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.

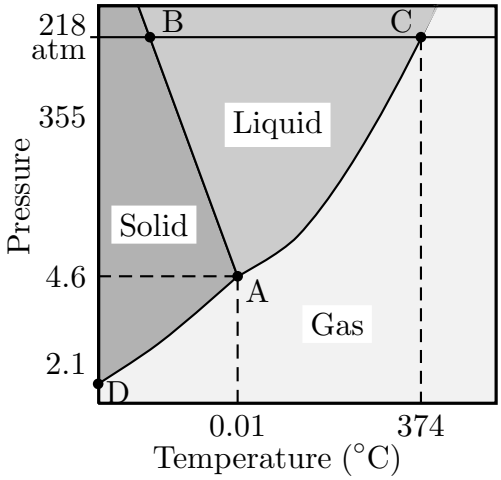
**3.** The vapor pressure in container X is greater.

**4.** The vapor pressures in both containers are equal. **correct**

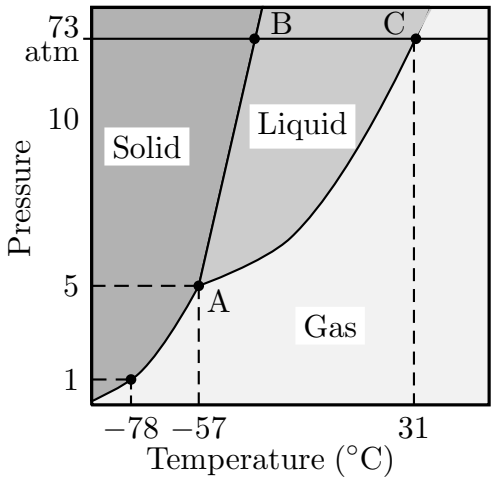
---

**Msci 13 1304**
**002 10.0 points**

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




and for carbon dioxide *(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.

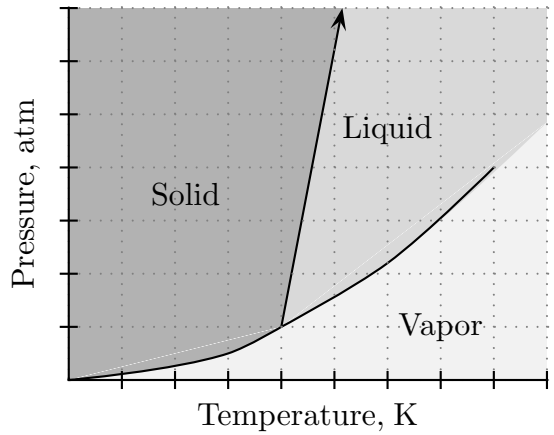
**4.** Water cannot exist as a liquid at pressures below 4.6 torr.

**5.** Water cannot exist as a liquid at −5°C. **correct**

---

**ChemPrin3e T08 35**
**003 10.0 points**

The phase diagram for $CO_2$ is given below.



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 0707**
**005 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**

**4.** increase of pressure or increase of temperature.

**5.** decrease of pressure or decrease of temperature.

---

**Mlib 04 4055**
**006 10.0 points**

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

**1.** ethanol ($CH_3CH_2OH$)

**2.** hexanol ($CH_3CH_2CH_2CH_2CH_2CH_2OH$) **correct**

**3.** propanol ($CH_3CH_2CH_2OH$)

**4.** methanol ($CH_3OH$)

**5.** pentanol ($CH_3CH_2CH_2CH_2CH_2OH$)

---

**Msci 14 0904**
**007 10.0 points**

The vapor pressure of pure $CH_2Cl_2$ (molecular weight = 85 g/mol) is 133 torr at 0°C and the vapor pressure of pure $CH_2Br_2$ (molecular weight 174 g/mol) is 11 torr at the same temperature. What is the total vapor pressure of a solution prepared from equal masses of these two substances?

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

**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 $Na_2SO_4$ (142.1 g/mol) made by dissolving 5.00 g of $Na_2SO_4$ in 250 grams of water? Note that $K_b = 0.512^\circ\text{C}/m$. Assume 100 percent dissociation.

**1.** 0.108°C

**2.** 0.072°C

**3.** 0.216°C **correct**

**4.** 0.018°C

**5.** 0.141°C

**6.** 0.363°C

---

**Msci 17 0203**

**012 10.0 points**

Consider the reaction

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

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

**1.** None of the other answers is correct.

**2.** $K_c = \dfrac{[\text{O}_2]}{[\text{HgO}]^2}$

**3.** $K_c = [\text{O}_2]$ **correct**

**4.** $K_c = [\text{Hg}]^2\,[\text{O}_2]$

**5.** $K_c = \dfrac{[\text{Hg}]^2\,[\text{O}_2]}{[\text{HgO}]^2}$

---

**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

$$C(s) + CO_2(g) \rightleftharpoons 2\,CO(g)$$

and $K_p = 1.90$ 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 0501**
**015 10.0 points**

The equilibrium constant for thermal dissociation of $F_2$

$$F_2(g) \rightleftharpoons 2\,F\,(g)$$

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

**7.** 0.418 mol

**8.** 0.239 mol **correct**

---

**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°C

$$CO_2(g) + C(s) \rightleftharpoons 2\,CO(g)\,,$$

will more CO form? The value of $K_c$ for this reaction is 1.17 at 1000°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 $CO_2$.

---

**Rxn Anal 09 75**
**017 10.0 points**

Which part(s) of the reaction

$$2\,HD(g) \rightleftharpoons H_2(g) + D_2(g)$$

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

$$2\,ICl(s) \rightleftharpoons I_2(s) + Cl_2(g)$$

and the thermodynamic data

| Species | $\Delta H_f$ kJ/mol | $S^0$ J/mol·K |
|---|---|---|
| ICl(s) | 17.78 | 242.4 |
| $I_2$(s) | 0.0 | 116.1 |
| $Cl_2$(g) | 0.0 | 223.0 |

calculate $K_p$ at 100°C .

**1.** 0.57

**2.** 0.023

**3.** 0.75

**4.** 0.0023 **correct**

**5.** 7.562

---

**Mlib 07 0165**
**019 10.0 points**

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.** $\dfrac{[H_3O^+]}{[OH^-]} = 10^{-14}$

**4.** $[H_3O^+][OH^-] = 10^{-14}$ **correct**

**5.** $\dfrac{[OH^-]}{[H_3O^+]} = 10^{-14}$

---

**DAL 02 0303**
**020 10.0 points**

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

---

**Msci 18 0453**
**021 10.0 points**

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 .

---

**Acid Strength 10 23**
**022 10.0 points**

Arrange the acids

I) phosphoric acid ($H_3PO_4$), $pK_a = 2.12$;
II) selenous acid ($H_2SeO_3$), $pK_a = 2.46$;
III) hydrogen selenate ion ($HSeO_4^-$), $pK_a = 1.92$;
IV) phosphorous acid ($H_3PO_3$), $pK_{a1} = 2.00$;

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.** $CH_3COOH$; 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 $Na_2NO_3$
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