States of Matter Remediation

States of matter is one of the most over reaching topics in chemistry. It is one of the most challenging due to the sheer quantity of material.

AP Chemistry 2014-2017 Test Analysis

Multiple choice: 18% or 9 questions

Written: Always integrated in to just about every topic in some way.

This chapter contains some very important topic but none are likely to rival the big concept of intermolecular forces and bonding states of matter. This is a large concept affecting solid, liquid and gaseous behavior. It will span multiple chapters and can likely be found in all aspects of chemistry.

Solids:

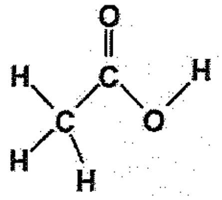
I. (#4-1a)What external factors are affecting the properties of a solid(liquids)?
   i. Student will be able to describe the actions and results of temperature change.
   ii. Student will be able to model/interpret the relationship between Pressure and temperature via a Heating curve.
   iii. Student will be able to model/interpret the relationship between Temperature and Energy via a heating curv
   iv. (#9-3a) Students will be able to determine the amount of energy given off by a chemical reaction or a fractio of that chemical reaction. (linear proportion)

II. (#4-1b /#3-4) What internal factors affecting the properties of a solid?
   a. (#3-4a) Student will be able to model, interpret, identify inter and intramolecular forces.
   b. (#3-4b) Student will be able to link inter and intramolecular forces to properties of solids, liquids, and dissolution
   c. (#3-4c) Student will be able to demonstrate how a molecule becomes polar.
   d. (#3-4d) Student will be able to label dipole moments to model a compounds solubility via particulate diagram.
   f. (#4- 1c) How do we mathematically measure the composition of solids?
      a. Students can use formulas to determine percent mass as a means describe the composition of a so
      b. Students shall be able to determine the mass of a substance via percent mass.
      c. Student should be able to determine the percent mass of a compound.
      d. Student will be able to determine the empirical formulas of ionic and covalent substances.
      e. Student shall be able to determine a molecular formula via an empirical formula.

Intermolecular forces are a large portion of this test!

1. (#3-4/#4-1b) A typical candle and Vaseline Jelly are refined straight carbon chains.
   a. What type of intermolecular force holds together the two substances? LDF
   b. What about the candle's formula make is more solid?

–longer chain



2. (#3-4/#4-1b) Pure acetic acid (see structure) solidifies at a cooler room temperature.

Covalent

a. What type of intramolecular forces that hold this molecule together? LDF / HBond
b. What are the intermolecular forces that hold this substance at a solid at just below room temperature?

3. (#3-4/#4-1b) Draw a saturated model of ~~acetic acid~~. Showing both dissolved and solid material in the beaker.

$MgCl_2$

Substance	Melting point
CaO	2613 C
NaO	1132

4. Answer the following questions relative to the data provided in the table.
   a. What types of bonding are present in each of these substances?
   Ionic
   b. Why is there a difference in the melting points?
   Calombic – size of charge.

2. Which of the following substances has the same percent mass of Carbon as $C_6H_{12}O_6$?
   a. CO_2
   [✓ b.] CH_2O
   c. CH_4
   d. C_2O_4

molecular
↓ →
CH_2O empirical
same %

3. (#4-1c) A 10g sample of hexene (C_6H_{14}) has a (Which are correct?)
I. larger mass of hydrogen then carbon N
II. larger number hydrogen atoms then carbon atoms Y
III. The C_3H_7 has percent mass of carbon and hydrogen as C_6H_{14} Y

Liquids (#4-2a)

(#3-4) <u>What are the Internal factors causing a substance to be a liquid?</u>

<u>(#4-2a) What are the external factors affecting liquids</u>

(#4-2b) <u>What are the properties of a liquid?</u>

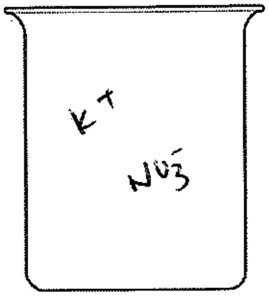
- i. (#4-2bi) Student shall be able to represent molecules dissolved in a solvent at a particulate drawing.
- ii. (#4-2bii) Student shall be able to interrelate factors affecting solubility
- iii. (#4-2biii) Student shall be able to interrelate solubility and conductivity
- iv. (#4-2biv) Student will be able to interrelate vapor pressure, temperature and how a liquid transforms to and from a liquid and a gas.
- v. Students should be able to create/interpret graphical/particulate models of solubility.
  - i. Lab: Crystal violet lab
    - 1. Students will be able to interpret a Beer's law plot.
  - ii. Lab: Make a solution via dissolving and solid and a liquid (dilute).

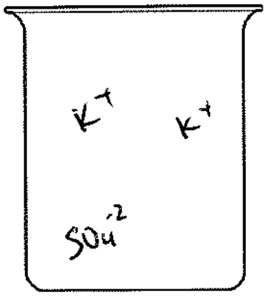
(#4- 2c) <u>How do we mathematically measure the composition of a liquid/aqueous?</u>

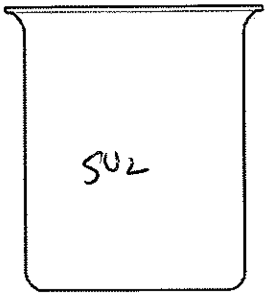
- i. (#4-2ci) Students will be able to describe the compositions of liquids. (example: Molarity).
- ii. Students will be able to describe the factors that affect the solubility of solutes in liquids.

The following clear solution have equal volumes of equal aqueous concentrations. KNO_3, K_2SO_4, and SO_2.

4. Draw a representational model of each solution.







5. Which solution is the best conductor? Justify (Which is the worst?)

K_2SO_4 – more ions

6. What might be a good way to test the concentration of one or more of these solutions in lab? Explain your why and how. → Gravimetric analysis

→

7. The following solutions are boiled away, which one would leave the largest mass of solid.

Same moles → K_2SO_4

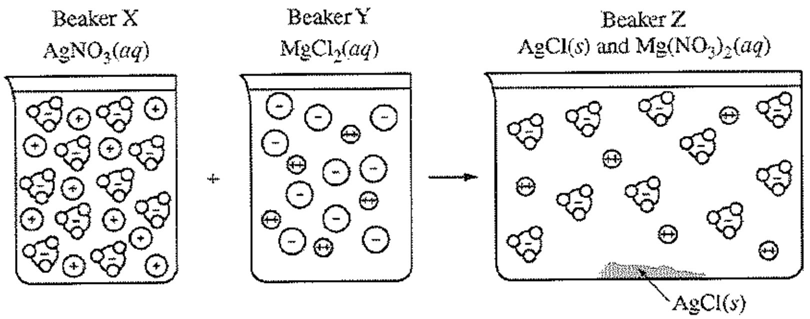
8. The SO_2 beaker was boiled away and nothing remained. Justify using principles of atomic structure and bonding. SO_2 is molecular, only needs to break IMF to boil away

9. (#4-2c) 25mL of 0.1M $MgCl_2$ is mixed with 25mL of the .2M NaCl. Which of the following is correct after the solutions are mixed? Which is correct?

I. Chloride ion concentration does not change. Yes

II. Magnesium ion concentration does not change. N

III. Sodium ion concentration is 0.1M Yes



(#4-4/11/4) Beaker X and beaker Y each contain 1.0 L of solution, as shown above. A student combines the solutions by pouring them into a larger, previously empty beaker Z and observes the formation of a white precipitate. Assuming that volumes are additive, which of the following sets of solutions could be represented by the diagram above?

$Ag^+ + Cl^- \to AgCl$

spectators: Mg^{+2} NO_3^-

	Beaker X	Beaker Y	Beaker Z
a.	2.0 *M* $AgNO_3$	2.0 *M* $MgCl_2$	4.0 *M* $Mg(NO_3)_2$ and $AgCl(s)$
b.	2.0 *M* $AgNO_3$	2.0 *M* $MgCl_2$	2.0 *M* $Mg(NO_3)_2$ and $AgCl(s)$
c.	2.0 *M* $AgNO_3$	1.0 *M* $MgCl_2$	1.0 *M* $Mg(NO_3)_2$ and $AgCl(s)$
[✓ d.]	2.0 *M* $AgNO_3$	1.0 *M* $MgCl_2$	0.50 *M* $Mg(NO_3)_2$ and $AgCl(s)$

1M Mg^{2+} → ½M

NO_3^- 2M → 1M

Gases

I. (#4- 3a/#3-4) What are the internal/external factors affecting the properties of a gas?
   a. Student can describe/recognize the difference between an ideal and non-ideal gas.
   a. (#3-4) Student shall be able to link inter molecular forces/bonding to the properties of a gas.

II. (#4-3b) What are the properties of gases?
   a. Student can interpret or model properties of gases in terms of the kinetic molecular theory.
   b. Student will be able to interpret or model changes in the following external variables
      1. Temperature
      2. Average kinetic vs. molecular speed
      3. Effusion and diffusion (calculations)
   c. Pressure; Volume; Density; Moles: (n) number of particles
   d. Students shall be able to create/interpret graphical/particulate representations of gases

III. (#4-3c) Students will be able to use the mathematical relationships of ideal gases.
   a. (#4-3c1) Combined gas law
   b. (#4-3c2) PV=nRT
   c. (#4-3c3) Students can calculate the partial pressures of gases
   d. (#4-3c4) Gas collection:
      i. Students will be able to set up a gas collection experiment.

Stoichiometry of Chemical reactions involving solids, liquids and gases

IV. (#4- 4) (All stoichiometry from honors)
   Can I use concepts of gases, liquids and solids to perform stoichiometry of chemical reactions?
   a. Student can utilize an ICE table in chemical stoichiometric calculations.
   b. Student can utilize gas laws with chemical stoichiometric calculations.
   c. Student can create models/particulate drawings that model solids, liquids and gases in chemical reactions.

10. A 4.4 L vessel at STP contains equal partial pressures of CO_2 and O_2.
   a. Draw a particulate model in the vessel to the right.
   b. What is the number of moles of each substance?
   c. What is the partial pressure of each substance?

PV=nRT or [illegible]

$n = \frac{PV}{RT}$ $\frac{1 \cdot 4.4}{.0821 \cdot 273}$ = 0.2 moles → .1 → .1

total moles (0.196)

half of total

1 atm total

½ atm

slower ↓ CO_2 ↑ faster O_2

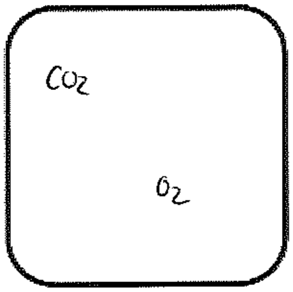
d. What is the relationship between molecular velocity CO_2 O_2

e. What is the relationship between average kinetic energy? → same

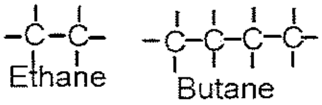
f. Under what conditions could you get one of these substances to liquify. Which one will liquify first?

↑P ↓T CO_2 ⇈ has mol LDF

Gas Density



11. (#4-3c) A 2.0L balloon is brought from the base of a skyscraper to the top. The atmospheric pressure at the base is 735mmHg and the top is 650mmHg The best approximate size of the balloon is
a. 2.0L b. 1.95L [✓ c. 2.10L] d. 4.0L



(#4-3a) If a sample of each of these ideal gases was cooled, which would likely deviate from an ideal gas?

a. ethane, due to lower molar mass

b. ethane, due to a higher amount of London Dispersion forces

[✓ c.] butane, due to a higher level of London dispersion forces

d. butane, due to a higher molar mass

$$1\,Zn + 2HCl \Rightarrow 1\,H_{2(g)} + ZnCl_2$$

12. A sample of zinc is reacted with excess HCl, producing gaseous $H_{2(g)}$. If 2.2L of H_2 of dry hydrogen gas is collected at STP, how many grams of zinc was processed by this chemical reaction? (#4-4)

$$2.2L \cdot \frac{1\,mol}{22.4\,L} = 0.1\,mol \cdot \frac{1\,mol\,Zn}{1\,mol\,H_2} = 0.1\,mol\,Zn$$

$$0.1\,mol\,Zn \cdot \frac{65\,g}{1\,mol} = 6.5\,g\,Zn$$

Gas collection