Analytical CHEMISTRY FINAL EXAM STUDY GUIDE 2019

Topics to Review:

Unit 6 Bonding - Lewis structures, types of bonds – ionic, covalent, metallic; polar vs. nonpolar bonds; formula writing, naming compounds, shapes of molecules and polarity using VSEPR models

Unit 7 IMF, Energy and States of Matter – IMF, Energy Transfer, States of Matter, phase changes, energy bar charts, specific heat capacity, Heat Calculations for temperature change and phase changes, endothermic, exothermic

Unit 8: Gas Laws
Diffusion, collisions, volume, temperature, pressure, PVTn tables, Kinetic Molecular Theory (KMT)

Unit 9 Chemical Reactions - Chemical vs. Physical changes; balancing equations; law of conservation of mass; types of reactions: single replacement, double replacement, combustion, neutralization, combination (synthesis), and decomposition; predicting products; recognizing & naming acids, bases and salts; energy, and endothermic vs. exothermic,

Unit 10 Stoichiometry - mole conversions (grams, liters, particles); limiting reagents (BCA table); PV=nRT

How You Should Prepare for the Exam:

- First and most importantly, **STUDY !!!!!!!!!!!!!!!!!!!!**
- DO NOT CRAM FOR THE EXAM!!!!! Start reviewing several weeks in advance, so you will have time to ask the teacher for any additional explanation you might need on a topic you are having difficulty with.
- **Review your notes, quizzes and tests.** Rework problems and ask for additional explanation for material you don't understand.
- Understand the material and be able to write the main ideas down in your own words
- Make flash cards or study sheets.
- Finally GET A GOOD NIGHT'S SLEEP the night before the exam and EAT A GOOD BREAKFAST and LUNCH the day of the exam.

NOTE – The review contains example problems, and is NOT the only material on the test.

Unit 6

1. Name the following:
   a. P_2O_5 –
   b. $CaCO_3$ –
   c. NH_4F –
   d. AlN -
   e. FeO -
   f. Au_2O –
   g. CO –
   h. Li_3P -
   i. K_2SO_4 –
   j. CCl_4 –
   k. CrF_2 –
   l. CuO –
   m. Cu_2O–
   n. $Al(PO_4)$ –
   o. $Mg(NO_3)_2$-
   p. N_2O_7-

2. Write formulas for the following:
   a. lead (II) sulfide -
   b. sodium cyanide -
   c. dinitrogen trioxide -
   d. chromium (III) hydroxide –
   e. silicon dioxide –
   f. sodium carbonate –
   g. sodium carbide –
   h. sulfur dibromide –
   i. ammonium oxide –
   j. dinitrogen tetraoxide –
   k. iron (II) nitrate –
   l. calcium nitride –

3. Draw Lewis structures for these ionic compounds: (show how the ionic bond is formed)
   a. NaF *b. CaI_2*

4. Fill in the following chart:

Formula	Lewis Structure	Geometry	Polar Bond?	Polar Molecule?	IMF
H_2O					
CCl_4					
CO_2					
CH_3F					
C_2H_2					
NBr_3					
BF_3					
SF_6					
SF_4					
NH_3					
PCl_5					
Honors PO_4^{-3}					

5. What determines if a **bond** is polar? What determines if a **molecule** is polar?

6. The symbol for chlorine gas is _____. Draw its Lewis structure.

7. Which bond is the strongest, single, double or triple?

8. Is energy absorbed or released when a chemical bond forms?_____

9. Are molecules more or less stable when bonded?

IMF

1. Distinguish between intramolecular and intermolecular forces

2. Define and describe the properties of each type of intermolecular force

- London Dispersion
- Dipole-dipole
- H-bond

(A) C_8H_{10} (B) Br_2 (C) NaI (D) H_2O (E) H_2S

3. Which of the above will have the weakest force?

4. Which of the above will have the strongest force?

5. Arrange the substances in order of increasing boiling point. Br_2, Cl_2, I_2 , F_2

6. Methane (CH_4) and water have the similar molecular masses. Why is CH_4 a gas at room temperature while H_2O is a liquid at room temperature?

<u>Unit 7– Energy & States of Matter</u>

1. Describe the properties, spacing, & motion of solids, liquids and gases.

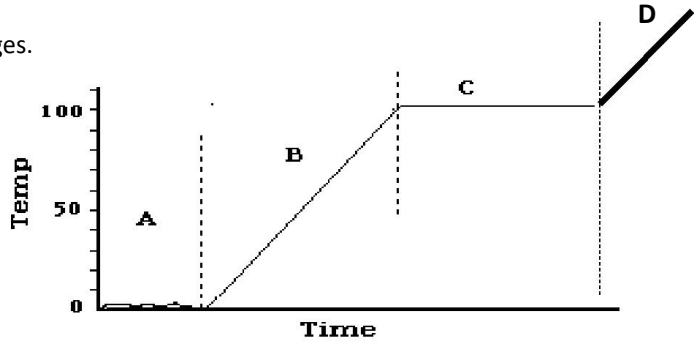
2. Which state of matter has the most ordered arrangement of their particles? Which has the least?

3. How is energy transferred from one molecule to another?

4. Two objects are placed side by side. Object A is 20°C and Object B is 95 °C. Which way will heat flow between them?

5. Label the heating curve for water with the phases and phase changes.

a. Draw a particle diagram for each section A - D



b. For each section (A-D), indicate what is happening to the phase, thermal energy, distance between molecules and velocity of the molecules. The change, or lack of, should be indicated by writing INCREASING(I), DECREASING(D), THE SAME(S)

A. Thermal energy distance between particles	Phase energy velocity of particles
B. Thermal energy distance between particles	Phase energy velocity of particles
C. Thermal energy distance between particles	Phase energy velocity of particles
D. Thermal energy distance between particles	Phase energy velocity of particles

7. What process is happening in A on the graph? In C?

8. What are the names of the reverse processes?

9. In a sample of boiling water, what is inside the bubbles? _____

10. Is this graph endothermic or exothermic?_____

Using the graph at the right, indicate the letter where the substance is:

11. being cooled as a solid _____
12. being cooled as a liquid _____
13. being cooled as a gas _____
14. changing from a liquid to a solid _____
15. changing from a gas to a liquid _____
16. What is its condensing temperature? _____
17. What is its freezing temperature? _____
18. What segments represent a change in E_{th} ?_____
19. Where on the curve do the molecules have the highest E_{th}? _____
20. Where on the curve do the molecules experience a change in E_{ph} ? _____
21. Moving on the graph from point B to point C, the molecules experience a *increase/decrease* in E_{th} / E_{ph}.
22. Moving on the graph from point E to point F, the molecules experience a *increase/decrease* in E_{th} / E_{ph}.
23. Which segment represents evaporation _____? Condensation _____? Melting _____? Freezing _____?
24. Is this graph endothermic or exothermic?_____
25. As time passes, what happens to the temperature of the air around the water sample? Explain. (THINK THIS THROUGH FIRST. WHERE IS THE ENERGY COMING FROM AND WHERE IS IT GOING?...REMEMBER, SURROUNDINGS AND SYSTEM)

26. How does heat affect the kinetic energy of particles?

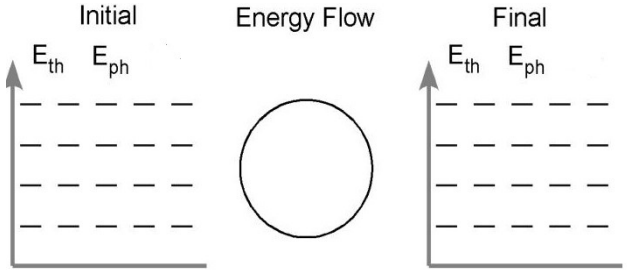
27. How does heat affect phase changes?

28. When this substance is melting, the temperature remains constant because:
    a. Heat is not being absorbed
    b. Heat energy is being stored as phase energy
    c. The ice is colder that the water
    d. Heat energy is being stored as thermal energy

29. When you are heating up a substance and graphing the temperature at the same time, you see one and only one phase in the beaker. What would you see on the graph (plateau or temperature change)? Is this Eth or Eph ?

30. Draw energy bar charts of the situations described below. MAKE SURE TO INDICATE THE DIRECTION OF ENERGY (HEAT = Q), ON THE MIDDLE CIRCLE. EACH ENERGY TYPE (Eth and Eph) need to have before and after bars. Look in your notes for # bars and phases and approx. temperatures. Then describe the motion & arrangement before and after.

a. A cup of ICED coffee sits on the counter and cools to room temp.



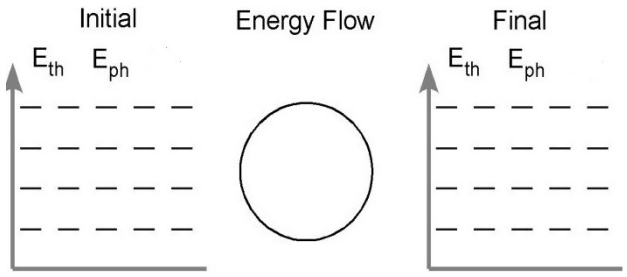
Motion before:

Motion after:

Arrangement before:

Arrangement after:

b. Cold water is heated on the stove until it boils and the water evaporates.



Motion before:

Motion after:

Arrangement before:

Arrangement after:

31. Which has more energy, a bucket of water at 50°C or a bathtub of 25°C water? Explain your reasoning.

32. You place water in an ice tray and allow the water turn to ice.

a. What happens to the overall heat (energy) OF THE SYSTEM? _____

b. What happens to the overall heat (energy) OF THE SURROUNDINGS? _____

c. What direction is the energy flowing? Into or out of the system? _____

33. When a substance is condensing, what phase (or phases) do you see in the beaker? If you graphing the process, what do you see on the graph (plateau or temperature change)? Is this Eth or Eph ?

34. On a counter is a glass of water with ice cubes floating in it. You measure the temperature and find it to be 0 ˚C. Would the temperature of the water change if you were to add more ice cubes to the glass? Explain your answer.

35. How much energy is transferred if a block of copper with a mass of 60 g is heated from 20°C to 100 °C? The specific heat of copper, Cu, is c = 0.386 J/g°C. $Q = mc\Delta T$

36. The specific heat for aluminum is c = 0.900 J/g°C. What mass of aluminum is required to cause a heat transfer of 1800 Joules if the temperature change is 33 °C? $Q = mc\Delta T$

37. How many joules of heat are required to heat 100.0 g of 28°C water to the boiling point? The specific heat of water is 4.184 J/g ^{0}C. $Q = mc\Delta T$

38. How many joules of heat are required to heat 45 g of tin from 30°C to 230°C? The specific heat of tin is 0.2274 J/g°C. $Q = mc\Delta T$

39. If it takes 24,500 J to heat 105 g of a substance from 25°C to 49°C, what is the specific heat of the substance? $Q = mc\Delta T$

Energy Calculations

Use the equations $Q = mH$ where, H_f = 334 J/g , H_V =2260 J/g to determine the energy transferred to or from water during a phase change. Use $Q = mc\Delta t$ and (c) the heat capacity of water to determine the energy transferred to or from water during heating or cooling. (C: Solid = 2.10 J/g˚C, Liquid = 4.18 J/g˚C, Vapor = 2.02 J/g˚C)

40. An ice cube tray full of 25.0 g of ice at -3.00 °C is allowed to sit on the counter until all the ice melts. How much energy must be absorbed by the contents of the tray in order for this to happen?(2 steps)

41. Calculate the amount of heat needed to increase the temperature of 350. g of water from 15.0°C to 75.0 °C.

42. Suppose that a burner transfers 325 kJ of energy to 450. g of liquid water at 20.0˚C. What **mass** of the water would be boiled away?

43. If 100. KJ were REMOVED from 200.0 g of <u>water at 0.00</u> <u>°C</u>, what would be the final temperature of the ice? (2 steps)

44. 1200. kJ of energy were absorbed by 1750. g of ice at 0.00°C. Will the ice reach its boiling point? If not, what will be the <u>final temperature of the</u> ***<u>water</u>*** ?

45. A 25.0 g sample of metal was heated to 100.0 °C and dropped into a beaker containing 90.0 g of water at 25.32 °C. The temperature of the water rose to a final value of 27.18 °C. What is the specific heat of the metal?

<u>Unit 8</u>

1. What are the relationships (direct or inverse) between the following variables:
   - Pressure (P) and Volume (V) _____
   - P and Temperature (T) in Kelvin _____
   - V and T _____
   - P and number of particles (n) _____

2. What happens to the number of collisions when the following happens in a balloon?
   - a. the T increases _____
   - b. the n decreases _____
   - c. the volume decreases _____

3. What is the relationship between pressure and the # of collisions?

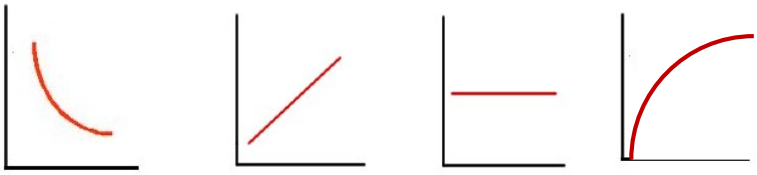
4. Look at the graphs below. Match the descriptions with the appropriate graphs. **Graphs can be chosen more than once, once or not at all.**

A. The relationship between volume and pressure

B. The relationship between the Kelvin temperature and pressure.

C. The relationship between the Kelvin temperature and volume.

D. The relationship between the number of particles and pressure.



PVTn Tables: ALL TEMPERATURES NEED TO BE IN KELVIN FOR GASES!!!

5. A balloon is filled with 3.50 L of water at 24.0°C and 2.27 atm. If the balloon in is placed outside on a hot day (34°C), what is the volume of the balloon (assuming constant pressure)? Explain –

6. A gas has a volume of 4.3 L at 115 kPa and 321 K. Find the pressure of the gas when the volume changes to 8.9 L and the temperature to 300. K.

7. A sample of gas occupies 1.5 L at STP. What would be the volume of gas if the temperature increased to room temperature (25.0°C) and a pressure of 600mmHg?

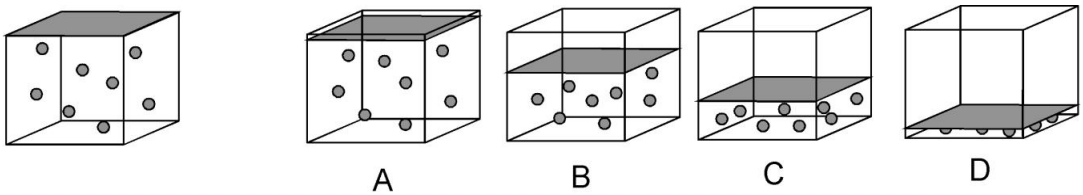
8. If 1.00 atm = 760. torr = 760. mmHg = 101.3kPa = 14.7 psi (standard pressure values), then what is 325.0 kPa in torr and atm?

9. A sample of gas has an original volume of 1500.0 mL , a temperature of 25°C and a pressure of 2.7 atm. What would the new volume be if the pressure increased to 350.0 kPa and the temperature decreased to temperature of 0°C?

10. What volume does a gas at 50.0°C, a pressure of 1125.0 torr and a volume of 525mL occupy at STP?

11. If I have 2.9 L of gas at a pressure of 5.0 atm and a temperature of 50. ^{0}C, what will be the temperature of the gas if I decrease the volume of the gas to 2.4 L and decrease the pressure to 3.0 atm?

12. Below is a gas originally at 100° C. Which would be the best representation of the same gas at -86.5 °C? (change to Kelvin first!!)



13. Draw a gas at low pressure. Then draw the same gas, in the same amount of volume and pressure but higher temperature.

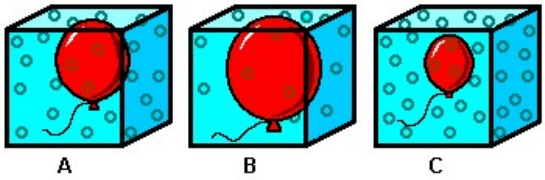
Draw "whooshies" on the particles ***in each box*** to represent their relative motion. Explain your drawing.

15. According to the kinetic-molecular theory of gases, molecules of an ideal gas —
    a. travel in curved lines of motion
    b. undergo elastic collisions
    c. are separated by small distances
    d. have strong forces between them

16. List the 7 rules for the kinetic molecular theory:

17. Three gases are mixed in a 1.00 L container. The partial pressure of CO_2 is 250 mm Hg, N_2 is 375 mm Hg, and He is 125 mm Hg. What is the pressure of the mixture of gases?

18. Label which balloon would be at 10°C, 25 °C, and 50 °C. Explain why.



19. Which molecule will diffuse faster, O_2 or Cl_2?

20. A sample of gas has a density of 3.83 g/L at 45°C and 2.50 atm. Find the density of the gas at 144 °C and 0.908 atm.

21. A sample of gas has a volume of 2.68 L when the temperature is –54.0°C and the pressure is 195.0 kPa. If the density of the gas is 0.322 g/L at STP, find the mass of the sample.

22. Compare the rates of diffusion for H_2 and N_2.

Unit 9 – REACTIONS

1. Identify reactants and products in the following equation: $CH_4 + 2\ O_2 \rightarrow CO_2 + 2H_2O$

2. Define the law of conservation of mass:

3. What is the difference between a chemical and a physical change?

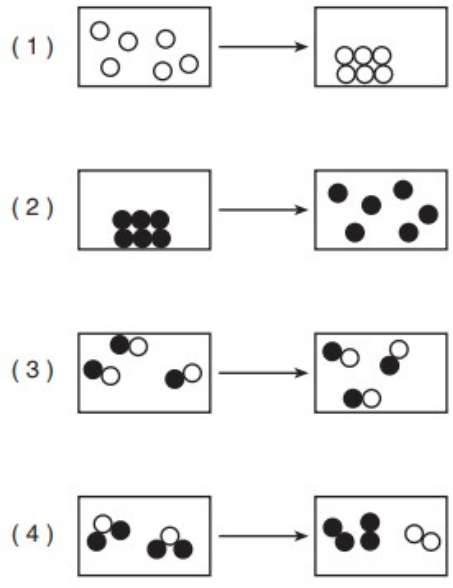
4. Identify if the following changes are chemical or physical:
    banana turning brown
    rusting bike
    making Kool-Aid
    boiling water
    grapes fermenting
    recycling aluminum
    melting gold
    baking a cake

6. Name the 4 indicators of a chemical change:

5.

Key
○ = an atom of element A
● = an atom of element Z

Which particle model diagram represents a chemical change?



7. Balancing the following equations and Name the type of reaction

____ $AlBr_3$ + ____ K → ____ KBr + ____ Al

____ FeO + ____ PdF_2 → ____ FeF_2 + ____ PdO

____ P_4 + ____ Br_2 → ____ PBr_3

____ LiCl + ____ Br_2 → ____ LiBr + ____ Cl_2

____ $CoBr_3$ + ____ $CaSO_4$ → ____ $CaBr_2$ + ____ $Co_2(SO_4)_3$

___ C_4H_{10} + ___ O_2 → ___ CO_2 + ___ H_2O

8. Illustrate a balanced equation using pictures:

____ H_2 + ____ N_2 → ____ NH_3

____ P_4 + ____ O_2 → ____ P_2O_5

9. Name and describe the 5 types of chemical reactions

10. How do I determine whether a SR reaction will occur in real life?

11. How do I determine whether a DR reaction will occur in real life?

12. Write balanced chemical equations from word descriptions, identify the type & if it occurs

    1. sulfur + oxygen → sulfur dioxide

    2. zinc + sulfuric acid (H_2SO_4)→ zinc (II) sulfate + hydrogen

    3. hydrogen + nitrogen → ammonia (NH_3)

    4. phosphorus + oxygen → diphosphorus pentoxide

    5. hydrochloric acid (HCl) + sodium hydroxide → sodium chloride + water

    6. aluminum sulfate + calcium hydroxide → aluminum hydroxide + calcium sulfate

    7. ethane (C_2H_6) + oxygen → carbon dioxide + water

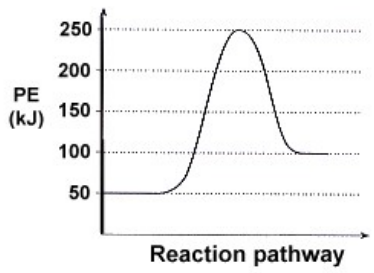
    8. aluminum oxide → aluminum + oxygen

    9. sodium oxide + aluminum phosphate → aluminum oxide + sodium phosphate

    10. potassium bromide + fluorine → potassium fluoride + bromine

13. Explain what must happen in order for a chemical reaction to occur.

14. What is the activation energy? What is ΔH? Endo or exo?



15. What factors affect the rate of a reaction?

16. Predict the products of reactions and balance the equations

1. $ZnSO_4$ + NaOH →
2. $FeCl_3$ + Na_3PO_4 →
3. $MgCO_3$ →
4. $Ba(ClO_3)_2$ + H_2SO_4 →
5. C_3H_8 + O_2 →

17. Predict the products of reactions from word descriptions & write balanced equations

a. Potassium is reacted with chlorine gas.

b. Calcium hydroxide breaks down.

c. Zinc (II) is placed in a solution of copper (II) sulfate.

d. A reaction takes place between aqueous calcium nitrate and aqueous sodium sulfate.

e. Potassium chlorate breaks down into a solid potassium chloride and oxygen gas.

f. Zinc (II) (s) + lead (II) nitrate (aq) yields

g. Aluminum bromide (aq) + chlorine (g) yields

h. hydrochloric acid + magnesium hydroxide yields

i. sulfuric acid + lithium hydroxide yields

j. phosphoric acid + aluminum hydroxide yields

18. Be able to name and write the formula of common acids and bases

1. HF = _____
2. HI = _____
3. H_2SO_4 = _____
4. HNO_2 = _____
5. NaOH = _____
6. Hydrobromic acid = _____
7. Nitric acid = _____
8. Phosphorus acid = _____
9. Sulfurous acid = _____
10. Zinc (II) hydroxide = _____

Unit 10 – Stoichiometry

1. Describe one mole of a substance in grams? In liters? In number of particles?

2. Molar mass of $CaCO_3$ =

3. Molar mass of magnesium chloride =

4. How many moles of Carbon are in 2.67 grams?

5. 4.95×10^{23} molecules of water is equal to how many moles of water?

6. How many moles of helium are in 10.72 Liters at STP?

7. How many atoms are in 1.88 grams of sulfur?

8. How many particles are in 2.50 moles of $CaCl_2$?

9. How many atoms are in 25.0 L of H_2 at STP?

10. If you had 3.35×10^{24} atoms of gold, what mass would it have in grams?

11. How many grams of sodium chloride are in 0.250 moles?

12. How many grams are in 25.0 L of H_2 at STP?

13. 0.750 moles of helium gas at STP would fill a balloon of what volume?

14. 45.70 grams of methane (CH_4) gas at STP would occupy what volume?

15. How many liters are in 4.50×10^{22} atoms of H_2 at STP?

16. For every 1 mole of Fe_2S there are how many moles of Fe? $2\ Fe\ (s) + S\ (l) \rightarrow Fe_2S\ (s)$

17. 8.500×10^{24} atoms of Fe will form how many grams of Fe_2S?

18. How many grams of NH_3 will form from 34.6 L of N_2 ? $3N_2\ (g) + H_2\ (g) \rightarrow 2NH_3\ (l)$

19. Identify the limiting reagent when given the masses of more than one reactant using a BCA table.
7.62 g of Fe are allowed to react with 8.67 g of S. $2\ Fe\ (s) + S\ (l) \rightarrow Fe_2S\ (s)$

a. Define limiting reagent –

b. What is the limiting reagent?

c. What is the reactant in excess? How much is left (g)?

d. Calculate the theoretical mass of Fe_2S formed.

e. What is the % Yield if only 1.3 grams of Fe_2S are formed when the reaction is carried out in the lab?

20. If I have 4.00 moles of a gas at a pressure of 5.60 atm and a volume of 12.0 liters, what is the temperature?

21. If I have an unknown quantity of gas at a pressure of 1.20 atm, a volume of 31.0 liters, and a temperature of 87.0 ^{0}C, how many moles of gas do I have?

22. If I contain 3.00 moles of gas in a container with a volume of 60.0 liters and at a temperature of 400. K, what is the pressure inside the container?

23. If I have 7.70 moles of gas at a pressure of 0.900 atm and at a temperature of 56.0 ^{0}C, what is the volume of the container that the gas is in?