

Avogadro's Number	$N_A = 6.02214 \times 10^{23} \text{ mol}^{-1}$
Faraday Constant	$F = 96485.33 \text{ C mol}^{-1}$
Atomic Mass Constant	$1 \text{ amu} = 1.660538 \times 10^{-27} \text{ kg}$
Molar Gas Constant	$R = 8.3144 \text{ J mol}^{-1} \text{ K}^{-1}$
$R = 62.36 \text{ L atm (mol K)}^{-1}$	$= 0.08205746 \text{ L atm K}^{-1} \text{ mol}^{-1}$
Coulomb's Constant	$k_e = 8.987551 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$
Speed of Light (Vacuum)	$c = 2.998 \times 10^6 \text{ m s}^{-1}$
Boltzmann Constant	$k_b = 1.3807 \times 10^{-23} \text{ J K}^{-1}$
Charge on a Proton/Electron	$e = 1.602 \times 10^{-19} \text{ C}$
Planck's Constant	$h = 6.626 \times 10^{-34} \text{ Js}$
Specific heat cap. of $\text{H}_2\text{O}_{(l)}$	$c = 4.18 \text{ kJ kg}^{-1} \text{ } ^\circ\text{C}^{-1}$

## Kinetics

$$[A]_t - [A]_0 = -kt \text{ (first order)}$$

$$\ln[A]_t - \ln[A]_0 = -k \text{ (second order)}$$

$$\frac{1}{[A]_t} - \frac{1}{[A]_0} = kt \text{ (third order)}$$

$$t_{1/2} = \frac{0.963}{t} \text{ (first order)}$$

## Equilibrium

$$K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}, \text{ where } aA + bB \rightleftharpoons cC + dD.$$

$$K_p = \frac{(P_C)^c (P_D)^d}{(P_A)^a (P_B)^b}$$

$$K_a = \frac{[\text{H}^+][\text{A}^-]}{[\text{HA}]}$$

$$K_1 = \frac{[\text{HA}]}{[\text{OH}^-][\text{HB}^+]}$$

$$K_w = K_a K_b = [\text{H}^+][\text{OH}^-]$$

$$= 1.0 \times 10^{-14} \text{ (25}^\circ \text{ C)}$$

$$\text{pH} = -\log[\text{H}^+], \text{pOH} = -\log[\text{OH}^-]$$

$$\text{pH} + \text{pOH} = 14.$$

$$\text{pH} = \text{p}K_a + \log \frac{[\text{A}^-]}{[\text{HA}]}$$

## Gasses/Solutions

$$PV = nRT$$

$$P_A = P_{\text{total}} X_A, \text{ where } X_A = \frac{\text{moles } A}{\text{total moles}}$$

$$P_{\text{total}} = P_A + P_B + P_C + \dots$$

$$M = \frac{\text{moles solute}}{\text{kg solvent}}$$

1 atm = 760 mmHg = 760 torr

STP = 273.15 K and 1.0 atm

At STP, ideal gas  $22.4\text{L mol}^{-1}$ .

Standard conditions are 25° C and 1 atm

## Thermo/Electrochem

$$q = mc\Delta T$$

$$\Delta S^\circ = \sum_{\text{products}} S^\circ - \sum_{\text{reactants}} S^\circ$$

Same for  $\Delta H^\circ$  and  $\Delta G^\circ$

$$\Delta G^\circ = \Delta H^\circ - T \Delta S^\circ$$

$$= -RT \ln K = -nFE^\circ$$

$$I = \frac{q}{t}$$

$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{RT}{nF} \ln Q.$$

[illegible]

Polyatomic Ions			
1+		2-	
(NH <sub>4</sub> ) <sup>+1</sup>	ammonium	(CrO <sub>4</sub> ) <sup>-2</sup>	chromate
<b>1-</b>		(Cr <sub>2</sub> O <sub>7</sub> ) <sup>-2</sup>	dichromate
(NO <sub>3</sub> ) <sup>-1</sup>	nitrate	(CO <sub>3</sub> ) <sup>-2</sup>	carbonate
(NO <sub>2</sub> ) <sup>-1</sup>	nitrite	(HPO <sub>4</sub> ) <sup>-2</sup>	dibasic phosphate or <u>hydrogen phosphate</u>
(OH) <sup>-1</sup>	hydroxide		
(HCO <sub>3</sub> ) <sup>-1</sup>	<u>bicarbonate</u> or hydrogen carbonate	(MnO <sub>4</sub> ) <sup>-2</sup>	manganate
(C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sup>-1</sup>	acetate	(O <sub>2</sub> ) <sup>-2</sup>	peroxide
		(S <sub>2</sub> O <sub>3</sub> ) <sup>-2</sup>	thiosulfate
(ClO <sub>4</sub> ) <sup>-1</sup>	perchlorate	(SO <sub>4</sub> ) <sup>-2</sup>	sulfate
(ClO <sub>3</sub> ) <sup>-1</sup>	chlorate	(SO <sub>3</sub> ) <sup>-2</sup>	sulfite
(ClO <sub>2</sub> ) <sup>-1</sup>	chlorite	(C <sub>2</sub> O <sub>4</sub> ) <sup>-2</sup>	oxalate
(ClO) <sup>-1</sup>	hypochlorite		
		<b>3-</b>	
(CN) <sup>-1</sup>	cyanide	(AsO <sub>4</sub> ) <sup>-3</sup>	arsenate
(SCN) <sup>-1</sup>	thiocyanate	(AsO <sub>3</sub> ) <sup>-3</sup>	arsenite
(HSO <sub>4</sub> ) <sup>-1</sup>	bisulfate or hydrogen sulfate	(BO <sub>3</sub> ) <sup>-3</sup>	borate
(MnO <sub>4</sub> ) <sup>-1</sup>	permanganate	(C <sub>6</sub> H <sub>5</sub> O <sub>7</sub> ) <sup>-3</sup>	citrate
(H <sub>2</sub> PO <sub>4</sub> ) <sup>-1</sup>	dihydrogen phosphate	(PO <sub>4</sub> ) <sup>-3</sup>	phosphate or tribasic phosphate
		(PO <sub>3</sub> ) <sup>-3</sup>	phosphite
(IO <sub>4</sub> ) <sup>-1</sup>	periodate		
(IO <sub>3</sub> ) <sup>-1</sup>	iodate	<b>4-</b>	
(IO) <sup>-1</sup>	hypoiodite		
		(SiO <sub>4</sub> ) <sup>-4</sup>	silicate (ortho)
(NH <sub>2</sub> ) <sup>-1</sup>	amide		
(CHO <sub>2</sub> ) <sup>-1</sup>	formate		

Atomic Ions			
+1		-1	
Li <sup>+1</sup>	Lithium	F <sup>-1</sup>	Fluoride
Na <sup>+1</sup>	Sodium	Br <sup>-1</sup>	Bromide
K <sup>+1</sup>	Potassium	Cl <sup>-1</sup>	Chloride
Ag <sup>+1</sup>	Silver	I <sup>-1</sup>	iodide
Cu <sup>+1</sup>	Copper (I)		
		<b>-2</b>	
Mg <sup>+2</sup>	Magnesium		
Ca <sup>+2</sup>	Calcium	O <sup>-2</sup>	Oxide
Ba <sup>+2</sup>	Barium	S <sup>-2</sup>	Sulfide
Zn <sup>+2</sup>	Zinc		
Cd <sup>+2</sup>	Cadmium (II)		
Hg <sup>+2</sup>	Mercury (II)		
Hg <sub>2</sub> <sup>+2</sup>	Mercury (I)		
Cu <sup>+2</sup>	Copper (II)		
Pb <sup>+2</sup>	Lead (II)		
Fe <sup>+2</sup>	Iron (II)		
Ni <sup>+2</sup>	Nickel (II)		
Mn <sup>+2</sup>	Manganese (II)		
Sn <sup>+2</sup>	Tin (II)		
		<b>+3</b>	
Al <sup>+3</sup>	Aluminum		
Fe <sup>+3</sup>	Iron (III)	N <sup>-3</sup>	Nitride
Ni <sup>+3</sup>	Nickel (III)	P <sup>-3</sup>	Phosphide
		<b>+4</b>	
Pb <sup>+4</sup>	Lead (IV)		
Si <sup>+4</sup>	Silicon (IV)		
Sn <sup>+4</sup>	Tin (IV)		
Mn <sup>+4</sup>	Manganese (IV)		