VDB Phase Change Thermo Signs 001
001  10.0 points
Substance A has undergone a phase transition (under constant pressure) where ∆H = 10 kJ/mol and ∆S = 36 J/K · mol. What phase transition could have occurred?

1. freezing
2. melting
3. deposition
4. condensation

LDE Gibbs Eqn 001
002  10.0 points
Phosphine (the common name for PH3, a highly toxic gas used for fumigation), has a ∆H^vap = 14.6 kJ·mol⁻¹ and a S^vap = 78.83 J·mol⁻¹·K⁻¹. What is the normal boiling point of phosphine expressed in centigrade?

1. 273 °C
2. 185.2 °C
3. −87.8 °C
4. −0.2 °C

Phase diag3c
003 (part 1 of 2) 10.0 points
Refer to the following phase diagram for the next question also.

What is the normal boiling point of this substance?

1. 200°C
2. 230°C
3. 100°C
4. 260°C
5. 0°C
6. 150°C

004 (part 2 of 2) 10.0 points
What is the critical pressure for this substance?

1. > 100 atm
2. 1 atm
3. 44 atm
4. 25 atm
5. 50 atm
6. 0.08 atm

Msci 13 0911
005  10.0 points
The vapor pressure of benzene (C₆H₆) is 120 torr at 27.0°C, and its normal boiling point is 80.1°C. What is the molar heat of vaporization of benzene?
1. $4.95 \times 10^4 \text{ J/mol}$
2. $4.56 \times 10^3 \text{ J/mol}$
3. $3.07 \times 10^4 \text{ J/mol}$
4. $2.49 \times 10^2 \text{ J/mol}$
5. $1.31 \times 10^3 \text{ J/mol}$

**Vapor Pressure IMF 01**

006 10.0 points

Rank these compound by vapor pressure from lowest to highest

1. $\text{CH}_4 < \text{CH}_3\text{OH} < \text{C}_3\text{H}_8 < \text{C}_3\text{H}_7\text{OH}$
2. $\text{CH}_4 < \text{C}_3\text{H}_8 < \text{CH}_3\text{OH} < \text{C}_3\text{H}_7\text{OH}$
3. $\text{CH}_3\text{OH} < \text{C}_3\text{H}_7\text{OH} < \text{CH}_4 < \text{C}_3\text{H}_8$
4. $\text{C}_3\text{H}_7\text{OH} < \text{C}_3\text{H}_8 < \text{CH}_3\text{OH} < \text{CH}_4$
5. $\text{C}_3\text{H}_7\text{OH} < \text{CH}_3\text{OH} < \text{C}_3\text{H}_8 < \text{CH}_4$
6. $\text{C}_3\text{H}_8 < \text{CH}_4 < \text{C}_3\text{H}_7\text{OH} < \text{CH}_3\text{OH}$

**VDB Vapor Pressure Qualitative 007**

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

7. only III

**Consider the phase diagram for sulfur below.**

At 424 K and 1300 atm,

1. only rhombic sulfur and sulfur gas exist in equilibrium.
2. only monoclinic sulfur is present.
3. rhombic sulfur, monoclinic sulfur, and liquid sulfur exist in equilibrium.
4. only rhombic sulfur is present.
5. rhombic sulfur, monoclinic sulfur, sulfur liquid, and sulfur gas exist in equilibrium.

**Colligative Property Concepts 01**

009 10.0 points

Which of the following statements about colligative properties of solutions is FALSE?

1. Osmosis is a colligative property.
2. Colligative properties assume ideal solutions
3. Colligative properties are identical for all solvents
4. The higher the concentration of solute in
the solution, the lower the vapor pressure of the solvent.

5. Colligative properties arise from the concentration of the solute but not the intermolecular forces of the solute.

---

**Henry's Law**

010 10.0 points

The partial pressure of CO$_2$ in the atmosphere is $3.9 \times 10^{-4}$ atm. When drinking soda is put in a can, assume that there is 2.0 atm CO$_2$ in the 2.0 mL gas space above the soda. (The actual CO$_2$ pressure varies with type of soda.) What is the approximate ratio of the molar concentrations of CO$_2$(aq) in the soda before it is opened to that in the soda after it has been opened and reached equilibrium with the surrounding atmosphere; i.e., has “gone flat?”

1. You need Henry’s Law constant for CO$_2$ in this soda.
2. $2 \times 10^{-4}$
3. You need Rault’s Law constant for CO$_2$ in this soda.
4. $5 \times 10^{3}$
5. $2 \times 10^{2}$

---

**LDE Salt Dissolution Theory 002**

011 10.0 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 exothermic.

1. $+380$, $-351$, and $29$ kJ $\cdot$ mol$^{-1}$
2. $-260$, $-278$, and $18$ kJ $\cdot$ mol$^{-1}$
3. $+461$, $-465$, and $-4$ kJ $\cdot$ mol$^{-1}$
4. $+302$, $-274$, and $-28$ kJ $\cdot$ mol$^{-1}$

---

**Freezing Point Depression Multiple 01**

012 10.0 points

Given that the freezing point depression constant for water is 1.86 K m$^{-1}$, what is the freezing point of a solution that contains 0.5 moles KNO$_3$ and 1 mole of sucrose (C$_{12}$H$_{22}$O$_{11}$) in 500 g of water?

1. -5.58 °C
2. -7.44 °C
3. -2.79 °C
4. -3.72 °C
5. -1.86 °C
6. -37.2 °C
7. +2.79 °C

---

**ChemPrin3e T08 69**

013 10.0 points

The addition of 125 mg of caffeine to 100 g of cyclohexane lowered the freezing point by 0.13 K. Calculate the molar mass of caffeine. The $k_f$ for cyclohexane is 20.1 K·kg·mol$^{-1}$.

1. 19.3 g·mol$^{-1}$
2. 47.8 g·mol$^{-1}$
3. 193 g·mol$^{-1}$
4. 481 g·mol$^{-1}$
5. 96.5 g·mol$^{-1}$

---

**ChemPrin3e T08 72**

014 10.0 points

An animal cell assumes its normal volume when it is placed in a solution with a total solute molarity of 0.3 M. If the cell is placed in a solution with a total solute molarity of 0.1 M,

1. water enters the cell, causing expansion.
2. water leaves the cell, causing contraction.
3. no movement of water takes place.

4. the escaping tendency of water in the cell increases.

Which of the statements concerning equilibrium is NOT true?

1. The value of the equilibrium constant for a given reaction is the same regardless of the direction from which equilibrium was attained.

2. The equilibrium constant usually is independent of temperature.

3. A system moves spontaneously toward a state of equilibrium.

4. A system that is disturbed from an equilibrium condition responds in a manner to restore equilibrium.

5. Equilibrium in molecular systems is dynamic, with two opposing processes balancing one another.

A mixture consisting of 0.250 M N\(_2\)\(\text{(g)}\) and 0.500 M H\(_2\)\(\text{(g)}\) reaches equilibrium according to the equation

\[
\text{N}_2\text{(g)} + 3\text{H}_2\text{(g)} \rightarrow 2\text{NH}_3\text{(g)}
\]

At equilibrium, the concentration of ammonia is 0.150 M. Calculate the concentration of H\(_2\)\(\text{(g)}\) at equilibrium.

1. 0.0750 M
2. 0.425 M
3. 0.275 M
4. 0.350 M
5. 0.150 M
Suppose the reaction
\[ \text{H}_2(g) + \text{I}_2(g) \rightleftharpoons 2 \text{HI}(g) \]
has an equilibrium constant \( K_c = 49 \) and the initial concentrations of \( \text{H}_2 \), \( \text{I}_2 \) and \( \text{HI} \) are 0.50 M, 0.50 M and 0.00 M, respectively. What is the correct value for the final concentration of \( \text{I}_2(g) \)?

1. 0.219 M
2. 0.599 M
3. 0.250 M
4. 0.778 M
5. 0.111 M
6. 0.389 M
7. 0.438 M

LDE Q vs K Reaction Direction 003

Consider the reaction:
\[ \text{H}_2\text{CO}_3(\text{aq}) \rightleftharpoons \text{H}_2\text{O}(\ell) + \text{CO}_2(\text{g}) \]
If \( K = 3.7 \) and the concentrations of \( \text{H}_2\text{CO}_3 \), \( \text{H}_2\text{O} \), and \( \text{CO}_2 \) are 7.63 M, 55.4 M, and 0.564 M, respectively, what will happen in order for the system to reach equilibrium?

1. the reaction will shift to the left
2. the reaction will shift to the right
3. not enough information
4. nothing will occur

Consider the reaction
\[ 3 \text{Fe(s)} + 4 \text{H}_2\text{O}(g) \rightarrow 4 \text{H}_2(g) + \text{Fe}_3\text{O}_4(s) \]
If the volume of the container is reduced,

1. more Fe(s) is produced.
2. more \( \text{H}_2(g) \) is produced.
3. the equilibrium constant increases.
4. more \( \text{H}_2\text{O}(g) \) is produced.
5. no change occurs.

ChemPrin3e T09 58

Consider the reaction
\[ 2 \text{NOCl(g)} \rightarrow 2 \text{NO(g)} + \text{Cl}_2(g) \]
is 0.51 at a certain temperature. A mixture of NOCl, NO, and Cl\(_2\) with concentrations 1.3, 1.2, and 0.60 M, respectively, was introduced into a container at this temperature. Which of the following is true?

1. No apparent reaction takes place.
2. \([\text{NOCl}] = [\text{NO}] = [\text{Cl}_2]\) at equilibrium.
3. \(\text{Cl}_2(g)\) is produced until equilibrium is reached.
4. \([\text{Cl}_2] = 0.30\) M at equilibrium.
5. NOCl(g) is produced until equilibrium is reached.

Equil Rctn Diag 05 W
024 10.0 points
The figure represents a reaction at 298 K.

Based on the figure, which of the following statements (if any) is false

1. at point C, the system is at equilibrium
2. none of the statements are false
3. at point D, the reaction will move towards the reactants to get to equilibrium
4. at point B, Q < K
5. for this reaction $\Delta G^\circ$ is negative

K from DeltaG
025 10.0 points
For the following reaction

$$HgO(s) \leftrightarrow Hg(l) + O_2(g)$$

A sample of solid HgO is heated to a temperature at which it is in equilibrium with liquid Hg and O$_2$ gas. At this temperature $\Delta G^\circ = 0 \text{ kJ mol}^{-1}$. What do you know about the O$_2$ gas at equilibrium?

1. the concentration of O$_2$ is 1 M
2. the concentration of O$_2$ is 1 ppm
3. the partial pressure of O$_2$ is 1 Torr
4. the partial pressure of O$_2$ is 1 atm
5. there is no way to know without the initial mass of the HgO solid

miscibility concept 02
026 10.0 points
"Like dissolves like" refers to the fact that two compounds are likely to spontaneously form a mixture when the two compounds

1. have similar molecular weights
2. have similar entropies
3. have intermolecular forces of the same strength
4. have intermolecular forces of the same type

LDE Equilibrium Conditions from K 003
027 10.0 points
Consider the reaction below:

$$2H_2O(g) \leftrightarrow 2H_2(g) + O_2(g)$$

If K is $10^{-80}$ and the initial concentrations of H$_2$O, H$_2$ and O$_2$ are 10 M, 0 M and 0 M respectively, what are the approximate equilibrium concentrations of these species, respectively?

1. 1 M, 9 M and 4.5 M, respectively
2. 0 M, 10 M and 5 M, respectively
3. 5 M, 5 M and 2.5 M, respectively
4. 10 M, 0 M and 0 M, respectively

Temperature Dependence of K 01
028 10.0 points
The temperature dependence of the equilibrium constant is determined by

1. the standard enthalpy of the reaction
2. the standard free energy of the reaction
3. the equilibrium constant is independent of temperature
4. the standard entropy of the reaction

Consider the reaction

\[ \text{PCl}_5(g) \rightarrow \text{PCl}_3(g) + \text{Cl}_2(g). \]

At a certain temperature, if the initial concentration of \( \text{PCl}_5(g) \) is 2.0 M, at equilibrium the concentration of \( \text{Cl}_2(g) \) is 0.30 M. Calculate the value of \( K_c \) at this temperature.

1. 0.045
2. 19
3. 0.064
4. 0.053
5. 0.090

**Equilibrium Binding 01**

A particular small molecule drug works by binding to the active site in a given enzyme

\[ \text{Drug(aq)} + \text{Enzyme(aq)} \rightleftharpoons \text{BoundComplex(aq)} \]

If the equilibrium constant for this reaction is \( 10^{10} \), at what concentration of free drug is there 1000 times more bound enzyme (complex) than unbound enzyme?

1. \( 10^{-3} \) M
2. \( 10^{-13} \) M
3. \( 10^{-7} \) M
4. \( 10^{-10} \) M
5. 1 M

**Extra credit**

If more points are awarded on this assignment, would you like them added to your score?

1. YES, I would like the points and the higher score.
2. NO, leave my score alone, I prefer the lower score