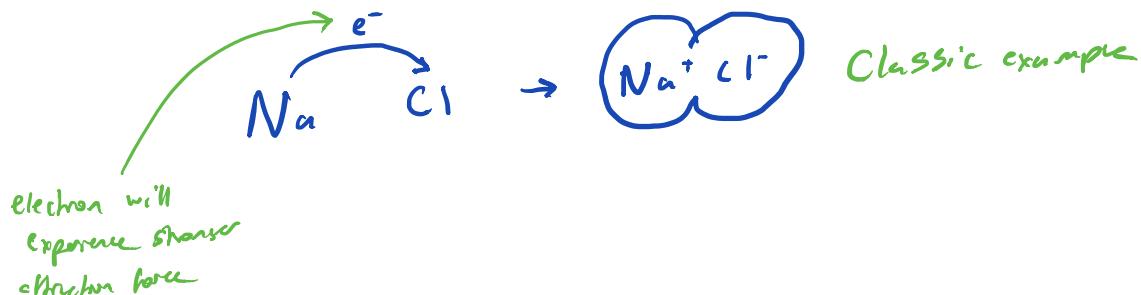
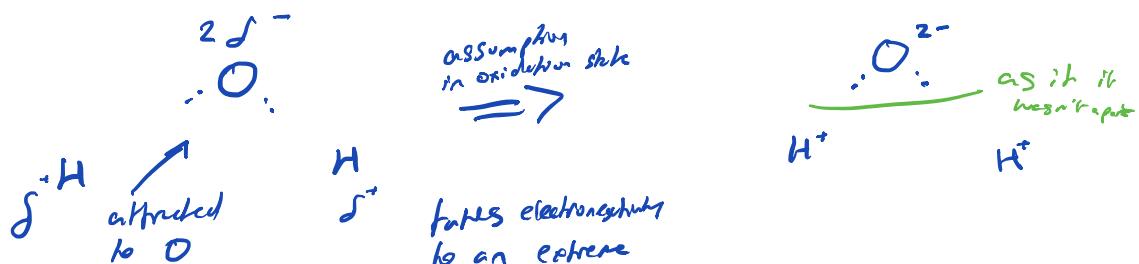


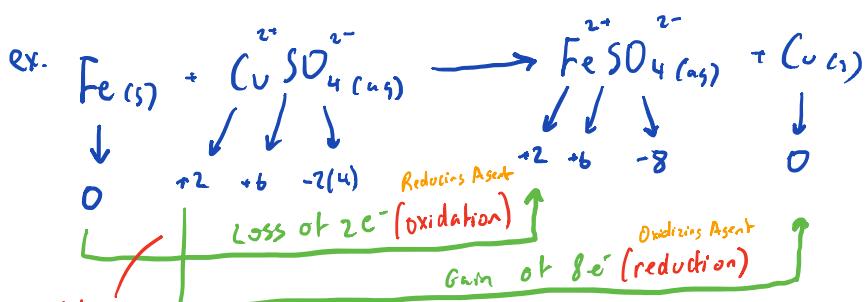
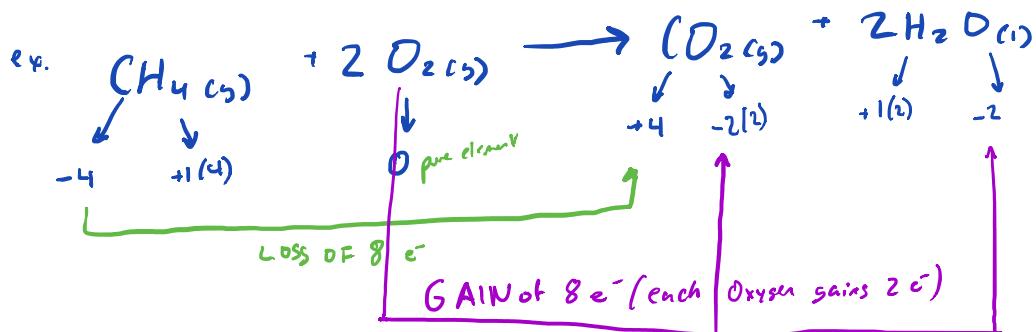
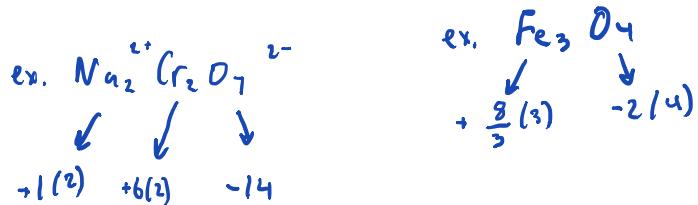
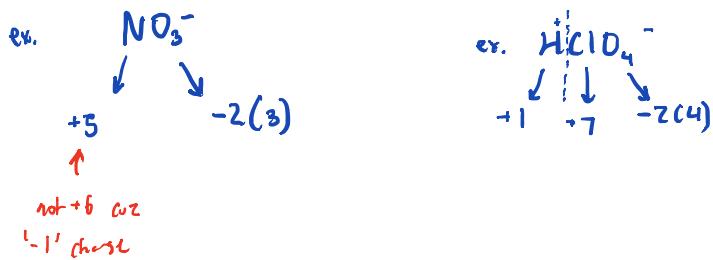
Oxidation-Reduction Reactions (REDOX)

Involves the transfer of electrons



- Covalent compounds
- Need to use oxidation states





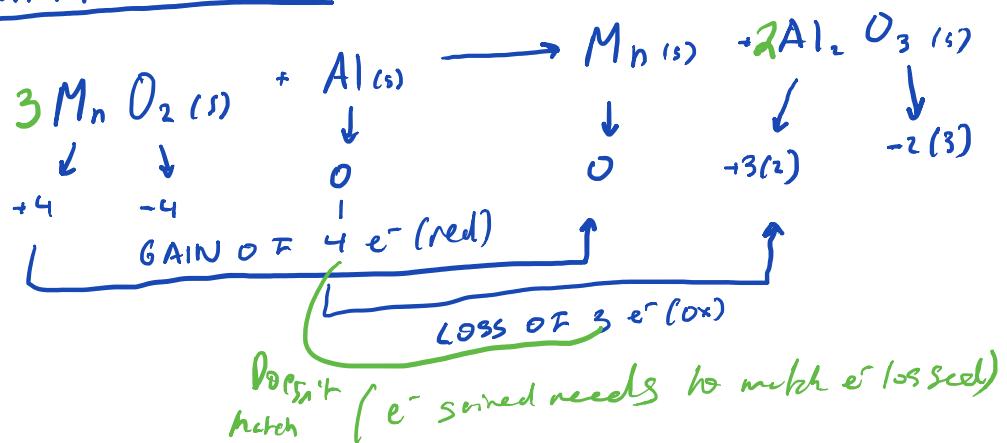
What undergoes oxidation is known as the reducing agent

OIL Oxidation involves loss of e^-

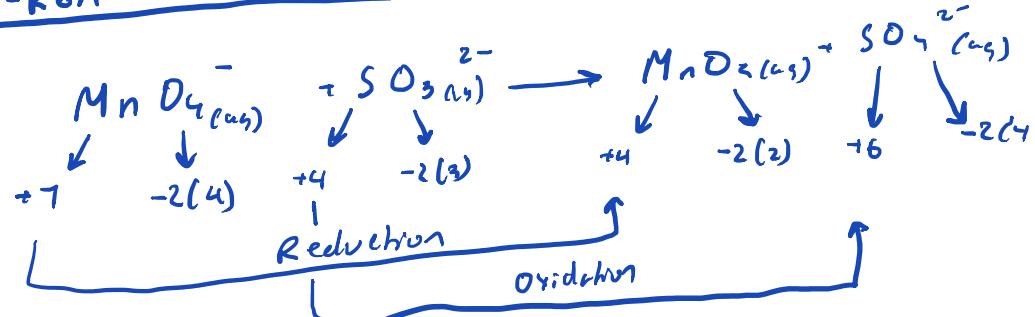
RIG Reduction involves gain of e^-

Balancing REDOX RXNS

OXIDATION STATES METHOD Only works for rxns in the solid state (s)



HALF-REACTION METHOD



Break into 2 parts

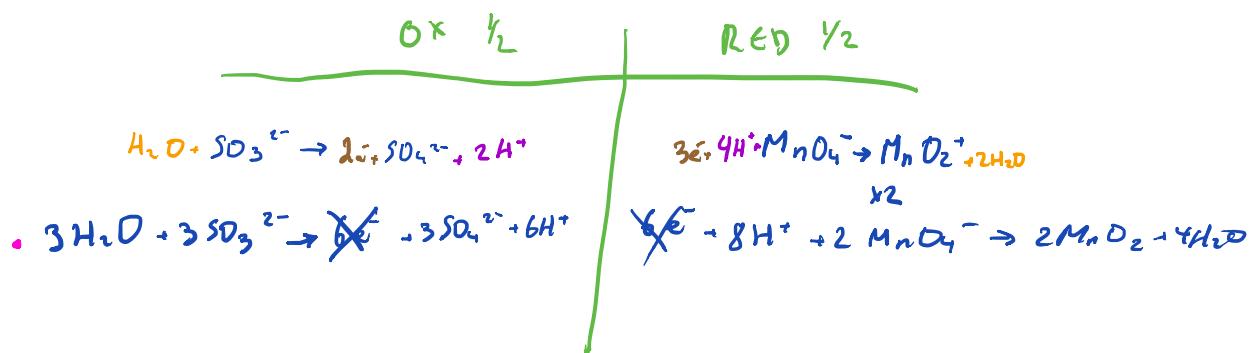
1) Balance all elements except O and H

2) Balance Oxygen using H_2O molecules

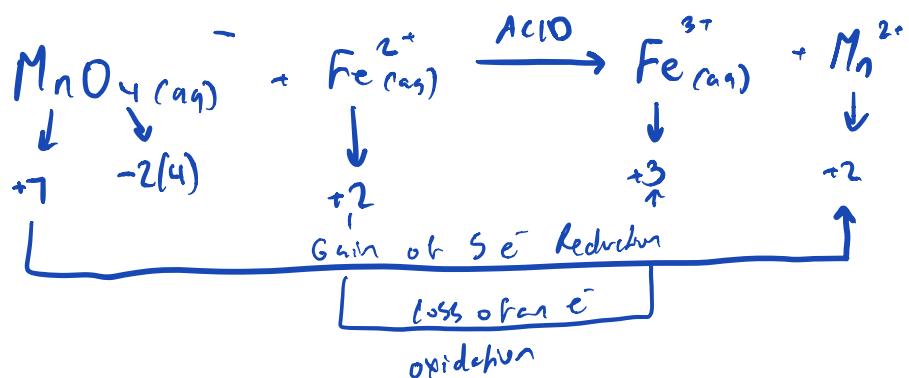
3) Balance Hydrogens using H^+ ions

4) Balance charges using electrons.

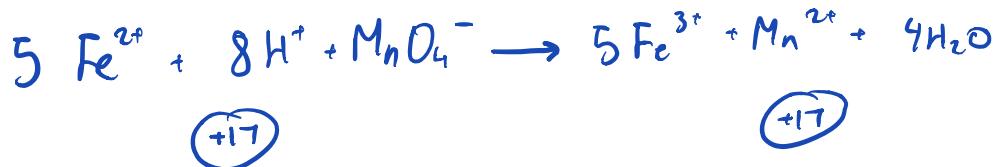
5) Add up the $\frac{1}{2}$ rxns making sure electrons exchanged are matching.



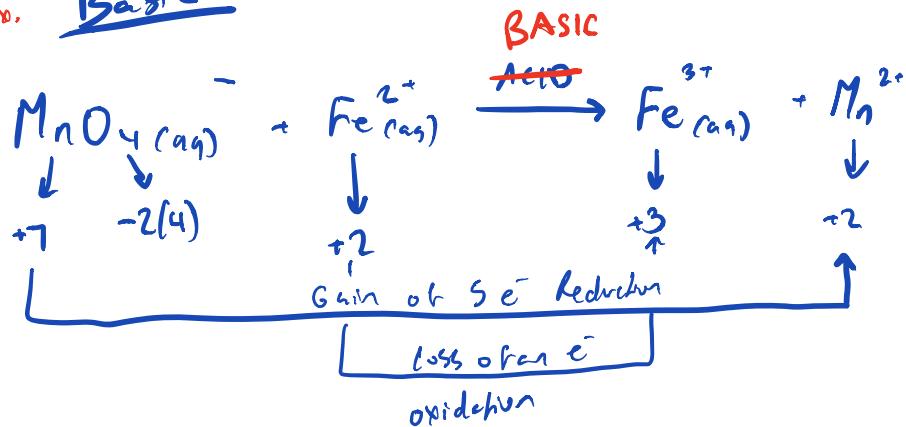
September 21, 2016



Ox. γ_2	Red. γ_2
$5 \text{Fe}^{2+} \rightarrow 5 \text{Fe}^{3+} + 5e^-$ $5 \text{Fe}^{2+} \rightarrow 5 \text{Fe}^{3+} + 5e^-$	$5e^- + 8\text{H}^+ + \text{MnO}_4^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$

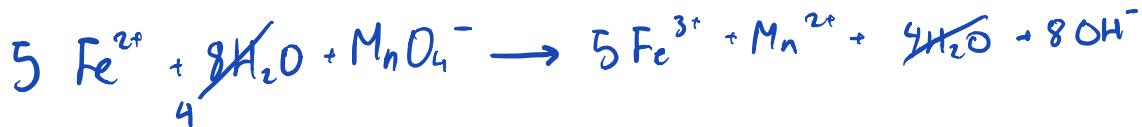


ex. Basic

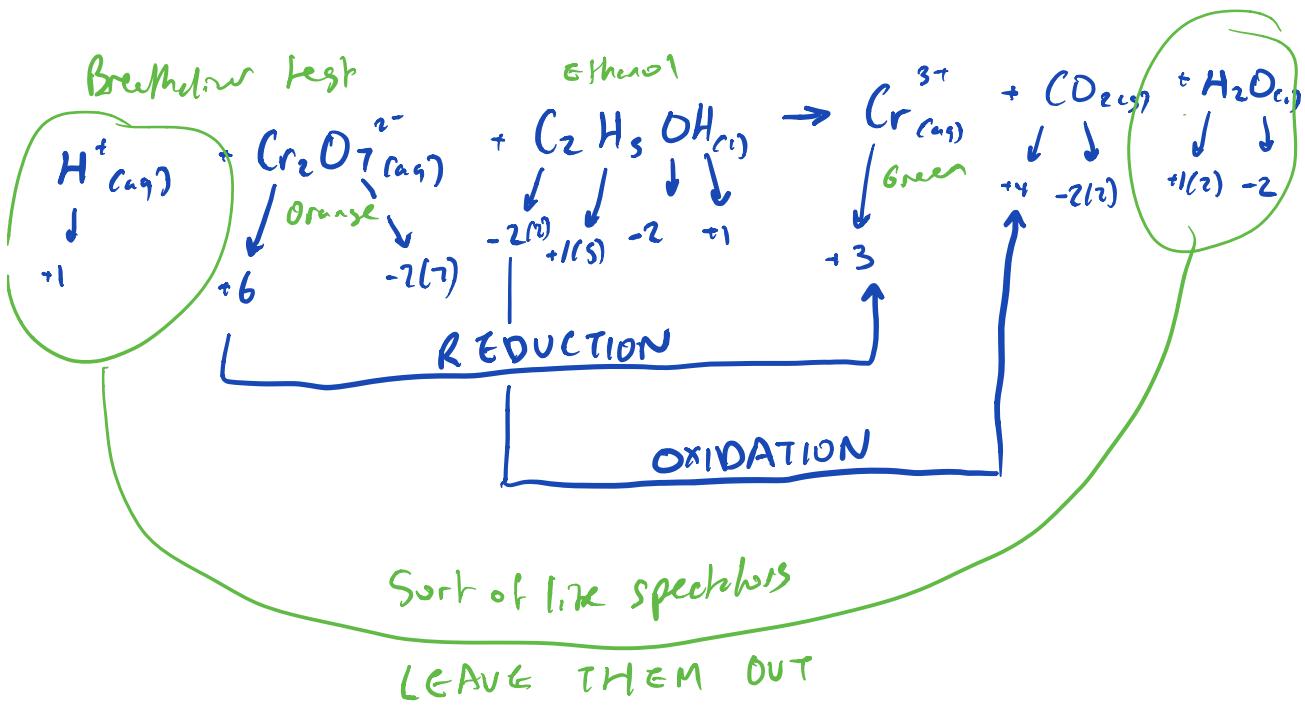


All steps are identical except the end.

Which side has an excess of H^+ ?

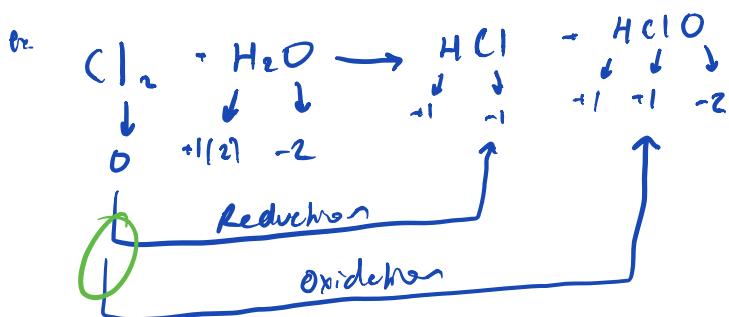
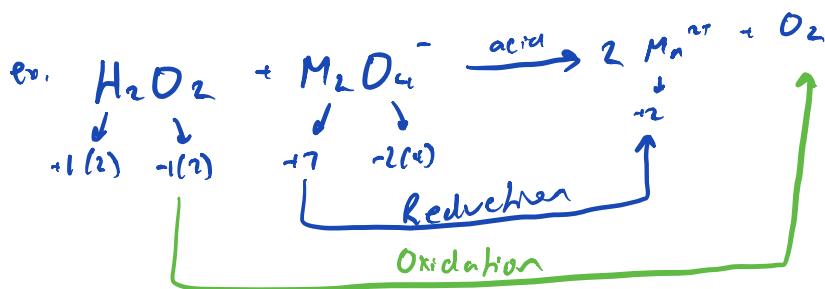
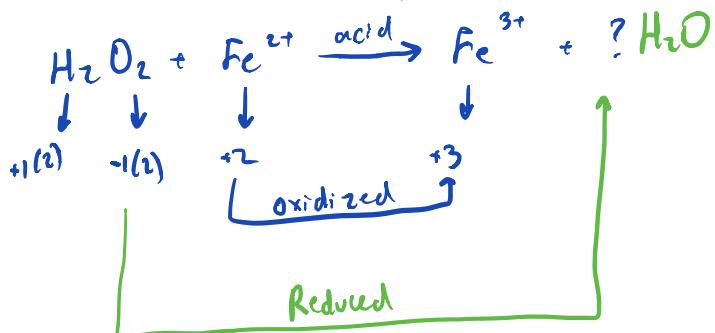


* great for titrations b.c. we don't need an indicator, color changes by itself



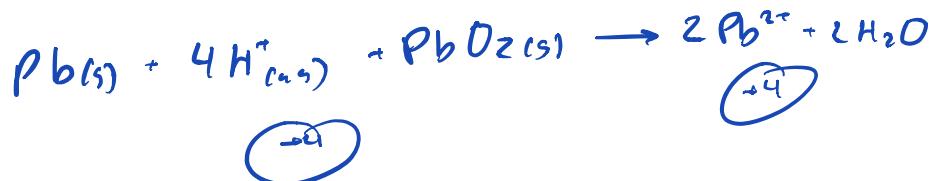
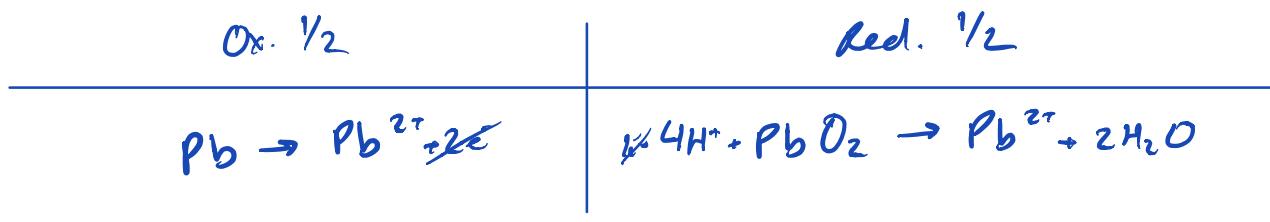
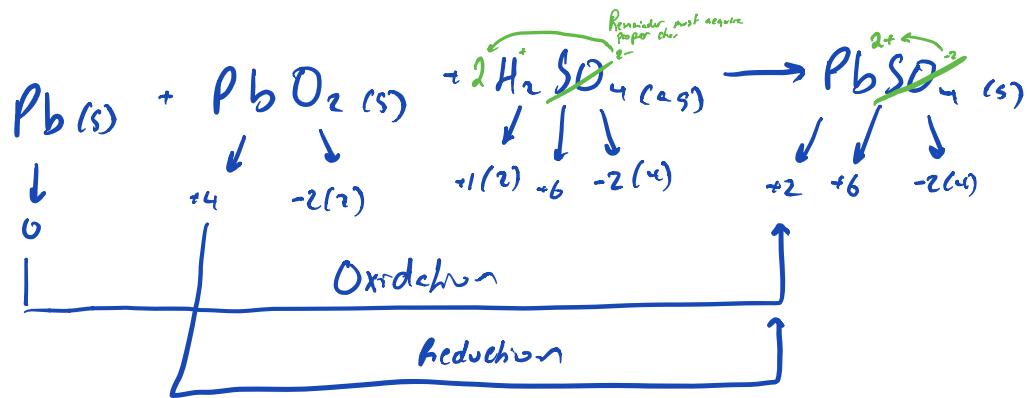
Ox. γ_2	Red. γ_2
$3H_2O + C_2H_5OH \rightarrow 2CO_2 + 2Cr^{3+} + 14H_2O$	$(6e^- + 14H^{\text{+}} + Cr_2O_7^{2-} \rightarrow 2Cr^{3+} + 7H_2O) \times 2$ $12e^- + 28H^{\text{+}} + 2Cr_2O_7^{2-} \rightarrow 4Cr^{3+} + 14H_2O$
$\cancel{3H_2O + Cr_2O_7^{2-} + 28H^{\text{+}} + 2C_2H_5OH \rightarrow 2CO_2 + 2Cr^{3+} + 4Cr_2O_7^{2-} + 14H_2O}$	

H_2O_2 Redox, H_2O_2



Same species being both oxidized & reduced
called: DISPROPORTIONATION RxN.

(2 Cl in Cl_2 , one oxidized, one reduced)



REDOX REACTIONS (IN CLASS PROBLEMS)

1. A 1.164 gram sample containing some Fe_2O_3 is dissolved, and all the iron is reduced to the Fe^{2+} ions. The resulting solution is titrated with 19.68 mL of a 0.1104 M KMnO_4 solution. Calculate the percent of Fe_2O_3 in the original sample.



2. A 13.38 grams sample of a material that contains some As_4O_6 was dissolved in water and required 5.330 grams of iodine for complete reaction according to the reaction:



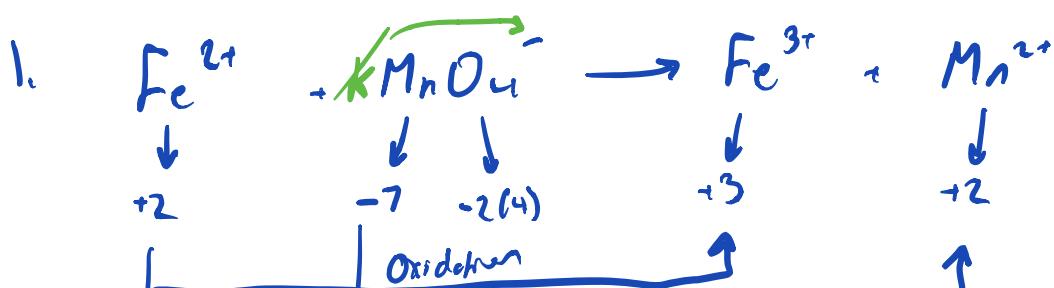
- a) Balance the equation by the 1/2 reaction method (acidic media).
- b) Determine the mass of As_4O_6 that reacted with iodine.
- c) Determine the mass percent of As_4O_6 in the original sample.

3. A mixture is made by combining 300.0 mL of 0.0200 M $\text{Na}_2\text{Cr}_2\text{O}_7$ with 400.0 mL of 0.060 M $\text{Fe}(\text{NO}_3)_2$. Initially, the H^+ concentration in the mixture is 0.400 M. Dichromate ion oxidizes Fe^{2+} to Fe^{3+} and is reduced to Cr^{3+} . After the reaction in the mixture has ceased, how many milliliters of 0.0100 M NaOH will be required to neutralize the remaining H^+ ?

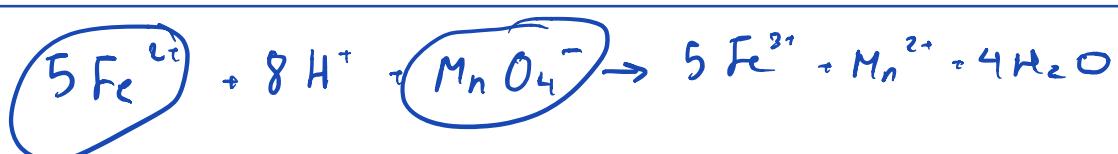
4. A mixture of SO_3^{2-} and $\text{S}_2\text{O}_3^{2-}$ reacts with CrO_4^{2-} in a basic solution to give CrO_2^- . The only sulfur containing product was SO_4^{2-} . Balance the equation using the 1/2 reaction method.

5. In an acidic sol'n HSO_3^- ion reacts with ClO_3^- ion to give SO_4^{2-} ion and Cl^- ion.

- a) Write a balanced net ionic eq. for the rxn.
- b) How many milliliters of 0.150 M NaClO_3 sol'n are needed to react completely with 30.0 mL of 0.450 M NaHSO_3 sol'n?



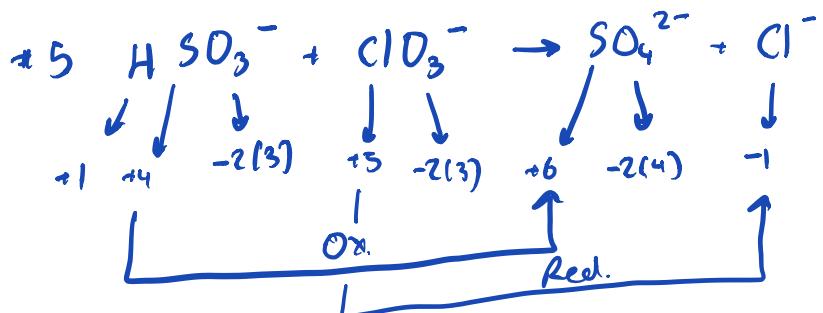
Reduction	
Ox. 1/2	Red. 1/2
$(Fe^{2+} \rightarrow Fe^{3+} + e^-) 5$ $5 Fe^{2+} \rightarrow 5 Fe^{3+} - 5e^-$	$5e^- + 8H^+ + MnO_4^- \rightarrow Mn^{2+} + 4H_2O$

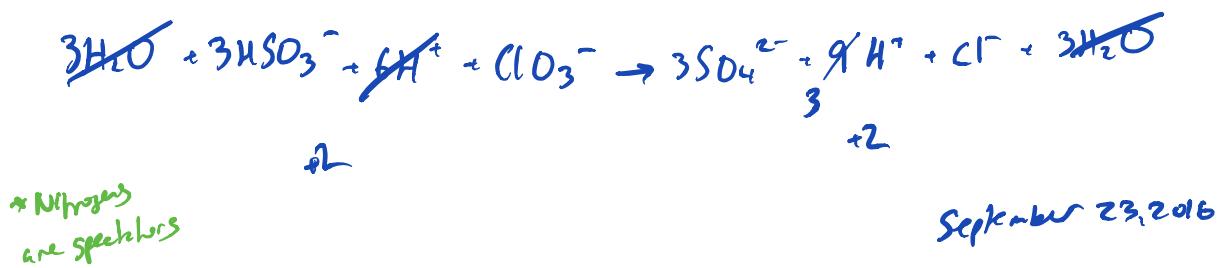
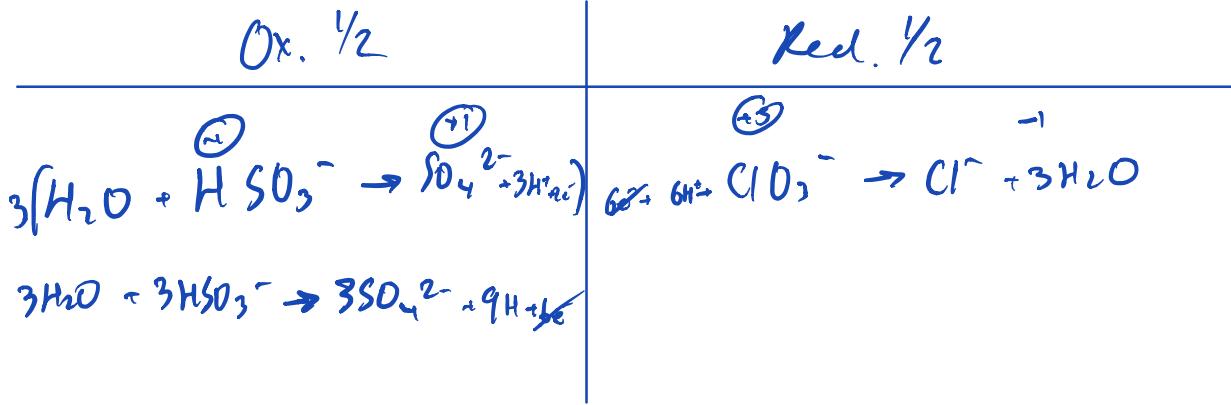


$$\frac{0.1104 \text{ mol } MnO_4}{\text{L}} \times 0.01968 \text{ L} \times \frac{5 \text{ mol } Fe^{2+}}{1 \text{ mol } MnO_4}$$

$$\times \frac{1 \text{ mol } Fe_2O_3}{2 \text{ mol } Fe^{2+}} \times \frac{159.7 \text{ g } Fe_2O_3}{1 \text{ mol } Fe_2O_3} = 0.867 \text{ g } Fe_2O_3$$

$$\% Fe_2O_3 = \frac{0.867 \text{ g } Fe_2O_3}{1.164 \text{ g sample}} \times 100 = 74.5 \% Fe_2O_3$$

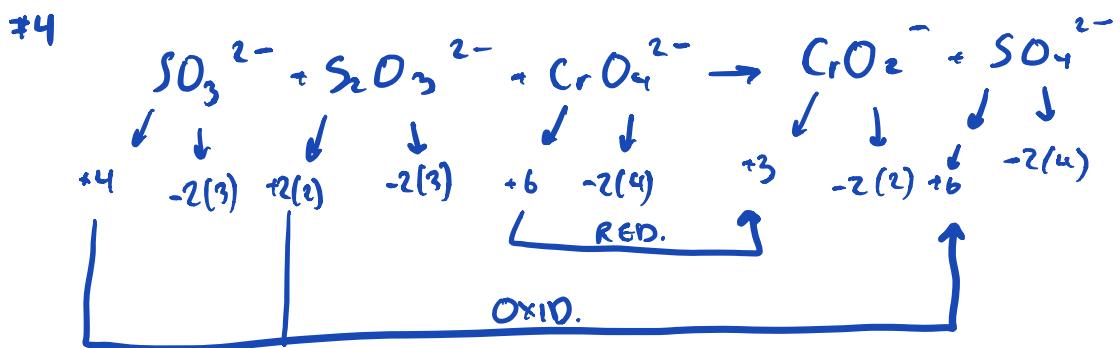


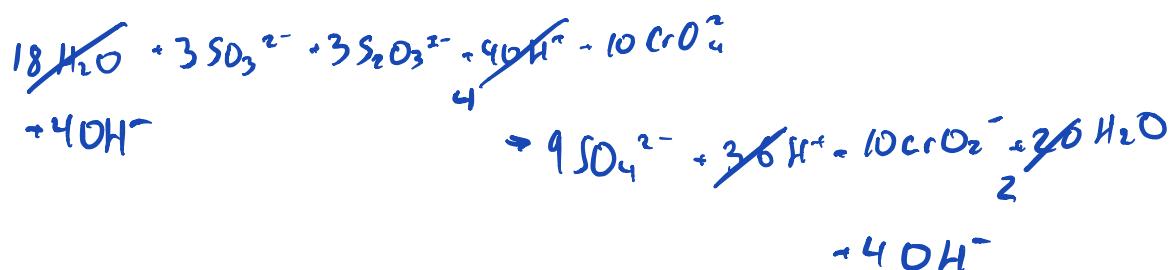
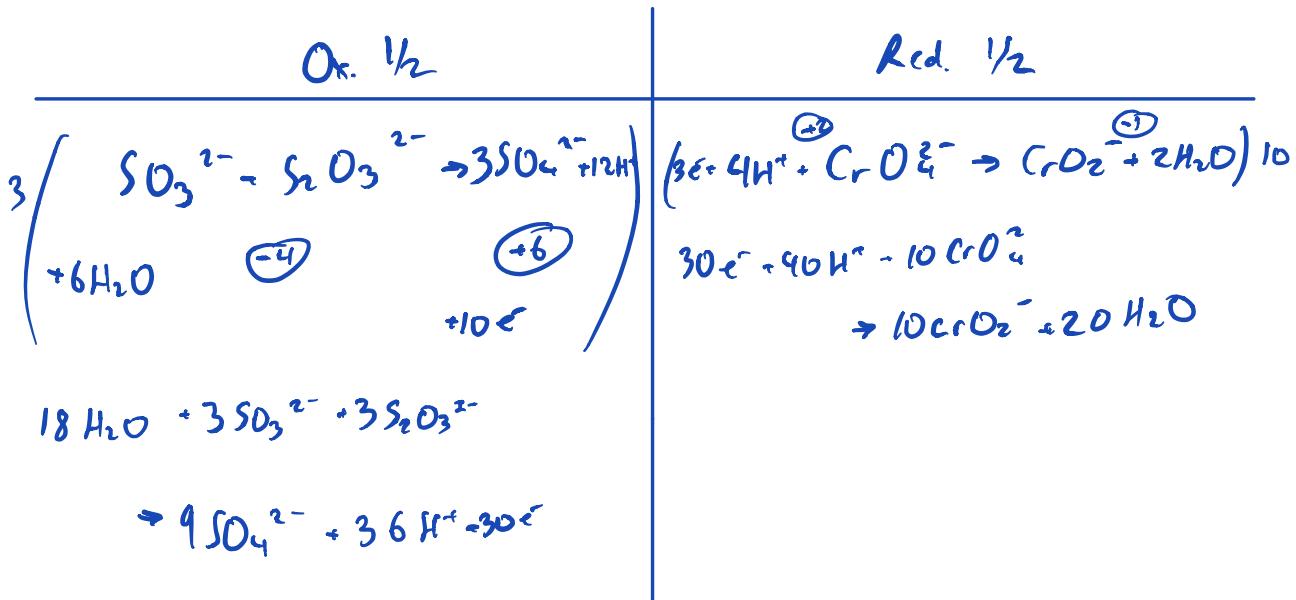


$$\frac{0.450 \text{ mol } \text{HSO}_3^-}{4} \times 0.030 \text{ L} \times \frac{1 \text{ mol } \text{ClO}_3^-}{3 \text{ mol } \text{HSO}_3^-}$$

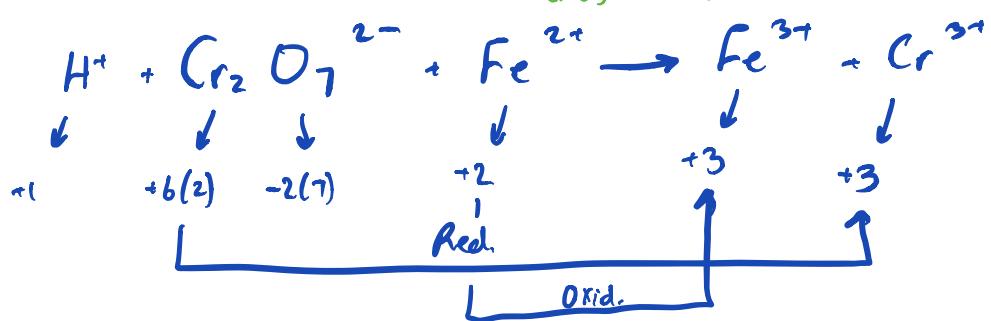
$$x \frac{1.0 \text{ L}}{0.150 \text{ mol H}_2\text{O}_2} = 0.300 \text{ L}$$

or 30.0 mL





#3 (Problem so long & complicated like this won't be on the test)
Others are spectators



Ox. 1/2	Red. 1/2
$6 \left(\text{Fe}^{2+} \rightarrow \text{Fe}^{3+} + \text{e}^- \right)$ $6 \text{Fe}^{2+} \rightarrow 6 \text{Fe}^{3+} + 6\text{e}^-$	$6\text{e}^- + 14\text{H}^+ + \text{Cr}_2\text{O}_7^{2-} \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$ e^- Cr^{3+}



$$\text{Cr}_2\text{O}_7^{2-}: \frac{0.0200 \text{ mol Cr}_2\text{O}_7^{2-}}{\cancel{K}} \times 0.300 \text{ K} \times \frac{7 \text{ mol H}_2\text{O}}{1 \text{ mol Cr}_2\text{O}_7^{2-}}$$

$$= 0.042 \text{ mol H}_2\text{O}$$

$$\text{Fe}^{2+}: \frac{0.0600 \text{ mol Fe}^{2+}}{\cancel{K}} \times 0.400 \cancel{L} \times \frac{7 \text{ mol H}_2\text{O}}{6 \text{ mol Fe}^{2+}}$$

$$= \boxed{0.028 \text{ mol H}_2\text{O}}$$

(0.042 + 0.028) Theoretical Yield

$$\text{H}^+: \frac{0.400 \text{ mol H}^+}{\cancel{K}} \times 0.700 \cancel{L} \times \frac{7 \text{ mol H}_2\text{O}}{14 \text{ mol H}^+}$$

$$= 0.14 \text{ mol H}^+$$

$$\text{H}^+ \text{ initial: } \frac{0.400 \text{ mol H}^+}{\cancel{K}} \times 0.700 \cancel{L} = 0.280 \text{ mol H}^+$$

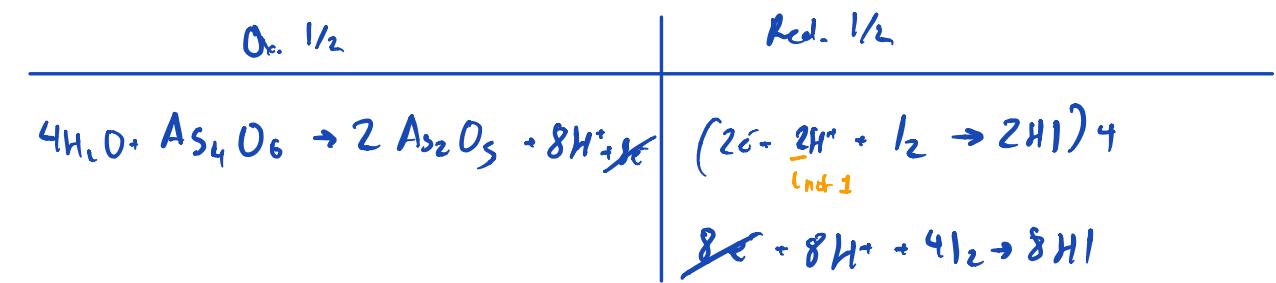
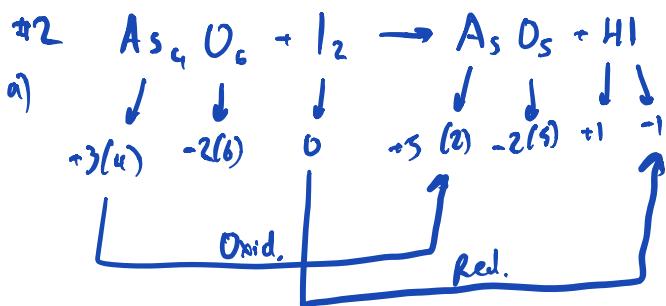
$$\text{H}^+ \text{ used up: } \frac{0.060 \text{ mol Fe}^{2+}}{\cancel{K}} \times 0.400 \times \frac{14 \text{ mol H}^+}{6 \text{ mol Fe}^{2+}}$$

$$= 0.056 \text{ mol H}^+$$

$$\begin{array}{r} \text{H}^+ \text{ remaining: } \\ \frac{0.280}{-0.056} \\ \hline 0.224 \end{array}$$



$$0.224 \text{ mol H}^+ \times \frac{1 \text{ mol OH}^-}{1 \text{ mol H}^+} \times \frac{1.0 \text{ L}}{0.000001 \text{ mol OH}^-} = 22.4 \text{ L NaOH}$$



b) $5.33 \text{ g I}_2 \times \frac{1 \text{ mol I}_2}{253.8 \text{ g I}_2} \times \frac{1 \text{ mol As}_4\text{O}_6}{4 \text{ mol I}_2} \times \frac{395.68 \text{ g As}_4\text{O}_6}{1 \text{ mol As}_4\text{O}_6} = 2.077 \text{ g As}_4\text{O}_6$

c) $\% \text{As}_4\text{O}_6 = \frac{2.077 \text{ g As}_4\text{O}_6}{13.38 \text{ g Sample}} = 15.5\% \text{ As}_4\text{O}_6$