic Acid – HBr, Hydroiodic Acid – HI, Nitric Acid – HNO_3, Perchloric Acid – $HClO_4$, Sulfuric Acid – H_2SO_4

61. List the strong bases.
Lithium Hydroxide – LiOH, Sodium Hydroxide – NaOH, Potassium Hydroxide – KOH, Rubidium Hydroxide – RbOH, Cesium Hydroxide – CsOH, Calcium Hydroxide – $Ca(OH)_2$, Strontium Hydroxide – $Sr(OH)_2$, Barium Hydroxide – $Ba(OH)_2$

62. What is a conjugate acid/base pair?
A conjugate acid/base pair is the beginning and ending substance of a substance acting as an acid and the result of that change and vice versa.

63. What is a neutralization reaction? What are the products?
A neutralization reaction is any reaction between an acid and a base. If the reaction is between a strong acid and a strong base, the products will be salt and water.

64. If the pH of a solution is 3.55, what is the pOH, $[H_3O^{+1}]$, and $[OH^{-1}]$ of the solution?
pOH = 10.45, $[H_3O^{+1}] = 2.82 \times 10^{-4}$, $[OH^{-1}] = 3.55 \times 10^{-11}$

65. What is the K_{eq} (or K_a) expression for $HC_2H_3O_2$?
$$K_a = \frac{[H^{+1}][C_2H_3O_2^{-1}]}{[HC_2H_3O_2]}$$

UNIT 16 – REACTION RATES

Some reactions occur in several steps. Each step may occur at a different rate. The reaction can only go as fast as its slowest step. This step is called the "rate-determining step".

66. What is the rate of reaction?
The rate at which the products disappear or the rate at which the products appear. It is the speed at which a reaction occurs.

67. How does a reaction occur?
Reactant particles must have the ability to move and come in contact with each other. The reaction occurs when two particles undergo an effective collision. The collision must have enough energy (activation energy) and collide with proper orientation. This will form an activated complex. The activated complex may break apart to form new molecules (products).

68. What is the process described in # 67 called?
The process that describes how a reaction occurs is called the Collision Theory.

69. What is an activated complex?
An activated complex is one large molecule that is formed when two reactant particles collide and allow for the possibility of new particles to form.

70. What can increase the rate of reaction?
Rate of reaction can be increased by increasing the concentration of a reaction, increasing the temperature, determining the nature of the reactants, and adding a catalyst.

71. What is used to slow down the rate of reaction?
An inhibitor slows down a reaction.

72. How does a catalyst speed up a reaction?
A catalyst speeds up a reaction by lowering the activation energy needed to form an activated complex. This increases the chances that the activated complex will form more often in order to produce products more frequently.

73. What is equilibrium?
Equilibrium occurs in a reversible reaction where the rate of the forward reaction is equal to the rate of the reverse reaction.

74. State LeChatelier's Principle.
Le Chatelier's Principle states that a system at equilibrium will shift that equilibrium in order to relieve an added stress.

75. What factors affect equilibrium?
Concentration of any substance in the system, temperature, and pressure affects the equilibrium of the system.

76. What is the equilibrium expression for the following reaction? $2\ Mg + O_2 \leftrightarrow 2\ MgO$

a. $2\ Mg\ (s) + O_2\ (g) \leftrightarrow 2\ MgO\ (s)$

$$K_{eq} = \frac{1}{[O_2]}$$

b. $2\ H_2\ (g) + O_2\ (g) \leftrightarrow 2\ H_2O\ (g)$

$$K_{eq} = \frac{[H_2O]^2}{[H_2]^2[O_2]}$$

c. $NH_3\ (aq) + HF\ (aq) \leftrightarrow NH_4^{+1}\ (aq) + F^{-1}(aq)$

$$K_{eq} = \frac{[NH_4^{+1}]\,[F^{-1}]}{[NH_3][HF]}$$

77. Fill in the following table for the following reaction.
$CH_4\ (g) + 2\ O_2\ (g) + 35\ kcal \leftrightarrow CO_2\ (g) + 2\ H_2O\ (l)$

If... Then...	Equilibrium Shift	$[CH_4]$	$[O_2]$	$[CO_2]$	$[H_2O]$
$[O_2]\uparrow$	→	↓	X	↑	↑
$[CH_4]\uparrow$	→	X	↓	↑	↑
$[CO_2]\uparrow$	←	↑	↑	X	↓
$[H_2O]\downarrow$	→	↓	↓	↑	X
Pressure ↓	←	↑	↑	↓	↓
Temp ↓	←	↑	↑	↓	↓