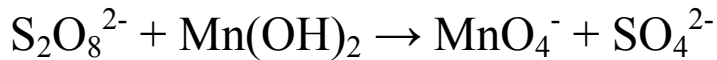


# EIT CHEMISTRY REVIEW

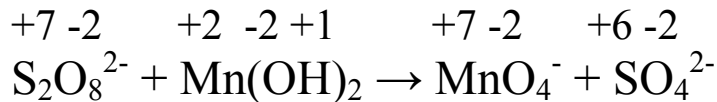
STEVE DANIEL

[sdaniel@mines.edu](mailto:sdaniel@mines.edu)

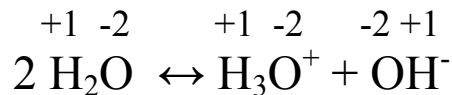
Balance in basic solution:



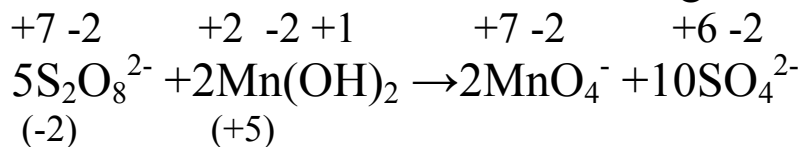
1. Assign oxidation numbers



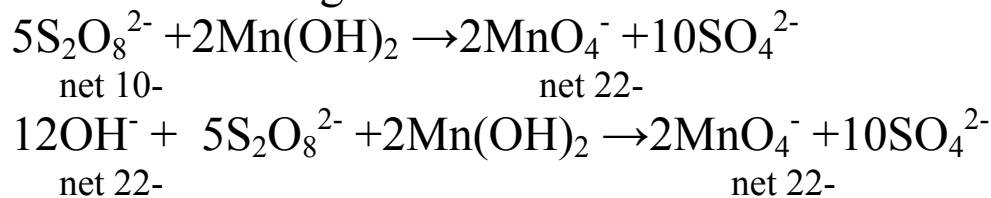
NOTE



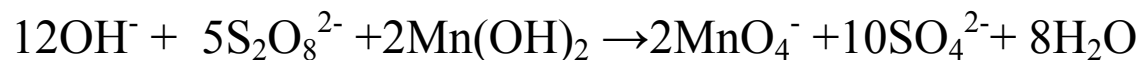
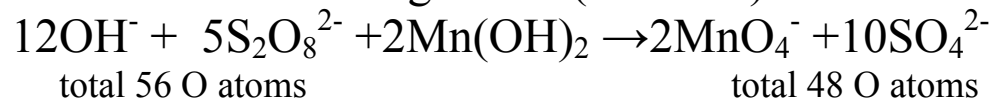
2. Balance oxidation number changes



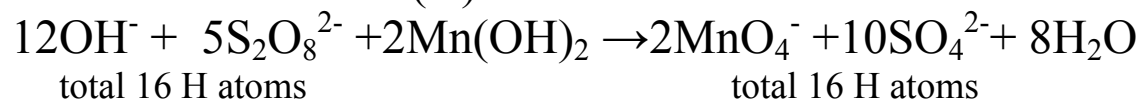
3. Balance charge



4. Balance remaining atoms (O and H)



5. Check last atoms (H)

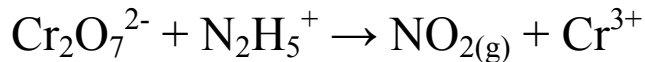


# ASSIGNING OXIDATION NUMBERS

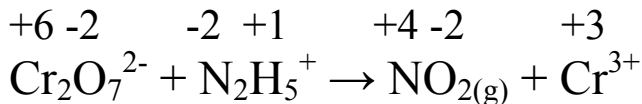
## RULES IN PRIORITY ORDER

1.  $\Sigma(\text{oxidation numbers}) = \text{charge}$
2. Group IA (Li,Na,K,etc) assign +1
3. Group 2A (Be,Mg,Ca,etc) assign +2
4. B, Al assign +3
5. Hydrogen assign +1
6. Oxygen assign -2

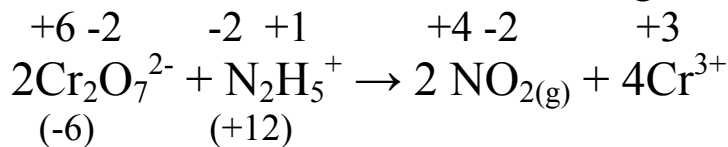
Balance in acidic solution:



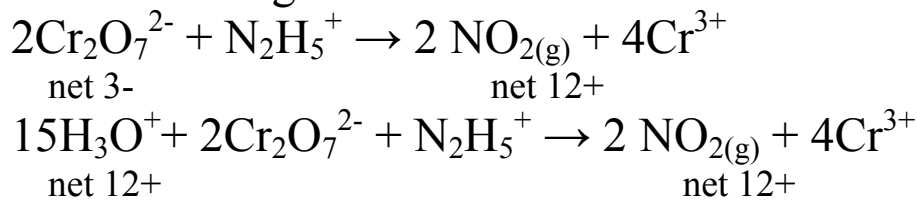
1. Assign oxidation numbers



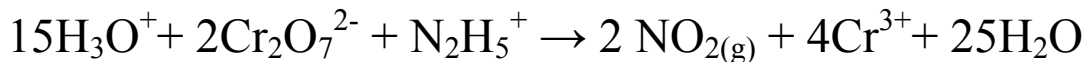
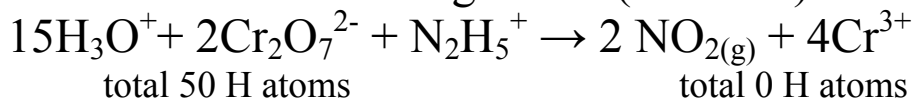
2. Balance oxidation number changes



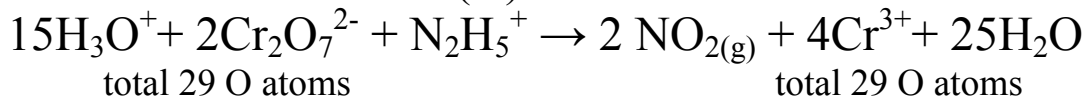
3. Balance charge



4. Balance remaining atoms (O and H)

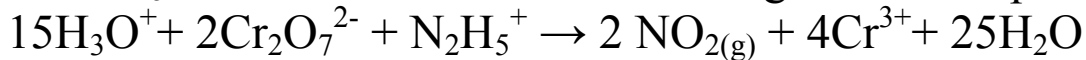


5. Check last atoms (O)



## STOICHIOMETRY

1. A solid sample is 15.0%  $\text{Na}_2\text{Cr}_2\text{O}_7$ . How many grams of  $\text{N}_2\text{H}_5\text{Cl}$  is needed to react with 5.00 g of this sample.



$$5.00\text{g sample} \times \frac{.150\text{g Na}_2\text{Cr}_2\text{O}_7}{\text{g sample}} \times \frac{\text{mole Na}_2\text{Cr}_2\text{O}_7}{262.0\text{g Na}_2\text{Cr}_2\text{O}_7} \times$$

$$\times \frac{\text{mole N}_2\text{H}_5\text{Cl}}{2 \text{ mole Na}_2\text{Cr}_2\text{O}_7} \times \frac{68.5\text{g N}_2\text{H}_5\text{Cl}}{\text{mole N}_2\text{H}_5\text{Cl}} = \mathbf{0.0980 \text{ g N}_2\text{H}_5\text{Cl}}$$

2. How many liters  $\text{NO}_{2(\text{g})}$  at  $30.0^\circ\text{C}$  and  $620.0\text{torr}$  are formed when the 5.00 g of sample is reacted?

$$5.00\text{g sample} \times \frac{.150\text{g Na}_2\text{Cr}_2\text{O}_7}{\text{g sample}} \times \frac{\text{mole Na}_2\text{Cr}_2\text{O}_7}{262.0\text{g Na}_2\text{Cr}_2\text{O}_7} \times$$

$$\times \frac{2\text{mole NO}_2}{2\text{mole Cr}_2\text{O}_7} \times \frac{.08205\text{Latm}}{\text{moleNO}_2\text{K}} \times \frac{303.15\text{K}}{620.0\text{torr}} \times \frac{760.0\text{torr}}{\text{atm}} = \mathbf{.0873 \text{ L}}$$

3. How many mLs of 3.00N  $\text{N}_2\text{H}_5\text{Cl}$  solution would be required to react with 5.00g of the sample?

$$5.00\text{g sample} \times \frac{.150\text{g Na}_2\text{Cr}_2\text{O}_7}{\text{g sample}} \times \frac{\text{mole Na}_2\text{Cr}_2\text{O}_7}{262.0\text{g Na}_2\text{Cr}_2\text{O}_7} \times$$

$$\times \frac{\text{mole N}_2\text{H}_5\text{Cl}}{2\text{mole Cr}_2\text{O}_7^{2-}} \times \frac{12 \text{ eq N}_2\text{H}_5\text{Cl}}{\text{mole N}_2\text{H}_5\text{Cl}} \times \frac{\text{L N}_2\text{H}_5\text{Cl}}{3.00\text{eq N}_2\text{H}_5\text{Cl}} \times$$

$$\times \frac{1000\text{mL}}{\text{L}} = \mathbf{5.73 \text{ mL}}$$

## IDEAL GAS LAW

$$PV = nRT \quad R = .08205 \text{ Lat/moleK}$$
$$V = nRT/P$$

## CONCENTRATION UNITS

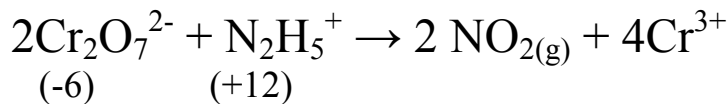
Molarity = M = moles solute/L solution

Molality = m = moles solute/kg solvent

Normality = N = equivalents solute/L solution

## REDOX

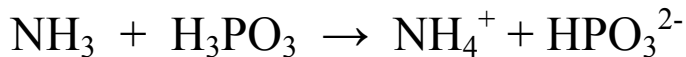
# equivalents/mole = ox.# change per formula



So  $\text{Na}_2\text{Cr}_2\text{O}_7$  has 6 eq/mole and  $\text{N}_2\text{H}_5\text{Cl}$  has 12eq/mole here

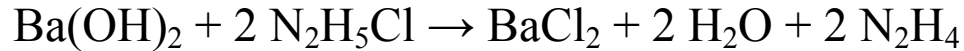
## ACID-BASE

# eq/mole = #  $\text{H}^+$  gained or lost per formula



$\text{NH}_3$  has 1eq/mole and  $\text{H}_3\text{PO}_3$  has 2eq/mole in this reaction

4. Titration of 35.00 mL of a Ba(OH)<sub>2</sub> solution requires 27.63 mL of 3.00 M N<sub>2</sub>H<sub>5</sub>Cl. What is the molarity of Ba(OH)<sub>2</sub> solution? What is its normality?



$$\frac{.02763\text{L N}_2\text{H}_5\text{Cl}}{.03500\text{L Ba(OH)}_2} \times \frac{3.00 \text{ mole N}_2\text{H}_5\text{Cl}}{\text{L N}_2\text{H}_5\text{Cl}} \times \frac{\text{mole Ba(OH)}_2}{2 \text{ mole N}_2\text{H}_5\text{Cl}} =$$

$$= 1.18 \text{ mole Ba(OH)}_2/\text{L Ba(OH)}_2 \text{ or } \mathbf{1.18M}$$

$$\frac{1.18 \text{ mole Ba(OH)}_2}{\text{L Ba(OH)}_2} \times \frac{2 \text{ eq Ba(OH)}_2}{\text{mole Ba(OH)}_2} = \mathbf{2.36N}$$

5. When 250 g CaCO<sub>3</sub> and 300 mL 3.00M H<sub>3</sub>PO<sub>4</sub> are mixed, how many L CO<sub>2(g)</sub> at 30.0°C and 700torr result?



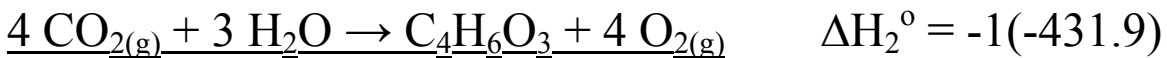
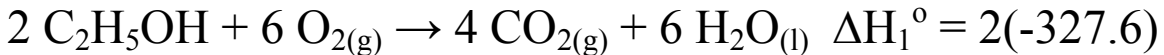
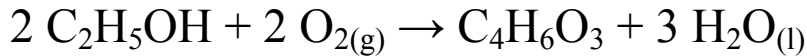
$$250\text{g CaCO}_3 \times \frac{\text{mole CaCO}_3}{100 \text{ g CaCO}_3} \times \frac{3 \text{mole CO}_2}{3 \text{mole CaCO}_3} \times \frac{.08205 \text{Latm}}{\text{mole CO}_2 \text{ K}}$$

$$\times \frac{303.15\text{K}}{700\text{torr}} \times \frac{760\text{torr}}{\text{atm}} = 67.4 \text{ L CO}_2$$

$$.300\text{L H}_3\text{PO}_4 \times \frac{3.00 \text{mole H}_3\text{PO}_4}{\text{L H}_3\text{PO}_4} \times \frac{3 \text{mole CO}_2}{2 \text{mole H}_3\text{PO}_4} \times \frac{\text{RT}}{\text{P}} = \mathbf{36.5L}$$

## HESS' LAW

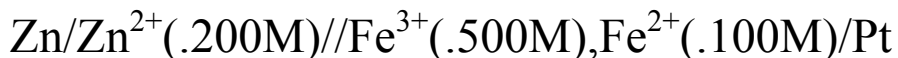
Heats of combustion of ethanol ( $C_2H_5OH$ ) and acetic anhydride ( $C_4H_6O_3$ ) are 327.6 and 431.9 kcal/mole, respectively. Calculate the standard enthalpy change for:



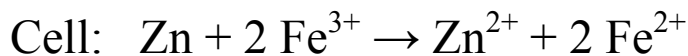
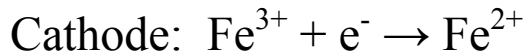
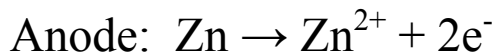
$$\Delta H_{rxn}^\circ = -655.2 - (-431.9) = -223.3 \text{ kcal/mole rxn}$$

## ELECTROCHEM

1. For the voltaic cell:



a. Write anode, cathode, and cell reactions ( $E^\circ = +0.761\text{v}$  and  $-0.771\text{v}$  for  $Zn \rightarrow Zn^{2+}$  and  $Fe^{2+} \rightarrow Fe^{3+}$ , respectively).



b. Calculate  $E^\circ$  and  $E$  for the cell.

$$E^\circ_{\text{cell}} = +0.761 - (-0.771) = +\mathbf{1.532\text{v.}}$$

$$E_{\text{cell}} = 1.532 - \frac{.0591}{n} \log \frac{[Zn^{2+}][Fe^{2+}]^2}{[Fe^{3+}]^2} =$$

$$= 1.532 - (.0591/2) \log (.100)^2 (.200) / (.500)^2 = +\mathbf{1.594\text{v.}}$$

- c. If each electrode compartment contains 500mL of solution and the Zn electrode weighs 5.00g, how long can the cell operate at an average current of 2.00amp?

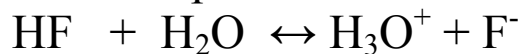
$$\frac{.500 \text{ mole Fe}^{3+}}{\text{L solution}} \times \frac{\text{eq Fe}^{3+}}{\text{mole Fe}^{3+}} \times .500 \text{ L} = 0.250 \text{ eq Fe}^{3+}$$

$$5.00 \text{ g Zn} \times \frac{\text{mole Zn}}{65.4 \text{ g Zn}} \times \frac{2 \text{ eq Zn}}{\text{mole Zn}} = 0.153 \text{ eq Zn}$$

$$.153 \text{ eq} \times \frac{96487 \text{ coul}}{\text{eq}} \times \frac{\text{second}}{2.00 \text{ coul}} = 7.38 \times 10^3 \text{ seconds}$$

### ACID-BASE EQUILIBRIA

1. Calculate the pH of 0.50M HF solution.  $K_a = 7.1 \times 10^{-4}$ .

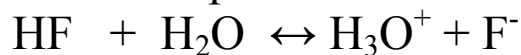


$$.50-x \qquad \qquad \qquad x \qquad x$$

$$K_a = 7.1 \times 10^{-4} = \frac{[\text{H}_3\text{O}^+][\text{F}^-]}{[\text{HF}]} = \frac{x^2}{(.50-x)}$$

$$x = 1.85 \times 10^{-2} \quad \text{pH} = -\log[\text{H}_3\text{O}^+] = 1.73$$

2. If 0.20 mole NaF is dissolved in 300.0mL 0.50M HF, what is the solution pH?



$$.50-x \qquad \qquad \qquad x \qquad (.20/.300)+x$$

$$7.1 \times 10^{-4} = \frac{[\text{H}_3\text{O}^+][\text{F}^-]}{[\text{HF}]} = \frac{x(.667+x)}{(.50-x)}$$

$$x = [\text{H}_3\text{O}^+] = 5.3 \times 10^{-4} \quad \text{pH} = 3.28$$