Periodic Table of the Elements

1A	2A	3B	4B	5B	6B	7B	8B	8B	8B	1B	2B	3A	4A	5A	6A	7A	8A
1																	2
H 1.0079																	**He** 4.0026
3	4											5	6	7	8	9	10
Li 6.941	**Be** 9.0122											**B** 10.811	**C** 12.011	**N** 14.0067	**O** 15.9994	**F** 18.9984	**Ne** 20.1797
11	12	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Na 22.9898	**Mg** 24.3050											**Al** 26.9815	**Si** 28.0855	**P** 30.9738	**S** 32.066	**Cl** 35.4527	**Ar** 39.948
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K 39.0983	**Ca** 40.078	**Sc** 44.9559	**Ti** 47.88	**V** 50.9415	**Cr** 51.9961	**Mn** 54.9380	**Fe** 55.847	**Co** 58.9332	**Ni** 58.69	**Cu** 63.546	**Zn** 65.39	**Ga** 69.723	**Ge** 72.61	**As** 74.9216	**Se** 78.96	**Br** 79.904	**Kr** 83.80
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Rb 85.4678	**Sr** 87.62	**Y** 88.9059	**Zr** 91.224	**Nb** 92.9064	**Mo** 95.94	**Tc** (98)	**Ru** 101.07	**Rh** 102.9055	**Pd** 106.42	**Ag** 107.8682	**Cd** 112.411	**In** 114.82	**Sn** 118.710	**Sb** 121.75	**Te** 127.60	**I** 126.9045	**Xe** 131.39
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Cs 132.9054	**Ba** 137.327	**La** 138.9055	**Hf** 178.49	**Ta** 180.9479	**W** 183.85	**Re** 186.207	**Os** 190.2	**Ir** 192.22	**Pt** 195.08	**Au** 196.9665	**Hg** 200.59	**Tl** 204.3833	**Pb** 207.2	**Bi** 208.9804	**Po** (209)	**At** (210)	**Rn** (222)
87	88	89	104	105	106	107	108	109									
Fr (223)	**Ra** (226)	**Ac** (227)	**Rf** (261)	**Db** (262)	**Sg** (263)	**Bh** (262)	**Hs** (265)	**Mt** (266)									

58	59	60	61	62	63	64	65	66	67	68	69	70	71
Ce 140.115	**Pr** 140.9076	**Nd** 144.24	**Pm** (145)	**Sm** 150.36	**Eu** 151.965	**Gd** 157.25	**Tb** 158.9253	**Dy** 162.50	**Ho** 164.9303	**Er** 167.26	**Tm** 168.9342	**Yb** 173.04	**Lu** 174.967
90	91	92	93	94	95	96	97	98	99	100	101	102	103
Th 232.0381	**Pa** 231.0359	**U** 238.0289	**Np** (237)	**Pu** (244)	**Am** (243)	**Cm** (247)	**Bk** (247)	**Cf** (251)	**Es** (252)	**Fm** (257)	**Md** (258)	**No** (259)	**Lr** (260)

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

Sparks 30
13:02, general, multiple choice, < 1 min, fixed.
001
Arrange the molecules

$$NBr_3, \ CO_2, \ HF, \ NaI$$

in order according to their boiling point, from lowest boiling point to highest boiling point

1. CO_2, NBr_3, HF, NaI **correct**

2. NBr_3, CO_2, HF, NaI

3. NaI, HF, NBr_3, CO_2

4. CO_2, HF, NBr_3, NaI

5. CO_2, NBr_3, NaI, HF

Explanation:

ChemPrin3e T07 51
15:12, basic, multiple choice, < 1 min, fixed.
002
Which one of the following statements is true?

1. *Labile* is a term that refers to the thermodynamic tendency of a substance to decompose.

2. A thermodynamically unstable compound is a compound with a positive standard free energy of formation. **correct**

3. Spontaneous reactions always have $\Delta S^\circ_r > 0$.

4. Spontaneous reactions always have $\Delta G^\circ_r > 0$.

5. Spontaneous reactions always have $\Delta H^\circ_r < 0$.

Explanation:

ACAMP FE 0005
15:12, general, multiple choice, > 1 min, fixed.
003
In order for an endothermic reaction to be spontaneous

1. the entropy increase in the system must be greater than the entropy decrease in the surroundings. **correct**

2. nothing special is required; they are always spontaneous.

3. heat must be supplied to the system.

4. endothermic reactions are never spontaneous.

5. the entropy increase in the system must equal the entropy decrease in the surroundings.

Explanation:
The Second Law of Thermodynamics states that in spontaneous reactions, the universe tends toward a state of greater disorder. When the entropy increase in the system is greater than the entropy decrese in the surroundings, the entropy of the universe will increase.

Msci 15 1212
15:12, general, multiple choice, > 1 min, fixed.
004
Which one of the following statements is the best statement of the Second Law of Thermodynamics?

1. The absolute entropy of a perfect crystal at 0 K would be 0.

2. For any spontaneous process, the entropy of the system must increase.

3. For any reversible process, the entropy change of the universe must be positive.

4. For any spontaneous process, the total

entropy of the universe must increase. **correct**

5. For any spontaneous process, the change in entropy of the universe must be negative.

Explanation:
The Second Law of Thermodynamics states that in spontaneous changes, the universe tends toward a state of greater disorder.

Msci 15 1223
15:13, basic, multiple choice, > 1 min, fixed.
005
Which of the following is the best definition of entropy?

1. Entropy is a state function such that a change in entropy is given by the flow of heat into a system in a reversible process divided by the temperature at which it occurs. **correct**

2. Entropy is a state function that is directly proportional to the degree of order in the system.

3. Entropy is a state function that is directly proportional to the logarithm of the degree of order in the system.

4. Entropy is the change in Gibbs free energy during a process divided by the temperature at which it occurs.

5. Entropy is a state function which achieves a maximum value when a reversible reaction comes to equilibrium.

Explanation:
The units of entropy are

$$\frac{\text{Heat}}{\text{Temperature}} = \frac{\text{J}}{\text{mol} \cdot \text{K}} , \frac{\text{cal}}{\text{g} \cdot \text{K}} , \text{etc.}$$
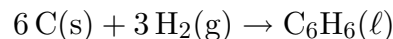
Entropy is a state function, so $\Delta S = S_{\text{f}} - S_{\text{i}}$.

ChemPrin3e T07 40
15:13, basic, multiple choice, < 1 min, fixed.
006
Calculate $\Delta S^{\circ}_{\text{surr}}$ at 298 K for the reaction

$$6\,\text{C(s)} + 3\,\text{H}_2(\text{g}) \rightarrow \text{C}_6\text{H}_6(\ell)$$

$\Delta H_{\text{r}}^{\circ} = +49.0$ kJ·mol^{-1} and $\Delta S_{\text{r}}^{\circ} = -253$ J·K^{-1}·mol^{-1}.

1. $+164$ J·K^{-1}·mol^{-1}

2. -417 J·K^{-1}·mol^{-1}

3. $+253$ J·K^{-1}·mol^{-1}

4. -164 J·K^{-1}·mol^{-1} **correct**

5. -253 J·K^{-1}·mol^{-1}

Explanation:

Msci 15 1226 alt
15:13, general, multiple choice, < 1 min, fixed.
007
What is the change in entropy when one mole of methane (CH_4) is frozen to a solid at its normal melting point of $-182°\text{C}$?
The heat of fusion of CH_4 is 0.92 kJ/mol. (Careful – watch your signs.)

1. $10.1 \dfrac{\text{J}}{\text{K} \cdot \text{mol}}$

2. $-10.1 \dfrac{\text{J}}{\text{K} \cdot \text{mol}}$ **correct**

3. $5.05 \dfrac{\text{J}}{\text{K} \cdot \text{mol}}$

4. $-5.05 \dfrac{\text{J}}{\text{K} \cdot \text{mol}}$

5. None of these

Explanation:
$\Delta H = 0.92$ kJ/mol
$T = -182°\text{C} + 273 = 91$ K

$$\frac{0.92 \text{ kJ/mol}}{91 \text{ K}} = 0.0101099 \frac{\text{kJ}}{\text{K} \cdot \text{mol}}$$

Freezing increases the order of the system, so the entropy change is $-10.1099 \dfrac{\text{J}}{\text{K} \cdot \text{mol}}$.

ChemPrin3e T07 55
15:14, basic, multiple choice, < 1 min, fixed.
008

Consider the following compounds and their standard free energies of formation:

	cpd	energy
1	$C_6H_{12}(\ell)$ cyclohexane	6.4 kJ·mol^{-1}
2	$CH_3OH(\ell)$ methanol	-166 kJ·mol^{-1}
3	$N_2H_4(\ell)$ hydrazine	149 kJ·mol^{-1}
4	$H_2O_2(\ell)$ hydrogen peroxide	-120 kJ·mol^{-1}
5	$CS_2(\ell)$ carbon disulfide	65.3 kJ·mol^{-1}

Which of these liquids is/are thermodynamically stable?

1. 2 and 4 only **correct**

2. 2 and 3 only

3. 1, 3, and 5 only

4. 1 only

5. 3 only

Explanation:

ChemPrin3e T07 58

15:15, basic, multiple choice, < 1 min, fixed.
009

For the reaction

$$2\,C(s) + 2\,H_2(g) \rightarrow C_2H_4(g)$$
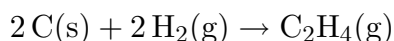
$\Delta H_r^\circ = +52.3 \text{ kJ· mol}^{-1}$ and $\Delta S_r^\circ = -53.07$ J· K^{-1}·mol^{-1} at 298 K.

This reaction will be spontaneous at

1. no temperature. **correct**

2. all temperatures.

3. temperatures below 985 K.

4. temperatures above 985 K.

5. temperatures below 1015 K.

Explanation:

Entropy Change Water

15:13, general, multiple choice, > 1 min, .
010

The entropy of vaporization of water is $+109 \dfrac{\text{J}}{\text{K} \cdot \text{mol}}$ and the enthalpy of vaporization of water is 40.7 kJ/mol at 100°C.

What is ΔS_{total} for the vaporization of water at 100°C?

1. $-4070 \dfrac{\text{J}}{\text{mol} \cdot \text{K}}$

2. $0 \dfrac{\text{J}}{\text{mol} \cdot \text{K}}$ **correct**

3. $-109 \dfrac{\text{J}}{\text{mol} \cdot \text{K}}$

4. $+4070 \dfrac{\text{J}}{\text{mol} \cdot \text{K}}$

5. $+109 \dfrac{\text{J}}{\text{mol} \cdot \text{K}}$

Explanation:

Msci 14 0102

14:01, general, multiple choice, > 1 min, fixed.
011

Water causes many electrolytes to dissociate

1. because water molecules are dipoles and the dipoles orient in an energetically favorable manner to solvate the ions. **correct**

2. because it undergoes hydrogen bonding to large halide ions.

3. because the dispersion forces between ion and solvent are strong.

4. because of repulsive interactions between ions in the crystalline state.
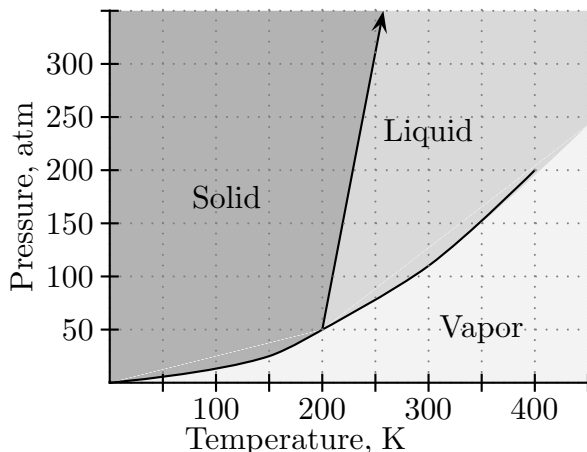
Explanation:
The more negative end of the water molecule orients toward the cation and the more positive end orients toward the anion; the ions remain apart.

ChemPrin3e T08 26
13:08, general, multiple choice, < 1 min, fixed.
012
The phase diagram for a pure substance is given below.

The substance is stored in a container at 150 atm at 25°C.

Describe what happens if the container is opened at 25°C.

1. The liquid in the container freezes.

2. The solid in the container sublimes.

3. The solid in the container melts.

4. The vapor in the container escapes.

5. The liquid in the container vaporizes. **correct**

Explanation:

ChemPrin3e T08 21
13:08, basic, multiple choice, < 1 min, fixed.
013
The phase diagram for a pure substance is given below.
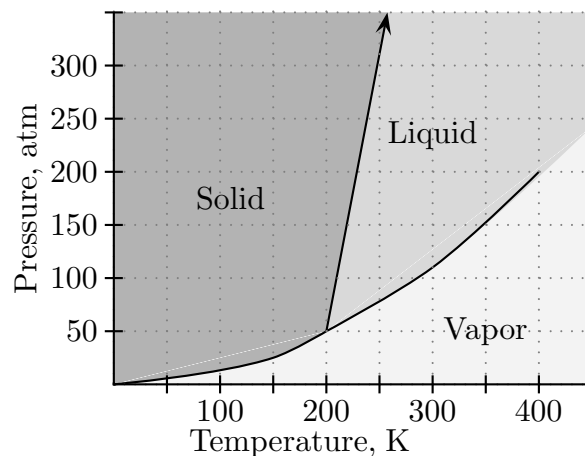
What is the critical temperature?

1. 0 K

2. 250 K

3. 300 K

4. 400 K **correct**
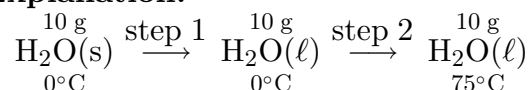
5. 200 K

Explanation:

Mlib 65 7087
13:07, general, multiple choice, > 1 min, fixed.
014
The specific heat of water is 1.00 cal/g·°C, the heat of vaporization of water is 540 cal/g, and the heat of fusion of water is 80 cal/g.

How much heat would be required to convert 10 grams of ice at 0°C to 10 grams of water at 75°C?

1. 1.55 kcal **correct**

2. 155 cal

3. 15.5 cal

4. 61.5 kcal

5. 6150 cal

Explanation:

$$\underset{0°C}{\overset{10\text{ g}}{H_2O(s)}} \overset{\text{step } 1}{\longrightarrow} \underset{0°C}{\overset{10\text{ g}}{H_2O(\ell)}} \overset{\text{step } 2}{\longrightarrow} \underset{75°C}{\overset{10\text{ g}}{H_2O(\ell)}}$$

Step 1: $\dfrac{80\text{ cal}}{\text{g}}(10\text{ g}) \;=\; 800\text{ cal}$

Step 2: $\dfrac{1\text{ cal}}{\text{g}\cdot^\circ\text{C}}(10\text{ g})(75-0)^\circ\text{C} \;=\; 750\text{ cal}$

$$\begin{aligned}\text{Total} \;&=\; 800\text{ cal} + 750\text{ cal}\\ &=\; 1550\text{ cal}\\ &=\; 1.55\text{ kcal}\end{aligned}$$

Mlib 04 4013
14:01, general, multiple choice, > 1 min, fixed.
015
For gases that do not react chemically with water, the solubility of the gas in water generally (decreases, increases) with an increase in the pressure of the gas and (decreases, increases) with increasing temperature.

1. increases; decreases **correct**

2. decreases; increases

3. increases; increases

4. decreases; decreases

Explanation:
An increase in pressure means that you have increased the concentration of gas above the solvent surface, thereby increasing the concentration of the gas in the solvent. Increasing the temperature will decrease the solubility of the gas.

Msci 14 5001
14:01, general, multiple choice, > 1 min, fixed.
016
Which one of the following statements is false?

1. Carbon tetrachloride (CCl_4) is more miscible with hexane (C_6H_{14}) than it is with a polar solvent such as methanol (CH_3OH).

2. Gases are generally more soluble in water under high pressures than under low pressures.

3. As temperature increases, the solubilities of some solids in liquids increase and the solubilities of other solids in liquids decrease.

4. Gases are generally more soluble in water at high temperatures than at low temperatures. **correct**

5. Water dissolves many ionic solutes because of its ability to hydrate ions in solution.

Explanation:
The polarity of water allows it to hydrate the individual ions in the ionic solute.

CCl_4 is non-polar and will be miscible with another non-polar liquid and not with a polar one.

Increasing temperature makes salts with exothermic ΔH_{sol} more soluble, but salts with endothermic ΔH_{sol} less soluble.

Gases are generally more soluble in water under high pressures than under low pressures because of Henry's Law; as the pressure of a gas above a liquid increases, the concentration of the gas in the solution increases.

Mlib 75 0163
14:01, general, multiple choice, > 1 min, fixed.
017
Which of the following is likely to be LEAST soluble in water?

1. C_6H_6 (benzene). **correct**

2. CH_3OH (methanol).

3. $C_6H_{12}O_6$ (glucose).

4. HCHO (formaldehyde).

Explanation:

Msci 14 0901
14:05, general, multiple choice, > 1 min, fixed.
018
The vapor pressure of a volatile component in a solution decreases as its mole fraction decreases.

This is known as

1. Raoult's Law. **correct**

2. Henry's Law.

3. Bragg's Law.

4. LeChatelier's Principle.

Explanation:
According to Raoult's Law, the vapor pressure of the volatile component of a solution equals its mole fraction in the solution times the vapor pressure of the pure solvent.

$$P = X \, P^0$$

ChemPrin3e T08 60
14:05, basic, multiple choice, < 1 min, fixed.
019
Calculate the vapor pressure at 25°C of a mixture of benzene and toluene in which the mole fraction of benzene is 0.650. The vapor pressure at 25°C of benzene is 94.6 torr and that of toluene is 29.1 torr.

1. 84.4 torr

2. 124 torr

3. 51.3 torr

4. 71.7 torr **correct**

5. 61.5 torr

Explanation:

ChemPrin3e T08 09
14:05, basic, multiple choice, < 1 min, fixed.
020
The vapor pressure of water at 37°C is 47.1 torr and its enthalpy of vaporization is 44.0 kJ·mol^{-1}.

Estimate the vapor pressure of water at 87°C. Assume the enthalpy of vaporization of water is independent of temperature.

1. 112 torr

2. 256 torr

3. 713 torr

4. 52 torr

5. 504 torr **correct**

Explanation:

Holt da 14 rev 35
14:07, highSchool, numeric, > 1 min, fixed.
021
Consider 0.01 m aqueous solutions of each of the following.
a) NaI;
b) CaCl$_2$;
c) K$_3$PO$_4$; and
d) C$_6$H$_{12}$O$_6$ (glucose)

Arrange the solutions in order of freezing point from lowest to highest. Assume that each compound behaves ideally.

1. d, a, b, c

2. a, b, c, d

3. d, c, b, a

4. c, b, a, d **correct**

5. a, d, b, c

6. c, b, d, a

7. b, a, d, c

8. c, d, a, b

9. None of these

Explanation:
solvent is H$_2$O $m = 0.01 \, m$
solutes are NaI, CaCl$_2$, K$_3$PO$_4$, C$_6$H$_{12}$O$_6$
FP depression of each solution = ?

$$\Delta t_f = K_f \, m$$

a) For the solute NaI,

$$\text{NaI(s)} \longrightarrow \text{Na}^+ + \text{I}^-(\text{aq})$$
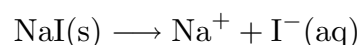
each formula unit of NaI yields two ions in solution:

$$\Delta t_f = \frac{-1.86°C \cdot kg\ H_2O}{mol\ ions} \cdot \frac{0.01\ mol\ NaI}{kg\ H_2O}$$
$$\cdot \frac{2\ mol\ ions}{mol\ NaI}$$
$$= -0.04°C$$

b) For the solute $CaCl_2$,

$$CaCl_2(s) \longrightarrow Ca^{2+} + 2\,Cl^-(aq)$$

each formula unit of $CaCl_2$ yields three ions in solution:

$$\Delta t_f = \frac{-1.86°C \cdot kg\ H_2O}{mol\ ions} \cdot \frac{0.01\ mol\ CaCl_2}{kg\ H_2O}$$
$$\cdot \frac{3\ mol\ ions}{mol\ CaCl_2}$$
$$= -0.06°C$$

c) For the solute K_3PO_4,

$$K_3PO_4(s) \longrightarrow 3\,K^+ + PO_4^{3-}(aq)$$
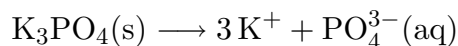
each formula unit of K_3PO_4 yields four ions in solution:

$$\Delta t_f = \frac{-1.86°C \cdot kg\ H_2O}{mol\ ions} \cdot \frac{0.01\ mol\ K_3PO_4}{kg\ H_2O}$$
$$\cdot \frac{4\ mol\ ions}{mol\ K_3PO_4}$$
$$= -0.07°C$$

d) For the solute $C_6H_{12}O_6$ (glucose),

$$\Delta t_f = \frac{-1.86°C \cdot kg\ H_2O}{mol\ ions} \cdot \frac{0.01\ mol\ C_6H_{12}O_6}{kg\ H_2O}$$
$$\cdot \frac{1\ mol\ ions}{mol\ C_6H_{12}O_6}$$
$$= -0.02°C$$

Arranging these from lowest to highest,

$$-0.07°C < -0.06°C > -0.04°C < -0.02°C,$$

so the order of increasing Δt_f is c, b, a, d.

Mlib 04 5017
14:07, general, multiple choice, > 1 min, fixed.
022
How many grams of methanol (CH_3OH) are needed to lower the freezing point of 400 mL of water by 2.5°C? (K_f water = 1.86°C/molality)

1. 17.2 **correct**

2. 18.3

3. 21.8

4. 9.71

5. 12.8

Explanation:
$K_{f\ H_2O} = 1.86°C/m$ $\qquad\qquad$ $V_{water} = 400\ L$
FP depression $= 2.5°C$

$$\Delta T_f = K_f \cdot m$$
$$m = \frac{\Delta T_f}{K_f} = \frac{2.5°C}{1.86°C/m} = 1.344\ m$$

$$m_{H_2O} = 400\ mL \times \frac{1.00\ g}{mL} \times \frac{10^{-3}\ kg}{g}$$
$$= 0.4\ kg\ H_2O$$

$$m = \frac{n_{CH_3OH}}{kg\ water} = \frac{\dfrac{g\ CH_3OH}{MW_{CH_3OH}}}{kg\ water}$$

$$g\ CH_3OH = m\,(kg\ water)\,(MW_{CH_3OH})$$
$$= \left(\frac{1.344\ mol\ CH_3OH}{kg\ water}\right)$$
$$\times (0.400\ kg\ water)$$
$$\times \left(\frac{32.0\ g\ CH_3OH}{mol\ CH_3OH}\right)$$
$$= 17.2\ g\ CH_3OH$$

Mlib 04 5021
14:08, general, multiple choice, > 1 min, fixed.
023
Many biological cells are killed if they are placed in pure water because

1. if nothing can pass through the cell wall, the greater pressure inside than outside causes the cell to burst open.

2. if nothing can pass through the cell wall, the greater pressure outside than inside causes the cell to collapse.

3. vital cell constituents dissolved in the cell fluid pass through the cell wall causing the cells to die.

4. the water in the cells passes out through the cell wall causing the cell to shrivel and die.

5. more water passes in through the cell wall than passes out so the cells swell and burst. **correct**

Explanation:
More solvent molecules pass through the semi-permeable cell membrance into the cell where the solvent concentration is low than in the other direction. This process coninues until pressure on both sides of the membrane is equal or until the cell from the large volume of excess water that enters.

ChemPrin3e T08 70
14:08, general, multiple choice, < 1 min, fixed.
024
Blood, sweat, and tears are about 0.15 M in sodium chloride.
Estimate the osmotic pressure of these solutions at 37°C. The gas constant is 0.0821 L· atm·mol^{-1}·K^{-1}.

1. 3.8 atm

2. 11 atm

3. 0.91 atm

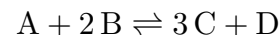**4.** 1.8 atm

5. 7.6 atm **correct**

Explanation:

Mlib 06 0019
17:01, general, multiple choice, > 1 min, fixed.
025
What is the equilibrium expression for the following equation?

$$A + 2\,B \rightleftharpoons 3\,C + D$$

Assume that all species here are gases.

1. $\dfrac{[C]^3\,[D]}{[A]\,[B]^2}$ **correct**

2. $\dfrac{[A]\,[B]^2}{[C]^3\,[D]}$

3. $\dfrac{3\,[C]\,[D]}{2\,[A]\,[B]}$

4. $\dfrac{2\,[A]\,[B]}{3\,[C]\,[D]}$
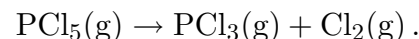
Explanation:
Equilibrium expressions are written with the products (raised to the powers of their coefficients) in the numerator and the reactants (raised to the powers of their coefficients) in the denominator.

ChemPrin3e T09 53
17:11, basic, multiple choice, < 1 min, fixed.
026
Consider the reaction

$$PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)\,.$$

At a certain temperature, if the initial concentration of $PCl_5(g)$ is 3.0 M, at equilibrium the concentration of $Cl_2(g)$ is 0.80 M.
Calculate the value of K_c at this temperature.

1. 0.21

2. 0.29 **correct**

3. 0.64

4. 3.4

5. 0.46

Explanation:

ChemPrin3e T09 48
17:02, general, multiple choice, < 1 min, fixed.
027
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. $K_\mathrm{c} = \dfrac{x^4}{1.0 - 4x}$

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

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

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

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

Explanation:

Msci 17 0210
17:01, general, multiple choice, > 1 min, fixed.
028
The reaction

$$\mathrm{A + B \rightleftharpoons C + 2\,D}$$
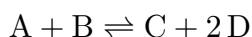
has an equilibrium constant of 3.7×10^{-3}. Consider a reaction mixture with
$[\mathrm{A}] = 2.0 \times 10^{-2}$ M $[\mathrm{C}] = 2.4 \times 10^{-6}$ M
$[\mathrm{B}] = 1.7 \times 10^{-4}$ M $[\mathrm{D}] = 3.5 \times 10^{-3}$ M
Which of the following statements is definitely true?

1. The forward reaction can occur to a greater extent than the reverse reaction until equilibrium is established. **correct**

2. The system is at equilibrium.

3. The reverse reaction can occur to a greater extent than the forward reaction until equilibrium is established.

4. Heat will be evolved.

5. No conclusions about the system can be made without additional information.

Explanation:

$$Q = \frac{[\mathrm{C}]\,[\mathrm{D}]^2}{[\mathrm{A}]\,[\mathrm{B}]}$$
$$= \frac{(2.4 \times 10^{-6}\ \mathrm{M})\,(0.0035\ \mathrm{M})^2}{(0.02\ \mathrm{M})\,(0.00017\ \mathrm{M})}$$
$$= 8.64706 \times 10^{-6}$$

Since $Q < K$ the foward reaction is favored.

Msci 17 0616
17:04, general, multiple choice, > 1 min, fixed.
029
Consider the system

$$2\,\mathrm{N_2O_5(g)} \rightleftharpoons 2\,\mathrm{N_2O_4(g)} + \mathrm{O_2(g)} + \text{heat}$$

at equilibrium at 25°C.
If the temperature were raised would the equilibrium be shifted to produce more $\mathrm{N_2O_5}$ or more $\mathrm{N_2O_4}$?

1. more $\mathrm{N_2O_5}$ **correct**

2. more $\mathrm{N_2O_4}$

3. There would be no effect.

Explanation:
This is an exothermic reaction and so increasing temperature provides more heat to the system, shifting equilibrium to the left and producing more $\mathrm{N_2O_5}$.

Msci 17 1101
17:10, general, multiple choice, > 1 min, normal.
030
Calculate the equilibrium constant at 25°C for a reaction for which $\Delta G^0 = -3.45$ kcal/mol.

1. 339.157 **correct**

2. 678.314

3. 169.578

4. −339.157

5. 3391.57

Explanation:
$T = 25°\text{C} + 273 = 298 \text{ K}$
$\Delta G^0 = -3450 \text{ cal/mol}$
  At equilibrium

$$\Delta G^0 = -R\,T \ln K$$
$$-3450 = (-1.987 \text{ cal/mol} \cdot \text{K})$$
$$\times (298 \text{ K})(\ln K)$$
$$K = 339.157$$