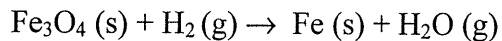
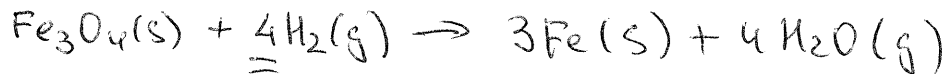


New Material

(1) What is the coefficient of H_2 when the following equation is correctly balanced?



- a) 1
- b) 3
- c) 2
- d) 5
- e) 4



(2) Steel is

- a) an alloy of iron
- b) pure iron
- c) oxidized iron
- d) a mixture of iron and silver
- e) a liquid at room temperature

(3) Which mineral contains aluminum?

- a) bauxite
- b) malachite
- c) cinnabar
- d) galena
- e) magnetite

(4) The Bayer process is a (an) _____ procedure.

- a) hydrometallurgical
- b) pyrometallurgical
- c) electrometallurgical
- d) gas phase
- e) oxidizing

(5) An alloy is a material that ____

- a) contains more than one element and has the characteristic properties of metals
 - b) contains gold
 - c) contains one element
 - d) conducts electricity
 - e) does not conduct electricity
-

(6) The electron configuration of Fe is $[\text{Ar}]4s^23d^6$, so that of Fe^{2+} is

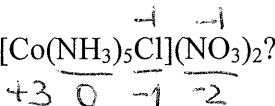
- a) $[\text{Ar}]4s^23d^7$
 - b) $[\text{Ar}]4s^23d^3$
 - c) $[\text{Ar}]4s^03d^5$
 - d) $[\text{Ar}]4s^03d^9$
 - e) $[\text{Ar}]4s^03d^6$
-

(7) When an atom or ion of the solid possesses one or more unpaired electrons, the substance is

- a) diamagnetic
 - b) paramagnetic
 - c) ferromagnetic
 - d) nonmagnetic
 - e) an electric conductor
-

(8) What is the oxidation state of cobalt in $[\text{Co}(\text{NH}_3)_5\text{Cl}](\text{NO}_3)_2$?

- a) +3
- b) +2
- c) +1
- d) 0
- e) +6

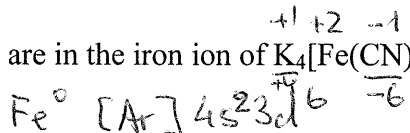


(9) Which one of the following species is a potential polydentate ligand (chelating agent)?

- a) NH_3
 - b) Cl^-
 - c) CN^-
 - d) H_2O
 - e) ethylenediamine
-

(10) How many d electrons are in the iron ion of $\text{K}_4[\text{Fe}(\text{CN})_6]$?

- a) 3
- b) 5
- c) 6
- d) 7
- e) 4



(11) The formula for sodium tetrachloroxomolybdate (IV) is

- a) $\text{Na}_2[\text{MoOCl}_4]$
 - b) $\text{Na}[\text{MoOCl}_4]$
 - c) $\text{Na}_2[\text{MoOCl}_5]$
 - d) $[\text{MoOCl}_4]\text{Na}_2$
 - e) $\text{Na}_4[\text{MoO}_2\text{Cl}_4]$
-

(12) The correct name for $\text{Na}_3[\text{CoF}_6]$ is

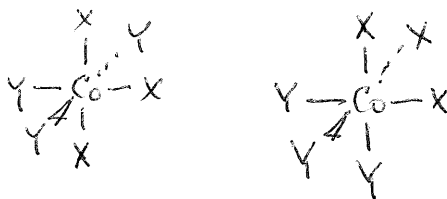
- a) trisodium hexakisfluorocobalt (III)
- b) trisodium hexakisfluorocobalt (II)
- c) trisodium hexakisfluorocobalt (IV)
- d) sodium hexafluorocobaltate (III)
- e) sodium hexafluorocobaltate (IV)

(13) A geometrical isomer with like groups located on opposite sides of the metal atom is denoted with the prefix

- a) cis-
- b) trans-**
- c) bis-
- d) tetrakis-
- e) d-

(14) How many isomers exist for the octahedral complex ion $[\text{Co}(\text{NH}_3)_3(\text{H}_2\text{O})_3]^{2+}$?

- a) 1
- b) 2**
- c) 3
- d) 4
- e) 5



(15) Which one of the following complex ions will be paramagnetic?

- a) $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ (low spin) $[\text{Ar}] 4s^0 3d^6$ $\uparrow\uparrow \uparrow\uparrow$
- b) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ (low spin) $[\text{Ar}] 4s^0 3d^5$ $\uparrow\uparrow \uparrow\uparrow \uparrow$**
- c) $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$ (low spin) $[\text{Ar}] 4s^0 3d^6$ $\uparrow\uparrow \uparrow\uparrow \uparrow\uparrow$
- d) $[\text{Zn}(\text{H}_2\text{O})_4]^{2+}$ $[\text{Ar}] 4s^0 3d^{10}$ $\uparrow\uparrow \uparrow\uparrow \uparrow\uparrow \uparrow\uparrow$
- e) $[\text{Zn}(\text{NH}_3)_4]^{2+}$ $[\text{Ar}] 4s^0 3d^{10}$ $\uparrow\uparrow \uparrow\uparrow \uparrow\uparrow \uparrow\uparrow$

(16) Which one of the following ions cannot form both a high spin and a low spin octahedral complex ion?

- a) $\text{Fe}^{3+} \rightarrow [\text{Ar}] 4s^0 3d^5$ $\uparrow\uparrow \uparrow\uparrow \uparrow$ and $\uparrow \uparrow \uparrow$
- b) $\text{Co}^{2+} \rightarrow [\text{Ar}] 4s^0 3d^7$ $\uparrow\uparrow \uparrow\uparrow \uparrow$ and $\uparrow \uparrow \uparrow$
- c) $\text{Cr}^{3+} \rightarrow [\text{Ar}] 4s^0 3d^3$ $\uparrow \uparrow \uparrow$ only**
- d) $\text{Mn}^{3+} \rightarrow [\text{Ar}] 4s^0 3d^4$ $\uparrow\uparrow \uparrow\uparrow$ and $\uparrow \uparrow \uparrow$
- e) $\text{Cr}^{2+} \rightarrow [\text{Ar}] 4s^0 3d^4$ $\uparrow\uparrow \uparrow\uparrow$ and $\uparrow \uparrow \uparrow$

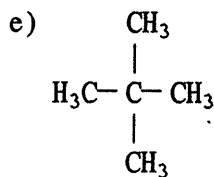
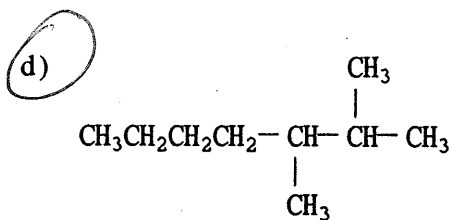
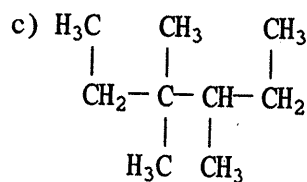
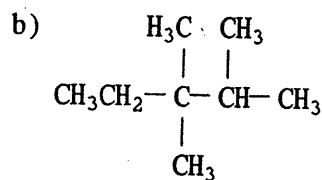
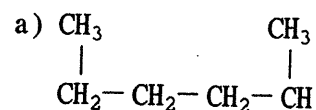
(17) Hydrocarbons containing carbon-carbon triple bonds are called _____

- a) alkanes
 - b) aromatic hydrocarbons
 - c) alkynes
 - d) alkenes
 - e) ketones
-

(18) The general formula of an alkane is _____

- a) $C_{2n}H_{2n+2}$
 - b) C_nH_{2n}
 - c) C_nH_{2n+2}
 - d) C_nH_{n-2}
 - e) C_nH_n
-

(19) The structure of 2,3-dimethylheptane is _____



(20) What is the general formula for an alcohol?

- a) $R-O-R'$
- b) $R-CO-H$
- c) $R-CO-OH$
- d) $R-OH$
- e) $R-CO-R'$

(21) What is the general formula for a ketone?

- a) R-O-R'
 - b) R-CO-H
 - c) R-CO-OH
 - d) R-OH
 - e) R-CO-R'
-

(22) The general formula of an aldehyde is _____.

- a) R-CO-H
 - b) R-CO-R'
 - c) R-CO-OH
 - d) R-O-R'
 - e) R-CO-OR'
-

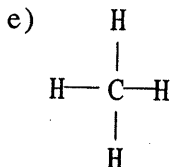
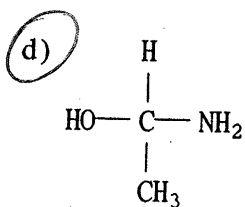
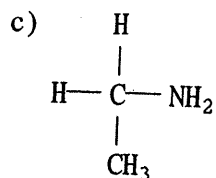
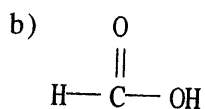
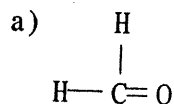
(23) The general formula of a carboxylic acid is

- a) R-O-R'
 - b) R-CO-R'
 - c) R-CO-OR'
 - d) R-H
 - e) R-CO-OH
-

(24) Optically active molecules that are mirror images of each other are called _____

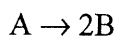
- a) allotropes
 - b) linkage isomers
 - c) enantiomers
 - d) cofactors
 - e) peptides
-

(25) Which one of the following molecules is chiral



Comprehensive Review Materials:

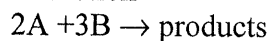
(26) Consider the following reaction:



The average rate of appearance of B is given by $\Delta[\text{B}]/\Delta t$. How is the average rate of appearance of B related to the average rate of disappearance of A?

- a) $-2\Delta[\text{A}]/\Delta t$
- b) $+\Delta[\text{A}]/\Delta t$
- c) $-\Delta[\text{A}]/\Delta t$
- d) $-\Delta[\text{A}]/2\Delta t$
- e) $+\Delta[\text{A}]/2\Delta t$

(27) If the reaction



is first order in A and second order in B, then the rate law will be rate = _____

- a) $k[\text{A}][\text{B}]$
- b) $k[\text{A}]^2[\text{B}]^3$
- c) $k[\text{A}][\text{B}]^2$
- d) $k[\text{A}]^2[\text{B}]$
- e) $k[\text{A}]^2[\text{B}]^2$

(28) Use the information below to determine the order of the reaction in reactant B.



Experiment Number	[A] (M)	[B] (M)	Initial Rate (M/s)
1	0.273	0.763	2.83
2	0.273	1.526	2.83
3	0.819	0.763	25.47

a) 1

b) 2

c) 3

d) 4

e) 0

$$\text{rate}_1 = k[A_1]^n[B_1]^m; \text{rate}_2 = k[A_2]^n[B_2]^m$$

$$\frac{\text{rate}_1}{\text{rate}_2} = \frac{k[A_1]^n[B_1]^m}{k[A_2]^n[B_2]^m} = \left(\frac{[B_1]}{[B_2]}\right)^m = \left(\frac{1}{2}\right)^m = 1;$$

$$[A_1] = [A_2] \quad m = 0$$

(29) The reaction $A + B = 2P$ has $K_c = 0.95$ at 600 K. At the equilibrium, _____

a) products predominate substantially

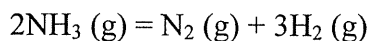
b) reactants predominate substantially

c) roughly equal molar amounts of products and reactants are present

d) only products exist

e) only reactants exist

(30) Consider the following reaction at equilibrium:



adding $\text{N}_2(\text{g})$ to the container will _____.

a) decrease the concentration of $\text{NH}_3(\text{g})$ at equilibrium

b) decrease the concentration of $\text{H}_2(\text{g})$ at equilibrium

c) increase the value of the equilibrium constant

d) cause the reaction to shift to the right

e) remove all the $\text{H}_2(\text{g})$

(31) What is the conjugate acid of OH⁻?

- a) O₂
- b) O⁻
- c) H₂O
- d) O²⁻
- e) OH⁺

(32) Calculate the pH of 0.25 M aqueous solution of NH₃. The K_b of NH₃ is 1.8 × 10⁻⁵.

- a) 2.67
 - b) 11.48
 - c) 2.52
 - d) 11.98
 - e) 11.33
- $$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]} = \frac{x^2}{0.25-x} = 1.8 \times 10^{-5}$$
$$x^2 = 0.25 \times 1.8 \times 10^{-5} = 4.5 \times 10^{-6}; x = 2.12 \times 10^{-3}; pOH = 2.67$$
$$pH = 14.00 - 2.67 = 11.33$$

(33) An aqueous solution of _____ will produce a basic solution.

- a) HCOONa
- b) NaNO₃
- c) NaCl
- d) HCOOH
- e) NH₄Cl

(34) Consider the titration of 50.0 mL of 0.750 M hydrozoic acid (HN₃) (K_a = 2.6 × 10⁻⁵) with 0.750 M NaOH. The pH of the solution before any NaOH is added is _____.

- a) 7.00
 - b) 8.79
 - c) 12.21
 - d) 2.35
 - e) 4.59
- $$HN_3(aq) \rightarrow H^+(aq) + N_3^-(aq)$$
$$K_a = \frac{[H^+][N_3^-]}{[HN_3]} = \frac{x^2}{0.750} = 2.6 \times 10^{-5}; x = 4.42 \times 10^{-3}$$
$$pH = 2.35$$

(35) Consider the titration of 50.0 mL of 0.750 M hydrozoic acid (HN₃) (K_a = 2.6 × 10⁻⁵) with 0.750 M NaOH. Calculate the pH of the solution after addition of 50.0 mL of NaOH solution.

- a) 2.64
 - b) 7.00
 - c) 12.21
 - d) 4.59
 - e) 9.08
- $$N_3^-(aq) + H_2O(l) \rightarrow HN_3(aq) + OH^-(aq)$$
$$K_b = \frac{[HN_3][OH^-]}{[N_3^-]} = \frac{x^2}{0.375} = \frac{K_w}{K_a} = 3.85 \times 10^{-10}$$
$$x = 1.20 \times 10^{-5}; pOH = 4.92; pH = 9.08$$

(36) Select the substance that is thought to be partially responsible for depleting the concentration of ozone in the stratosphere.

- a) CFC1₃
 - b) CO₂
 - c) O₂
 - d) N₂
 - e) He
-

(37) The thermodynamic quantity that expresses the degree of disorder in a system is _____.

- a) enthalpy
 - b) internal energy
 - c) bond energy
 - d) entropy
 - e) heat flow
-

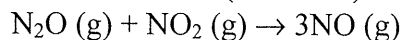
(38) Which species below has $\Delta G_f^0 = 0$?

- a) H₂O (l)
 - b) PF₃ (g)
 - c) H₂O (g)
 - d) HCo(PF₃)₄ (g)
 - e) H₂ (g)
-

(39) Consider the following table of thermodynamic data. All values are tabulated for 25°C.

Substance	ΔG_f^0 (kJ/mol)	$S^0 = 0$ (J/mol·K)
N ₂ O (g)	103.6	220
NO ₂ (g)	51.8	240
NO (g)	86.7	211

What is the value of ΔH^0 (in kJ/mol) for the reaction described below?



- a) 156.2
- b) 5.5
- c) 53.2
- d) 109.0
- e) 52.4

$$\Delta G = 3\Delta G_f^0(\text{NO}) - \Delta G_f^0(\text{N}_2\text{O}) - \Delta G_f^0(\text{NO}_2) = 104.7 \text{ kJ/mol}$$

$$\Delta S = 3S^0(\text{NO}) - S^0(\text{N}_2\text{O}) - S^0(\text{NO}_2) = 173 \text{ J/mol}\cdot\text{K}$$

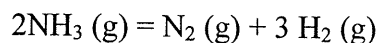
$$\Delta G = \Delta H - T\Delta S$$

$$\Delta H = \Delta G + T\Delta S = 104.7 + \frac{298 \times 173}{1000} = 156.2$$

(40) Which one of the following statements is true about the equilibrium constant for a reaction if ΔG for the reaction is zero?

- a) $Q=K$
- b) $Q>K$
- c) $Q<K$
- d) $K<1$
- e) more information is needed

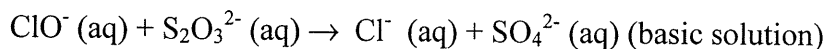
(41) The value of ΔG° for the reaction below is _____ kJ/mol, given that $K=2.0 \times 10^{-9}$ and $T=25^\circ\text{C}$.



- a) +50
- b) -4.2
- c) -25
- d) -50
- e) -22

$$\Delta G^\circ = -RT \ln K = +49.6 \text{ kJ/mol}$$

(42) What is the coefficient of SO_4^{2-} when the following equation is correctly balanced?



- a) 1
 - b) 3
 - c) 2
 - d) 5
 - e) 4
- $(2e + 2H^+ + ClO^-(aq) \rightarrow Cl^-(aq) + H_2O(l)) \times 4$
 $(S_2O_3^{2-}(aq) \rightarrow 2SO_4^{2-}(aq) + 10H^+(aq) + 8e) \times 1$
 ~~$8e + 8H^+(aq) + 4ClO^-(aq) + 8H_2O(l) + S_2O_3^{2-}(aq) \rightarrow 4Cl^-(aq) + 4H_2O(l) + 2SO_4^{2-}(aq) + 10H^+(aq) + 8e$~~
 $4ClO^-(aq) + 2OH^-(aq) + S_2O_3^{2-}(aq) \rightarrow 4Cl^-(aq) + 2SO_4^{2-}(aq) + H_2O(l)$

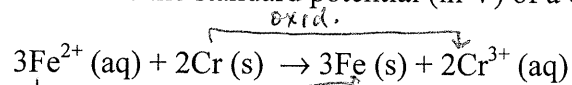
(43) Which of the following reactions is a redox reaction?

- a) $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
- b) $\text{Pb}^{2+} + 2\text{Cl}^- \rightarrow \text{PbCl}_2$
- c) $\text{AgNO}_3 + \text{HCl} \rightarrow \text{HNO}_3 + \text{AgCl}$
- d) $\text{K}_2\text{CrO}_4 + \text{BaCl}_2 \rightarrow \text{BaCrO}_4 + 2\text{KCl}$
- e) $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$

(44) Given the following information

Half-reaction	E°_{red}
$\text{Fe}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Fe}(\text{s})$	-0.44 V
$\text{Cr}^{3+}(\text{aq}) + 3\text{e}^{-} \rightarrow \text{Cr}(\text{s})$	-0.74 V

determine the standard potential (in V) of a cell based on the reaction:



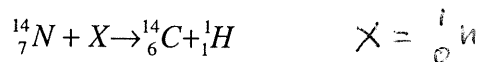
$$E^{\circ}_{\text{cell}} = E^{\circ}_{\text{red}}(\text{cath}) - E^{\circ}_{\text{red}}(\text{an}) = -0.44\text{V} - (-0.74\text{V}) = +0.30\text{V}$$

- a) +0.30
 - b) +2.80
 - c) +3.10
 - d) +0.83
 - e) -0.16
-

(45) What one of the following processes results in an increase in the atomic number?

- a) gamma emission
 - b) positron emission
 - c) beta emission
 - d) alpha emission
 - e) corrosion
-

(46) The reaction shown below is responsible for creating ^{14}C in the atmosphere. What is the bombarding particle?



- a) alpha particle
- b) electron
- c) neutron
- d) positron
- e) proton

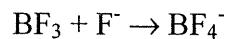
(47) What is the oxidation state of nitrogen in hydrazine?

- a) -3
 - b) -2
 - c) +1
 - d) 0
 - e) +4
-

(48) The oxidation state of oxygen in O_2F_2 is

- a) 0
 - b) +2
 - c) +1
 - d) -1
 - e) -2
-

(49) In the reaction below, BF_3 acts as a (an) _____ acid



- a) Arrhenius
 - b) Bronsted-Lowry
 - c) Lewis
 - d) all of these
 - e) none of these
-

(50) P_4O_6 is the anhydride of

- a) H_3PO_3
- b) H_3PO_4
- c) P_4O_{10}
- d) white phosphorus
- e) red phosphorus.

