NAME: _____

Chemistry Final Exam Review KEY

Unit 1: Math & Measurement

Practice Problems:

1. How many nanometers are in 10 meters? **1×10^{10} nm**
2. How many liters are in 345 milliliters? **0.345 L**
3. How many grams are in 2.45 kilograms? **2450 g**
4. Round your answer to the correct number of significant figures: $3.45 - 1.434 - 0.4 =$ **1.6**
5. Round your answer to the correct number of significant figures: $4.50 \times 4.245 =$ **19.1**

Unit 2: Matter & Change

Practice Problems:

6. A student mixes two chemicals in a test tube. The test tube turns hot and bubbles appear. What indicators of chemical reaction is the student observing?
   a. Change in color and formation of precipitate.
   b. Change in color and formation of a gas.
   c. Change in temperature and formation of a precipitate.
   d. **Change in temperature and formation of gas.**
7. What is the difference between a heterogeneous and homogeneous mixture? **You are able to see particles (different components) in a heterogeneous solution. A homogeneous solution looks the same.**
8. What is the difference between a chemical and physical change? Give evidences of both types of changes. **A chemical change is when a substance changes composition (becomes something new)- example: temperature change. A physical change is when there is a change but it is still the same substance- example: a rock breaking apart.**

Unit 3: Atoms

Practice Problems:

9. Which atomic symbol represents an isotope of sulfur with 17 neutrons?
   a. $^{17}_{16}$ X   **b. $^{33}_{16}$ X**   c. $^{17}_{32}$ X   d. $^{49}_{32}$ X
10. How are isotopes different? **Isotopes are the same element but with different atomic masses.**
11. What are the differences between an atom of nitrogen-15 and sodium-24 (compare neutrons, protons, electrons)? **Nitrogen – p=7, n=8, e=7; Sodium- p=11, n=13, e=11**
12. How many moles are in a 35.3 gram sample of $Ca(NO_3)_2$? **0.215 moles**
13. How many grams are in a 0.453 mole sample of $Zn(OH)_2$? **45.0 grams**
14. How many molecules are in a 34.5 gram sample of KCl? **2.79×10^{23} molecules**

Unit 4: Electrons

15. Predict the electron configuration for an element with 36 electrons. **$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$**
16. Which is the electron configuration of calcium?
   a. $1s^2 2s^2 2p^6 3s^2 3p^8$ c. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2$
   b. **$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$**   d. $1s^2 2s^2 2p^6 3s^2 3p^6$
17. Use the Bohr model to explain the release of energy in return of electrons to a ground state. **When electrons become excited they move to a higher energy level and will release energy when they return back to the ground state. The energy that the electrons release is electromagnetic radiation.**
18. An electron in an atom of hydrogen goes from energy level 6 to energy level 2. What is the wavelength of the electromagnetic radiation emitted?
   a. **410 nm**   b. 434 nm   c. 486 nm   d. 656 nm
19. How many electrons are in the outermost energy level of an electrically neutral atom of fluorine? **7**

Unit 5: Periodic Table

Practice Problems:

20. Be able to classify elements as metals, nonmetals, or metalloids. **Know where they are located on the periodic table**
21. Where are the transition metals located? **They are located in groups 3-12**
22. How many periods are on the periodic table and in which direction do periods run? **7; horizontal**

23. How many groups are on the periodic table and in which direction do groups run? **18; vertical**
24. The nucleus of an atom is shown.

8 protons
9 neutrons
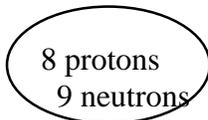
Which statement best describes the element?
   a. It is a nonmetal in group 2.
   b. **It is a nonmetal in group 16**.
   c. It is a metal in group 2.
   d. It is a nonmetal in group 17.
25. Which atom has the largest radius? Justify your answer.
   a. Bromine
   b. Chlorine
   c. **Selenium- radius increases**
   to the left on a period
   and down a group
   d. Sulfur
26. Arrange the following elements in order of increasing electronegativity, from lowest to highest: F, K, Si, and S.
   a. $F < K < S < Si$
   b. **$K < Si < S < F$**
   c. $Si < F < K < S$
   d. $S < Si < F < K$
27. Does potassium (K) have more similar properties to sodium (Na) or calcium (Ca)? Justify your answer.
   Sodium because they are in the same group; elements in the same group have similar properties
28. Which pair of elements is both brittle and not able to conduct heat?
   a. Bromine and silver
   b. **Iodine and neon**
   c. Iron and bromine
   d. Silver and iron
29. An atom of which element has the weakest attraction for electrons?
   a. Ba
   b. **Cs**
   c. O
   d. F
30. Describe the trends of electronegativity, ionization energy, and atomic radius.
   Electronegativity is the ability to attract electrons; increases to the right and up.
   Ionization energy is the amount of energy it takes to remove an electron; increases to the right and up.
   Atomic radius is the distance between nuclei of an element; increases to the left and down.

Unit 6: Chemical Bonding
31. Which statement compares the amount of energy needed to break the bonds in $CaCl_2$ (E_1) and $C_{12}H_{22}O_{11}$ (E_2)?
   a. $E_1 > E_2$, as $CaCl_2$ is a covalent bond
   b. $E_1 < E_2$, as $CaCl_2$ is a covalent bond
   c. **$E_1 > E_2$, as $CaCl_2$ is an ionic bond**
   d. $E_1 < E_2$, as $CaCl_2$ is an ionic bond
32. Given the pairs of atoms below, predict whether the bond formed between the atoms is either ionic or covalent, and if ionic, write the formula for the predicted compound.
   a. Na and F**ionic**
   b. C and O**covalent**
   c. K and Br**ionic**
   d. Ca and F**ionic**
   e. H and N**covalent**
   f. Mg and O**ionic**
33. Which statement describes the compound formed between sodium and oxygen?
   a. It is NaO_2, which is ionic.
   b. It is NaO_2, which is covalent.
   c. **It is Na_2O, which is ionic.**
   d. It is Na_2O, which is covalent.
34. Compare the physical properties (melting point, boiling point, solubility, electrical conductivity) of ionic, covalent, and metallic compounds.
   Ionic bonds have a high solubility, high melting point and conduct electricity.
   Covalent bonds have a low solubility, low melting point and have low electrical conductivity.
   Metallic compounds have a high boiling and melting point and conduct electricity
35. An unknown substance is tested in the laboratory. The physical test results are listed below:
   • Nonconductor of electricity
   • Insoluble in water
   • Soluble in oil
   • Low melting point
   Based on these results, what is the unknown substance?
   a. Ionic and polar
   b. Ionic and nonpolar
   c. Covalent and polar
   d. **Covalent and nonpolar**
36. Which combination of elements would most likely form a covalent bond?

a. Hydrogen and oxygen
c. Potassium and nickel
b. Sodium and fluorine
d. Lithium and hydrogen

37. What is the difference between bond and molecular polarity? **Bond polarity refers to the equal (nonpolar) or unequal (polar) sharing of electrons; molecular polarity refers to the symmetry (nonpolar) or asymmetry (polar) of a molecule**

38. How do you determine if there is a polar bond? **A bond is polar if it has an unequal sharing of electrons and it is between two different nonmetals.**

39. How do you determine if there is a polar molecule? **A molecule is polar if it is asymmetrical which means that it has a pair of unshared pair of electrons on the central atom and/or it has different surrounding atoms**

Unit 7: Chemical Formulas
Practice Problems:

40. Given the name of the compound below, infer its formula.
    a. Diphosphorusheptoxide   **P_2O_7**
    b. chromium (II) bromide   **$CrBr_2$**
    c. calcium nitrate   **$Ca(NO_3)_2$**
    d. nickel (II) oxide **NiO**

41. Given the formula below, write the name.
    a. $Be(OH)_2$ **Beryllium hydroxide**
    b. $Sn(NO_3)_2$ **Tin (II) nitrate**
    c. P_2F_3**diphosphurous trifluride**
    d. Mg_3P_2**magnesium phosphide**

42. What is the IUPAC name for the compound represented by the formula $Mg(OH)_2$?
    a. Magnesium hydroxide
    b. Magnesium dihydroxide
    c. Magnesium (II) hydroxide
    d. Magnesium (II) dihydroxide

43. A compound consisting of 56.38% phosphorus and 43.62% oxygen has a molecular mass of 220 g/mole. What is the molecular formula of this compound?
    a. PO
    b. PO_2
    c. P_2O_3
    d. P_4O_6

44. A 10.10 g sample of barium chloride hydrate is heated in a crucible. After all the water is driven off, 8.50 g of the anhydrous barium chloride remains in the crucible. What is the formula of the hydrate? **$BaCl_2 \cdot 2H_2O$**

45. When zinc and chlorine react, what compound is produced (give chemical formula)?**$ZnCl_2$**

46. What is the formula for tin (II) phosphate? **$Sn_3(PO_4)_2$**

47. What is the name for the chemical formula Fe_2Se_3?**Iron (III) selenide**

48. A compound with a molecular mass of 252 g/mol contains the elements carbon, hydrogen, and oxygen in a ratio of 2 carbon: 2 hydrogen: 1 oxygen. What is the empirical formula? What is the molecular formula? What is the percent composition of hydrogen in this compound? **C_2H_2O; $C_{12}H_{12}O_6$; 4.76% H**

Unit 8: Chemical Equations
Practice Problems:

49. Write a balanced chemical equation for each reaction (include phases). Identify the type of reaction.
    a. ~~Sodium metal dropped into a beaker of water. Na (s) + 2H₂O (l)→ Na⁺ (aq) + 2OH⁻ (aq) + H₂ (g)~~
    b. Silver nitrate is added to sodium chloride. **$AgNO_3$ (s) + NaCl (s) ➔ AgCl (s) + $NaNO_3$ (s) (double replacement reaction)**

50. Consider the combustion reaction equation: $C_4H_{10} + O_2$➔ $CO_2 + H_2O$
    When the equation is balanced, what will be the coefficient of O_2?
    a. 1
    b. 7
    c. 10
    d. 13

51. 10.3 grams of sodium hydrogen carbonate reacts with an excess of hydrochloric acid. A white crystalline substance is produced and the mass of the product is 7.59 g.
    a. What type of reaction occurred? **Double replacement**
    b. Write the balanced chemical equation for this reaction. **$NaHCO_3$ + HCl ➔ NaCl + CO_2 +H_2O**
    c. What is the identity of the white crystalline product? **Salt**

    d. Based on the data from the reaction, determine the molar ratio between the given reactant and product. **1:1**

52. Balance the following equation: **3** H_2SO_4 + **2**$B(OH)_3$➔ __ $B_2(SO_4)_3$ + **6** H_2O
53. When Cu^{+2} is mixed with Cl^{-1}, which type of reaction will occur? **Synthesis**

Unit 9: Stoichiometry

Practice Problems:

54. Given the balanced chemical equation the reaction, $P_4 + 5O_2$➔ P_4O_{10}
    What mass of oxygen is needed to completely react with 7.75 g P_4?
    a. 2.00 grams   **c. 10.00 grams**
    b. 5.00 grams   d. 40.00 grams
55. A 70.0 g sample of limestone consists of a large percentage of calcium carbonate. The sample reacts with an excess of hydrochloric acid and 14.0 L of carbon dioxide is generated at STP. What is the percentage of calcium carbonate in the limestone? Write the balanced chemical equation for this reaction. **89.38% $CaCO_3$**
    $CaCO_3$ + 2HCl ➔ CO_2 + $CaCl_2$ + H_2O
56. Given the balanced chemical equation the reaction, $P_4 + 5O_2$➔ P_4O_{10}
    How many moles of P_4O_{10} is produced with 45.1 g O_2? **0.282 mol P_4O_{10}**
57. Given the balanced chemical equation the reaction, $P_4 + 5O_2$➔ P_4O_{10}
    How many moles of P_4O_{10} is produced when 2.3 moles of P_4 react with O_2? **2.3 mol P_4O_{10}**

Unit 10: Gases

Practice Problems:

58. What causes an inflated balloon to shrink when it is cooled?
    a. Because cooling the balloon causes gas to escape from the ball
    b. Because cooling the balloon causes the gas molecules to collide more frequently
    c. Because cooling the balloon causes gas molecules to become smaller
    d. Because cooling the balloon causes the average kinetic energy of the gas molecule to decrease
59. The Kelvin temperature and the pressure of a sample of gas are doubled. What will be the effect on the density of gas? **Density will not change (D=MM·P/RT)**
60. How many moles of oxygen gas are in 45 mL of oxygen gas at STP? **0.0020 mol**
61. A mixture of gases (O_2, CO_2, N_2) is collected in a bottle. The partial pressure of O_2 is 795 torr, and the partial pressure of CO_2 is 845 torr. If the total pressure of the gases is 2540 torr, what is the partial pressure of N_2 (in atm)? **900. torr = 1.18 atm**
62. How does decreasing temperature affect the collisions that occur among gas particles? **If you decrease the temperature, it slows the gas particles down. When the gas particles slow down the collisions occur at a slower rate.**

Unit 11: Solids, Liquids, Phase Changes

Practice Problems:

63. What causes the process of perspiration to be cooling for human skin? (applies to Unit 15 as well)
    a. It involves condensation and is exothermic.
   b. It involves evaporation and is exothermic.
    c. It involves condensation and is endothermic.

    d. It involves evaporation and is endothermic.

64. When is a liquid considered to be boiling? Explain your reasoning. **When a liquid goes from liquid to gas and evaporates**

65. Given the heating curve, what is occurring between minutes 6 and 12?
   a. There is an increase in kinetic energy and vaporization is occurring.
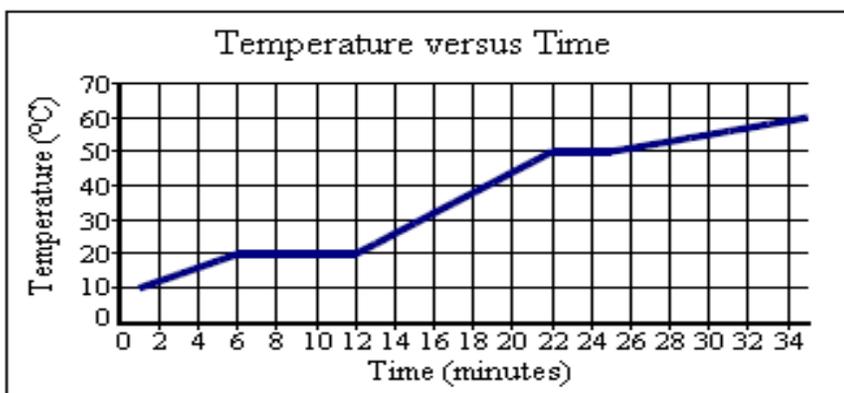
Temperature versus Time

b. There is an increase in kinetic energy and condensation is occurring.
c. There is an increase in potential energy and freezing is occurring.
d. There is an increase in potential energy and melting is occurring.

Phase Diagram of Water

Phase Diagram of a Substance
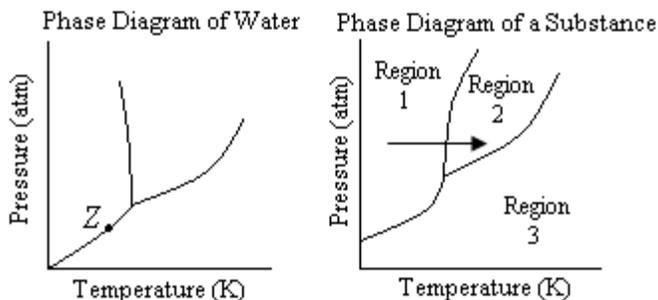
66. Compare the phase diagrams. What can be said about the relationship between the processes of melting for the two substances above? What can you determine about the densities of the solids compared to the liquids of each substance? Explain your reasoning. **The melting point of water is at a lower pressure than the other substance. As the pressure increases the temperature that it takes to melt the substance decreases. The solid of the water is less dense than the liquid substance of water. As the pressure increases it takes less heat to melt the substance. The opposite is true for the other substance.**
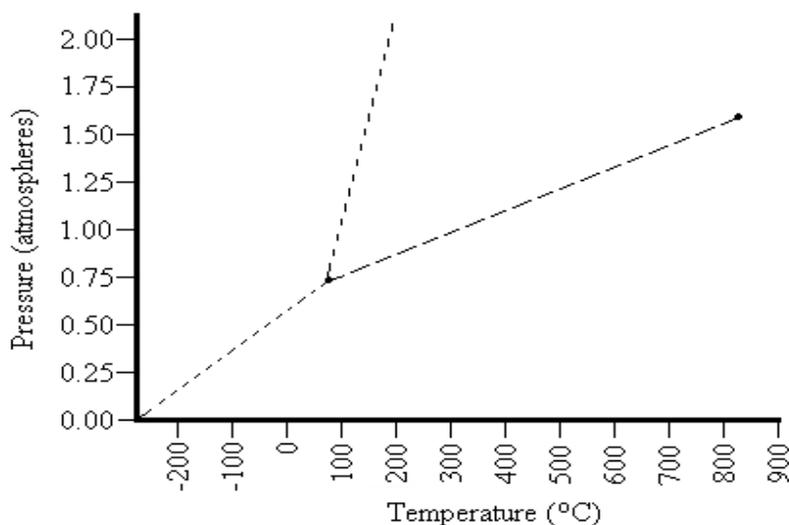
67. Be able to interpret and label (solid, liquid, gas, freezing/melting point, evaporation/condensation point) heating and cooling curves. **Review this information from your notes**
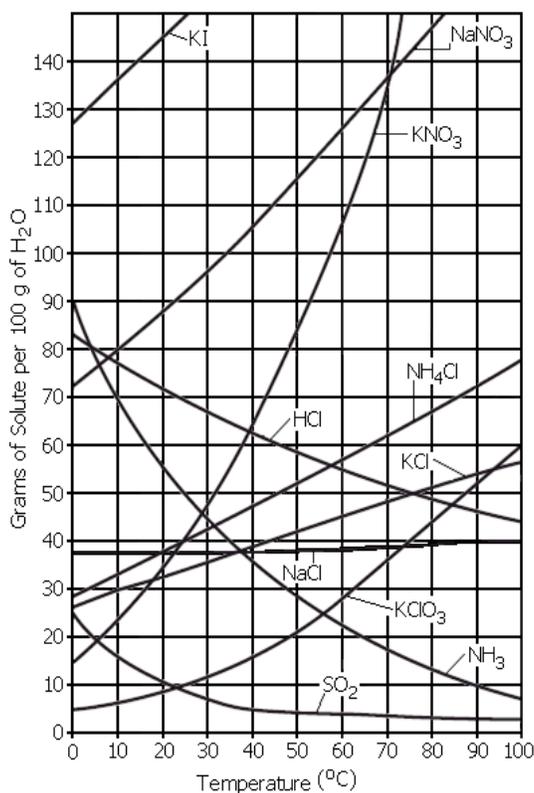
68. According to the phase diagram, what is the boiling point of this substance at a pressure of 1.25 atmospheres?

a. 100°C
b. 150°C
c. 300°C
d. 500°C

69. 1000 J of heat is added to 2 g of the following substances. Which one will experience the biggest change in temperature? (need to look up the specific heat for these metals)
a. Aluminum
b. Copper
c. Iron
d. lead

Unit 12: Solutions
Practice Problems:
70. Heat is added to a solution to
a. Increase the solubility of a solid solute
b. Increase the solubility of a gas solute
c. Increase the miscibility of the solution
d. Increase the degree of saturation of the solution
71. How many grams of KCl are required to make a saturated solution in 50.0 g of water at 80°C?
a. 25.0 g
b. 50.0 g
c. 100. g
d. 150. g

72. Why does the solubility of NH_3 decrease as the temperature increases? **It is a gas; solubility decreases in gases as temperature increases**

73. At what temperature will 60 g of HCl produce a saturated solution when dissolved in 100 g of water? **45°C**

74. Which salt solution should contain approximately 8o g of solute per 100 g of H_2O at 10°C?**NaNO₃**

Unit 13: Equilibrium

Practice Problems:

75. What determines if a system is at equilibrium? **If the rates of the forward and reverse reaction are equal**

76. A scientist observes a chemical reaction as it takes place. What can the scientist do in order to tell if the reaction has achieved equilibrium?
    a. **Measure concentration of products and reactants over time.**
    b. Monitor the temperature of the reaction over time.
    c. Measure the pH of the solution over time.
    d. Wait for the formation of a precipitate.

77. Given different equilibrium equations, determine the shift in equilibrium and the effects for a variety of changes (concentration of reactant or product, change in temperature, change in pressure, adding a catalyst).

78. Write the equilibrium expression for the following reaction: $2SO_2$ (g) + O_2 (g)<==> $2SO_3$ (g)

$$\frac{[SO_3]^2}{[SO_2]^2\,[O_2]}$$

79. For the reaction $2SO_2$ (g) + O_2(g)<==> $2SO_3$ (g) + heat
    Which action will increase the concentration of SO_3?
    a. Removing SO_2
    b. Increasing the temperature
    c. **Increasing the pressure**
    d. Adding a catalyst

Unit 14: Acids & Bases

Practice Problems:

80. Based on the hydroxide ion concentration, which unknown substance would be an acid?
    a. Substance A, $[OH^-] = 1.0$ x 10^{-2} M
    b. Substance B, $[OH^-] = 1.0$ x 10^{-4} M
    c. Substance C, $[OH^-] = 1.0$ x 10^{-6} M
    d. **Substance D, $[OH^-] = 1.0$ x 10^{-8} M**

81. Given a list of substances and their hydronium ion concentrations, classify them as acidic, basic, or neutral.

82. Give the data table below, which substance is an acid?

|	Substance			
	W	**X**	**Y**	**Z**
Tastes bitter	?	Yes	Yes	No
Tastes sour	No	No	?	Yes
Feels slippery	No	Yes	Yes	?
Turns litmus blue	Yes	Yes	Yes	?
Turns litmus red	?	No	No	Yes

    a. Substance W
    b. Substance X
    c. Substance Y
    d. **Substance Z**

83. List properties, interactions, concentration ranges, pH's, etc. for acids, bases, and neutral substances.
    Review notes

84. What volume of 0.200M HCl will neutralize 10.0mL of 0.400M KOH?
    a. 40.0mL
    b. **20.0mL**
    c. 8.00mL
    d. 5.00mL

85. 25.0mL of 12.0M H_2SO_4 is diluted to a total volume of 1.00L. What is the concentration of the newly diluted solution? Justify your answer. **0.300M (show work)**
86. Why is HCl considered an Arrhenius acid? **It begins with H**
87. What is the difference between a strong and weak acid/base? **A strong acid/base completely dissociates in water. A weak acid/base does not completely dissociate in water.**

Unit 15: Reaction Energy

Practice Problems:
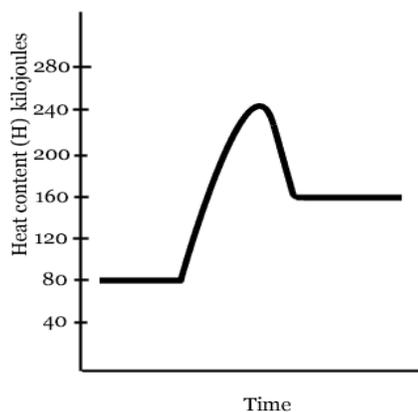

88. Given the energy diagram, which statement describes the forward reaction?

a. It is an exothermic reaction with an energy change of 160 kJ.
b. It is an exothermic reaction with an energy change of 80 kJ.
c. It is an endothermic reaction with an energy change of 160 kJ.
d. It is an endothermic reaction with an energy change of 80 kJ.
89. What type of reaction is represented by the diagram below? **Exothermic**
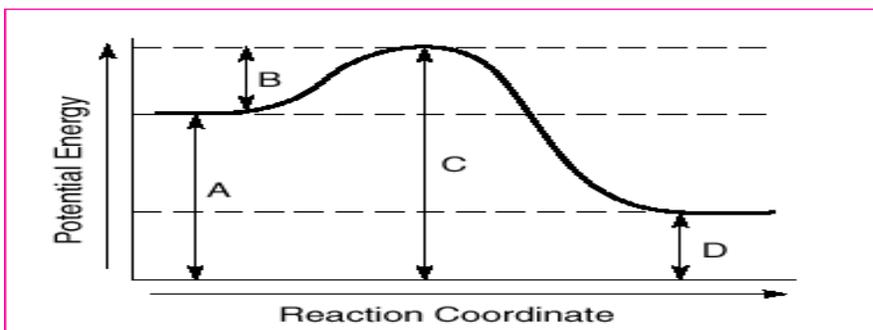
Label the location of the energy of reactants **A** , energy of the products **D**, activation energy **B**, and enthalpy (heat of reaction)**C-D**. If a catalyst were added to this reaction, what quantities would change? Justify your reasoning. **B and C would change because you are speeding up the reaction.**

90. Explain how temperature, concentration, particle size and a catalyst affect the rate of a chemical reaction. Give examples of each. **Increase in temperature increases the reaction rate (glow sticks); smaller particle size, increases surface area, which increases rate of reaction (paper clip vs. steel wool); catalyst increases rate of reaction by lowering activation energy (yeast)**
91. When a set amount of marble chips ($CaCO_3$) is added to a small amount of dilute hydrochloric acid, a reaction occurs. What should be done to decrease the rate of reaction the next time the experiment is performed?
   a. Use more acid
   b. Stir
   c. Use larger marble chips
   d. Add heat

Unit 16: Nuclear Chemistry

Practice Problems:

92. The half-life of a radioactive isotope is 20 minutes. What is the total amount of 1.00 g of sample of this isotope remaining after 1 hour?
   a. 0.500 g   b. 0.333 g   c. 0.250 g   **d. 0.125 g**

93. The nuclear reaction below represents the beta decay of $^{14}_{6}C$:
   $^{14}_{6}C \rightarrow X + {}^{0}_{-1}\beta$
   What is the mass number of the element represented by X? **14**