

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

1) In the chemical reaction : $\text{Sn(s)} + 2\text{H}_3\text{O}^+(\text{aq}) \rightarrow 2\text{H}_2\text{O(l)} + \text{H}_2(\text{g}) + \text{Sn}^{2+}(\text{aq})$, select the species that is oxidized.

- a) $\text{H}_3\text{O}^+(\text{aq})$ b) $\text{H}_2\text{O(l)}$ c) Sn(s) d) $\text{H}_2(\text{g})$

2) Given the half reaction : $\text{MnO}_4^- + 2\text{H}_2\text{O} \rightarrow 4\text{OH}^- + \text{MnO}_2$, 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 $\text{S}_2\text{O}_6^{2-}$ is :

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

6) Which is the oxidizing agent in : $\text{Sn}^{2+} + 2\text{I}^- \rightarrow \text{Sn} + \text{I}_2$?

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

7) When balancing the following redox reaction which statement below is true ? $\text{Cu} + \text{MnO}_4^- + \text{H}_2\text{O} \rightarrow \text{Cu}^{2+} + \text{OH}^- + \text{MnO}_2$

- 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 : $\text{IO}_3^- + 6\text{H}^+ \rightarrow 1/2 \text{I}_2 + 3\text{H}_2\text{O}$, 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) $\text{Co(s)} \rightarrow \text{Co}^{2+} + 2e^-$ b) $\text{Pb(s)} \rightarrow \text{Pb}^{2+} + 2e^-$
c) $\text{Cu(s)} \rightarrow \text{Cu}^{2+} + 2e^-$ d) $2\text{H}^+ + 2e^- \rightarrow \text{H}_2$

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 $\text{Cr}_2\text{O}_7^{2-}$?

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

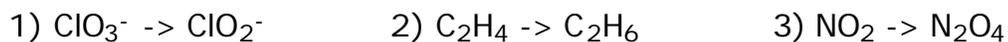
13) Balance the half cell reaction $\text{Cr}^{3+} \rightarrow \text{CrO}_4^{2-}$ (basic)

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 $\text{UO}_2(\text{NO}_3)_2$, 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 ?



- 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 ?
 $3\text{Cu} + 2\text{NO}_3^- + 8\text{H}^+ \rightarrow 3\text{Cu}^{2+} + 2\text{NO} + 4\text{H}_2\text{O}$

- 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 ?
 $\text{Hg}^{2+}(\text{aq}) + \text{H}_2\text{O}_2(\text{aq}) \rightarrow \text{Hg}(\text{l}) + \text{O}_2(\text{g}) + 2\text{H}^+(\text{aq})$

- 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 :
 $\text{W} + \text{Y}^+ \rightleftharpoons \text{W}^+ + \text{Y}$? $K = 10^{-35}$

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

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

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

- a) $\text{S}_2\text{O}_3^{2-}$ b) $\text{S}_2\text{O}_8^{2-}$ c) $\text{S}_4\text{O}_8^{2-}$ d) SO_3^{2-}

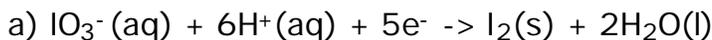
22) Which of the following species is the strongest reducing agent ?

- 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 $\text{NO}_2(\text{g})$ acts as an oxidizing agent ?

- a) $\text{NO}(\text{g})$ b) $\text{N}_2\text{O}_5(\text{g})$ c) $\text{NO}_3^-(\text{aq})$ d) $\text{N}_2\text{O}_4(\text{g})$

24) Which of the following half reactions is balanced ?



- b) $\text{ClO}^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightarrow \text{Cl}^-(\text{aq}) + 2\text{OH}^-(\text{aq})$
 c) $\text{SO}_4^{2-}(\text{aq}) + 8\text{H}^+(\text{aq}) + 6\text{e}^- \rightarrow \text{H}_2\text{S}(\text{g}) + 4\text{H}_2\text{O}(\text{l})$
 d) $\text{NO}_2^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightarrow 2\text{H}^+(\text{aq}) + \text{NO}_3^-(\text{aq})$

25) Which one of the following changes involves reduction ?

- a) $\text{Fe}^{2+}(\text{aq}) \rightarrow \text{Fe}^{3+}(\text{aq}) + \text{e}^-$ b) $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}(\text{s})$
 c) $2\text{Br}^-(\text{aq}) \rightarrow \text{Br}_2(\text{l}) + 2\text{e}^-$ d) $\text{NaCl}(\text{aq}) \rightarrow \text{Na}^+(\text{aq}) + \text{Cl}^-(\text{aq})$

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

- a) $\text{Fe}(\text{s}) + 2\text{H}^+(\text{aq}) \rightarrow \text{Fe}^{2+}(\text{aq}) + \text{H}_2(\text{g})$
 b) $\text{Zn}(\text{s}) + 2\text{H}^+(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{H}_2(\text{g})$
 c) $\text{Hg}(\text{l}) + 2\text{H}^+(\text{aq}) \rightarrow \text{Hg}^{2+}(\text{aq}) + \text{H}_2(\text{g})$
 d) $\text{Mg}(\text{s}) + 2\text{H}^+(\text{aq}) \rightarrow \text{Mg}^{2+}(\text{aq}) + \text{H}_2(\text{g})$

27) An example of oxidation is :

- a) $\text{Mg}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Mg}(\text{s})$
 b) $2\text{Cl}^-(\text{aq}) \rightarrow \text{Cl}_2(\text{g}) + 2\text{e}^-$
 c) $\text{Ba}^{2+}(\text{aq}) + \text{S}^{2-}(\text{aq}) \rightarrow \text{BaS}(\text{s})$
 d) $\text{NH}_3(\text{aq}) + \text{H}^+(\text{aq}) \rightarrow \text{NH}_4^+(\text{aq})$

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

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

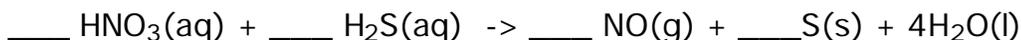
29) Which species acts as the reducing agent in the reaction :



- a) $\text{Cr}_2\text{O}_3(\text{s})$ b) $\text{NO}_3^-(\text{aq})$ c) $\text{H}_2\text{O}(\text{l})$ d) $\text{CrO}_4^{2-}(\text{aq})$

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 :



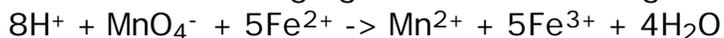
- a) 4,2,4,1 b) 4,1,4,1 c) 2,3,2,3 d) 2,1,2,1

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

48) The oxidation number for a sulfur atom in $\text{Na}_2\text{S}_2\text{O}_5$ is:

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

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

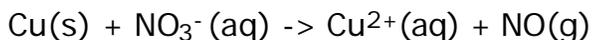


- a) H^+ b) Mn^{2+} c) Fe^{2+} d) MnO_4^-

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) $\text{S}_2\text{O}_5^{2-}$

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



52) Experiments were performed with three metal strips, X, Y, and Z and their corresponding 1.0 M nitrate solutions, $\text{X}(\text{NO}_3)_2$, $\text{Y}(\text{NO}_3)_2$ and $\text{Z}(\text{NO}_3)_3$.

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

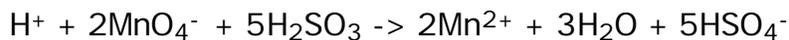
54) Which species will act as the reducing agent in forming Br_2 ?

- 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.



- 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.



- 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) $\text{Cu} + \text{H}^+$ b) $\text{Cr} + \text{Ca}^{2+}$ c) $\text{Sn}^{2+} + \text{Fe}^{3+}$ d) $\text{Ag} + \text{H}_3\text{PO}_4$

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) $\text{Cr}^{3+} + 8\text{OH}^- \rightarrow \text{CrO}_4^{2-} + 4\text{H}_2\text{O} + 3\text{e}^-$, 14) +3, +5, +5, 15) c, 16) d, 17) b, 18) c, 19) a, 20) $2\text{Co}^{2+} + \text{OCl}^- + \text{H}_2\text{O} + 4\text{OH}^- \rightarrow 2\text{Co}(\text{OH})_3 + \text{Cl}^-$, 21) a, 22) a, 23) a, 24) b, 25) b, 26) c, 27) b, 28) c, 29) a, 30) c, 31) a, 32) $5\text{C}_2\text{O}_4^{2-} + 2\text{MnO}_4^- + 16\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 10\text{CO}_2 + 8\text{H}_2\text{O}$, 33) c, 34) a, 35) b, 36) d, 37) d, 38) a, 39) The reducing agent donates electrons, 40) $2\text{MnO}_4^- + 5\text{SO}_2 + 2\text{H}_2\text{O} \rightarrow 2\text{Mn}^{2+} + 5\text{SO}_4^{2-} + 4\text{H}^+$, 41) b, 42) a, 43) b, 44) d, 45) c, 46) $\text{N}_2\text{O} + 2\text{ClO}^- + \text{H}_2\text{O} \rightarrow 2\text{NO}_2^- + 2\text{Cl}^- + 2\text{H}^+$, 47) b, 48) c, 49) d, 50) a, 51) $3\text{Cu} + 2\text{NO}_3^- + 8\text{H}^+ \rightarrow 3\text{Cu}^{2+} + 2\text{NO} + 4\text{H}_2\text{O}$, 52) a, 53) d, 54) b, 55) d, 56) c, 57) a, 58) c.