003 version ______ last name ______ first name ______ signature

practice Exam 1 practice

MWF Classes · Spring 2016

REMEMBER: Bubble in ALL Bubblesheet information!

This includes your first and last name, your UTEID, and your version number.

Please refer to the back of the bubble sheet for more info.

$R = 8.314$ J/mol·K

$R = 0.08206$ L atm/mol·K

$R = 62.36$ L torr/mol·K

1 atm $= 1.01325 \times 10^5$ Pa

1 atm $= 760$ torr

1 atm $= 14.7$ psi

water data

$K_f = 1.86\ °C/m$

$K_b = 0.512\ °C/m$

$C_{s,ice} = 2.09$ J/g K

$C_{s,water} = 4.184$ J/g K

$C_{s,steam} = 2.03$ J/g K

$\Delta H_{fus} = 334$ J/g

$\Delta H_{vap} = 2260$ J/g

$PV = nRT$

$q = m \cdot C_s \cdot \Delta T \qquad q = m \cdot \Delta H_{change}$

$\ln\left(\frac{P_2}{P_1}\right) = \frac{\Delta H_{vap}}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

$\Delta H_{solution} = \Delta H_{lattice} + \Delta H_{hydration}$

$P_A = \chi_A \cdot P_A^\circ$

$\Delta T_f = i \cdot K_f \cdot m \qquad \Delta T_b = i \cdot K_b \cdot m$

$\Pi = i \cdot MRT$

$G = H - TS \qquad \Delta G = \Delta H - T\Delta S$

NOTE: Please keep your Exam copy intact (all pages still stapled). You must turn in your exam copy, plus your bubble sheet, and any scratch paper.

This print-out should have 25 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 4.0 points

On a hiking expedition with Bear Grylls, you 'accidentally' end up in a huge chasm 2 km below sea level. Bear, being the resourceful TV star that he is, builds a fire and promptly starts to heat some water to cook the local snake for dinner. At what temperature do you expect Bear's water to boil?

1. At 100°C exactly

2. Higher than 100°C

3. None of these; Bear Grylls eats his food raw!

4. Lower than 100°C

002 4.0 points

Nitrogen gas, $N_2(g)$, has a certain solubility when dissolved in water. In which of the following cases would the solubility of $N_2(g)$ increase?

I) changing to a less polar solvent
II) increasing the amount of solvent
III) increasing the pressure of $N_2(g)$

1. I only

2. I, II and III

3. I and II

4. I and III

5. II only

6. III only

7. II and III

003 4.0 points

A solution containing all of the solute that a solvent can dissolve at a certain temperature and pressure is called

1. an unsaturated solution.

2. a supersaturated solution.

3. a concentrated solution.

4. a saturated solution.

004 4.0 points

What is K_{sp} for Ag_3PO_4, if its molar solubility is 2.7×10^{-6} mol/L?

1. 1.4×10^{-21}

2. 7.3×10^{-12}

3. 5.3×10^{-16}

4. 2.0×10^{-17}

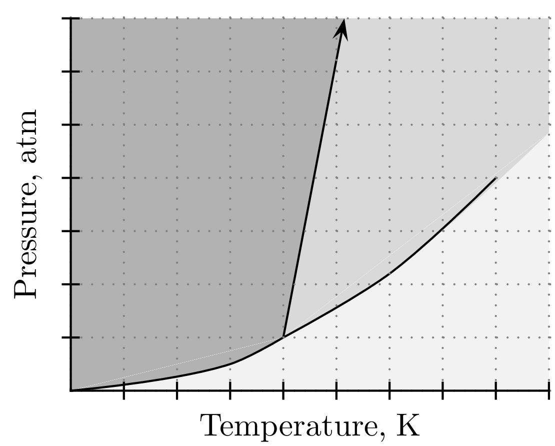
5. 5.3×10^{-23}

6. 4.8×10^{-22}

7. 1.7×10^{-14}

005 4.0 points

The phase diagram for a pure compound is given below.



All of the following could have a similar phase diagram except

1. methanol.

2. carbon dioxide.

3. benzene.

4. water.

5. carbon tetrachloride.

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006 4.0 points

Theoretically, it would be harder to dissolve ($NaCl/Al_2S_3$) in water because the (higher/lower) the charge density, the lower the solubility.

1. Al_2S_3, higher

2. Al_2S_3, lower

3. NaCl, higher

4. NaCl, lower

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007 4.0 points

What mass of ethylene glycol ($(CH_2OH)_2$ with molecular weight 62 g/mol) must be added to 1.00 L of H_2O (of mass 1 kg) to lower the freezing point to -5°C? $K_{\mathrm{f}\ H_2O} = 1.86$°C/$m$.

1. 330 g

2. 66 g

3. 25 g

4. 167 g

5. 123 g

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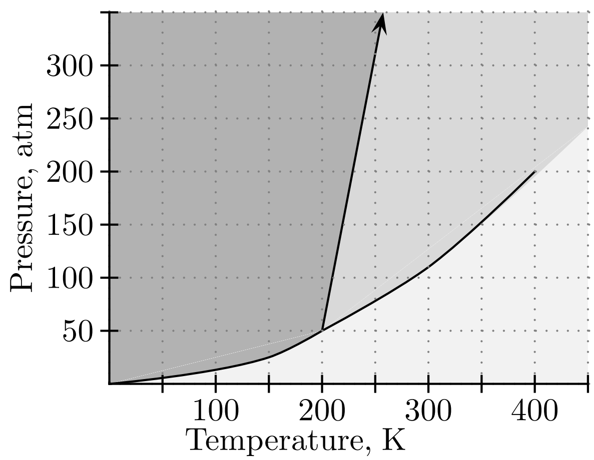
008 4.0 points

The phase diagram for a pure substance is given below.



The substance is stored in a container at 150 atm at 25°C. Describe what happens if the container is opened at 25°C.

1. The liquid in the container vaporizes.

2. The solid in the container melts.

3. The vapor in the container escapes.

4. The liquid in the container freezes.

5. The solid in the container sublimes.

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009 4.0 points

$\Delta G^\circ_{\mathrm{vap}}$ for $H_2O(\ell)$ at 85°C is (< 0, $= 0$, > 0) and at 100°C is (< 0, $= 0$, > 0).

1. < 0; < 0

2. < 0; > 0

3. > 0; $= 0$

4. < 0; $= 0$

5. > 0; > 0

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010 4.0 points

Estimate the enthalpy of vaporization of CCl_4 given that at 25°C and 58°C its vapor pressure is 107 and 405 torr, respectively. Assume that the enthalpy of vaporization is independent of the temperature.

1. 48.6 kJ$\cdot$ mol^{-1}

2. 33.1 kJ·mol^{-1}

3. 142 kJ·mol^{-1}

4. 3.98 kJ·mol^{-1}

5. 486 J·mol^{-1}

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011 4.0 points

What is the molar solubility of Ag_2S? The K_{sp} is 6.3×10^{-51}.

1. 6.37×10^{-15}

2. 7.94×10^{-26}

3. 5.8×10^{-18}

4. 2.82×10^{-13}

5. 1.16×10^{-17}

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012 4.0 points

Consider a 200 g block of ice at standard pressure. If it is initially at −23 °C and is heated until it is steam at 148 °C, how much total heat was added to the sample of water? Use the following thermodynamic values for your calculation:

$c_{ice} = 2.09\ \mathrm{J \cdot g^{-1} \cdot K^{-1}}$
$c_{water} = 4.184\ \mathrm{J \cdot g^{-1} \cdot K^{-1}}$
$c_{steam} = 2.03\ \mathrm{J \cdot g^{-1} \cdot K^{-1}}$
$\Delta H_{vap} = 2260\ \mathrm{J \cdot g^{-1}}$
$\Delta H_{fus} = 334\ \mathrm{J \cdot g^{-1}}$

1. 565 kJ

2. 548 kJ

3. 822 kJ

4. 29.1 kJ

5. 632 kJ

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013 4.0 points

Suppose that you wanted to be sure that a metal ion, any metal ion, would dissolve in water.

What salt of the metal ion compound would you choose?

1. the nitrate (NO_3^-) salt of the metal ion

2. the hydroxide (OH^-) salt of the metal ion

3. the carbonate (CO_3^{2-}) salt of the metal ion

4. the chloride (Cl^-) salt of the metal ion

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014 4.0 points

Which of the following salts would have the greatest molar solubility?

1. $Al(OH)_3$ $K_{sp} = 1.90 \times 10^{-33}$

2. $PbCrO_4$ $K_{sp} = 1.77 \times 10^{-14}$

3. CdS $K_{sp} = 3.60 \times 10^{-29}$

4. Cu_2S $K_{sp} = 2.00 \times 10^{-47}$

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015 4.0 points

Which of the following highly soluble salts would be the most useful for lowering the freezing point of a solution?

1. $Ce_2(SeO_4)_3$

2. $(NH_4)_3PO_4$

3. KBr

4. Cs_2SO_4

5. $Cs_2Cr_2O_7$

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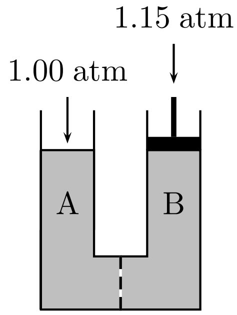
016 4.0 points

Water from a local stream is added to one side of the U-tube shown below. Pure water is placed in the tube on the other side of the semipermeable membrane. With the left side open to barometric pressure of 1.0 atm and 1.15 atm applied to the right side, the two liquids do not move.



In which half of the U-tube is the pure water located?

1. A

2. B

3. Not enough information is given.

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017 4.0 points

In general, decreasing the temperature makes which phase transitions more likely to occur?

1. evaporation, fusion, sublimation

2. evaporation, deposition, freezing

3. sublimation, condensation, freezing

4. condensation, freezing, deposition

5. condensation, fusion, deposition

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018 4.0 points

Pure water is saturated with $PbCl_2$. In this saturated solution

1. $[Pb^{2+}] = 0.5\,[Cl^-]$.

2. $K_{sp} = [Pb^{2+}]$.

3. $[Pb^{2+}]\,[Cl^-] = K_{sp}$.

4. $[Pb^{2+}] = [Cl^-]$.

5. $2\,[Cl^-] = [Pb^{2+}]$.

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019 4.0 points

Assume the molar solubility of silver chromate (Ag_2CrO_4) is represented as x. Which of the following expressions correctly expresses the relationship between the molar solubility of silver chromate and the solubility product constant (K_{sp}) for this compound?

1. $K_{sp} = 2\,x^2$

2. $K_{sp} = x^2$

3. $K_{sp} = 4\,x^2$

4. $K_{sp} = 2\,x^3$

5. $K_{sp} = 4\,x^3$

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020 4.0 points

The vapor pressure of pure CH_2Cl_2 (with molecular weight 85 g/mol) is 133 torr at 0°C and the vapor pressure of pure CH_2Br_2 (with molecular weight 174 g/mol) is 11 torr at the same temperature. What is the total vapor pressure at 0°C of a solution prepared from equal masses of these two substances?

1. 124 torr

2. 89 torr

3. 72 torr

4. 7.4 torr

5. 3.6 torr

6. 105 torr

7. 93 torr

8. 144 torr

9. 44 torr

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021 4.0 points

Rank the liquids

NH_3, CH_3OH, CH_3CH_2F, CCl_4

by their miscibility in heptane (C_7H_{16}), from most miscible to least.

1. $NH_3 > CH_3OH > CH_3CH_2F > CCl_4$

2. $CCl_4 > CH_3CH_2F > NH_3 > CH_3OH$

3. $CH_3CH_2F > CCl_4 > CH_3OH > NH_3$

4. $CH_3CH_2F > CH_3OH > CCl_4 > NH_3$

5. $CCl_4 > CH_3CH_2F > CH_3OH > NH_3$

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022 4.0 points

K_{sp} for CaF_2 is 3.9×10^{-11}. Would a precipitate of CaF_2 form if $Ca(NO_3)_2$ and NaF solutions were mixed such that $[Ca^{2+}] = 2.0 \times 10^{-4}$ M, and $[F^-] = 3.0 \times 10^{-4}$ M?

1. yes, because Q is larger than K_{sp}

2. yes, because Q is smaller than K_{sp}

3. no

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023 4.0 points

Identify the spectator ion(s) in the equation

$$CaCl_2(aq) + Na_2CO_3(aq) \rightarrow CaCO_3(s) + 2NaCl(aq).$$

1. Na^+, Cl^-

2. Ca^{2+}, CO_3^{2-}

3. Ca^{2+}, Cl^-

4. Na^+, CO_3^{2-}

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024 4.0 points

The solubility product constant of Ag_2CrO_4 is 9.0×10^{-12}. What is the molar solubility of Ag_2CrO_4 in a solution in which the silver ion concentration is maintained at 2.0×10^{-3} M by addition of $AgNO_3$?

1. 5.6×10^{-7}

2. 4.0×10^{-3}

3. 2.3×10^{-6}

4. 1.3×10^{-4}

5. 4.5×10^{-9}

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025 4.0 points

Which of the following would raise the vapor pressure of a sample of isopropanol in a closed container?

I) increasing the size of the container
II) increasing the temperature of the sample
III) increasing the applied pressure

1. III only

2. I, II and III

3. I only

4. I and III

5. I and II

6. II and III

7. II only