

112

version

last name

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McCord CH302
50375 / 50380

Exam 1

Spring 2017

Reminder: Be sure and correctly bubble in your name, uteid, and version number on your bubblesheet.

The Periodic Table plus conversion factors and data should be provided on a separate sheet.

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

This print-out should have 30 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

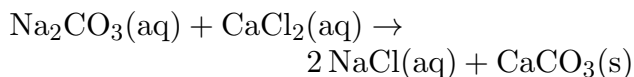
001 3.0 points

A compound is sparingly soluble in water. You would expect ΔG for this dissolution process to be (negative/positive) and that this compound would have a (large/small) K_{sp} value.

1. positive ; large
2. positive ; small
3. negative ; small
4. negative ; large

002 3.0 points

Identify the spectator ions in the following reaction.



1. Ca^{2+} , CO_3^{2-}
2. Na^+ , CO_3^{2-}
3. Ca^{2+} , Cl^-
4. Na^+ , Cl^-
5. There are no spectator ions.

003 3.0 points

The vapor pressure of a pure liquid depends on which of the following

- I. the volume of the liquid
- II. the volume of the gas
- III. the surface area of the liquid
- IV. the temperature

1. only III
2. only IV

3. only I
4. I and II
5. only II
6. all of them
7. III and IV

004 4.0 points

Rank following salts in order of molar solubility from the least to most soluble:

BaCrO_4	$K_{sp} = 1.2 \times 10^{-10}$
Cu_2O	$K_{sp} = 2.0 \times 10^{-15}$
Li_3PO_4	$K_{sp} = 2.4 \times 10^{-4}$
$\text{Ni}_3(\text{PO}_4)_2$	$K_{sp} = 4.7 \times 10^{-32}$

1. $\text{Ni}_3(\text{PO}_4)_2 < \text{BaCrO}_4 < \text{Cu}_2\text{O} < \text{Li}_3\text{PO}_4$
2. $\text{Li}_3\text{PO}_4 < \text{BaCrO}_4 < \text{Cu}_2\text{O} < \text{Ni}_3(\text{PO}_4)_2$
3. $\text{Li}_3\text{PO}_4 < \text{Cu}_2\text{O} < \text{BaCrO}_4 < \text{Ni}_3(\text{PO}_4)_2$
4. $\text{Ni}_3(\text{PO}_4)_2 < \text{Li}_3\text{PO}_4 < \text{Cu}_2\text{O} < \text{BaCrO}_4$
5. $\text{Ni}_3(\text{PO}_4)_2 < \text{Cu}_2\text{O} < \text{BaCrO}_4 < \text{Li}_3\text{PO}_4$

005 3.0 points

Which of the following is true concerning any liquid substance which is currently in the act of boiling?

1. $\Delta T > 0$
2. $T = 100^\circ\text{C}$
3. $\Delta H = 0$
4. $\Delta G > 0$
5. $\Delta S > 0$

006 3.0 points

Which of the following solutes is likely to be most soluble in water?

1. ethanol ($\text{CH}_3\text{CH}_2\text{OH}$)

2. carbon tetrachloride (CCl_4)

3. CS_2

4. Br_2

007 3.0 points

What is K_{sp} for PbCrO_4 , if its molar solubility is 1.3×10^{-7} mol/L?

1. 6.9×10^{-9}

2. 1.69×10^{-14}

3. 5.2×10^{-19}

4. 1.4×10^{-21}

5. 0.0053

008 4.0 points

In which of the following will a sample of CaF_2 ($K_{\text{sp}} = 3.45 \times 10^{-11}$) be the least soluble?

1. 100 mL 0.01 M CaCl_2

2. 100 mL 0.002 M HCl

3. 100 mL 0.001 M NaF

4. 100 mL pure water

5. 100 mL 0.001 M NaOH

009 3.0 points

Which of the following statements about the solubility of O_2 in water is true?

1. O_2 dissolves in water endothermically, so decreasing the temperature decreases its solubility in water.

2. O_2 dissolves in water endothermically, so decreasing the temperature increases its solubility in water.

3. O_2 dissolves in water exothermically, so decreasing the temperature decreases its solubility in water.

4. The solubility of inert gases is temperature independent.

5. O_2 dissolves in water exothermically, so decreasing the temperature increases its solubility in water.

010 3.0 points

A 35 gram sample of isopropanol is cooled from 100°C to 0°C . The boiling point and melting points of isopropanol are 83°C and -89°C , respectively. What are the signs of the change in enthalpy and the change in entropy for this process?

1. $\Delta H < 0, \Delta S > 0$

2. $\Delta H = 0, \Delta S > 0$

3. $\Delta H < 0, \Delta S < 0$

4. $\Delta H > 0, \Delta S < 0$

5. $\Delta H > 0, \Delta S > 0$

011 4.0 points

A 0.25 gram sample of an unknown compound (a nonelectrolyte where $i = 1$) is dissolved in 225 mL of water. This solution is found to have an osmotic pressure of 342 torr at a temperature of 28°C . What is the molar mass of the unknown compound?

1. 94 g/mol

2. 14 g/mol

3. 282 g/mol

4. 61 g/mol

5. 220 g/mol

012 3.0 points

Identify the TRUE statement about K_{sp}

1. K_{sp} is a constant that is specific to each compound.

2. K_{sp} is a function of the number of electrons released from a given salt.

3. K_{sp} is measure of energy.

4. K_{sp} is used to describe salt solutions where the minimum amount of salt has been dissolved into the solvent.

5. K_{sp} is called the solute product for a saturated solution.

013 4.0 points

An autoclave works rather like a pressure cooker. High pressure steam is used to sterilize equipment loaded inside the chamber. Assume that inside a particular autoclave, the pressure is 20psi higher than normal atmospheric pressure (1 atm = 14.70 psi). In other words, the pressure inside the autoclave is actually 2.36 atm. At this pressure, what will be the boiling point of water inside the cooker? The molar enthalpy of vaporization of water is $40.7 \text{ kJ} \cdot \text{mol}^{-1}$.

1. 110°C
2. 172°C
3. 101°C
4. 135°C
5. 126°C

014 4.0 points

Acetone, CH_3COCH_3 (58 g/mol), and ethyl acetate, $\text{C}_2\text{H}_5\text{COOCH}_3$ (88 g/mol), are common organic solvents. At 30°C , the vapor pressure of acetone is 285 torr, and the vapor pressure of ethyl acetate is 120 torr. What is the vapor pressure at 30°C of a solution prepared by dissolving 11 g of ethyl acetate into 29 g of acetone?

1. 203 torr
2. 252 torr

3. 405 torr

4. 231 torr

5. 153 torr

015 4.0 points

Solid silver phosphate is allowed to equilibrate with water at 25°C until the solution is saturated. What is the silver ion concentration in this saturated solution? K_{sp} for Ag_3PO_4 is equal to 8.9×10^{-19} .

1. $4.3 \times 10^{-5} \text{ M}$
2. $5.6 \times 10^{-5} \text{ M}$
3. $1.5 \times 10^{-6} \text{ M}$
4. $2.8 \times 10^{-6} \text{ M}$
5. $2.1 \times 10^{-6} \text{ M}$
6. $1.3 \times 10^{-4} \text{ M}$

016 3.0 points

Consider an ideal gas dissolving into a liquid. Which of the following is/are true?

- I) ΔS is negative for this process.
- II) $\Delta H_{\text{solution}}$ is positive for this process.
- III) This process only occurs at high enough temperatures.
- IV) $\Delta H_{\text{lattice}}$ is equal to zero for the gas.

1. I and III only
2. I and IV only
3. I, II, and IV only
4. I, III, and IV only
5. I only
6. I and II only

7. I, II, III, and IV

017 4.0 points

The solubility of mercury(II) thiocyanate, $\text{Hg}(\text{SCN})_2$, is listed as 0.0683 g per 100 mL in a book. Convert that solubility term into a value for K_{sp} .

- 4.0×10^{-8}
- 3.2×10^{-20}
- 5.3×10^{-12}
- 2.6×10^{-10}
- 4.6×10^{-6}

018 3.0 points

Consider ammonia (NH_3), phosphine (PH_3), silane (SiH_4), and methane (CH_4). Their vapor pressures in no particular order are 408, 3.5, 4520, and 128 kPa. Their ΔH_{vap} values in no particular order are 23.33, 8.19, 12.1, and 14.6 kJ/mol. What is the vapor pressure and ΔH_{vap} of phosphine?

- 128 kPa, 14.6 kJ/mol
- 408 kPa, 14.6 kJ/mol
- 128 kPa, 12.1 kJ/mol
- 408 kPa, 12.1 kJ/mol

019 4.0 points

30 grams of liquid ethanol, $\text{CH}_3\text{CH}_2\text{OH}$, is mixed with 70 g water. The density of pure ethanol is 0.789 g/mL. The density of water is 1 g/mL. What is the molality of the ethanol in this solution?

- 6.52 *m*
- 6.04 *m*
- 45.4 *m*
- 9.32 *m*

5. 8.41 *m*

020 3.0 points

Maintaining electrolyte balance in the body is essential for regular cell function. Based on what you know about osmotic pressure, which of the following is most likely to occur if the ion concentration outside of a cell suddenly becomes much higher than the ion concentration on the inside of the cell?

- Water will flow out of the cell, causing the cell to shrink.
- Nothing. The flow of water is not dependent on ion concentrations.
- Water will flow into the cell, causing the cell to swell.
- Water will flow out of the cell, causing the cell to swell.
- Water will flow into the cell, causing the cell to shrink.

021 3.0 points

Which of the following is a possible combination of values for $\Delta H_{\text{lattice}}$ and $\Delta H_{\text{hydration}}$ respectively for a gas whose dissolution process is exothermic?

- +640, -620 kJ/mol
- 0, -210 kJ/mol
- +500, -520 kJ/mol
- 210, 0 kJ/mol

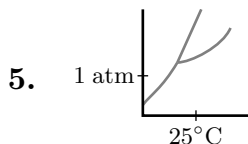
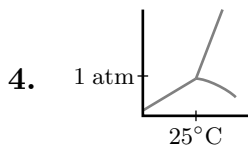
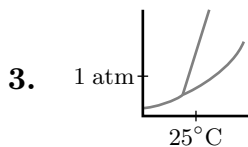
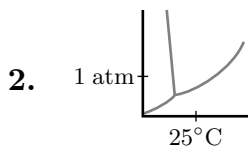
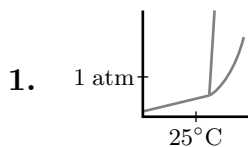
022 4.0 points

A 0.34 *m* solution of lead(IV) nitrate would be expected to have the same boiling point as which of the following solutions?

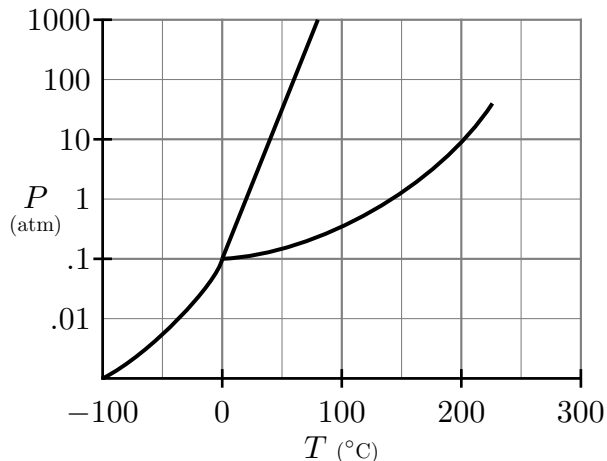
- 0.85 *m* CuSO_4
- 0.34 *m* sucrose

3. 0.34 *m* NaCl4. 1.7 *m* Ba(NO₃)₂5. 0.85 *m* K₂SO₄**023 3.0 points**

A solid sample of a substance is removed from the freezer and placed at standard conditions. It is observed that the sample sublimates. Which could be the correct phase diagram for this substance?

**024 (part 1 of 2) 2.0 points**

Interpret the following phase diagram and estimate the value for the critical pressure, P_c . Do note that the vertical axis is logarithmic in scale.



1. 35 atm

2. 1000 atm

3. 102 atm

4. 6.7 atm

5. 225 atm

6. 10 atm

025 (part 2 of 2) 2.0 points

Referring to the phase diagram in part 1, determine what the normal boiling point is for this substance.

1. 225°C

2. 140°C

3. 53°C

4. 0°C

5. 205°C

6. 100°C

026 3.0 points

The enthalpy of vaporization of acetone is 31.3 kJ/mol, and its boiling point is 56.3°C. What is the entropy change for the vaporization (boiling) of acetone?

1. 556 J/mol K

2. Not enough information is given.

3. 95.0 J/mol K

4. 556 kJ/mol K

5. 10.5 kJ/mol K

027 4.0 points

50 mL of 0.05 M sodium phosphate, Na_3PO_4 , is mixed with 50 mL of 0.08 M aluminum chloride, AlCl_3 . What precipitate, if any, forms? $K_{\text{sp}}(\text{AlPO}_4) = 9.8 \times 10^{-21}$

1. AlPO_4 and NaCl

2. No precipitate

3. AlPO_4 only4. NaCl only

028 4.0 points

A 5 g sample of CaI_2 is completely dissolved in 22 g of water, what is the freezing point of the solution? Assume complete dissociation of the salt. K_f for water is $1.86 \text{ }^\circ\text{C}/m$.

1. 2.63°C 2. -4.31°C 3. 1.19°C 4. -2.63°C 5. 4.31°C 6. -1.19°C

029 3.0 points

Which of the following shows the right equation for the ion product of lead(II) chlorate, $\text{Pb}(\text{ClO}_3)_2$?

1. $[\text{Pb}^{2+}][\text{ClO}_3^-]^2$ 2. $[\text{Pb}^{2+}][\text{ClO}_3^-]$ 3. $[\text{Pb}^{2+}](2 * [\text{ClO}_3^-])^2$ 4. $[\text{Pb}^{2+}]^2[\text{ClO}_3^-]$ 5. $[\text{Pb}^{2+}]^2[\text{ClO}_3^-]^2$

030 4.0 points

What is the molar solubility of barium nitrate, $\text{Ba}(\text{NO}_3)_2$, which has a K_{sp} value of 4.6×10^{-3} ?

1. 0.10 M

2. 0.034 M

3. 0.0046 M

4. 0.17 M

5. 0.048 M