Name: ANSWER KEY

Chemistry 30

Unit 6: Redox Reactions and Electrochemistry

Assignment 2: Balancing Redox Reactions

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1. Balance the following reactions using the oxidation number method.

a. $NaClO + H_2S \rightarrow NaCl + H_2SO_4$

	initial		final	change		Coefficient		Total e^-
Cl	+1	→	-1	2	×	**4**	=	8
S	-2	→	+6	8	×	**1**	=	8

$4\ NaClO + 1\ H_2S \rightarrow 4\ NaCl + 1\ H_2SO_4$

b. $Sn + HNO_3 + H_2O \rightarrow H_2SnO_3 + NO$

	initial		final	change		Coefficient		Total e^-
Sn	0	→	+4	4	×	**3**	=	12
N	+5	→	+2	3	×	**4**	=	12

$3\ Sn + 4\ HNO_3 + 1\ H_2O \rightarrow 3\ H_2SnO_3 + 4\ NO$

c. $K_2Cr_2O_7 + SnCl_2 + HCl \rightarrow CrCl_3 + SnCl_4 + KCl + H_2O$

	initial		final	change		no. atoms		No. e^-		Coefficient		Total e^-
Cr	+6	→	+3	3	×	2		6	×	**1**	=	6
Sn	+2	→	+4	2			=	2	×	**3**	=	6

$1\ K_2Cr_2O_7 + 3\ SnCl_2 + 14\ HCl \rightarrow 2\ CrCl_3 + 3\ SnCl_4 + 2\ KCl + 7\ H_2O$

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6 2. Balance the following half-reactions. Be sure to balance for atoms first, then balance for charge by adding electrons to the appropriate side of the equation. Also identify each as either an oxidation or reduction.

a. $Br_2 \rightarrow Br^-$ **$Br_2 + 2\ e^- \rightarrow 2\ Br^-$** **reduction**

b. $Fe^{2+} \rightarrow Fe^{3+}$ **$Fe^{2+} \rightarrow Fe^{3+} + 1e^-$** **oxidation**

c. $MnO_4^- + H^+ \rightarrow Mn^{2+} + H_2O$ **$MnO_4^- + 8\ H^+ + 5e^- \rightarrow Mn^{2+} + 4\ H_2O$** **reduction**

4 3. Break each equation into two half-reactions. Identify each half-reaction as oxidation or reduction.

a. $2\ K + I_2 \rightarrow 2\ KI$

$2\ K \rightarrow 2\ K^+ + 2\ e^-$ **oxidation**

$I_2 + 2\ e^- \rightarrow 2\ I^-$ **reduction**

b. $2\ Br^- + F_2 \rightarrow Br_2 + 2\ F^-$

$F_2 + 2\ e^- \rightarrow 2\ F^-$ **reduction**

$2Br^- \rightarrow Br_2 + 2\ e^-$ **oxidation**

4 4. Balance the following reactions using the half-reaction method.

a. $Na + Br_2 \rightarrow NaBr$

Step 1	**Step 2**	**Step 3**
Write the two balanced half-reactions, removing any spectator ions:	**Balance for electrons**	**Add the half-reactions, replacing any spectator ions that were removed and/or recombining compounds**
$Na \rightarrow Na^+ + 1\ e^-$	$\times 2$	$2Na \rightarrow 2Na^+ + 2\ e^-$
$Br_2 + 2\ e^- \rightarrow 2\ Br^-$		$Br_2 + 2\ e^- \rightarrow 2\ Br^-$
	added together:	$2Na + Br_2 \rightarrow 2Na^+ + 2\ Br^-$
	reform compound:	**$2\ Na + Br_2$** $\rightarrow 2\ NaBr$

b. $CrO_4^{2-} + H^+ + Cl^- \rightarrow Cr^{3+} + Cl_2 + H_2O$

Remember to balance for atoms before adding electrons to balance for charge.

Step 1	Step 2	Step 3
Write the two balanced half-reactions, removing any spectator ions:	**Balance electrons**	**Add the half-reactions, replacing any spectator ions that were removed and/or recombining compounds**
$CrO_4^{2-} + 8\ H^+ + 3e^- \rightarrow Cr^{3+} + 4\ H_2O$	$\times 2$	$2\ CrO_4^{2-} + 16\ H^+ + 6\ e^- \rightarrow 2\ Cr^{3+} + 8\ H_2O$
$2\ Cl^- \rightarrow Cl_2 + 2\ e^-$	$\times 3$	$6\ Cl^- \rightarrow 3\ Cl_2 + 6\ e^-$
	added together:	$2CrO_4^{2-} + 16H^+ + 6Cl^- \rightarrow 2Cr^{3+} + 3Cl_2 + 8H_2O$

4 3. Balance the following reactions using either the oxidation number method or the half-reaction method.

a. $NO + As + H_2O \rightarrow N_2O + HAsO_2$

	initial		final	change		no. atoms		No. e^-		Coefficient		Total e^-
N	+2	$\rightarrow$	+1	1	$\times$	2 (in N_2O)	=	2	$\times$	**3**	=	6
As	0	$\rightarrow$	+3	3				3	$\times$	**2**	=	6

Answer: **$6\ NO + 2\ As + H_2O \rightarrow 3\ N_2O + 2\ HAsO_2$**

b. $Ce^{4+} + I^- + OH^- \rightarrow Ce^{3+} + IO_3^- + H_2O$

Step 1	Step 2	Step 3
Write the two balanced half-reactions, removing any spectator ions:	**Balance electrons**	**Add the half-reactions, replacing any spectator ions that were removed and/or recombining compounds**
$Ce^{4+} + 1\ e^- \rightarrow Ce^{3+}$	$\times 6$	$6Ce^{4+} + 6\ e^- \rightarrow 6Ce^{3+}$
$I^- + 6\ OH^- \rightarrow IO_3^- + 3\ H_2O + 6\ e^-$		$I^- + 6\ OH^- \rightarrow IO_3^- + 3\ H_2O + 6\ e^-$
	added together:	$6\ Ce^{4+} + I^- + 6\ OH^- \rightarrow 6\ Ce^{3+} + IO_3^- + 3\ H_2O$