This print-out should have 18 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 10.0 points

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

1. condensation, fusion, deposition

2. condensation, freezing, deposition

3. evaporation, deposition, freezing

4. sublimation, condensation, freezing

5. evaporation, fusion, sublimation

002 10.0 points

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

1. $-450,\ +400,$ and $-50\ \text{kJ}\cdot\text{mol}^{-1}$,

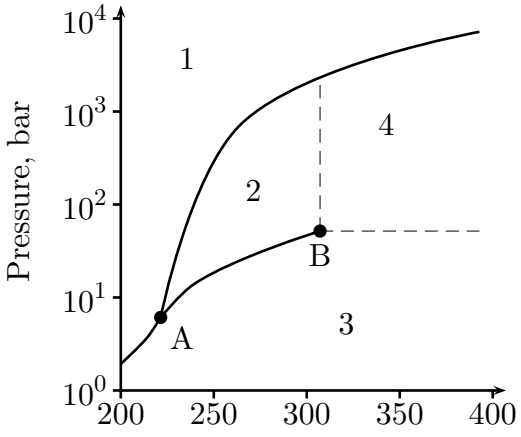
2. $-900,\ -900,$ and $-1800\ \text{kJ}\cdot\text{mol}^{-1}$,

3. $+640,\ -620,$ and $+20\ \text{kJ}\cdot\text{mol}^{-1}$,

4. $+550,\ -480,$ and $+1030\ \text{kJ}\cdot\text{mol}^{-1}$,

003 10.0 points

Carbon Dioxide



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, supercritical fluid

2. 3, gas

3. 2, supercritical fluid

4. 2, gas

5. 2, liquid

004 10.0 points

30.2 g of glycerine ($C_3H_8O_3$) are dissolved in 150 g of water. What is the boiling point of the solution? (K_b of water = 0.515°C/m)

1. 101.13°C

2. 1.13°C

3. 0.104°C

4. 100.10°C

5. 103.52°C

005 10.0 points

For the system

$$H_2(g) + CO_2(g) \rightleftharpoons H_2O(g) + CO(g)$$

at equilibrium, the addition of $H_2(g)$ would cause (according to LeChatelier's principle)

1. only more $H_2O(g)$ to form.

2. only more $CO_2(g)$ to form.

3. more $H_2O(g)$ and $CO(g)$ to form.

4. no change in amounts of products or reactants.

5. only more CO(g) to form.

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006 10.0 points

$K_c = 2.6 \times 10^8$ at 825 K for the reaction

$$2\,H_2(g) + S_2(g) \rightleftharpoons 2\,H_2S(g)$$

The equilibrium concentration of H_2 is 0.0020 M and that of S_2 is 0.0010 M. What is the equilibrium concentration of H_2S?

1. 0.10 M

2. 1.02 M

3. 0.0010 M

4. 10 M

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007 10.0 points

Write the equilibrium expression for the following reaction:

$$2\ Fe(s) + \frac{3}{2}\ O_2(g) \longleftrightarrow Fe_2O_3(s)$$

1. $K = \dfrac{1}{P_{O_2}}$

2. $K = \dfrac{P_{Fe}^2}{{P_{O_2}}^{3/2} \cdot P_{Fe_2O_3}}$

3. $K = \dfrac{1}{P_{O_2}^{3/2}}$

4. $K = \dfrac{P_{Fe}}{P_{O_2} \cdot P_{Fe_2O_3}}$

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008 10.0 points

Consider the reaction:

$2\,HI(g) \leftrightarrow H_2(g) + I_2(g)$

If we start out with pure HI and the equilibrium hydrogen gas concentration is 0.233 M at 730 K and at this temperature Kc = 0.12, what is the correct expression for the equilibrium concentration of HI(g)?

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

2. $[HI] = \left(\dfrac{0.233 \cdot 0.233}{0.12}\right)^{1/2}$

3. $[HI] = (0.233 \cdot 0.233 \cdot 0.12)$

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

5. $[HI] = \left(\dfrac{0.233 \cdot 0.233}{0.12}\right)$

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009 10.0 points

Consider the reaction,

$$A(aq) + B(aq) \longleftrightarrow C(aq)$$

The equilibrium constant, K, is 2. If the concentrations of A, B and C are 2 M, 2 M and 10 M, respectively, which of the following would occur?

1. the reaction would move left

2. nothing would occur

3. the reaction would move right

4. not enough information

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010 10.0 points

An acetic acid solution is allowed to come to equilibrium:

$$CH_3COOH + H_2O \rightleftharpoons H_3O^+ + CH_3COO^-$$

If some silver ion (Ag^+) is then added to the solution, solid silver acetate (CH_3COOAg) is formed.

The resulting amount of undissociated acetic acid (CH_3COOH) in the solution would be

1. unchanged from that in the original solution.

2. higher than that in the original solution.

3. zero.

4. lower than that in the original solution.

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011 10.0 points

Consider the reaction

$$\mathrm{Ni(CO)_4(g) \rightarrow Ni(s) + 4\,CO(g)}\,.$$

If the initial concentration of $\mathrm{Ni(CO)_4(g)}$ is 1.0 M, and x is the equilibrium concentration of $\mathrm{CO(g)}$, what is the correct equilibrium relation?

1. $K_\mathrm{c} = \dfrac{x^5}{1.0 - \dfrac{x}{4}}$

2. $K_\mathrm{c} = \dfrac{x}{1.0 - \dfrac{x}{4}}$

3. $K_\mathrm{c} = \dfrac{x^4}{1.0 - 4x}$

4. $K_\mathrm{c} = \dfrac{4\,x}{1.0 - 4x}$

5. $K_\mathrm{c} = \dfrac{x^4}{1.0 - \dfrac{x}{4}}$

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012 10.0 points

Which of the following equilibrium reactions is NOT affected by changes in pressure?

1. $\mathrm{H_2(g) + Br_2(\ell) \rightarrow 2\,HBr(g)}$

2. $\mathrm{H_2(g) + I_2(s) \rightarrow 2\,HI(g)}$

3. $\mathrm{2\,CO_2(g) \rightarrow 2\,CO(g) + O_2(g)}$

4. $\mathrm{2\,BrCl(g) \rightarrow Br_2(g) + Cl_2(g)}$

5. $\mathrm{2\,H_2O_2(\ell) \rightarrow 2\,H_2O(\ell) + O_2(g)}$

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013 10.0 points

Consider the solutions

I) 1.0 M $\mathrm{Na_2SO_4}$,
II) 1.0 M NaCl, and
III) 1.0 M sugar.

What answer gives the expected order of decreasing (highest, next, lowest) osmotic pressure?

1. II, III, I

2. III, I, II

3. II, I, III

4. All would have the same osmotic pressure.

5. III, II, I

6. I, II, III

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014 10.0 points

A container holds a mixture of acetone and water at 40 °C. If χ_acet, the mole fraction of acetone, is 0.1, what is the total vapor pressure? (The equilibrium vapor pressures for pure acetone and pure water at 40 °C are roughly 400 torr and 50 torr respectively.)

1. 50 torr

2. 85 torr

3. 365 torr

4. 40 torr

5. 400 torr

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015 10.0 points

Which of the solutions below will have the greater boiling point and what will it be? $K_b = 0.512$ °C/m for water.

I) 135 g of glucose ($\mathrm{C_6H_{12}O_6}$) dissolved in 0.5 kg water
II) 35 g of NaCl dissolved in 0.5 kg of water

1. Solution I with a boiling point of 118.4 °C

2. Solution I with a boiling point of 100.8 °C

3. Solution II with a boiling point of 101.2 °C

4. Solution II with a boiling point of 100.6 °C

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016 10.0 points

How much heat is required to vaporize 50.0 g of water if the initial temperature of the water is 25.0°C and the water is heated to its boiling point where it is converted to steam? The specific heat capacity of water is 4.18 $J \cdot (°C)^{-1} \cdot g^{-1}$ and the standard enthalpy of vaporization of water at its boiling point is 40.7 $kJ \cdot mol^{-1}$.

1. 23.5 kJ

2. 64.2 kJ

3. 40.7 kJ

4. 169 kJ

5. 129 kJ

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017 10.0 points

For an endothermic dissolution process, as temperature increases, solubility

1. increases.

2. decreases.

3. stays the same.

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018 10.0 points

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

$$HI, SO_3, NH_3, O_2, NO_2, HF, Cl_2$$

1. Cl_2, NO_2, SO_3, HI

2. all of them

3. HI, NH_3

4. SO_3, NO_2, HI

5. NO_2, O_2, HI

6. NO_2, SO_3