

ADVANCED PLACEMENT CHEMISTRY EQUATIONS AND CONSTANTS

ATOMIC STRUCTURE

$$E = h\nu \quad c = \lambda\nu$$

$$\lambda = \frac{h}{m\nu} \quad p = m\nu$$

$$E_n = \frac{-2.178 \times 10^{-18}}{n^2} \text{ joule}$$

EQUILIBRIUM

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

$$K_b = \frac{[\text{OH}^-][\text{HB}^+]}{[\text{B}]}$$

$$K_w = [\text{OH}^-][\text{H}^+] = 1.0 \times 10^{-14} \text{ @ } 25^\circ\text{C}$$

$$= K_a \times K_b$$

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

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

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

$$\text{pOH} = \text{p}K_b + \log \frac{[\text{HB}^+]}{[\text{B}]}$$

$$\text{p}K_a = -\log K_a, \text{p}K_b = -\log K_b$$

$$K_p = K_c(RT)^{\Delta n},$$

where  $\Delta n = \text{moles product gas} - \text{moles reactant gas}$

THERMOCHEMISTRY/KINETICS

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

$$\Delta H^\circ = \sum \Delta H_f^\circ \text{ products} - \sum \Delta H_f^\circ \text{ reactants}$$

$$\Delta G^\circ = \sum \Delta G_f^\circ \text{ products} - \sum \Delta G_f^\circ \text{ reactants}$$

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

$$= -RT \ln K = -2.303 RT \log K$$

$$= -n\mathcal{F}E^\circ$$

$$\Delta G = \Delta G^\circ + RT \ln Q = \Delta G^\circ + 2.303 RT \log Q$$

$$q = mc\Delta T$$

$$C_p = \frac{\Delta H}{\Delta T}$$

$$\ln[A]_t - \ln[A]_0 = -kt$$

$$\frac{1}{[A]_t} - \frac{1}{[A]_0} = kt$$

$$\ln k = \frac{-E_a}{R} \left( \frac{1}{T} \right) + \ln A$$

$E = \text{energy}$        $v = \text{velocity}$   
 $\nu = \text{frequency}$        $n = \text{principal quantum number}$   
 $\lambda = \text{wavelength}$        $m = \text{mass}$   
 $p = \text{momentum}$

Speed of light,  $c = 3.0 \times 10^8 \text{ m s}^{-1}$

Planck's constant,  $h = 6.63 \times 10^{-34} \text{ J s}$

Boltzmann's constant,  $k = 1.38 \times 10^{-23} \text{ J K}^{-1}$

Avogadro's number =  $6.022 \times 10^{23} \text{ mol}^{-1}$

Electron charge,  $e = -1.602 \times 10^{-19} \text{ coulomb}$

1 electron volt per atom =  $96.5 \text{ kJ mol}^{-1}$

Equilibrium Constants

- $K_a$  (weak acid)
- $K_b$  (weak base)
- $K_w$  (water)
- $K_p$  (gas pressure)
- $K_c$  (molar concentrations)

$S^\circ = \text{standard entropy}$

$H^\circ = \text{standard enthalpy}$

$G^\circ = \text{standard free energy}$

$E^\circ = \text{standard reduction potential}$

$T = \text{temperature}$

$n = \text{moles}$

$m = \text{mass}$

$q = \text{heat}$

$c = \text{specific heat capacity}$

$C_p = \text{molar heat capacity at constant pressure}$

$E_a = \text{activation energy}$

$k = \text{rate constant}$

$A = \text{frequency factor}$

Faraday's constant,  $\mathcal{F} = 96,500 \text{ coulombs per mole of electrons}$

Gas constant,  $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$   
 $= 0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1}$   
 $= 8.31 \text{ volt coulomb mol}^{-1} \text{ K}^{-1}$