

ANSWERS TO PROBLEM SET No. 1

1. (a) +4 (b) +3 (c) +4 (d) -3
2. (a) +4 (b) -1 (c) +4 (d) -2
3. (a) $\text{NO}_3^-(aq)$ oxidizing agent and $\text{Sn}(s)$ reducing agent
 (b) $\text{MnO}_4^-(aq)$ oxidizing agent and $\text{Cl}^-(aq)$ reducing agent
4. (a) $\text{Cr}_2\text{O}_7^{2-}(aq)$ oxidizing agent and $\text{SO}_3^{2-}(aq)$ reducing agent
 (b) $\text{NO}_3^-(aq)$ oxidizing agent and $\text{Zn}(s)$ reducing agent
5. (a) $4\text{Zn} + \text{NO}_3^- + 10\text{H}^+ \rightarrow 4\text{Zn}^{2+} + \text{NH}_4^+ + 3\text{H}_2\text{O}$
 (b) $3\text{Cl}_2 + 2\text{ReO}_2 + 4\text{H}_2\text{O} \rightarrow 6\text{Cl}^- + 2\text{HReO}_4 + 6\text{H}^+$
 (c) $5\text{HNO}_2 + 2\text{MnO}_4^- + \text{H}^+ \rightarrow 5\text{NO}_3^- + 2\text{Mn}^{2+} + 3\text{H}_2\text{O}$
 (d) $3\text{Cu} + 2\text{NO}_3^- + 8\text{H}^+ \rightarrow 3\text{Cu}^{2+} + 2\text{NO} + 4\text{H}_2\text{O}$
6. (a) $4\text{ClO}^- + \text{S}_2\text{O}_3^{2-} + 2\text{OH}^- \rightarrow 4\text{Cl}^- + 2\text{SO}_4^{2-} + \text{H}_2\text{O}$
 (b) $2\text{Fe} + 3\text{NiO}_2 + 6\text{H}_2\text{O} \rightarrow 2\text{Fe}(\text{OH})_3 + 3\text{Ni}(\text{OH})_2$
 (c) $\text{SbH}_3 + 3\text{H}_2\text{O} + \text{OH}^- \rightarrow \text{Sb}(\text{OH})_4^- + 3\text{H}_2$
 (d) $2\text{P}_4 + 4\text{H}_2\text{O} + 8\text{OH}^- \rightarrow 4\text{PH}_3 + 4\text{HPO}_3^{2-}$
7. (a) $\text{Pb} + \text{PbO}_2 + 4\text{H}^+ + 2\text{SO}_4^{2-} \rightarrow 2\text{PbSO}_4 + 2\text{H}_2\text{O}$
 (b) $64 \text{OH}^- + 27\text{Cl}_2 + 2 \text{CrI}_3 \rightarrow 2\text{CrO}_4^{2-} + 6\text{IO}_4^- + 54\text{Cl}^- + 32\text{H}_2\text{O}$
 (c) $2\text{XO}_2^+ + 10\text{YO}^+ + 22 \text{OH}^- \rightarrow \text{X}_2\text{O}_4^{3-} + \text{Y}^- + 3\text{Y}_3\text{O}_7^{2-} + 11\text{H}_2\text{O}$ (**One of many possible answers**)
8. (a) $4\text{H}_2\text{O}_2 + 2\text{S}_2\text{O}_3^{2-} \rightarrow \text{S}_3\text{O}_6^{2-} + \text{SO}_4^{2-} + 4\text{H}_2\text{O}$
 (b) H_2O_2 is the oxidizing agent
 (c) Equivalent mass of $\text{H}_2\text{O}_2 = (34.0\text{g/mol})/(2 \text{equiv/mol}) = 17.0 \text{g/equiv}$
 (d) Normality - $(0.040 \text{M})(2 \text{equiv/mol}) = 0.080 \text{N}$
9. $\text{I}_2 + 2\text{S}_2\text{O}_3^{2-} \rightarrow 2\text{I}^- + \text{S}_4\text{O}_6^{2-}$
 moles of $\text{I}_2 = 7.50 \text{g}/253.8 \text{g/mol} = 2.955 \times 10^{-2} \text{mol I}_2 = 29.55 \text{mmol I}_2$
 moles of $\text{S}_2\text{O}_3^{2-}$ needed = $2 \times 2.955 \times 10^{-2} = 5.910 \times 10^{-2} = 59.10 \text{mmol S}_2\text{O}_3^{2-}$
 and volume of $0.100 \text{M Na}_2\text{S}_2\text{O}_3$ needed = 591mL
10. (a) **Four moles of iodate (IO_3^-)** form per mole of thyroxine
 (b) **12 moles of I_2** are formed per mole of thyroxine. The oxidizing agent is IO_3^- and the reducing agent is I^- .
 (c) % thyroxine in extract = $(55.77 \text{mg} \times 100)/433.2 \text{mg} = \mathbf{12.88\%}$