This is a sample Midterm #1 (way longer then one midterm) that I (Rolf Unterleitner) have made up for all the sections of chemistry 2B. I will go over the solutions **from 7:00 pm->?(likely 2 hours) Wedn. the 23st in 3216 Dutton Hall.** Please **do not** ask the Prof. or the TA's for the solution they do not have them thank you. **The answers are on the last page.**

1) If 10 J of heat is added to 5.00 grams of copper (Csp=0.39 J/g°C) at 25°C what will its final temperature be?
   a) 25°C
   b) 153.2°C
   c) 30.2°C
   d) 19.9°C

2) All of the following except one of these is exothermic which is not.

   a) condensation b) combustion c) freezing
   d) boiling e) $\Delta H°_f$ of Si(g)

3) Which of the following substances would have the highest equilibrium vapor pressure.

   a) C_2H_5OH b) $KClO_3$ c) CH_4 d) H_2O

4) If a salt is added to a solvent which of the following would not be correct.

   a) the boiling point would be higher.
   b) the freezing point would be lower
   c) the equilibrium vapor pressure of the solvent over the solution would be lowered
   d) the equilibrium vapor pressure of the solute over the solution would be lowered

5) Which is the reason for the fact the H_2O has a much higher boiling point then H_2S.

   a) H_2S is larger
   b) H_2O has hydrogen bonding H_2S doesn't
   c) H_2O is lighter
   d) The ionic bonding in H_2O is stronger

6) Which of the following is not a state function.

   a) total internal energy
   b) change in heat at constant pressure
   c) work
   d) temperature

7) If the structure of an element is found to have 4 atoms per unit cell then it is said to be:
   a) face centered b) body centered c) self centered d) simple

8) Which of the following is the correct reason for why molality is used instead of molarity for freezing point depression and boiling point elevation.
a) Molality is easy to calculate
b) Molality is independent of temperature
c) Molality can more easily be measured when things are cold
d) Molarity is independent of temperature

9) Which of the following is false for the change in enthalpy.

a) It is equal to the heat at constant pressure (or $\Delta H=q_p$).
b) $\Delta H=\Delta U+ \Delta PV+ P\Delta V$
c) $\Delta H=\Delta U+ P\Delta V$ @ constant pressure
d) It is always positive.

10) Which of the following is not a state function?
a) ΔH b) ΔU c) T d) V e) w

11) Which of the following phase changes would give off the most heat?
a) l ⇒ s b) l ⇒ g c) g ⇒ l d) g ⇒ s

12) Consider the following substances CH_3CH_2OH, SiH_4, SiF_4, CH_3OCH_3, and $Ca(ClO_3)_2$. Which answer has the substances arranged in order of increasing enthalpy of vaporization?

a) $CH_3OCH_3 < CH_3CH_2OH < SiH_4 < SiF_4 < Ca(ClO_3)_2$
b) $SiH_4 < SiF_4 < CH_3OCH_3 < CH_3CH_2OH < Ca(ClO_3)_2$
c) $SiF_4 < SiH_4 < CH_3OCH_3 < CH_3CH_2OH < Ca(ClO_3)_2$
d) $Ca(ClO_3)_2 < CH_3CH_2OH < SiF_4 < SiH_4 < CH_3OCH_3$

13) Which of the following reactions would the do the most work @ constant T and P.

a) $CH_4(g) + 3/2\ O_2(g) \Rightarrow CO_2(g) + 2H_2O(g)$
b) $C_3H_6O_3(g) +3\ O_2(g) \Rightarrow 3\ CO_2(g) + 3\ H_2O(l)$
c) $2\ SO_2(g) + O_2(g) \Rightarrow 2\ SO_3(g)$
d) $2C_6H_{12}O_5(s) + 13\ O_2(g) \Rightarrow 12\ CO_2(g) + 12\ H_2O(l)$

14) Above which point can a gas never be turned into a liquid by applying pressure.

a) triple point
b) the boiling point
c) the critical point
d) the melting point

15) The colligative molarity (M•i) of a 5.0 M $Al_2(SO_4)_3$ is?
a) 5 M_c b) 20M_c c) 25 M_c d) 15 M_c

16) $\Delta H°_f$ for elements in there natural state is always:
a) Positive b) Negative c) Zero

17) On a face centered cubic how much of atoms on the faces are in the unit cell?

a) 1 b) 1/2 c) 1/8 d) 1/4

18) Which of the following is not a colligative property?

a) Freezing pt depression
b) Osmotic pressure
c) Vapor pressure lowering
d) Henry's Law

19) A cell with a colligaive molarity (M•i) of .30 M_c is placed in a solution with a colligaive molarity of 0.20 M_c which of the following would be true.

a) The solute would flow into the cell causing the concentration in the cell to increase.
b) The solvent would flow from the cell to the solution causing the cell to shrink.
c) The solvent would flow from the solution to the cell causing the cell to expand.
d) The solute would flow from the cell to the solution causing the cell to shrink..
e) The cell would remain unchanged.

20) What is the best reason that the boiling point of HBr is higher then HCl

a) Ionic bonding b) dipole dipole interaction c) hydrogen bonding d) london forces

21) Which of the following solutions would have the lowest boiling point the solvent in each case is ethenol CH_3CH_2OH.(assume solublity is about the same in ethenol as water)

a) 1.00 m $CaBr_2$ b) 1.50 m NaCl c) 2.00 m HF d) 2.00 m H_2O e) 1.50 m CH_3OH

22) Given the molality of a aqueous NH_4ClO_4 solution is about 0.20 m, estimate the boiling point of the solution.

a) 99.8°C
b) 100.0°C
c) .21°C
d) 100.21°C
e) 0.21 K

23) A 0.500 g sample of a Vitamin K is dissolved in 10.0 grams of camphor.. The resulting solution has a freezing point of 175.37°C. Given K_f=40.0°C/m_c and n.m.p=179.8°C. Calculate the molar mass of the Vitamin K $g \cdot mol^{-1}$:

a) 171
b) 451
c) 8.53
d) 0.721
e) 3.47

24) The osmotic pressure of a .30 M solution of sucrose $C_{12}H_{22}O_{11}$ in water at 37°C is

a) 27atm
b) 7.6 atm
c) 14.7 atm
d) 1.0 atm
e) 3.5 atm

25) How many grams of CO_2 would be released if 250.0mL if the pressure of $CO_2(g)$ over a water is changed from 1.00 atm to 0.50 atm. Given the $k_h=3.03x10^{-5}$ M/torr for $CO_2(g)$ over water.

a) 0.507 grams
b) 1.67x10-4 grams
c) 0.127 grams
d) 1.0 grams
e) 3.5 grams

Part II

1) What would the equilibrium vapor pressure over $Br_2(l)$ be at 45°C given bromine's normal boiling point of 332 K and $\Delta H_{vap}=29.5kJ/mol$. (Hint: You should be able to tell me the equilibrium vapor pressure of the $Br_2(g)$ at 332 K)

2) A 28.2 gram sample of copper (C_{sp}=.685 J/gK) is placed in a coffee cup calorimeter containing 100.0 gram of water that just stopped boiling after some time the temperature of the water becomes constant at 92.3°C. Assuming the atmospheric pressure is 1 atm calculate the initial temperature of the copper block assume no heat is lost to the surroundings.
Cp(H_2O)=75.2 J/mole K

 T_i=_____

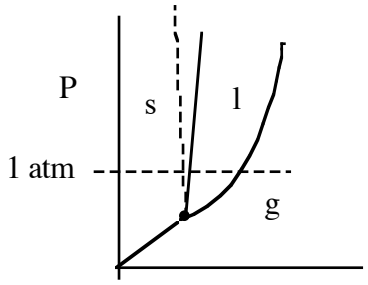
3) Calculate $\Delta H°_f$ for ethanol $C_2H_5OH(l)$ liquid. Given that $\Delta H°_{comb}$=-1368kJ/mole for $C_2H_5OH(l)$, $\Delta H°_f(CO_2)$=-393.0 kJ/mol, $\Delta H°_f(H_2O(l))$=-285.0kJ/mol
(Hint: You need the balanced chemical equation.)

ΔH_____

4) Given the following values for a new compound 2BX

normal boiling point=280 K, normal melting point=130 K, triple point =100 K at .25 atm the critical point is=465K at 150 atm.
For the phase for 2BX below label all appropriate points.

Might complete first



Using the above information answer the following

1) Over what temperature range would sublimation take place. _____

2) Above or below (circle one) what pressure would sublimation not take place._____

3) Above or below (circle one) what temperature would you be unable to liquefy the

vapor?_____

4) At what temperature and pressure would all three phases co-exist._____

5) You can condense 2BX vapor by reducing or increasing (circle one) the pressure

between what temperatures._____ _____

5) 25.0 grams of CaO(s) is added to a calorimeter made up of 10.0 grams of ice in100.0 grams of water all in a cup with a heat capacity of 15 J/°C. Calculate the final temperature of the bath after the rxn is completed. Given C_p=4.184 J/g°C for water, ΔH_{fus}=6.01kJ/mole for H_2O. (Assume: The solutions heat capacity and volume after the reaction is the same as the total H_2O, and that the amount of water is used in the reaction is not significant.)

$$CaO(s) + H_2O(l) \Rightarrow Ca(OH)_2(aq) \qquad \Delta H°_{rxn}=-66.17kJ$$

T_f=_____

6) Calculate $\Delta H°_{rxn}$ for:

$$2\ O_2(g) + 8\ NO(g) + 2\ C_6H_{12}O_6(s) \Rightarrow 8\ NH_3(g) + 12\ CO_2(g)$$

Given that $\Delta H°_{comb}$ for $C_6H_{12}O_6(s)$ is -2815.8kJ/mole and that $\Delta H°_{vap}$ for water=40.7kJ/mole as well as the reaction below,

$$4\ NH_3(g) + 5\ O_2(g) \Rightarrow 4\ NO(g) + 6\ H_2O(g) \quad \Delta H°_{rxn}=-1170kJ$$

$\Delta H°_{rxn}$=_____

7) Calculate the following for an aqueous solution that is 50% by volume ethanol C_2H_5OH (density=0.789g/mL for ethanol). Assume the volumes are additive upon mixing.

a) The mole fraction of each in the liquid phase.

X_{H_2O}=_____ $X_{C_2H_5OH}$=_____

b) Calculate the total pressure over the solution at 25°C given that the equilibrium vapor pressure of water is 23.8 torr and ethanol is 45.2 torr.

P_t=_____

c) The mole fraction of each in the gas phase.

X_{H_2O}=_____ $X_{C_2H_5OH}$=_____

8) Platinum is know to crystallizes in a face centered cubic lattice and has a crystallographic radious of 139 pm. Calculate the density of platinum in g/cm^3. (hint: in a face centered cubic lattice the atoms atoms touch along the diagnal accross the face of the cube so $4r=\sqrt{2}\cdot l$)

9) Match only the ΔH___ **below** with the corresponding reaction put in NR if there is **n**o **r**elationship to enthalpies given below. Use coefficents and signs to make the relationship correct, there could be more than one possiblity. In those cases give both answers.

The enthalpies for this problem

ΔH_{vap} , ΔH_{fus} , $\Delta H°_f$, $\Delta H°_{comb}$

a) $Na(s) \Rightarrow Na(g)$ _____

b) $2\ Na(s) + S(s) + 3/2\ O_2(g) \Rightarrow Na_2SO_4(s)$ _____

c) $P(s) \Rightarrow P(l)$ _____

d) $C(s)(graphite) + O_2(g) \Rightarrow CO_2(g)$ _____

e) $C(s)(diamond) + O_2(g) \Rightarrow CO_2(g)$ _____

f) $2\ C_2H_6(g) + 7\ O_2(g) \Rightarrow 4\ CO_2(g) + 6\ H_2O(l)$ _____

g) $2\ C_2H_6(g) \Rightarrow 4\ C(s) + 6\ H_2(g)$ _____

h) $2\ H_2(g) + O_2(g) \Rightarrow 2\ H_2O(l)$ _____

i) $3Fe(g) \Rightarrow 3Fe(l)$ _____

Answers to the sample test

Warning: There may be mistakes by the end of the review all the mistakes should have been corrected, do not spend hours on one problem that could simply just be the wrong answer typed down here.

Page 1 1) c 2) d 3) c 4) d 5) b 6) c 7) a 8) b

Page 2 9) d 10) e 11) d 12) b 13) a 14) c 15) c 16) c 17) b 18) d

Page 3 19) c 20) d 21) e 22) d 23)b 24)b 25) c

Page 4 part II 1) 0.628 atm 2) -74.1°C

Page 5 3) -273 kJ/mole

4) 1) 0 K⇒100 K 2) above .25 atm 3) above 465 K 4) 100 K, 0.25 atm

5) incr 100 K⇒465 K c) yes, but at low pressure.

Page 6 5) 55,0°C

Page 7 6) -2800 kJ

Page 8) 7) a) $X(H_2O)$ =0.764 $X(C_2H_5OH)$ =0.236

b) 28.86 torr c) $X(H_2O)$ =0.630 $X(C_2H_5OH)$ =0.370 8) 21.3 g/cm^3

Page 9) 9) a) $\approx\Delta H_{vap} + \Delta H_{fus}$ (it is ΔH_{sub}) also it is $\Delta H°_f$ of Na(g) b) $\Delta H°_f$ of $Na_2SO_4(s)$

c) ΔH_{fus} also it is $\Delta H°_f$ of P(l) d) $\Delta H°_f$ of $CO_2(g)$ also $\Delta H°_{comb}$ of C(s) graphite

e) only $\Delta H°_{comb}$ of C(s) diamond f) $2\Delta H°_{comb}$ of $C_2H_6(g)$

g) $-2\Delta H_f°$ of $C_2H_6(g)$ h) $2\Delta H°_f$ of $H_2O(l)$ also $2\Delta H°_{comb}$ of $H_2(g)$ i) $-3\Delta H_{vap}$ of Fe