

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

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**LDE Temperature and Phase Changes 001**  
**001 6.0 points**

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

1. condensation, freezing, deposition **correct**
2. evaporation, deposition, freezing
3. sublimation, condensation, freezing
4. evaporation, fusion, sublimation
5. condensation, fusion, deposition

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**LDE Vapor Pressure Theory 001**  
**002 6.0 points**

Consider the following statements. Which are true?

- I) Vapor pressure is an equilibrium phenomenon.
- II) The smaller the IMF, the smaller the vapor pressure.
- III) The volume of a liquid does not affect the vapor pressure
- IV) Vapor pressure is temperature dependent.

1. III, and IV
  2. I, II, III, and IV
  3. I, III, and IV **correct**
  4. I, II, and III
  5. II, III, and IV
  6. I, II, and IV
  7. I, and III
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**LDE Salt Dissolution Theory 001**  
**003 6.0 points**

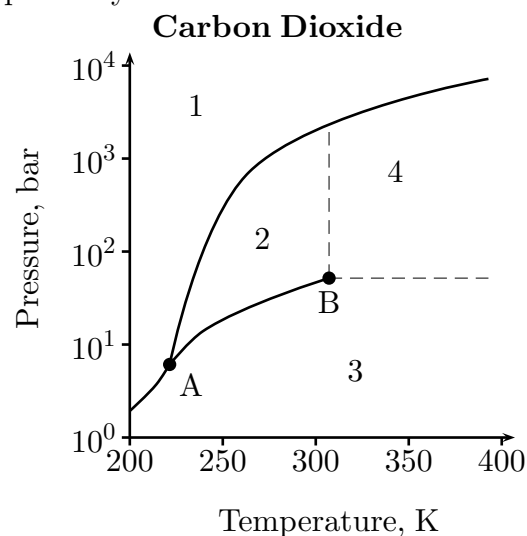
Which of the following is a possible combination of values for  $\Delta H_{\text{lattice}}$ ,  $\Delta H_{\text{hydration}}$  and  $\Delta H_{\text{solution}}$ , respectively, for a salt whose dissolution is endothermic.

1.  $-900$ ,  $-900$ , and  $-1800 \text{ kJ} \cdot \text{mol}^{-1}$ ,
2.  $+550$ ,  $-480$ , and  $+1030 \text{ kJ} \cdot \text{mol}^{-1}$ ,
3.  $+640$ ,  $-620$ , and  $+20 \text{ kJ} \cdot \text{mol}^{-1}$ , **correct**
4.  $-450$ ,  $+400$ , and  $-50 \text{ kJ} \cdot \text{mol}^{-1}$ ,

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**LDE Phase Diagram Interpretation 001**  
**004 6.0 points**

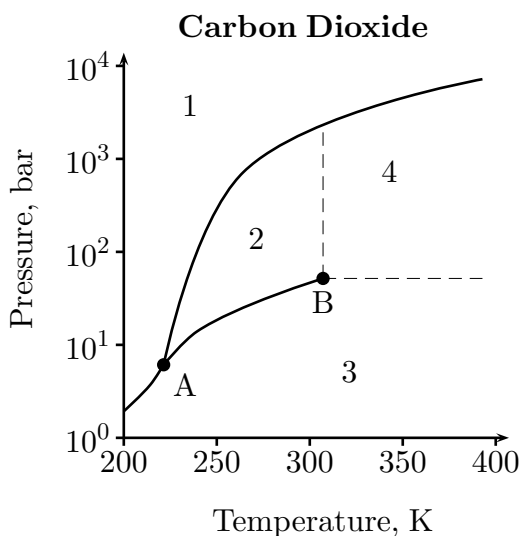
According to the given phase diagram for carbon dioxide, what are regions 1, 3 and B respectively?



1. solid, liquid, triple point
2. solid, vapor, triple point
3. solid, liquid, critical point
4. solid, vapor, critical point **correct**
5. liquid, vapor, critical point

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**LDE Phase Diagram Navigation 001**  
**005 6.0 points**



A sample of carbon dioxide is stored at  $10^4$  bar and 250 K. This sample is then decompressed to  $10^0$  bar at constant temperature. Then, at constant pressure it is heated to 400 K. Next, it is compressed at constant temperature to 200 bar. According to the phase diagram, how many phase transitions has the carbon dioxide gone through, and what is its final state?

1. 3, gas
2. 2, gas
3. 2, supercritical fluid **correct**
4. 3, supercritical fluid
5. 2, liquid

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**LDE Phase Change Enthalpy Calc 001**  
**006 6.0 points**

How much heat is released when 10 g of steam at  $115^\circ\text{C}$  is cooled to ice at  $-15^\circ\text{C}$ ? Use the approximate values below for your calculation.

$$c_{ice} = 2 \text{ J/g} \cdot ^\circ\text{C}$$

$$c_{steam} = 2 \text{ J/g} \cdot ^\circ\text{C}$$

$$c_{water} = 4 \text{ J/g} \cdot ^\circ\text{C}$$

$$\Delta H_{vap} = 2,260 \text{ J/g}$$

$$\Delta H_{fus} = 340 \text{ J/g}$$

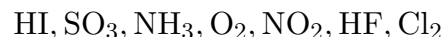
1. -4,000 J

2. -30,300 J
3. -26,600 J
4. -30,600 J **correct**
5. -8,000 J
6. -30,000 J

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**LDE Gas Dissolution Theory 003**  
**007 6.0 points**

Which of the following gases are more soluble in water when their partial pressure above the solution is increased?



1. HI,  $\text{NH}_3$
2. all of them **correct**
3.  $\text{Cl}_2, \text{NO}_2, \text{SO}_3, \text{HI}$
4.  $\text{NO}_2, \text{O}_2, \text{HI}$
5.  $\text{NO}_2, \text{SO}_3$
6.  $\text{SO}_3, \text{NO}_2, \text{HI}$

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**LDE Rank Miscibility in Non-polar 001**  
**008 6.0 points**

Rank the following liquids in decreasing order of solubility in heptane ( $\text{C}_7\text{H}_{16}$ ):  $\text{NH}_3$ ,  $\text{CH}_3\text{OH}$ ,  $\text{CH}_3\text{CH}_2\text{F}$ ,  $\text{CCl}_4$ .

1.  $\text{NH}_3 > \text{CH}_3\text{OH} > \text{CH}_3\text{CH}_2\text{F} > \text{CCl}_4$
2.  $\text{CCl}_4 > \text{CH}_3\text{CH}_2\text{F} > \text{NH}_3 > \text{CH}_3\text{OH}$
3.  $\text{CH}_3\text{CH}_2\text{F} > \text{CH}_3\text{OH} > \text{CCl}_4 > \text{NH}_3$
4.  $\text{CH}_3\text{CH}_2\text{F} > \text{CCl}_4 > \text{CH}_3\text{OH} > \text{NH}_3$
5.  $\text{CCl}_4 > \text{CH}_3\text{CH}_2\text{F} > \text{CH}_3\text{OH} > \text{NH}_3$   
**correct**

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**LDE Simple Raoult's Law Calc 001**  
**009 6.0 points**

The vapor pressure of pure acetone ( $\text{CH}_3\text{COCH}_3$ ) at  $30^\circ\text{C}$  is 240 torr. If salt ( $\text{NaCl}$ ) is dissolved into a sample of acetone until the total vapor pressure of the mixture at  $30^\circ\text{C}$  is 180 torr, what is the mol fraction of acetone?

- 0.8
- 0.25
- 0.2
- 0.75 **correct**

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**LDE Clausius-Clapeyron Setup 001**  
**010 6.0 points**

An unknown liquid has a vapor pressure of 88 mmHg at  $45^\circ\text{C}$  and 39 mmHg at  $25^\circ\text{C}$ . What is its heat of vaporization?

- 32000 kJ/mol
- 2000 J/mol
- 32 kJ/mol **correct**
- 2000 kJ/mol

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**LDE van't Hoff Factor 001**  
**011 6.0 points**

Assuming all of the following salts dissolve completely in water, which one would be the best to use if you were trying to raise the boiling point of the solution?

- $\text{Na}_3\text{PO}_4$
- $\text{Al}_2(\text{SO}_4)_3$  **correct**
- $\text{KNO}_3$
- $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$
- $\text{NaCl}$

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**LDE Colligative Property Application 001**  
**012 6.0 points**

Which of the following statements regarding colligative properties is/are true?

- Pure liquid water exhibits a lower freezing point than a solution of magnesium chloride in water.
- For completely soluble compounds that do not ionize in solution, the van't Hoff factor,  $i = 1$ .
- Osmotic pressure is pressure exerted on a semipermeable membrane between solutions with different concentrations of solutes.

- III only
- I only
- II, III **correct**
- I, II
- II only
- I, III
- I, II, III

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**LDE Colligative Property Calculation 001**  
**013 6.0 points**

Which of the following two solutions will achieve the greatest boiling point increase and what will the new temperature be? Assume that  $K_b = 0.52^\circ\text{C}/\text{m}$  for water.

- 105 g sucrose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) dissolved in 0.5 kg water
- 35 g of  $\text{NaCl}$  dissolved in 0.5 kg of water

- Solution II with a boiling point of  $100.63^\circ\text{C}$
- Solution I with a boiling point of  $101.92^\circ\text{C}$
- Solution II with a boiling point of

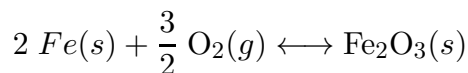
101.25 °C **correct**

4. Solution I with a boiling point of 100.32 °C

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**LDE Keq from Balanced Equation 001**  
**014 6.0 points**

Write the equilibrium expression for the following reaction:



1.  $K = \frac{1}{P_{\text{O}_2}^{3/2}}$  **correct**

2.  $K = \frac{P_{\text{Fe}}^2}{P_{\text{O}_2}^{3/2} \cdot P_{\text{Fe}_2\text{O}_3}}$

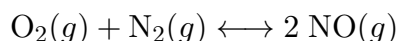
3.  $K = \frac{P_{\text{Fe}}}{P_{\text{O}_2} \cdot P_{\text{Fe}_2\text{O}_3}}$

4.  $K = \frac{1}{P_{\text{O}_2}}$

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**LDE Importance of Magnitude of Keq 001**  
**015 6.0 points**

Nitric oxide, NO, is a toxic chemical produced in automobile engines.



At 2100 °C,  $K = 0.0031$  and at 25 °C,  $K = 2.5 \times 10^{-32}$ .  $\Delta H$  of this reaction is (positive/negative) and it would be best to run an engine as (hot/cold) as possible to reduce emissions of NO.

1. negative, cold

2. positive, hot

3. negative, hot

4. positive, cold **correct**

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**LDE Equilibrium Conditions from K 001**  
**016 6.0 points**

Consider the reaction:  $2 \text{HI}(g) \leftrightarrow \text{H}_2(g) +$

$\text{I}_2(g)$  If we start out with pure HI and the equilibrium hydrogen gas concentration is 0.233 M at 730 K and at this temperature  $K_c = 0.12$ , what is the correct expression for the equilibrium concentration of HI(g)?

1.  $[\text{HI}] = \left( \frac{0.233 \cdot 0.233}{0.12} \right)$

2.  $[\text{HI}] = (0.233 \cdot 0.233 \cdot 0.12)$

3.  $[\text{HI}] = (0.233 \cdot 0.233 \cdot 0.12)^{1/2}$

4.  $[\text{HI}] = \left( \frac{0.233}{0.12} \right)^{1/2}$

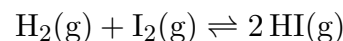
5.  $[\text{HI}] = \left( \frac{0.233 \cdot 0.233}{0.12} \right)^{1/2}$  **correct**

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**Msci 17 0508**

**017 6.0 points**

Suppose the reaction



has an equilibrium constant  $K_c = 49$  and the initial concentration of  $\text{H}_2$  and  $\text{I}_2$  is 0.5 M and HI is 0.0 M. Which of the following is the correct value for the final concentration of HI(g)?

1. 0.389 M

2. 0.599 M

3. 0.778 M **correct**

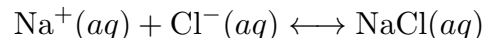
4. 0.219 M

5. 0.250 M

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**LDE Q vs K Reaction Direction 001**  
**018 6.0 points**

Consider the reaction,



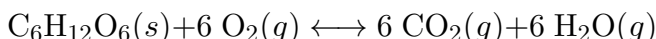
The equilibrium constant,  $K$ , is 2. If the concentrations of  $\text{Na}^+$ ,  $\text{Cl}^-$  and NaCl are 2, 2 and 10 M, respectively, which of the following would occur?

- nothing would occur
- not enough information
- the reaction would move left **correct**
- the reaction would move right

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**LDE Le Chatelier Reaction Direction 001**  
**019 6.0 points**

Consider the combustion of glucose:



$\Delta H$  for this reaction is  $-3 \text{ kJ/mol}$ . Which of the following conditions would result in the production of additional water vapor?

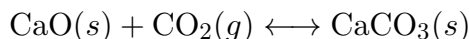
- Adding more carbon dioxide.
- Performing the reaction in a hotter environment.
- Decreasing the pressure of the system.
- Adding a reagent that irreversibly binds glucose and prevent it from further reactions.

- I only
- III only **correct**
- I, III
- III, IV
- II only
- I, II, III

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**LDE Le Chatelier Reaction Direction 003**  
**020 6.0 points**

Consider the following exothermic reaction:



In response to a decrease in temperature, the system would:

- shift right **correct**
- shift left

- not change
- not enough information

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**LDE Relating G and K 001**  
**021 6.0 points**

The change in free energy for the given reaction is  $-1 \text{ kJ/mol}$  at room temperature. What is the equilibrium constant for the reaction at the same temperature? ( $R = 8.3 \text{ J} \cdot \text{K}^{-1} \cdot \text{mol}^{-1}$ )

- 1.5 **correct**
- 1.3
- 3
- 0.01
- 1.0

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**LDE Water Auto-protolysis Theory 001**  
**022 6.0 points**

Consider a glass of water at  $80 \text{ }^\circ\text{C}$ , which of the following statements is true?

- The auto-protolysis of water is an exothermic process
- The concentrations of  $\text{H}^+$  and  $\text{OH}^-$  are equal **correct**
- The water is acidic because its pH is slightly lower than 7
- The water is neutral because its pH is 7

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**LDE Temperature Dependence of Kw 001**  
**023 6.0 points**

If  $K_w$  for water at  $0 \text{ }^\circ\text{C}$  is  $0.114 \times 10^{-14}$ , what is the pH of water at freezing point?

- 9.25
- 5.31
- 7.00

4. 6.87

5. 7.47 correct

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**LDE Molar Solubility Calculation 001****024 6.0 points**Determine the molar solubility of calcium chloride ( $\text{CaCl}_2$ ) if  $K_{sp} = 2.5 \times 10^2$ .

1. 1 M

2. 4 M correct

3. 0.005 M

4. 10 M

5. 0.1 M

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**LDE Rank Molar Solubility by Ksp 001****025 6.0 points**

WITHDRAWN

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**LDE Converting pH, pOH etc 001****026 6.0 points**Which of the following equations is **untrue** for a solution with a pH of 3?

1. all of these equations are true

2.  $\text{pOH} = -\log \frac{\text{p}K_w}{10^{-3}}$  correct3.  $\text{pOH} = -\log \frac{K_w}{10^{-3}}$ 4.  $[\text{H}^+] = 10^{-3}$ 5.  $[\text{OH}^-] = \frac{K_w}{10^{-3}}$ 

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**LDE Rank Acid Strength by Ka 001****027 6.0 points**Rank following acids from most to least acidic:  
hydrocyanic acid (HCN)  $K_a = 6.2 \times 10^{-10}$   
hypoiodous acid (HOI)  $K_a = 2 \times 10^{-11}$   
chlorous acid ( $\text{HClO}_2$ )  $K_a = 1.2 \times 10^{-2}$   
acetic acid ( $\text{CH}_3\text{COOH}$ )  $K_a = 1.8 \times 10^{-5}$ 1.  $\text{CH}_3\text{COOH} > \text{HCN} > \text{HOI} > \text{HClO}_2$ 2.  $\text{HCN} > \text{HOI} > \text{HClO}_2 > \text{CH}_3\text{COOH}$ 3.  $\text{HClO}_2 > \text{CH}_3\text{COOH} > \text{HCN} > \text{HOI}$   
correct4.  $\text{HOI} > \text{HClO}_2 > \text{CH}_3\text{COOH} > \text{HCN}$ 

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**LDE Simple Strong Base Calculation 001****028 6.0 points**What would be the pOH of a solution of  $\text{Sr}(\text{OH})_2$  (strontium hydroxide) prepared by dissolving 122 g of the base into 10 L of pure water ( $\text{H}_2\text{O}$ )?

1. 13

2. 13.3

3. 0.7 correct

4. 1

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**LDE Simple Weak Base Calculation 001****029 6.0 points**What would be the pH of a 0.25 M solution of phenylamine ( $\text{C}_6\text{H}_5\text{NH}_2$ ) at room temperature? The  $K_b$  of phenylamine is  $4 \times 10^{-10}$ .

1. 5

2. 1

3. 9 correct

4. 10.5

5. 13

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**LDE Simple Weak Acid Calculation 001****030 6.0 points**What would be the pH of a solution of hypobromous acid ( $\text{HOBr}$ ) prepared by dissolving 9.7 grams of the acid in 20 mL of pure water ( $\text{H}_2\text{O}$ )? The  $K_a$  of hypobromous acid is  $2 \times 10^{-9}$ 

1. 6

**2. 4 correct**

**3. 10**

**4. 1**

**5. 13**