ADVANCED PLACEMENT CHEMISTRY EQUATIONS AND CONSTANTS

ATOMIC STRUCTURE

$$E = hv c = \lambda v$$

$$\lambda = \frac{h}{mv} p = mv$$

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

EQUILIBRIUM

$$K_{a} = \frac{[H^{+}][A^{-}]}{[HA]}$$

$$K_{b} = \frac{[OH^{-}][HB^{+}]}{[B]}$$

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

$$= K_{a} \times K_{b}$$

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

$$14 = pH + pOH$$

$$pH = pK_{a} + \log\frac{[A^{-}]}{[HA]}$$

$$pOH = pK_{b} + \log\frac{[HB^{+}]}{[B]}$$

$$pK_{a} = -\log K_{a}, pK_{b} = -\log K_{b}$$

$$K_{p} = K_{c}(RT)^{\Delta n},$$

where Δn = moles product gas – moles reactant gas

THERMOCHEMISTRY/KINETICS

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

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

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

$$\Delta G^{\circ} = \Delta H^{\circ} - T \Delta S^{\circ}$$
$$= -RT \ln K = -2.303 RT \log K$$
$$= -n \mathcal{F} E^{\circ}$$

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

$$q = mc\Delta T$$

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

$$\ln[\mathbf{A}]_t - \ln[\mathbf{A}]_0 = -kt$$

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

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

$$E = \text{energy}$$
 $v = \text{velocity}$

$$v =$$
frequency $n =$ principal quantum number

$$\lambda = \text{wavelength} \qquad m = \text{mass}$$

$$p = momentum$$

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

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,
$$e = -1.602 \times 10^{-19}$$
 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)

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

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

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

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

$$T = temperature$$

$$n = moles$$

$$m = mass$$

$$q = \text{heat}$$

$$c =$$
specific heat capacity

$$C_p$$
 = molar heat capacity at constant pressure

$$E_a$$
 = activation energy

$$k = \text{rate constant}$$

$$A =$$
frequency factor

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

Gas constant,
$$R = 8.31 \,\mathrm{J \, mol^{-1} \, K^{-1}}$$

$$= 0.0821 L atm mol^{-1} K^{-1}$$

$$= 62.4 \text{ L torr mol}^{-1} \text{ K}^{-1}$$

$$= 8.31 \text{ volt coulomb mol}^{-1} \text{ K}^{-1}$$