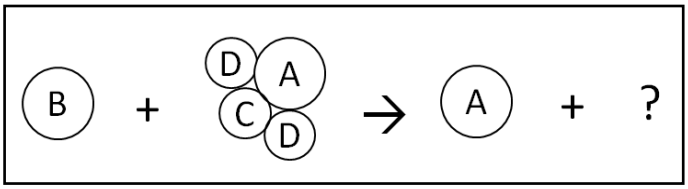
Chemistry Name: KEY

2nd Semester Study Guide 2017

Unit 6: Chemical Reactions and Balancing

1. Draw the remaining product



2. Write a balanced equation for the following reaction: The reaction between sodium metal and water yields aqueous sodium hydroxide and hydrogen gas. $2Na + 2H_2O \rightarrow 2NaOH + H_2$

3. If you leave your bike outside for an extended period of time and the bike rusts, would you expect your bike to weigh less, more or the same then it originally did? More – rusting is iron combining with oxygen

4. Balance the following reactions:
   (a) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
   (b) Sodium carbonate reacts with hydrochloric acid to yield, sodium chloride, water, and carbon dioxide
   $Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$
   (c) Copper + silver nitrate → silver + copper (II) nitrate
   $Cu + 2AgNO_3 \rightarrow 2Ag + Cu(NO3)_2$
   (d) $C_2H_6O + 3O_2 \rightarrow 2CO_2 + 3 H_2O$

5. Interpret the following equation $2H_2 + O_2 \longrightarrow 2H_20$ in terms of atoms
   4 atoms of hydrogen plus 2 atoms of oxygen yields 4 atoms of hydrogen and 2 atoms of oxygen

6. Balance, **and** name the type of reaction for each of the following:
   (a) $AgNO_3 + KCl \rightarrow AgCl + KNO_3$ Balanced – double replacement
   (b) $Cl_2 + 2KI \rightarrow 2KCl + I_2$ single replacement
   (c) $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ combustion
   (d) $2Mg + O_2 \rightarrow 2MgO$ combination or synthesis
   (e) $2NaCl \rightarrow 2Na + Cl_2$ decomposition

7. Use the equation below to answer questions A-E
   $3Ba + Fe_2O_3 \rightarrow 3 BaO + 2 Fe$

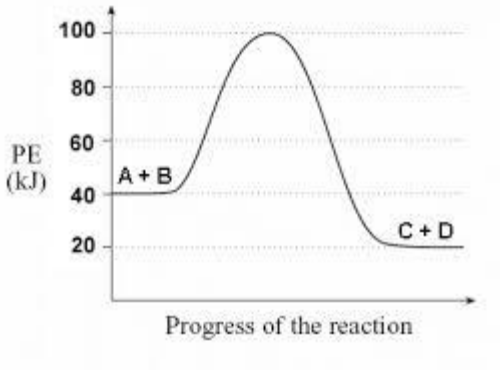
   a. Which of the above substances are reactants? Barium, iron(III)oxide
   b. Which are products? barium oxide, iron
   c. What type of reaction is this? Single replacement

8. How many molecules of Fe_2O_3 are represented in the above reaction? 1

9. How many Be atoms, and how many O atoms are in the formula: $2Be_3(PO_4)_2$? 6 Ba, 16 O

10. Give the proper balanced equation from the following word equation:
    Aluminum metal reacts with Sulfuric Acid (H_2SO_4) to produce Aluminum Sulfate and Hydrogen gas
    $2Al + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3H_2$

11. *Use the potential energy diagram to the right to answer the following questions.*
    a. Is the reaction releasing energy or absorbing energy? releasing
    b. How much energy is being absorbed or released? 20kJ
    c. Is the reaction endothermic or exothermic?
    exothermic
    d. How much energy do the reactants need to gain in order for the reaction to occur? 60kJ



e. Write an equation for this reaction and include where heat would be placed in the equation.
A + B → C + D + heat

Unit 7- Moles, Molarity and Dilutions

12. What is the molar mass for $Ba(NO_3)_2$?
Ba – 137.33 (1) = 137.33
N – 14.01 (2) = 28.02
O – 16.00 (6) = +96.00
261.35 g/mol

13. How many atoms of oxygen are in $Ba(NO_3)_2$?
6 atoms

14. How many molecules are in 2 moles of NO_2?
$\frac{x \text{ molecules}}{2 \text{ moles}} = \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mole}}$ **x = 1.2 x 10^{24}**

15. A sample of C_8H_{18} (octanol) has a mass of 35 grams, how many moles does it contain?
C – 12.01 (8) = 96.08
H – 1.01 (18) = +18.18
114.26 g/mol
$\frac{x \text{ moles}}{35 \text{ g}} = \frac{1 \text{ mole}}{114.26 \text{ g}}$ **x = .31 mol**

16. What is Avogadro's number, and what is it used for?
Avogadro's number is 6.02 x 10^{23}. It is the number of particles in a mole and is used to count the number of atoms by weight. The term "particles" can represent atoms, molecules, ions, or formula units.

17. How many moles are in 4.1 x 10^{24} molecules of KOH?
$\frac{4.1 \times 10^{24} \text{ molecules}}{x \text{ mol}} = \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}}$ **x= 6.81 moles**

18. How many grams are in 3.0 mol of $Be(NO_2)_2$?
Be – 9.01 (1) = 9.01
N – 14.01 (2) = 28.02
O – 16.00 (4) = +64.00
101.03 g/mol
$\frac{3.0 \text{ mol}}{x \text{ g}} = \frac{1 \text{ mol}}{101.03 \text{ g}}$ **x = 303.09 grams**

19. If 25.1 grams of Na combines completely with 38.9 grams of Cl, what is the percent composition of the Na in the compound?
25.1 g Na
+ 38.9 g Cl
64.0 g total
$\frac{25.1 \text{ g Na}}{64.0 \text{ g total}} \times 100 =$ **39.22% Na**

20. Find percent composition of carbon in Na_2CO_3? What about the percent of oxygen?
Na – 22.99 (2) = 45.98
C – 12.01 (1) = 12.01
O – 16.00 (3) = +48.00
105.99 g/mol
$\frac{12.01 \text{ g C}}{105.99 \text{ g total}} \times 100 =$ **11.33 % C**
$\frac{48.00 \text{ g O}}{105.99 \text{ g total}} \times 100 =$ **45.29% O**

21. Explain the difference between a solute and a solvent. A solute is the substance that dissolves in a solution. The solvent is the substance used to do the dissolving.

22. Given 9.5g of KBr (molar mass is 119 g/mol) dissolved in water (molar mass is 18 g/mol) to make a 175mL solution, what would the molarity be?
$\frac{9.5\text{g KBr}}{X \text{ mol}} = \frac{119 \text{ g}}{1\text{mol}}$ x = .080mol .080mol/.175L = .46M

23. In the previous question what is the solute? What is the solvent?
KBr = solute H_2O = solvent

24. Calculate the moles and grams of solute in each solution
    a. 1.5 L of 2.0 M KCl

$\frac{2.0\ M}{} = \frac{x\ mol}{1.5\ L}$ x = 3 mol KCl $\frac{3\ mol\ KCl}{x\ g} = \frac{1\ mol}{74.55g}$ x = 223.65g

    b. 300 ml of a .30M NaCl

$\frac{.30\ M}{} = \frac{x\ mol}{0.300\ L}$ x = .09 mol NaCl $\frac{.09\ mol\ NaCl}{x\ g} = \frac{1\ mol}{58.44g}$ x = 5.26g

    c. 500 ml of a 1.5M $CaCl_2$

$\frac{1.5\ M}{} = \frac{x\ mol}{0.500\ L}$ x = .75 mol $CaCl_2$ $\frac{.75\ mol\ CaCl_2}{x\ g} = \frac{1\ mol}{110.91g}$ x = 83.18g

25. Calculate the molarity of the following solutions
    a. 2.0 mole KOH in 330 ml of solution

$\frac{2.0\ mol}{.330L} = 6.06\ M$

    b. .75 mol BF in a 3.2 L of solution

$\frac{.75\ mol}{3.2\ L} = .23\ M$

    c. .22 mol of H_20 in 275 ml of solution

$\frac{.22\ mol}{.275\ L} = .8\ M$

26. Calculate the following dilution problems:
    a. How would you dilute a 3.0M solution of KNO_3 in order to get 240 ml of a .5M solution?
    $(3.0M)(V_1) = (.5M)(240mL)$ $V_1 = 40mL$ Take 40mL of the 3.0M solution, dilute with water up to 240 mL.

    b. You are asked to make a 2.0L solution of .55M HCl by diluting the concentrated 16.0 M HCl. What volume of acid would be needed to make the dilution?
    $(16.0M)(V_1) = (2.0L)(.55M)$ $V_1 = .069L$

    c. How would you dilute a 3.0 M solution of $AgNO_3$ in order to get 200 ml of a .60M solution?
    $(3.0M)(V_1) = (.60M)(200mL)$ $V_1 = 40mL$ Take 40mL of the 3.0M solution, dilute with water up to 200mL

Unit 8: Stoichiometry

** Use the following equation to solve questions 27-30*:

$2\ Fe(s) + 6\ HCl(aq) \rightarrow 2\ FeCl_3(s) + 3H_2(g)$

27. What is the mole ratio of Fe reacted to $FeCl_3$ produced?
    2 Fe: 2 $FeCl_3$ or 1 Fe: 1 $FeCl_3$

28. How many moles of HCl are needed to react with 3.5 moles of Fe ?

	2 Fe +	6 HCl	→	2 $FeCl_3$ +	3 H_2
B	**3.5 mol**			0 mol	0 mol
C	- 3.5 mol	**-10.5 mol**		+ 3.5 mol	+ 5.25 mol
A	0 mol			3.5 mol	5.25 mol

Answer: 10.5 mol HCl

29. Given 6.1 moles of HCl, how many grams of $FeCl_3$ are produced?

	$2\ Fe$ +	$6\ HCl$ →	$2\ FeCl_3$ +	$3\ H_2$
B		**6.1 mol**	0 mol	0 mol
C	-2.03 mol	-6.1 mol	+2.03 mol	+3.05 mol
A		0 mol	**2.03 mol**	3.05 mol

$$\frac{162.2\text{ g } FeCl_3}{1\text{ mol } FeCl_3} = \frac{x\text{ grams } FeCl_3}{2.03\text{ mol } FeCl_3}$$

Answer: 329.27 g $FeCl_3$

30. If 9g of Fe reacts with 14g of HCl, How many grams of H_2 will be produced? Which is the limiting reactant?

$$\frac{55.85\text{ g Fe}}{1\text{ mol Fe}} = \frac{9\text{ grams}}{x\text{ mol Fe}}$$

$= 0.161$ mol Fe

$$\frac{36.46\text{ g HCl}}{1\text{ mol HCl}} = \frac{14\text{ g HCl}}{x\text{ mol HCl}}$$

$= 0.384$ mol HCl

	$2\ Fe$ +	$6\ HCl$ →	$2\ FeCl_3$ +	$3\ H_2$
B	**0.161 mol**			0 mol
C	-0.161			+0.242
A	0			0.242

	$2\ Fe$ +	$6\ HCl$ →	$2\ FeCl_3$ +	$3\ H_2$
B		**0.384 mol**		0 mol
C		-0.384 mol		+0.192
A		0 mol		**0.192**

$$\frac{2.02\text{ g } H_2}{1\text{ mol } H_2} = \frac{x\text{ grams } H_2}{0.192\text{ mol } H_2}$$

Answer: 0.388 g H_2, Limiting Reactant - HCl

** Use the following equation to solve questions 31-32*:

Na_2SiF_6 + 4 Na → Si + 6 NaF

31. Find the mass of Na needed to react with 1.36 mol of Na_2SiF_6.

	Na_2SiF_6 +	4 Na →	Si +	6 NaF
B	**1.36 mol**		0 mol	0 mol
C	-1.36 mol	**-5.44 mol**	+1.36 mol	+8.16 mol
A	0 mol		1.36 mol	8.16 mol

$$\frac{22.99\text{ g Na}}{1\text{ mol Na}} = \frac{x\text{ grams Na}}{5.44\text{ mol Na}}$$

Answer: 125.07 g Na

32. If 92.3 g of Na reacts, how many moles of NaF will be produced?

$$\frac{22.99\text{ g Na}}{1\text{ mol Na}} = \frac{92.3\text{ grams Na}}{x\text{ mol Na}}$$

$= 4.01$ mol Na

	Na_2SiF_6 +	4 Na →	Si +	6 NaF
B		**4.01 mol**	0 mol	0 mol
C	-1.00 mol	-4.01 mol	+1.00 mol	+6.02 mol
A		0 mol	1.00 mol	**6.02 mol**

Answer: 6.02 mol NaF

33. $2\ C_2H_5 + 5\ O_2 \rightarrow 4\ CO_2 + 2\ H_2O$

(a) If 40 g of C_2H_5 reacts with 90 g of O_2, What is the limiting reactant?

$\frac{29.07\ g\ C_2H_5}{1\ mol\ C_2H_5} = \frac{40\ g\ C_2H_5}{x\ mol\ C_2H_5}$ $\qquad$ $\frac{32.00\ g\ O_2}{1\ mol\ O_2} = \frac{90\ g\ O_2}{x\ mol\ O_2}$

$= 1.38\ mol\ C_2H_5$ $\qquad$ $= 2.81\ mol\ O_2$

	$2\ C_2H_5$ +	$5\ O_2$	$\rightarrow$	$4\ CO_2$ +	$2\ H_2O$
B	**1.38 mol**			0 mol	
C	-1.38 mol			+2.76 mol	
A	0 mol			2.76 mol	

	$2\ C_2H_5$ +	$5\ O_2$	$\rightarrow$	$4\ CO_2$ +	$2\ H_2O$
B		**2.81 mol**		0 mol	
C		-2.81 mol		+2.24 mol	
A		0 mol		**2.24 mol**	

Answer: Limiting Reactant – O_2

(b) How many grams of CO_2 will be produced?

$\frac{44.01\ g\ CO_2}{1\ mol\ CO_2} = \frac{x\ grams\ CO_2}{2.24\ mol\ CO_2}$

Answer: 98.58 g CO_2

34. Determine the mass of water vapor you would expect to form (and the percent yield) in the reaction between 17 g of NH_3 and excess oxygen to produce water and nitrogen monoxide (NO). The mass of water actually formed is 23 g.

Balanced Equation: $4\ NH_3 + 5\ O_2 \rightarrow 6\ H_2O + 4\ NO$

$\frac{17.04\ g\ NH_3}{1\ mol\ NH_3} = \frac{17\ g\ NH_3}{x\ mol\ NH_3}$

$= 1.00\ mol\ NH_3$

	$4\ NH_3$ +	$5\ O_2$	$\rightarrow$	$6\ H_2O$ +	$4\ NO$
B	**1.00 mol**	xs		0 mol	0 mol
C	-1.00 mol	-1.25 mol		+1.50 mol	+1.00 mol
A	0 mol	xs		**1.50 mol**	1.00 mol

$\frac{18.02\ g\ H_2O}{1\ mol\ H_2O} = \frac{x\ grams\ H_2O}{1.50\ mol\ H_2O}$

$= 27.03\ g\ H_2O \leftarrow$ theoretical yield

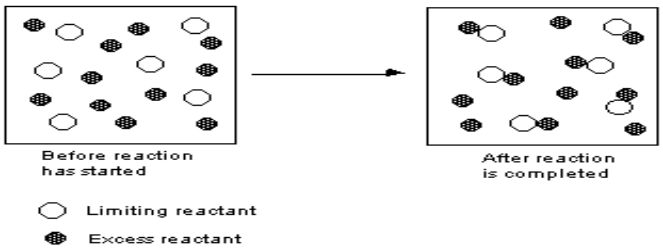
$\%\ Yield = \frac{Actual\ Yield}{Theoretical\ Yield} \times 100$

$85\% = \frac{23\ g}{27.03\ g} \times 100$

Answer: 85% Yield

35. Which of the following is the excess reactant?

The element represented by the white dots is the limiting reactant, and the element represented by the black dots is the excess reactant. This can be determined by having unreacted black dots in the particle representation after the reaction is completed.



Unit 9 Acids and Bases

36. Describe the reactants and products of a neutralization reaction. An acid reacts with a base to produce a salt and water.

37. What is the concentration of HCl if 30 mL of acid is neutralized by 25 mL of .2 M NaOH? 0.17M

38. How does each number change on the pH scale relate to its level of acidity? A number change on the pH scale changes the H+ and OH- concentration by a factor of 10.

39. In a solution, if the $[H^+] = 3.9 \times 10^{-4}$, then the $[OH^-]$ would equal what? 2.56×10^{-11}

40. Give 3 properties of an acid. They have a tart taste, a pH less than 7, will turn litmus paper red, releases H+ ions when dissolved in water.

41. Define an acid and define a base, and explain why water has a neutral pH? An acid will release H+ when dissolved in water. A base contains releases OH- ions when dissolved in water. What is neutral because it contains equal amounts of H+ and OH-

42. If the pH of a substance is 9.5, what would the pOH be? 4.5

43. A solution has a concentration of H^+ ions of 1.0×10^{-5} M, so the pH would be what? 5

44. Predict the products of the following neutralization reaction: $H_2SO_4 + NaOH \rightarrow$? $2H_2O + Na_2SO_4$

45. If the pH scale increases by increments of 10, how many times more acidic is a solution with a pH of 2 than a solution with pH of 4? 100 times

46. Which pH value is associated with the largest [H+], what about [OH-]? 0, and 14

47. What is Bronsted/Lowry's acid base theory? Acids are H+ (proton) donors, and bases are H+ (proton) acceptors

48. What is the Arrhenius acid/base theory? Acids release H+ ions when dissolved in water, while bases release OH- ions.

49. What is the molarity of phosphoric acid if 15.0 ml of the solution is completely neutralized by 38.5mL of .150M NaOH? 0.13M

50. How many milliliters of .50M hydrochloric acid must be added to 20mL of .90M potassium hydroxide to make a neutral solution? 36mL

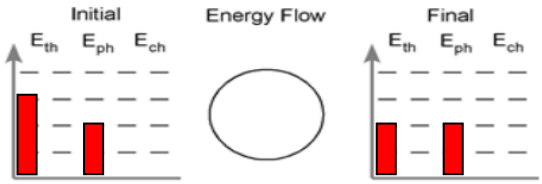
51. Calculate the pH of the following and identify as an acid or base
    A) pOH= 12 B) $[H^+] = 2.2 \times 10^{-5}$ C) $[OH^-] = 1.0 \times 10^{-5}$
    a) 2, acid b) 4.7, acid c) 9, base

Unit 10: Energy

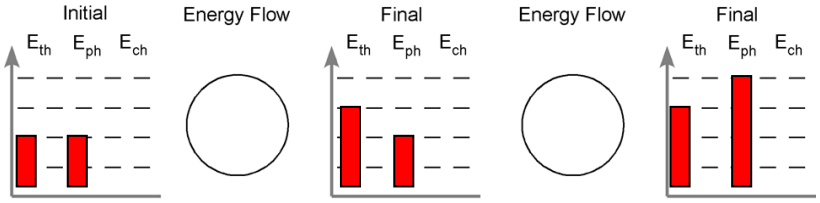
52. Describe the ways energy is stored in solids, liquids and gases:
Thermal energy – The energy associated with the movement of the particles. The higher the temperature, the more movement, the more thermal energy.
Phase energy – The energy associated with the arrangement of the particles. Solids have the least, gases have the most.

53. Describe what happens (at the particle level) when a glass of cold water warms up to room temperature.
The particles gain kinetic energy and begin to move faster as temperature goes up. Particle arrangement stays the same.

54. A cup of 70°C hot tea is left on the lab table for 15 minutes. Complete the bar chart that show this process.



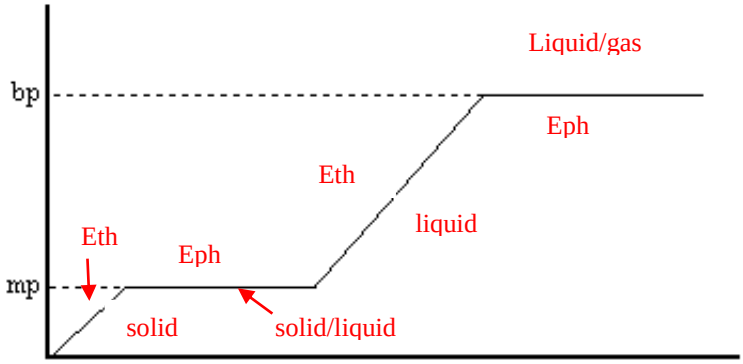
55. A sample of water at 25˚C is heated on a stove until it all becomes water vapor.



When energy is transferred to a sample of matter, either the particles speed up (temperature increases) or they get pulled apart (phase change), but not both at the same time. This helps account for the shape of the warming curve you got in the Icy Hot lab.

56. On the graph, label which phases are present in each portion of the curve.

57. On the graph, label the sections in which the thermal energy (E_{th}) of the sample is changing and where the phase energy (E_{ph}) is changing.



58. Describe the phase energy and thermal energy change of ice being heated from 0°C to 40°C. Be sure to include particle motion and arrangement for each change. From ice at 0°C, to liquid at 0°C, the particles are moving farther apart, but motion is staying the same. From liquid at 0°C to liquid at 40°C, the arrangement is the same but the particles are moving faster.

2.1 J/g˚C Specific Heat (C) of solid water
4.18 J/g˚C Specific Heat (C) of liquid water

For each of the situations below sketch a heating curve for water. Be sure to include beginning and ending temperatures as well as the temperature during any phase change. Label which phase(s) is (are) present in each portion of the curve.

59. A sample of ice at – 5˚C is heated until it becomes liquid water at 30˚C.

60. A sample of liquid water at 30˚C is heated until it all boils away.

61. If the specific heat of iron is .46 J/g x °C, and silver is .24 J/g x °C, then which would increase its temperature more quickly (assuming the same mass of each)? Silver, because it takes less energy to raise the temperature

62. Use the data table on the right from a calorimetry lab to calculate the heat absorbed by the water in the can?
q = 50.0g(4.18J/g °C)(60-35°C) = 5225 J

mass of water heated	50.0 g
mass of ethanol burned	3.0 g
initial water temperature	35°C
final water temperature	60°C

63. A 55mL sample of water at 25°C is heated to 47.5°C. How much heat was absorbed?

q= 55g(4.18J/g°C)(47.5-25°C) = 5172.75 J

Unit 11- Kinetics and Equilibrium

64. Give the two conditions that must be met for the collisions to be effective.

They must collide with sufficient energy (activation energy) and proper orientation.

65. For the reaction, $6\ HCl + 2\ Al \rightarrow 2\ AlCl_3 + 3\ H_2$, aluminum foil reacts with hydrochloric acid.

a. What happens to the speed of the reaction if more concentrated HCl is used? Explain why.
The rate of the reaction will increase because increased concentration means more collisions, which will speed up the reaction.

b. What happens to the speed of the reaction if the aluminum foil is cut into small strips? Explain why.
The rate of the reaction will increase because smaller strips means more surface area. Increased surfaced area means more collisions which will speed up the reaction.

c. What happens to the speed of the reaction if the temperature is raised to 40°C? Explain why.
The rate of the reaction will increase because increased temperature means more kinetic energy. More kinetic energy means more collisions which will speed up the reaction.

66. For the reaction below, which change would cause the equilibrium to shift to the right? None

$CH_{4\,(g)} + 2H_2S_{\,(g)} \leftrightarrow CS_{2\,(g)} + 4H_{2\,(g)} + \text{Heat}$

(a) Decrease the concentration of dihydrogen sulfide.
(b) Increase the pressure on the system.
(c) Increase the temperature of the system.
(d) Increase the concentration of carbon disulfide.
(e) Decrease the concentration of methane.

67. What would happen to the position of the equilibrium (left, right, no shift) when the following changes are made to the equilibrium system below?

$2SO_{3\,(g)} + \text{heat} \leftrightarrow 2SO_{2\,(g)} + O_{2\,(g)}$

(a) Sulfur dioxide is added to the system. left
(b) Sulfur trioxide is removed from the system. left
(c) Oxygen is added to the system. left
(d) Temperature decreases. left
(e) Pressure is increased. left