This print-out should have 27 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

**Sparks vp 010**

001 10.0 points

Consider two closed containers. Container X is a 2 L container that contains 0.5 L of acetone. Container Y is a 3 L container that contains 1.8 L of acetone. Both containers and contents are at 28°C. Which of the following is true?

1. You would need information about the shape of the containers to be able to answer this question.
2. The vapor pressure in container Y is greater.
3. The vapor pressure in container X is greater.
4. The vapor pressures in both containers are equal. **correct**

**Msci 13 1304**

002 10.0 points

Consider the phase diagram for water *(not to scale)*

Which of the following statements is NOT true?

1. We could cause gaseous carbon dioxide to solidify at −78°C by increasing the pressure to greater than 1 atm.
2. Liquid water is more dense than ice.
3. Carbon dioxide cannot exist as a liquid at temperatures below −57°C.
4. Water cannot exist as a liquid at pressures below 4.6 torr.
5. Water cannot exist as a liquid at −5°C. **correct**

**ChemPrin3e T08 35**

003 10.0 points

The phase diagram for CO₂ is given below.

and for carbon dioxide *(not to scale)*
The triple point is at 5.1 atm and 217 K. What happens if carbon dioxide at −50°C and 25 atm is suddenly brought to 1 atm?

1. The solid remains stable.
2. The solid melts.
3. The solid and vapor are in equilibrium.
4. The liquid and solid are in equilibrium.
5. The solid vaporizes. **correct**

**Sparks phase change calc 001**

**004 10.0 points**

How much energy is released when 150 g water at 52°C freezes and forms ice with a temperature of −14°C? The specific heat of water in the liquid state is 4.18 J/g°C, in the solid state is 2.09 J/g°C, and in the gaseous state is 2.03 J/g°C. The heat of fusion is 334 J/g and the heat of vaporization is 2260 J/g.

1. 37 kJ
2. 87 kJ **correct**
3. 45 kJ
4. 93 kJ
5. 102 kJ
6. 22 kJ

**Msci 14 0904**

**007 10.0 points**

The heat of vaporization of water is 9.73 kcal/mol. At what pressure (in torr) would pure water boil at 90°C?

1. vapor pressure = 144 torr
2. vapor pressure = 124 torr
3. vapor pressure = 105 torr
4. vapor pressure = 72 torr
5. vapor pressure = 89 torr
6. vapor pressure = 93 torr **correct**

**Msci 13 0915**

**008 10.0 points**

The solubility of a gas in water decreases with

1. increase of pressure or decrease of temperature.
2. the effect of temperature and pressure depend on the identity of the gas.
3. decrease of pressure or increase of temperature. **correct**

**Mlib 04 4055**

**006 10.0 points**

Which of the following alcohols would be the least miscible with water?

1. ethanol (CH<sub>3</sub>CH<sub>2</sub>OH)
2. hexanol (CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OH) **correct**
3. propanol (CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>OH)
4. methanol (CH<sub>3</sub>OH)
5. pentanol (CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OH)
1. 1058 torr
2. 705 torr
3. 529 torr correct
4. 397 torr
5. 265 torr

ChemPrin3e T09 66
009 10.0 points
For the decomposition of ammonia to nitrogen and hydrogen, the equilibrium constant is $1.47 \times 10^{-6}$ at 298 K. Calculate the temperature at which $K = 1.00$. For this reaction, $\Delta H^\circ = 92.38 \text{ kJ} \cdot \text{mol}^{-1}$.

1. 219 K
2. 492 K
3. 466 K correct
4. 193 K
5. 353 K

ChemPrin3e T08 72
010 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 leaves the cell, causing contraction.
2. water enters the cell, causing expansion. correct
3. no movement of water takes place.
4. the escaping tendency of water in the cell increases.

Msci 14 1111B

011 10.0 points
What is the boiling point elevation of a solution of Na$_2$SO$_4$ (142.1 g/mol) made by dissolving 5.00 g of Na$_2$SO$_4$ in 250 grams of water? Note that $K_b = 0.512^\circ \text{C}/\text{m}$. Assume 100 percent dissociation.

1. 0.108$^\circ \text{C}$
2. 0.072$^\circ \text{C}$
3. 0.216$^\circ \text{C}$ correct
4. 0.018$^\circ \text{C}$
5. 0.141$^\circ \text{C}$
6. 0.363$^\circ \text{C}$

Msci 17 0203
012 10.0 points
Consider the reaction

$$2 \text{HgO}(s) \rightleftharpoons 2 \text{Hg}(l) + \text{O}_2(g).$$

What is the form of the equilibrium constant $K_c$ for the reaction?

1. None of the other answers is correct.
2. $K_c = \frac{[\text{O}_2]}{[\text{HgO}]^2}$
3. $K_c = [\text{O}_2]$ correct
4. $K_c = [\text{Hg}]^2 [\text{O}_2]$
5. $K_c = \frac{[\text{Hg}]^2 [\text{O}_2]}{[\text{HgO}]^2}$

Concept DeltaG and K W
013 10.0 points
If $\Delta G^\circ_{\text{rxn}}$ is positive, then the forward reaction is (spontaneous / nonspontaneous) and K is (less / greater) than one.

1. spontaneous, greater
2. None of these; $\Delta G$ is not directly related to $K$.
3. spontaneous, less
4. nonspontaneous; greater
5. nonspontaneous; less **correct**

**Msci 17 0801**

014 10.0 points

Given that CO\(_2\) (g) reacts with C(s) via the reaction

\[ \text{C(s) + CO}_2(\text{g}) \rightleftharpoons 2 \text{CO(g)} \]

and \( K_p = 1.90 \text{ atm} \), what is the equilibrium partial pressure of CO\(_2\) if 1.00 atm of CO\(_2\) is placed in a vessel with PURE SOLID CARBON? (Note: There was no CO initially.)

1. 0.51 atm **correct**
2. 0.85 atm
3. 0.55 atm
4. 0.60 atm
5. 0.43 atm

**Msci 17 0614**

016 10.0 points

A 10.0 L vessel contains 0.0015 mole CO\(_2\) and 0.10 mole CO. If a small amount of carbon is added to this vessel and the temperature is raised to 1000\({}^\circ\)C,

\[ \text{CO}_2(\text{g}) + \text{C(s)} \rightleftharpoons 2 \text{CO(g)} \]

will more CO form? The value of \( K_c \) for this reaction is 1.17 at 1000\({}^\circ\)C. Assume that the volume of the gas in the vessel is 10.0 L.

1. Unable to determine this from the data provided.
2. Yes, the rate of the forward reaction will increase to produce more CO. **correct**
3. No, the rate of the reverse reaction will increase to produce more CO\(_2\).

**Msci 17 0501**

015 10.0 points

The equilibrium constant for thermal dissociation of F\(_2\)

\[ \text{F}_2(\text{g}) \rightleftharpoons 2 \text{F(g)} \]

is 0.300. If initially 1.00 mol F\(_2\) is placed in a 1.00 L container, which of the following is the correct number of moles of F\(_2\) that have dissociated at equilibrium?

1. 0.474 mol
2. 0.548 mol
3. 0.956 mol
4. 0.130 mol
5. 0.213 mol
6. 0.176 mol

**Rxn Anal 09 75**

017 10.0 points

Which part(s) of the reaction

\[ 2 \text{HD(g)} \rightleftharpoons \text{H}_2(\text{g}) + \text{D}_2(\text{g}) \]

will be favored by an increase in the total pressure (resulting in compression)?

1. Neither is favored. **correct**
2. Unable to determine
3. reactants
4. products

**Msci 17 1203**

018 10.0 points

Given the reaction

\[ 2 \text{ICl(s)} \rightleftharpoons \text{I}_2(s) + \text{Cl}_2(\text{g}) \]
and the thermodynamic data

<table>
<thead>
<tr>
<th>Species</th>
<th>$\Delta H_f$ (kJ/mol)</th>
<th>$S^0$ (J/mol·K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICl(s)</td>
<td>17.78</td>
<td>242.4</td>
</tr>
<tr>
<td>I$_2$(s)</td>
<td>0.0</td>
<td>116.1</td>
</tr>
<tr>
<td>Cl$_2$(g)</td>
<td>0.0</td>
<td>223.0</td>
</tr>
</tbody>
</table>

Calculate $K_p$ at 100°C.

1. 0.57
2. 0.023
3. 0.75
4. 0.0023 correct
5. 7.562

Which of the following expressions correctly describes the relationship between $[H_3O^+]$ and $[OH^-]$ in any aqueous solution at 25°C?

1. $[H_3O^+] - [OH^-] = 14$
2. $[H_3O^+] [OH^-] = 14$
3. $\frac{[H_3O^+]}{[OH^-]} = 10^{-14}$
4. $[H_3O^+] [OH^-] = 10^{-14}$ correct
5. $\frac{[OH^-]}{[H_3O^+]} = 10^{-14}$

Which of the following statements is true with respect to the autodissociation of water when sipping a glass of ice water?

I. pH = pOH = 7
II. pH < 7
III. pH = pOH
IV. pH > 7

1. II only
2. III and IV only correct
3. IV only
4. I and III only

A typical fresh egg white will have a pH of 7.80. This corresponds to

1. $[H_3O^+]$ of $8.5 \times 10^{-7}$ M; $[OH^-]$ of $5.5 \times 10^{-7}$ M.
2. $[H_3O^+]$ of $7.0 \times 10^{-8}$ M; $[OH^-]$ of $1.4 \times 10^{-7}$ M.
3. $[H_3O^+]$ of $3.0 \times 10^{-8}$ M; $[OH^-]$ of $3.3 \times 10^{-7}$ M.
4. $[H_3O^+]$ of $1.6 \times 10^{-8}$ M; $[OH^-]$ of $6.3 \times 10^{-7}$ M correct.
5. $[H_3O^+]$ of $8.0 \times 10^{-7}$ M; $[OH^-]$ of $1.3 \times 10^{-8}$ M.

Arrange the acids

I) phosphoric acid (H$_3$PO$_4$), $pK_a$ = 2.12;
II) selenous acid (H$_2$SeO$_3$), $pK_a$ = 2.46;
III) hydrogen selenate ion (HSeO$_4^-$), $pK_a$ = 1.92;
IV) phosphorous acid (H$_3$PO$_3$), $pK_{a1}$ = 2.00;

in decreasing order of strengths.

1. II, I, IV, III
2. IV, I, III, II
3. Cannot be determined
4. None of these
5. II, I, III, IV
6. IV, III, I, II
7. II, IV, I, III
8. III, I, IV, II
9. II, III, I, IV
10. III, IV, I, II correct

Msci 18 0387
023 10.0 points
The pH of a solution of hydrochloric acid is 2.80. What is the molarity of the acid?
1. $4.2 \times 10^{-2}$ M
2. $6.3 \times 10^{-3}$ M
3. $6.3 \times 10^{-2}$ M
4. $4.2 \times 10^{-3}$ M
5. $1.6 \times 10^{-3}$ M correct

Msci 18 0402
024 10.0 points
What is the $H^+$ ion concentration in a 0.50 mol/L solution of a weak base that has an ionization constant ($K_b$) of $2.0 \times 10^{-8}$?
1. $1.0 \times 10^{-4}$ mol/L
2. $2.0 \times 10^{-10}$ mol/L
3. $1.0 \times 10^{-8}$ mol/L
4. $1.0 \times 10^{-10}$ mol/L correct
5. $8.0 \times 10^{-16}$ mol/L

Msci 18 0408
025 10.0 points
0.50 moles of HCN are added to a liter of water. What is the pH? ($K_a$ of HCN is $4.0 \times 10^{-10}$)
1. 5.35
2. 9.40
3. 4.69
4. 4.35
5. 4.85 correct

Brodbelt 04 05
026 10.0 points
Everyone should recognize that _?_ is a strong acid, _?_ is a weak acid, _?_ is a strong base, and _?_ is a salt.
1. CH$_3$COOH; HF; KOH; KBr
2. HCl; HNO$_3$; NaOH; LiCl
3. HCl; HCN; Cu(OH)$_2$; LiCl
4. HNO$_3$; HCN; KOH; CO
5. HNO$_3$; HCN; KOH; LiCl correct

DAL 0301 10
027 10.0 points
Each of the following samples was placed in 1 liter of water.
I) 0.6 mol NaOH
II) 0.7 mol KCl
III) 0.5 mol Na$_2$NO$_3$
IV) 1 mol of sugar
Rank the solutions that are made in terms of increasing order of boiling point elevation.
( Remember your solubility rules.)
1. III, I, II, IV
2. IV, II, I, III
3. IV, I, II, III correct
4. III, I, IV, II
5. II, IV, I, III