

## ADVANCED PLACEMENT CHEMISTRY EQUATIONS AND CONSTANTS

Throughout the test the following symbols have the definitions specified unless otherwise noted.

L, mL = liter(s), milliliter(s)  
g = gram(s)  
nm = nanometer(s)  
atm = atmosphere(s)

mm Hg = millimeters of mercury  
J, kJ = joule(s), kilojoule(s)  
V = volt(s)  
mol = mole(s)

### ATOMIC STRUCTURE

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

$E$  = energy  
 $\nu$  = frequency  
 $\lambda$  = wavelength

Planck's constant,  $h = 6.626 \times 10^{-34}$  J s

Speed of light,  $c = 2.998 \times 10^8$  m s<sup>-1</sup>

Avogadro's number =  $6.022 \times 10^{23}$  mol<sup>-1</sup>

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

### EQUILIBRIUM

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

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

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

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

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

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

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

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

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

#### Equilibrium Constants

$K_c$  (molar concentrations)

$K_p$  (gas pressures)

$K_a$  (weak acid)

$K_b$  (weak base)

$K_w$  (water)

### KINETICS

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

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

$$t_{1/2} = \frac{0.693}{k}$$

$k$  = rate constant

$t$  = time

$t_{1/2}$  = half-life

## GASES, LIQUIDS, AND SOLUTIONS

$$PV = nRT$$

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

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

$$n = \frac{m}{M}$$

$$K = ^\circ\text{C} + 273$$

$$D = \frac{m}{V}$$

$$KE \text{ per molecule} = \frac{1}{2}mv^2$$

Molarity,  $M$  = moles of solute per liter of solution

$$A = abc$$

$P$  = pressure  
 $V$  = volume  
 $T$  = temperature  
 $n$  = number of moles  
 $m$  = mass  
 $M$  = molar mass  
 $D$  = density  
 $KE$  = kinetic energy  
 $v$  = velocity  
 $A$  = absorbance  
 $a$  = molar absorptivity  
 $b$  = path length  
 $c$  = concentration

Gas constant,  $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$   
 $= 0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1}$   
 $= 62.36 \text{ L torr mol}^{-1} \text{ K}^{-1}$   
 $1 \text{ atm} = 760 \text{ mm Hg}$   
 $= 760 \text{ torr}$   
STP =  $0.00^\circ\text{C}$  and  $1.000 \text{ atm}$

## THERMOCHEMISTRY/ ELECTROCHEMISTRY

$$q = mc\Delta T$$

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

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

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

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

$$= -RT \ln K$$

$$= -nFE^\circ$$

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

$q$  = heat  
 $m$  = mass  
 $c$  = specific heat capacity  
 $T$  = temperature  
 $S^\circ$  = standard entropy  
 $H^\circ$  = standard enthalpy  
 $G^\circ$  = standard free energy  
 $n$  = number of moles  
 $E^\circ$  = standard reduction potential  
 $I$  = current (amperes)  
 $q$  = charge (coulombs)  
 $t$  = time (seconds)

Faraday's constant,  $F = 96,485 \text{ coulombs per mole}$   
of electrons  
 $1 \text{ volt} = \frac{1 \text{ joule}}{1 \text{ coulomb}}$