Chem12 Oxidation/Reduction : M.C. Problems - 30

1) In the chemical reaction : $Sn(s) + 2H_3O^+(aq) \rightarrow 2H_2O(l) + H_2(g) + Sn^{2+}(aq)$, select the species that is oxidized.

a) $H_3O^+(aq)$ b) $H_2O(l)$ c)$Sn(s)$ d) $H_2(g)$

2) Given the half reaction : $MnO_4^- + 2H_2O \rightarrow 4OH^- + MnO_2$, which procedure will balance electric charge ?

a) add $3e^-$ to left side b) add $3e^-$ to right side
c) add $4e^-$ to left side d) add $4e^-$ to right side

3) IO_3^- is reduced to I^- in basic solution. If the coefficient of IO_3^- in the half-reaction equation is 1, the coefficient of OH^- will be :

a) 0 b) 2 c) 3 d) 6

4) A student has been asked to oxidize iron (Fe) to Fe^{2+} but not to Fe^{3+}. A suitable choice for the oxidizing agent could be a solution containing :

a) Zn^{2+} b) Sn^{2+} c)Ag^+ d)F^-

5) The oxidation number of S in $S_2O_6^{2-}$ is :

a) 5 b) 6 c) -6 d) 10

6) Which is the oxidizing agent in : $Sn^{2+} + 2I^- \rightarrow Sn + I_2$?

a) I^- b) I_2 c) Sn d) Sn^{2+}

7) When balancing the following redox reaction which statement below is true ? $Cu + MnO_4^- + H_2O \rightarrow Cu^{2+} + OH^- + MnO_2$

a) The coefficient of MnO_4^- and MnO_2 is 2
b) The coefficient of MnO_4^- and MnO_2 is 3
c) The coefficient of Cu and Cu^{2+} is 1
d) The relative coefficients of all species cannot be determined.

8) NO_3^- is reduced in acidic solution to NO. If the coefficient of NO_3^- in the half reaction equation is 1, what will the coefficient of H^+ be ?

a) 1 b) 2 c) 3 d) 4

9) Given the half reaction expression : $IO_3^- + 6H^+ \rightarrow 1/2\ I_2 + 3H_2O$, which one of the following procedures will balance electric charge ?

a) add $5e^-$ to the left side
b) add $5e^-$ to the right side
c) add $6e^-$ to the left side
d) add $6e^-$ to the right side

10) From the table of standard reduction potentials, select the half-reaction which will reduce Sn^{4+} to Sn^{2+} but which will not reduce Sn^{2+} to Sn.

a) $Co(s) \rightarrow Co^{2+} 2e^-$
b) $Pb(s) \rightarrow Pb^{2+} + 2e^-$
c) $Cu(s) \rightarrow Cu^{2+} 2e^-$
d) $2H^+ + 2e^- \rightarrow H_2$

11) You are given a solution containing I^- and Br^- ions and instructed to oxidize the I^- to I_2 without oxidizing the Br^- to Br_2. Which one of the following could be a suitable oxidizing agent ?

a) Al^{3+} b) Fe^{2+} c)Fe^{3+} d)Sn^{4+}

12) What is the oxidation number of Cr in $Cr_2O_7^{2-}$?

a) 3 b) 6 c) 7 d) 12

13) Balance the half cell reaction $Cr^{3+} \rightarrow CrO_4^{2-}$ (basic)

14) Arsenic forms 3 compounds containing chlorine, $AsCl_3$, $AsCl_5$ and $AsOCl_3$. What is the oxidation number of As in each of these compounds ?

15) What change in the oxidation number of uranium occurs when pitchblende (U_3O_8) reacts with nitric acid to form $UO_2(NO_3)_2$, uranyl nitrate ?

a) -10/3 b) -4/3 c) 2/3 d) 10/3

16)Which one of the following skeleton half reactions are not oxidations ?

1) ClO_3^- -> ClO_2^- 2) C_2H_4 -> C_2H_6 3) NO_2 -> N_2O_4

a) 1 only b) 1 and 3 c) 2 and 3 d) 1,2, and 3

17) Which one of the statements below is incorrect, given the following equation for the reaction that occurs when copper metal is dissolved in nitric acid ? $3Cu + 2NO_3^- + 8H^+ \rightarrow 3Cu^{2+} + 2NO + 4H_2O$

a) Copper is oxidized
b) The product of the oxidation is NO
c) The reducing agent is metallic copper
d) The oxidation number of Hydrogen doesn't change

18) Which one of the species below is losing electrons in the reaction ?
$Hg^{2+}(aq) + H_2O_2(aq) \rightarrow Hg(l) + O_2(g) + 2H^+(aq)$

a) Hg b) Hg^{2+} c) H_2O_2 d) O_2

19) Which one of the following is the weakest reducing agent in the reaction : $W + Y^+ \leftrightarrow W^+ + Y$? $K = 10^{-35}$

a) W b) W^+ c) Y d) Y^+

20) Balance in base : $Co^{2+} + OCl^- \rightarrow Co(OH)_3 + Cl^-$

21) In which one of the following substances does sulfur have the lowest oxidation number ?

a) $S_2O_3^{2-}$ b) $S_2O_8^{2-}$ c) $S_4O_8^{2-}$ d) SO_3^{2-}

22) Which of the following species is the strongest reducing agent ?

a) Ba b) Fe c) Sn^{2+} d) H_2O_2

23) Which one of the following species could be a product of a reaction where $NO_2(g)$ acts as an oxidizing agent ?

a) NO(g) b) $N_2O_5(g)$ c)$NO_3^-(aq)$ d)$N_2O_4(g)$

24) Which of the following half reactions is balanced ?

a) $IO_3^-(aq) + 6H^+(aq) + 5e^- \rightarrow I_2(s) + 2H_2O(l)$

b) $ClO^-(aq) + H_2O(l) + 2e^- \rightarrow Cl^-(aq) + 2OH^-(aq)$
c) $SO_4^{2-}(aq) + 8H^+(aq) + 6e^- \rightarrow H_2S(g) + 4H_2O(l)$
d) $NO_2^-(aq) + H_2O(l) + 2e^- \rightarrow 2H^+(aq) + NO_3^-(aq)$

25) Which one of the following changes involves reduction ?

a) $Fe^{2+}(aq) \rightarrow Fe^{3+}(aq) + e^-$
b) $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$
c) $2Br^-(aq) \rightarrow Br_2(l) + 2e^-$
d) $NaCl(aq) \rightarrow Na^+(aq) + Cl^-(aq)$

26) Which one of the following reactions is non-spontaneous ?

a) $Fe(s) + 2H^+(aq) \rightarrow Fe^{2+}(aq) + H_2(g)$
b) $Zn(s) + 2H^+(aq) \rightarrow Zn^{2+}(aq) + H_2(g)$
c) $Hg(l) + 2H^+(aq) \rightarrow Hg^{2+}(aq) + H_2(g)$
d) $Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$

27) An example of oxidation is :

a) $Mg^{2+}(aq) + 2e^- \rightarrow Mg(s)$
b) $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$
c) $Ba^{2+}(aq) + S^{2-}(aq) \rightarrow BaS(s)$
d) $NH_3(aq) + H^+(aq) \rightarrow NH_4^+(aq)$

28) What is the oxidation number of nitrogen in NO_3^- ?

a) 2 b) 4 c) 5 d) 6

29) Which species acts as the reducing agent in the reaction :
$2H_2O(l) + Cr_2O_3(s) + 3NO_3^-(aq) \rightarrow 2CrO_4^{2-}(aq) + 3NO_2^-(aq) + 4H^+(aq)$?

a) $Cr_2O_3(s)$ b) $NO_3^-(aq)$ c) $H_2O(l)$ d) $CrO_4^{2-}(aq)$

Note : A Reducing Agent is defined as a molecule or ion in a redox reaction that contains an atom or atoms that undergo an increase in oxidation state.

30) Which of the following sets of coefficients balances the equation :

___ $HNO_3(aq)$ + ___ $H_2S(aq)$ -> ___ $NO(g)$ + ___$S(s) + 4H_2O(l)$

a) 4,2,4,1 b) 4,1,4,1 c) 2,3,2,3 d) 2,1,2,1

31) Which of the following agents would reduce $Sn^{4+}(aq)$ to $Sn^{2+}(aq)$

a) $Fe(s)$ b) $I^-(aq)$ c) $Fe^{2+}(aq)$ d) $Ag(s)$

32) Write a balanced equation for the reaction between $C_2O_4^{2-}(aq)$ and $MnO_4^-(aq)$ in an acidic solution to yield $CO_2(g)$ and $Mn^{2+}(aq)$.

33) The process of oxidation involves a :

a) loss of protons b) gain of protons
c) loss of electrons d) gain of electrons

34) Given the half cell reaction : $S_2O_8^{2-} + 2H^+ \rightarrow 2HSO_4^-$, which of the following will balance electric charge ?

a) Add $2e^-$ to the left side b) Add $2e^-$ to the right sidec) Add $3e^-$ to the left side d) Add $3e^-$ to the right side

35) Identify the oxidizing agent in : $2H^+(aq) + Pb(s) \rightarrow H_2(g) + Pb^{2+}(aq)$

a) $H_2(g)$ b) $H^+(aq)$ c) $Pb(s)$ d) $Pb^{2+}(aq)$

36) An example of reduction is

a) $Mn(s) \rightarrow Mn^{2+}(aq) + 2e^-$
b) $Mn^{2+}(aq) + S^{2-}(aq) \rightarrow MnS(s)$
c) $H^+(aq) + MnO_4^-(aq) + K^+(aq) + OH^-(aq) \rightarrow K^+(aq) + MnO_4^-(aq) + H_2O(l)$
d) $MnO_2(s) + 4H^+(aq) + 2e^- \rightarrow Mn^{2+}(aq) + 2H_2O(l)$

37) Which one of the following combinations could result in a spontaneous reaction at standard conditions ?

a) $I^- + Fe^{2+}$ b) $Fe^{3+} + I_2$ c) $I_2 + Fe^{2+}$ d) $Fe^{3+} + I^-$

38) Given : Cl_2 is pale yellow in CCl_4, Cl^- is colorless in water
Br_2 is red in CCl_4 Br^- is colorless in water

Aqueous Cl_2 and aqueous KBr are shaken with CCl_4 in a test tube. The CCl_4 layer is red and the water layer is colorless. What is the best conclusion ?

a) Br^- was oxidized b) no reaction occurred
c) Cl_2 was oxidized d) CCl_4 was oxidized

39) Define : Reducing Agent

40) Balance the equation for the following redox reaction :

$MnO_4^-(aq) + SO_2(aq) \rightarrow Mn^{2+}(aq) + SO_4^{2-}(aq)$ (acidic)

41) The oxidation number of As in $H_2AsO_4^-$ is

a) 1 b) 5 c) 6 d) 7

42) An example of an oxidation-reduction reaction is

a) $4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$
b) $SO_3(g) + H_2O(l) \rightarrow H^+(aq) + HSO_4^-(aq)$
c) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
d) $Fe^{3+}(aq) + 3OH^-(aq) \rightarrow Fe(OH)_3(s)$

43) Which substance is being oxidized in the following reaction ?
$PbO_2(s) + Pb(s) + 4H^+(aq) \rightarrow 2Pb^{2+}(aq) + 2H_2O(l)$

a) $H^+(aq)$ b) $Pb(s)$ c) $Pb^{2+}(aq)$ d) $PbO_2(s)$

44) Which one of the following species is most easily reduced under standard conditions ?

a) $Na^+(aq)$ b) $Sn^{2+}(aq)$ c) $Cl^-(aq)$ d) $Ag^+(aq)$

45) The correctly balanced half-reaction for $ClO^-(aq) \rightarrow Cl^-(aq)$ in a basic solution is

a) $2H^+(aq) + ClO^-(aq) + 2e^- \rightarrow Cl^-(aq) + H_2O(l)$
b) $H_2O(l) + ClO^-(aq) \rightarrow Cl^-(aq) + 2OH^- + 2e^-$
c) $H_2O(l) + ClO^-(aq) + 2e^- \rightarrow Cl^-(aq) + 2OH^-(aq)$
d) $2H^+(aq) + ClO^-(aq) \rightarrow Cl^-(aq) + H_2O(l) + 2e^-$

46) Balance the following oxidation-reduction equation :

$N_2O(g) + ClO^-(aq) \rightarrow Cl^-(aq) + NO_2^-(aq)$ (acidic)

47) When a substance is reduced it

a) loses electrons b) causes oxidation
c) undergoes oxidation d) increases in oxidation number

48) The oxidation number for a sulfur atom in $Na_2S_2O_5$ is:

a) -2 b) 1 c) 4 d) 8

49) What is the oxidizing agent in the following reaction ?

$8H^+ + MnO_4^- + 5Fe^{2+} \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$

a) H^+ b) Mn^{2+} c) Fe^{2+} d) MnO_4^-

50) Which of the following could be a product of a reaction in which SO_3^{2-} acts as a reducing agent ?

a) SO_4^{2-} b) SO_2 c) S_2O d) $S_2O_5^{2-}$

51) Balance the equation for the following reaction in an acidic solution

$Cu(s) + NO_3^-(aq) \rightarrow Cu^{2+}(aq) + NO(g)$

52) Experiments were performed with three metal strips, X, Y, and Z and their corresponding 1.0 M nitrate solutions, $X(NO_3)_2$, $Y(NO_3)_2$ and $Z(NO_3)_3$.

Metal Y reacted with X^{2+} but not with Z^{3+}.
Metal X did not react with any of the solutions.

Which of the following gives the metals in order of decreasing strength as reducing agent (strongest reducing agent first)

a) Z, Y, X b) X, Y, Z c) Y, Z, X d) X, Z, Y

53) A reducing agent in a redox reaction causes another species to be:

a) oxidized while itself being reduced
b) oxidized while itself being oxidized
c) reduced while itself being reduced
d) reduced while itself being oxidized

54) Which species will act as the reducing agent in forming Br_2 ?

a) BrO^- b) Br^- c) BrO_2^- d) BrO_3^-

55) The oxidation number of I in H_3IO_6 is

a) -1 b) -3 c) 3 d) 9

56) Identify the atom that is losing electron(s) in the following redox reaction.

$$H^+ + 2MnO_4^- + 5H_2SO_3 \rightarrow 2Mn^{2+} + 3H_2O + 5HSO_4^-$$

a) H^+ b) Mn in MnO_4^- c) S in H_2SO_3 d) O in MnO_4^-

57) Identify the atom that is gaining electron(s) in the following redox reaction.

$$2NO_2 + 2OH^- \rightarrow NO_2^- + NO_3^- + H_2O$$

a) N in NO_2 b) O in NO_2 c) O in OH^- d) H in OH^-

58) Which of the following will result in a spontaneous reaction ?

a) Cu + H^+ b) Cr + Ca^{2+} c) Sn^{2+} + Fe^{3+} d) Ag + H_3PO_4

Answers : 1) c, 2) a, 3) d, 4) b, 5) a, 6) d, 7) a, 8) d, 9) a, 10) b, 11) c, 12) b, 13) $Cr^{3+} + 8\ OH^- \rightarrow CrO_4^{2-} + 4H_2O + 3e^-$,14) +3, +5, +5, 15) c, 16) d, 17) b, 18) c, 19) a, 20) $2Co^{2+} + OCl^- + H_2O + 4OH^- \rightarrow 2Co(OH)_3 + Cl^-$, 21) a, 22) a, 23) a, 24) b, 25) b, 26) c, 27) b, 28) c, 29) a, 30) c, 31) a, 32) $5C_2O_4^{2-} + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$, 33) c, 34) a, 35) b, 36) d, 37) d, 38) a, 39) The reducing agent donates electrons, 40) $2MnO_4^- + 5SO_2 + 2H_2O \rightarrow 2Mn^{2+} + 5SO_4^{2-} + 4H^+$, 41) b, 42) a, 43) b, 44) d, 45) c, 46) $N_2O + 2ClO^- + H_2O \rightarrow 2NO_2^- + 2Cl^- + 2H^+$, 47) b, 48) c, 49) d, 50) a, 51) $3Cu + 2NO_3^- + 8H^+ \rightarrow 3Cu^{2+} + 2NO + 4H_2O$, 52) a, 53) d, 54) b, 55) d, 56) c, 57) a, 58) c.