Name: _____

GENERAL CHEMISTRY
CHEM. 111 SEC. 001

EXAM II

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Spring, 2006

Answer all the questions. Do not write on this examination paper, use the blank sheets at the end of the exam for your answers. Credit will not be given for numerical questions unless all relevant calculations are shown. Please give answers to numerical questions to 3 significant figures.

1. a) 20.1g of copper(II) nitrate are dissolved in water to produce 450mL of solution. Calculate:

   i) The formal molar concentration of the solution.
   ii) The species or equilibrium molar concentrations of the solution.

   10 points

   b) 17.3g of calcium chloride are dissolved in water to produce 750mL of solution whose density is 1.031g.mL^{-1}. Calculate:

   i) The weight percent (Wt. %) of calcium chloride in the solution.

   5 points

   ii) The formal molal concentration of calcium chloride in solution.

   7 points

   iii) The species or equilibrium molal concentrations in the solution.

   3 points

   iv) The mole fraction of all components in the solution.

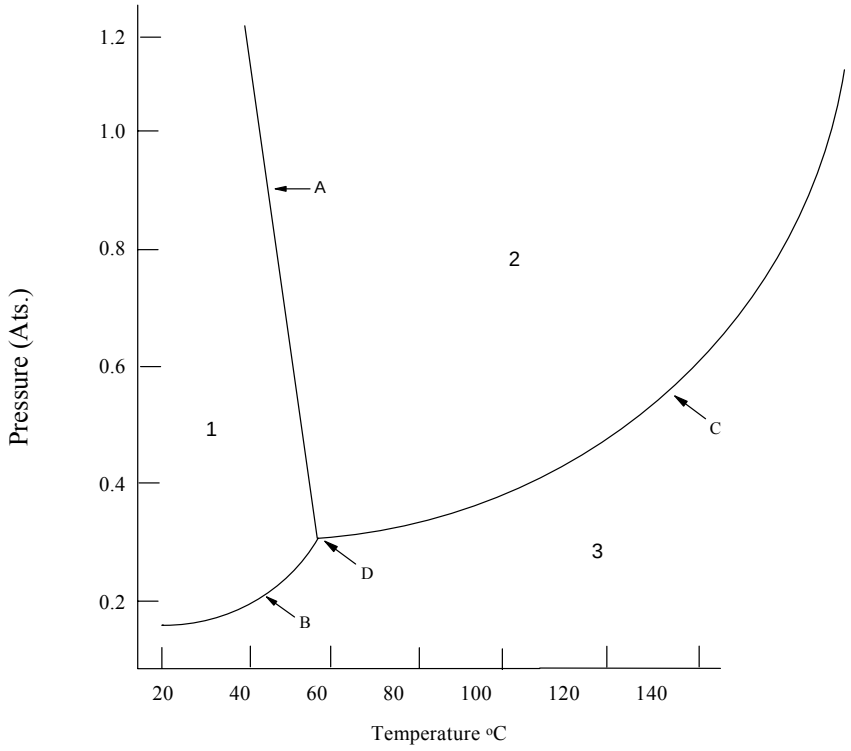
   10 points

2. Define or explain the following as appropriate.

i) Unit cell
ii) Lattice site
iii) Allotrope
iv) Le Châtelier's Principle
v) Dynamic equilibrium
vi) Miscible
vii) Saturated solution

14 points

3. The following is a phase diagram for a compound:



i) What phase exist in regions 1, 2, and 3?

6 points

ii) What phases exist in equilibrium at points A, B, C and D?

8 points

iii) At 1.0 atmosphere pressure at what temperature does the compound melt?

4 points

iv) At 1.0 atmosphere pressure at what temperature does the compound boil?

4 points

v) At 30°C if I increase the pressure from 0 – 1.0 ats. what phase changes take place?

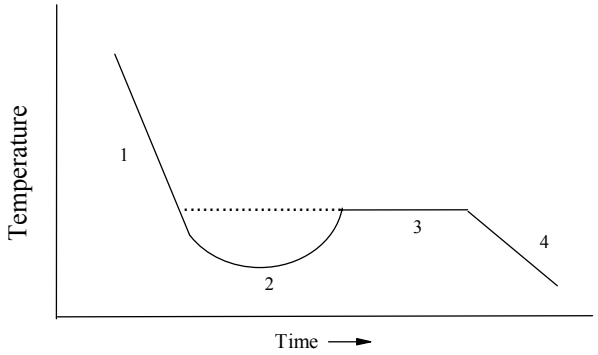
4 points

4. a) Explain the difference in melting points of the following compounds:

Compound	**Melting Point**
Ne	-248°C
HCl	-115°C
H_2O	0°C
NaCl	801°C

5 points

b)



The above is a cooling curve for a compound. Explain what is happening at points 1, 2, 3, and 4.

10 points

c) Acetylene is a gas which is soluble in a liquid acetone. At 1.0 ats pressure the solubility of acetylene in acetone is $20 g.L^{-1}$. Calculate the solubility of acetylene in acetone at 20 ats pressure.

10 points

USEFUL INFORMATION

$C_{(g)} = k\ P_{(g)}$

$C_{(g)}$ = concentration of gas in solution

k = Henry's law constant

$P_{(g)}$ = Partial pressure of the gas

ANSWERS

1. a)

   i) 0.238M

   ii) $[Cu^{2+}] = 0.238M$

   $\left[NO_3^-\right] = 0.476M$

   b)

   i) 2.24 wt%
   ii) 0.206m
   iii) $[Ca^{2+}] = 0.206m$
   $[Cl^-] = 0.413m$
   iv) Species in solution Ca^{2+}, Cl^-, H_2O
   $\chi_{Ca^{2+}} = 3.67 \text{ X } 10^{-3}$

   $\chi_{Cl^-} = 7.35 \text{ X } 10^{-3}$

   $\chi_{H_2O} = 0.988$

2.

   i) A unit cell is the basic unit that is repeated through a crystal structure to give the bulk crystalline material.

   ii) A lattice site is a position in a crystal structure occupied by an atom, molecule or ion.

   iii) An allotrope is when a compound occurs with different crystal structures each having the same chemical composition.

   iv) Le Châtelier's Principle states that when a stress is placed upon a system in dynamic equilibrium, the equilibrium will move in a direction to oppose that stress.

   v) A dynamic equilibrium is a system that appears to remain unchanged on a macro scale but is undergoing constant change on the molecular scale.

   vi) This is when two materials are mutually soluble

   vii) This is a solution that has the maximum amount of solute possible dissolved in it at some constant temperature.

3.

   i) solid, liquid, gas
   ii) solid/liquid, solid/gas, liquid/gas, solid/liquid/gas
   iii) ~ 43° C

iv) ~155° C

v) gas, gas/solid, solid

4 a) Even though the compounds have different molecular weights, this alone cannot explain the boiling points. The boiling points do however follow the strength of the intermolecular forces. Ne has only London Dispersion forces, HCl has dipole-dipole forces, H_2O has hydrogen bonding and NaCl has ionic interactions.

b) The material is cooling down and loosing kinetic energy (KE). The compound is supercooled and remains a liquid below its freezing point. The material is at its freezing point and the liquid is converting to a solid. It is loosing potential energy (P.E.) The solid is cooling down and loosing KE.

c) $400 g.L^{-1}$