Chapter 20 Worksheet: Redox **ANSWERS**

I. Determine what is oxidized and what is reduced in each reaction. Identify the oxidizing agent and the reducing agent, also.

1. $2Sr + O_2 \longrightarrow 2SrO$ Sr^0 to Sr^{2+}; oxidized/reducing agent O^0 to O^{2-}; reduced/ox. ag.

2. $2Li + S \longrightarrow Li_2S$ Li^0 to Li^{1+}; oxidized/red. ag. S^0 to S^{2-}; reduced/ox. ag.

3. $2Cs + Br_2 \longrightarrow 2CsBr$ Cs^0 to Cs^{1+}; oxidized/red. ag. Br^0 to Br^{1-}; reduced/ox. ag.

4. $3Mg + N_2 \longrightarrow Mg_3N_2$ Mg^0 to Mg^{2+}; oxidized/red. ag. N^0 to N^{3-}; reduced/ox. ag.

5. $4Fe + 3O_2 \longrightarrow 2Fe_2O_3$ Fe^0 to Fe^{3+}; oxidized/red. ag. O^0 to O^{1-}; reduced/ox. ag.

6. $Cl_2 + 2NaBr \longrightarrow 2NaCl + Br_2$ Cl^0 to Cl^{1-}; reduced/ox. ag. Br^{1-} to Br^0; oxidized/red. ag.

7. $Si + 2F_2 \longrightarrow SiF_4$ Si^0 to Si^{4+}; oxidized/red. ag F^0 to F^{1-}; reduced/ox. ag.

9. $Mg + 2HCl \longrightarrow MgCl_2 + H_2$ Mg^0 to Mg^{2+}; oxidized/red. ag. H^{1+} to H^0; reduced/o.a.

10. $2Na + 2H_2O \longrightarrow 2NaOH + H_2$ Na^0 to Na^{1+}; oxidized/r.a. H^{1+} to H^0; reduced/o.a.

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11. Give the oxidation number of each kind of atom or ion.

a. sulfate	b. Sn	c. S^{2-}	d. Fe^{3+}	e. Sn^{4+}	f. nitrate	g. ammonium
2-	**0**	**2-**	**3+**	**4+**	**1-**	**1+**

12. Calculate the oxidation number of chromium in each of the following.

a. Cr_2O_3	b. $Na_2Cr_2O_7$	c. $CrSO_4$	d. chromate	e. dichromate
3+	**6+**	**2+**	**7+**	**6+**

13. Use the changes in oxidation numbers to determine which elements are oxidized and which are reduced in these reactions. (Note: it is not necessary to use balanced equations)

a. $C + H_2SO_4 \longrightarrow CO_2 + SO_2 + H_2O$ C^0 to C^{4+}; oxidized S^{6+} to S^{4+}; reduced

b. $HNO_3 + HI \longrightarrow NO + I_2 + H_2O$ N^{5+} to N^{2+}; reduced I^{1-} to I^0; oxidized

c. $KMnO_4 + HCl \longrightarrow MnCl_2 + Cl_2 + H_2O + KCl$ Mn^{7+} to Mn^{2+}; reduced; Cl^{1-} to Cl^0; oxidized

d. $Sb + HNO_3 \longrightarrow Sb_2O_3 + NO + H_2O$ Sb^0 to Sb^{3+}; oxidized N^{5+} to N^{2+}; red.

14. For each reaction in problem 13, identify the oxidizing agent and reducing agent.

a. oxidizing agent: sulfur reducing agent: carbon
b. oxidizing agent: nitrogen reducing agent: iodine
c. oxidizing agent: manganese reducing agent: chlorine
d. oxidizing agent: nitrogen reducing agent: antimony

15. Write half-reactions for the oxidation and reduction process for each of the following.

a. $Fe^{2+} + MnO_4^- \longrightarrow Fe^{3+} + Mn^{2+}$

$Fe^{2+} \longrightarrow Fe^{3+}$; oxidation $Mn^{7+} \longrightarrow Mn^{2+}$; reduction

b. $Sn^{2+} + IO_3^- \longrightarrow Sn^{4+} + I^-$

$Sn^{2+} \longrightarrow Sn^{4+}$; oxidation $I^{5+} \longrightarrow I^{1-}$; reduction

c. $S^{2-} + NO_3^- \longrightarrow S + NO$

$S^{2-} \longrightarrow S$; oxidation $N^{5+} \longrightarrow N^{2+}$; reduction

d. $NH_3 + NO_2 \longrightarrow N_2 + H_2O$

$N^{3-} \longrightarrow N^0$; oxidation $N^{4+} \longrightarrow N^0$; reduction

16. Complete and balance each reaction using the half-reaction method.

a. $Fe^{2+} + MnO_4^- \longrightarrow Fe^{3+} + Mn^{2+}$

$[Fe^{2+} \longrightarrow Fe^{3+} + 1e^-] \times 5$

$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$

$5Fe^{2+}_{(aq)} + MnO_4^-{}_{(aq)} + 8H^+_{(aq)} \longrightarrow 5Fe^{3+}_{(aq)} + Mn^{2+}_{(aq)} + 4H_2O_{(l)}$

b. $Sn^{2+} + IO_3^- \longrightarrow Sn^{4+} + I^-$

$6H^+_{(aq)} + 3Sn^{2+}_{(aq)} + IO_3^-{}_{(aq)} \longrightarrow 3Sn^{4+}_{(aq)} + I^-_{(aq)} + 3H_2O_{(l)}$

c. $S^{2-} + NO_3^- \longrightarrow S + NO$

$8H^+_{(aq)} + 3S^{2-}_{(aq)} + 2NO_3^-{}_{(aq)} \longrightarrow 3S_{(s)} + 2NO_{(g)} + 4H_2O_{(l)}$

d. $NH_3 + NO_2 \longrightarrow N_2 + H_2O$

$8NH_{3(g)} + 6NO_{2(g)} \longrightarrow 7N_{2(g)} + 12H_2O_{(l)}$

e. $Mn^{2+} + BiO_3^- \longrightarrow Bi^{2+} + MnO_4^-$

$3Mn^{2+}_{(aq)} + 5BiO_3^-{}_{(aq)} + 6H^+_{(aq)} \longrightarrow 5Bi^{2+}_{(aq)} + 3MnO_4^-{}_{(aq)} + 3H_2O_{(l)}$

f. $I_2 + Na_2S_2O_3 \longrightarrow Na_2S_2O_4 + NaI$

$Na_2S_2O_{3(aq)} + H_2O_{(l)} + I_{2(s)} + 2Na^+_{(aq)} \longrightarrow Na_2S_2O_{4(aq)} + 2H^+_{(aq)} + 2NaI_{(aq)}$