CHM 1046 ACS Questions

Molecular Structure and Bonding

12. Which concept describes the formation of four equivalent, single, covalent bonds by carbon in its compounds that resemble methane, CH_4?

(A) Hydrogen Bonding
(B) Hybridization
(C) Sigma Bonding
(D) Coordinate Covalent Bonding

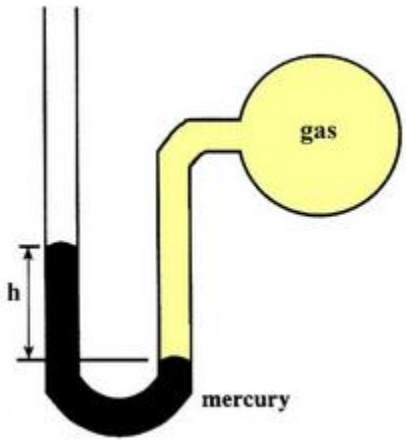
Answer: B

States of Matter/Solutions

24. 800 g of ethanol, C_2H_5OH, was added to 8.0 x 10^3 g of water. How much would this lower the freezing point? (K_f for water = 1.86 °C*m^{-1})

(A) 3.2 °C
(B) 4.1 °C
(C) 8.2 °C
(D) 16 °C

30. An open ended mercury manometer is used to measure the pressure exerted by trapped gas as shown in the figure.



Atmospheric pressure is 749 mmHg. What is the pressure of the trapped gas? (h = 29.2 cm)

(A) 292 mmHg
(B) 457mmHg

(C) 749 mmHg
(D) 1041 mmHg

Answers:

24. B

30. D

Energetics

4. When a material in the liquid state is vaporized and then condensed to a liquid, the steps in the process are, respectively,

(A) exothermic and exothermic.
(B) exothermic and endothermic.
(C) endothermic and exothermic.
(D) endothermic and endothermic.

23. For which of these processes is the value of ΔS expected to be negative?

I. Sugar is dissolved in water.
II. Steam is condensed
III. $CaCO_3$ is decomposed into CaO and CO_2

(A) I only
(B) I and III only
(C) II only
(D) II and III only

25. In which process is entropy decreased?

(A) Dissolving sugar in water
(B) Expanding a gas
(C) Evaporating a liquid
(D) Freezing water

28. When solid NH_4NO_3 is dissolved in water at 25 °C, the temperature of the solution decreases. What is true about the signs of ΔH and ΔS for this process?

(A) ΔH is negative, ΔS is positive
(B) ΔH is negative, ΔS is negative
(C) ΔH is positive, ΔS is positive
(D) ΔH is positive, ΔS inegative

Answers:

4. C

23. C

25. D

28. C

Dynamics

2. For the reactions of chlorine and nitric oxide,

$$2NO_{(g)} + Cl_{2(g)} \rightarrow 2NOCl_{(g)}$$

Doubling the concentration of chlorine doubles the rate of the reaction. Doubling the concentration of both reactants increases the rate of the reaction by a factor of eight. The reaction is

(A) First order in both NO and Cl_2
(B) First order in NO and second order in Cl_2
(C) Second order in NO and first order in Cl_2
(D) Second order in both NO and Cl_2

5. The rate law for the reaction

$$H_2O_2 + 2H^+ + 2I^- \rightarrow I_2 + 2H_2O$$

Is rate = k $[H_2O_2]$ $[I^-]$. The overall order of the reaction is

(A) Five
(B) Three
(C) Two
(D) One

11. All of these changes increase the value of the rate constant for a reaction **except**

(A) Decreasing the activation energy
(B) Raising the temperature
(C) Adding a catalyst
(D) Increasing the concentration of reactants

15. The Arrhenius equations describes the relationship between the rate constant, k, and the energy of the activation, E_a.

$$k = Ae^{-\frac{E_a}{RT}}$$

In this equation, A is an empirical constant, R is the ideal-gas constant, *e* is the base of natural logarithms, and T is the absolute temperature. According to the Arrhenius equation,

(A) At constant temperature, reactions with lower activation energies proceed more rapidly.
(B) At constant temperature, reactions with lower activation energies proceed less rapidly.
(C) At constant energy of activation, reactions at lower temperatures process more rapidly.
(D) At constant energy of activation, reactions with smaller values of A proceed more rapidly.

21. Consider the reaction,

$$Cl_{2(aq)} + H_2S_{(aq)} \rightarrow S_{(s)} + 2H^+_{(aq)} + 2Cl^-_{(aq)}$$

The rate equation for the reaction is

$$\text{Rate} = k\,[Cl_2]\,[H_2S]$$

Which of these mechanisms is (or are) consistent with this rate equation?

I. $Cl_2 + H_2S \rightarrow H^+ + Cl^- + Cl^+ + HS^-$ (slow)
$Cl^+ + HS^- \rightarrow H^+ + Cl^- + S$ (fast)
II. $H_2S \leftrightarrow H^+ + HS^-$ (fast equilibrium)
$Cl_2 + HS^- \rightarrow 2Cl^- + H^+ + S$ (slow)

(A) I only
(B) II only
(C) Both I and II
(D) Neither I or II

24. If the half-life of a reaction is independent of concentration, the reaction can be

I. First Order
II. Second Order
III. Zero Order

(A) I and II only
(B) II and III only
(C) I only
(D) II only

Answers:

2. C

3. A

11. D

15. A

21. A

24. C

Equilibrium

3. Consider this reaction

$$2SO_{3(g)} \leftrightarrow 2SO_{2(g)} + O_{2(g)}$$

What is the correct K_p expression for this reaction?

(A) $K_P = \frac{P_{SO_2}^2 P_{O_2}}{P_{SO_3}^2}$

(B) $K_P = \frac{P_{SO_2} P_{O_2}}{P_{SO_3}}$

(C) $K_P = \frac{(2P_{SO_2})^2 P_{O_2}}{(2P_{SO_3})^2}$

(D) $K_P = \frac{2P_{SO_2}^2 P_{O_2}}{2P_{SO_3}^2}$

8. Chemical equilibrium is the result of

(A) Formation of products equal in mass to the mass of the reactants
(B) The unavailability of one of reactants
(C) A stoppage of further reaction
(D) Opposing reactions attaining equal speeds

9. Consider this gas-phase reaction

$$H_{2(g)} + I_{2(g)} \leftrightarrow 2HI_{(g)} \quad \Delta H = 53 \text{ kJ}$$

Which reaction characteristics will be affected by a change in temperature?

1. Value of equilibrium
2. Equilibrium concentrations
   (A) 1 only
   (B) 2 only
   (C) 1 and 2
   (D) Neither 1 nor 2

12. Consider the reaction, carried out at a constant volume.

$$2SO_{2(g)} + O_{2(g)} \leftrightarrow 2SO_{3(g)} \qquad \Delta H = -198 \text{ kJ}$$

The concentrations of $O_{2(g)}$ at equilibrium increases if

(A) SO_2 is added to the system
(B) SO_3 is added to the system
(C) The temperature of the system is lowered.
(D) An inert gas is added to the system.

21. What is the correct equation for the ion product constant of water at 25 °C

(A) $[H_3O^+][OH^-] = 10^{-14}$
(B) $[H_3O^+]+[OH^-] = 10^{-14}$
(C) $\frac{[H_3O^+]}{[OH^-]} = 10^{-14}$
(D) $\frac{[H_3O^+][OH^-]}{[H_2O]} = 10^{-14}$

22. What is the solubility product, K_{sp}, of $Mg(OH)_2$ if its solubility in water is 1.6×10^{-4} mol*L^{-1}?

(A) 1.6×10^{-11}
(B) 2.6×10^{-8}
(C) 3.2×10^{-4}
(D) 4.1×10^{-12}

28. A 0.15 M solution of a weak acid is found to be 1.3% ionized. What is its K_a?

(A) 1.3×10^{-2}
(B) 2.0×10^{-3}
(C) 1.1×10^{-3}
(D) 2.6×10^{-5}

Answers:

3. A
8. D
9. C
12. B
21. A
22. A
28. D

Electrochemistry and Redox

21. What is the oxidation number of chromium in $Na_2Cr_2O_7$?
    (A) +12
    (B) +6
    (C) +3
    (D) -2

12. Which of these ions is best reducing agents?

Standard Reduction Potentials (E°)

$Fe^{3+}_{(aq)} + e^- \rightarrow Fe^{2+}_{(aq)}$ = +0.77 V

$Cu^{2+}_{(aq)} + e^- \rightarrow Cu^{+}_{(aq)}$ = +0.15 V

    (A) Fe^{3+}
    (B) Fe^{2+}
    (C) Cu^{2+}
    (D) Cu^{+}

17. What is the standard cell potential, E°, for this reaction?

Standard Reduction Potentials (E°)

$Mn^{2+}_{(aq)} + 2e^- \rightarrow Mn_{(s)}$ = -1.18 V

$AuCl_4^-{}_{(aq)} + 3e^- \rightarrow Au_{(s)} + 4Cl_{(aq)}$ = +1.00 V

    (A) -0.18 V
    (B) -2.18 V
    (C) +2.18 V
    (D) +5.54 V

20. During the electrolysis of an aqueous solution of $CuSO_4$, using inert electrodes,

    (A) The anode loses mass and the cathode gains mass
    (B) The mass of the anode decreased but the mass of the cathode remains constant
    (C) The mass of the anode remains the same but the cathode gains mass
    (D) The anode and the cathode neither gain nor lose mass

23.What mass of platinum could be plated on an electrode from the electrolysis of $Pt(NO_3)_2$ solution with a current of 0.500 A for 55.0 s?

(A) 27.3 mg
(B) 45.5 mg
(C) 53.6 mg
(D) 91.0 mg

27. How many minutes will be required to deposit 1.00 g of chromium metal from an aqueous CrO_4^{2-} solution using a current of 6.00 Amperes?

(A) 186 min
(B) 30.9 min
(C) 15.4 min
(D) 5.15 min

29.Consider this reaction.

$$Sn^{2+}_{(aq)} + 2Fe^{3+}_{(aq)} \rightarrow Sn^{4+}_{(aq)} + 2Fe^{2+}_{(aq)} \qquad E° = 0.617\ V$$

The Nernst Equation

$E = E° - (0.0592/n)\log Q$

(A) 0.069 V
(B) 0.679 V
(C) 0.658 V
(D) 0.576 V

Answers:

3. B
12. D
17. C
20. C
23. A
27. B
29. A