HW01 - Phase Changes/Diagrams & Colligative Properties

Question 1 0.75 pts

Given that you have 14.5 moles of N_2, how many moles of H_2 are theoretically needed to produce 30.0 moles of NH_3 according to reaction below?

$$N_2 + 3H_2 \rightarrow 2NH_3$$

- 15.0 moles of H_2
- 45.0 moles of H_2
- No matter how many moles of H_2 are added, 30.0 moles of NH_3 cannot be produced.
- 33.8 moles of H_2

Question 2 0.75 pts

Consider the following reaction:

$$2NH_3 + CH_3OH \rightarrow \text{products}$$

How much NH_3 is needed to react completely with 34g of CH_3OH?

- 1.3g NH_3
- 128g NH_3
- 36g NH_3
- 9g NH_3

Question 3 0.75 pts

Ice is heated at a constant pressure until it melts and vaporizes. What signs are associated with the total change in entropy and enthalpy (ΔS and ΔH) for this sample of water?

- $\Delta S = -$, $\Delta H = +$
- $\Delta S = -$, $\Delta H = -$
- $\Delta S = +$, $\Delta H = -$
- $\Delta S = +$, $\Delta H = +$

Question 4 0.75 pts

Which of the phase changes below might have a $\Delta H = 11.6\ kJ \cdot mol^{-1}$?

- condensation
- freezing
- deposition
- evaporation

Question 5 0.75 pts

Which of the following statements is ALWAYS true about deposition?

- $\Delta G < 0$
- $\Delta S > 0$
- $\Delta H < 0$
- None of the other answers are correct

Question 6 0.75 pts

Consider liquid ethane (CH_3CH_3) and liquid methanol (CH_3OH). Which would you expect to have a larger ΔH of vaporization?

- Methanol, because it has stronger IMFs.
- Ethane, because it has stronger IMFs.
- It is impossible to tell unless you know the amount of each liquid involved.
- Methanol because it has a larger molar mass.

Question 7 0.75 pts

What is the change in entropy (ΔS_{vap}) for the vaporization of ethanol ($\Delta H_{vap} = 38.6\ kJ \cdot mol^{-1}$) at its standard boiling temperature (78.4°C)?

- 0.110 J·mol-1·K-1
- 492 J·mol-1·K-1
- 110 $J \cdot mol^{-1} \cdot K^{-1}$
- 0.492 J·mol-1·K-1

Question 8 0.75 pts

The $\Delta H°_{vap}$ of methane is 8.519 $kJ \cdot mol^{-1}$ and its $\Delta S°_{vap}$ is 85.58 $J \cdot mol^{-1} \cdot K^{-1}$. What is the boiling point of methane?

- 0.09954 K
- 99.54 K
- 0.09954°C
- 372.54 K

Question 9 0.75 pts

How much heat is required to heat 2 grams of ice at -30°C to steam at 100°C. Use the approximate values below for your calculations:

$c_{ice} = 2\ J\ g^{-1}\ °C^{-1}$

$\Delta H_{fus} = 340\ J\ g^{-1}$

$c_{water} = 4\ J\ g^{-1}\ °C^{-1}$

$\Delta H_{vap} = 2260\ J\ g^{-1}$

$c_{steam} = 2\ J\ g^{-1}\ °C^{-1}$

- 6120 kJ
- 6.12 kJ
- 1.60 kJ
- 6.00 kJ

Question 10 0.75 pts

Which of the following would change the vapor pressure of a sample of water in a closed container?

1. decreasing the size of the container
2. lower the container temperature
3. removing water from the container

- 1, 2, and 3
- 2 and 3
- 1 and 2
- 2 only

Question 11 0.75 pts

Which would have a higher vapor pressure: ethanol (C_2H_5OH) or dimethyl ether (CH_3OCH_3)?

- They would have the same vapor pressure as their molecular weights are the same.
- ethanol
- It is impossible to tell unless the amount of each substance is known.
- dimethyl ether

Question 12 0.75 pts

Rank the following liquids by vapor pressure from lowest to highest: C_5H_{12}, CH_4, C_3H_8, C_2H_6, C_4H_{10}.

- $C_5H_{12} < C_4H_{10} < C_3H_8 < C_2H_6 < CH_4$
- $CH_4 < C_2H_6 < C_3H_8 < C_4H_{10} < C_5H_{12}$
- $CH_4 < C_5H_{12} < C_4H_{10} < C_3H_8 < C_2H_6$
- $C_2H_6 < C_3H_8 < C_4H_{10} < C_5H_{12} < CH_4$

Question 13 0.75 pts

In a closed vessel containing water, the pressure is 18 torr. If we add more water to the vessel, this equilibrium pressure would...

- change, but it is not possible to know if it will increase or decrease without more information.
- decrease.
- increase.
- remain the same.

Question 14 0.75 pts

Consider two empty containers A and B whose volumes are 10mL and 20mL respectively. 1mL of liquid water is put into each container and the temperature of each container is adjusted to 20°C. The gas pressure in container B, which still has some liquid water in it, is found to be 17 torr. How would the pressure in container A and the amount of liquid water in container A compare to that of container B?

- the pressure would be greater, there would be an equal amount of liquid water
- the pressure would be greater, there would be less liquid water
- the pressure would be the same, there would be more liquid water
- the pressure would be the same, there would be an equal amount of liquid water

Question 15 0.75 pts

What is the vapor pressure of carbon disulfide at its normal boiling point?

- 22.4 atm
- 2.0 atm
- Not enough information.
- 1.0 atm

Question 16 1.75 pts

At 20°C the vapor pressure of dry ice is 56.5 atm. If 10g of dry ice (solid CO_2) is placed in an evacuated 0.25 L chamber at a constant 20°C, will all of the solid sublime?

- Some of the dry ice will sublime, but not all of it.
- Yes.
- There is not enough information to answer this question.
- None of dry ice would sublime.

Question 17 1 pts

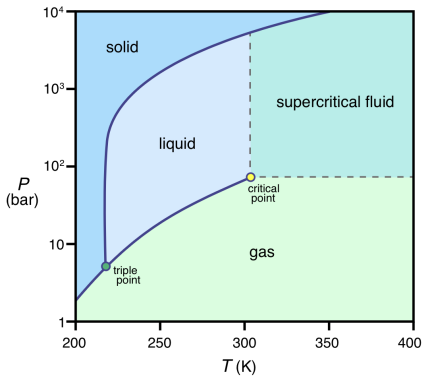
An unknown liquid has a vapor pressure of 88 mmHg at 45°C and 39 mmHg at 25°C. What is its heat of vaporization?

- 2000 J/mol
- 2000 kJ/mol
- 32,000 kJ/mol
- 32 kJ/mol

Question 18 1 pts

Use the phase diagram for CO_2 provided below to answer the following question:

At 300K and 10 bar, what is the stable phase of carbon dioxide?



- gaseous carbon dioxide
- carbon dioxide as supercritical fluid
- liquid carbon dioxide
- solid carbon dioxide

Question 19 1 pts

Use the phase diagram for CO_2 in the question above to answer the following:

A sample of carbon dioxide is stored at 10,000 bar and 250K. This sample is then decompressed to 1 bar at constant temperature. Then, at constant pressure it is heated to 400K. Next, it is compressed at constant temperature to 200 bar. According to the phase diagram, how many phase transitions has the sample of carbon dioxide gone through, and what is its final state?

- 3, supercritical fluid
- 2, gas
- 2, supercritical fluid
- 3, liquid

Question 20 1 pts

_____ are made when _____ are dissolved in _____.

- solutions, solutes, solvents
- solutes, solutions, solvents
- solvents, solutes, solutions
- solutions, solvents, solutes

Question 21 1 pts

Both ammonia (NH_3) and phosphine (PH_3) are soluble in water. Which is least soluble and why?

- ammonia because it does not form hydrogen bonds with water molecules
- phosphine because the P-H bonds are so strong that they cannot break to enable phosphine to hydrogen-bond with water
- ammonia because the N-H bonds are so strong that they cannot break to enable the ammonia to hydrogen-bond with water
- phosphine because it does not form hydrogen bonds with water molecules

Question 22 1 pts

Rank the following in terms of decreasing miscibility in C_8H_{18} (octane), a major component of gasoline: C_2H_5Cl (chloroethane), H_2O (water), C_2H_5F (fluoroethane), and C_9H_{20} (nonane).

- $H_2O > C_9H_{20} > C_2H_5Cl > C_2H_5F$
- $C_2H_5Cl > C_2H_5F > H_2O > C_9H_{20}$
- $C_9H_{20} > C_2H_5Cl > C_2H_5F > H_2O$
- $H_2O > C_2H_5F > C_2H_5Cl > C_9H_{20}$

Question 23 1 pts

Which of the following is a possible combination of values for $\Delta H_{lattice}$ and $\Delta H_{hydration}$ respectively for a salt whose dissolution is endothermic?

- +500, -520
- -200, -304
- +640, -620
- -560, +560

Question 24 1 pts

Which of the following would increase the solubility of a gas in water?

1. increase the temperature of the water

2. decrease the temperature of the water

3. increase the pressure of the gas above the water

- 1 only
- 2 only
- 2 and 3
- 1 and 3

Question 25 1 pts

In which of the following pairs do both compounds have a van't Hoff factor (i) of 2?

- sodium chloride and magnesium sulfate
- glucose and sodium chloride
- perchloric acid and barium hydroxide
- sodium sulfate and potassium chloride

Question 26 1 pts

For solutions of a non-electrolyte, the van't Hoff factor is:

Question 27 1 pts

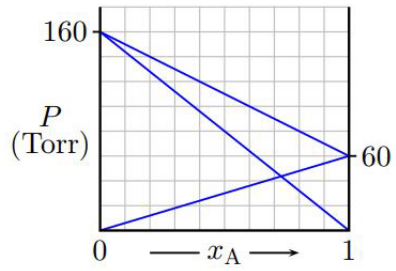
How many moles of ions are contained in 1.27 L of a 1.75 M solution of $Mg(NO_3)_2$? Please answer in mol.

Question 28 1 pts

Calculate the vapor pressure at 20°C of a solution containing 0.61g of naphthalene in 16g of chloroform ($CHCl_3$). Naphthalene ($C_{10}H_8$) has a low vapor pressure and may be assumed to be nonvolatile. The vapor pressure of chloroform at 20°C is 156 torr. Please answer in torr.

Question 29 1 pts

Substances A and B are mildly volatile solvents. Using the diagram below, determine the mole fraction of B when the vapor pressure of the mixture is 80 Torr.



Question 30 1 pts

At 293 K, methanol has a vapor pressure of 97.7 Torr and ethanol has a vapor pressure of 44.6 Torr. What would be the vapor pressure of a mixture of 80 g of ethanol and 97 g of methanol at 293 K? Please answer in torr.

Question 31 1 pts

The freezing point of seawater is about -1.85°C. If seawater is an aqueous solution of sodium chloride, calculate the molality of seawater. The k_f for water is 1.86 K/m. Please answer in molal.

Question 32 1 pts

What will be the freezing point of a solution of 8 moles of sodium dichromate ($Na_2Cr_2O_7$) dissolved in 16 kg of water? Please answer in K.

Use the following values:

K_b = 0.512 K/m

K_f = 1.86 K/m

Question 33 1 pts

Rank the following aqueous solutions from lowest to highest boiling point: 0.5 m NaCl, 1 m KCl, 0.5 m $BaCl_2$, and 1 m $Ba(NO_3)_2$. All salt are dissolved in water.

- 1 m $Ba(NO_3)_2$ < 0.5 m NaCl < 0.5 m $BaCl_2$ < 1 m KCl
- 0.5 m NaCl < 0.5 m $BaCl_2$ < 1 m KCl < 1 m $Ba(NO_3)_2$
- 1 m KCl < 1 m $Ba(NO_3)_2$ < 0.5 m NaCl < 0.5 m $BaCl_2$
- 0.5 m $BaCl_2$ < 1 m KCl < 1 m $Ba(NO_3)_2$ < 0.5 m NaCl