Chemistry Revision Sheets
Equations for CIE

Moles (amounts of substance)

Mass

$$\text{moles} = \frac{\text{mass}}{\text{molar mass}}$$

moles = g
molar mass = g mol^{-1}

Solution

moles = concentration x volume

concentration = mol dm^{-3}
volume = dm^{3}

Gas

$$pV = nRT$$

p = pressure (Pa) *R = gas constant (8.31 J K^{-1} mol^{-1})*
V = volume (m^{3}) *T = temperature (K)*

Energy, Enthalpy and Entropy

Calorimetry

$$q = mc\Delta T$$

q = energy change (J or kJ) *c = specific heat capacity (J g^{-1} K^{-1})*
ΔT = temperature change (K or °C)

Bond Enthalpies

$$\Delta H = \sum(\text{bond energies of reactants}) - \sum(\text{bond energies of products})$$

ΔH = change in enthalpy (kJ mol^{-1}), bond enthalpies = kJ mol^{-1})

Enthalpy

$$\text{enthalpy} = \frac{\text{moles}}{\text{energy change (q)}}$$

enthalpy = kJ mol^{-1}
energy change (q) = kJ

Gibbs Free Energy

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

ΔG = Gibbs Free Energy (kJ mol^{-1}) *ΔH = enthalpy change (kJ mol^{-1})*
*ΔS = entropy change (**kJ** K^{-1} mol^{-1})* *T =temperature (K)*

$$\Delta G = -RT \ln K$$

R = gas constant (8.31 J K^{-1} mol^{-1}) *K = rate constant*
ln = natural logarithm *T =temperature (K)*

Entropy

$$\Delta S = \sum S^{\circ}(\textit{products}) - \sum S^{\circ}(\textit{reactants})$$

ΔS = entropy change (J K^{-1} mol^{-1})
$S^{\ominus}$ = standard entropy (J K^{-1} mol^{-1})

Rates of Reaction

Rate Equation

$$\text{rate} = k \times [A]^x[B]^y[C]^z$$

Rate = mol dm^{-3} s^{-1} , [ ] = concentration
^{x,y,z} = orders with respect to A, B and C

Equilibrium

Equilibrium Constant K_c

$$K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

For the equilibrium $aA + bB \rightleftharpoons cC + dD$
[ ] = concentration

Equilibrium Constant K_p

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

For the equilibrium $aA_{(g)} + bB_{(g)} \rightleftharpoons cC_{(g)} + dD_{(g)}$
P_x = partial pressure (Pa)

Solubility Constant K_{sp}

$$K_{sp} = [A^{x+}]^a [B^{y-}]^b$$

For the equilibrium $A_aB_b(s) \rightleftharpoons aA^{x+}(aq) + bB^{y-}(aq)$
[ ] = concentration
K_{sp} = solubility constant

Partition Coeffcient K_{pc}

$$K_{pc} = \frac{[A\ (organic)]}{[A\ (aqueous)]}$$

For the equilibrium $A(aqueous) \rightleftharpoons A(organic)$
[ ] = concentration
K_{pc} = partician coefficient

Stability Constant K_{stab}

$$K_{stab} = \frac{[M(X)_6]}{[M(H_2O)_6][X]^6}$$

For the equilibrium $[M(H_2O)_6]^{+} + 6X \rightleftharpoons [M(X)_6]^{+} + 6H_2O$
[ ] = concentration
K_{stan} = stability constant

Chromatography

Retention Factor R_f

$$R_f = \frac{\text{Distance travelled by sample}}{\text{Solvent Front}}$$

R_f = no units
solvent front = distance travelled by solvent

Acids, Bases and pH

Acid Dissociation Constant K_a

$$K_a = \frac{[H^+_{(aq)}][A^-_{(aq)}]}{[HA_{(aq)}]}$$

For the weak acid dissociation $HA \rightleftharpoons H^+ + A^-$
[ ] = concentration
K_a = acid dissociation constant (mol dm^{-3})

pK_a

$$pK_a = -\log_{10}K_a$$

Ionic Product of Water K_w

$$K_w = [H^+_{(aq)}][OH^-_{(aq)}]$$

K_w = ionic product of water (mol^2 dm^{-6})
at 298K, $K_w = 1.00 \times 10^{-14}$ mol^2 dm^{-6}

pH

$$pH = -\log_{10}[H^+_{(aq)}]$$

$[H^+_{(aq)}]$ = concentration of $H^+_{(aq)}$

$$[H^+_{(aq)}] = 10^{-pH}$$

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Electrochemistry

Electromotive Force E_{cell}

$E_{cell} = E_{reduction} - E_{oxidation}$

E_{cell} = EMF (electromotive force) of electrochemical cell (V)
$E_{redution}$ = standard electrode potential of cathode
$E_{oxidation}$ = standard electrode potential of anode

Conditions for standard electrode potentials = 298K, 1 mol dm^{-3} and 100kPa

Faraday Constant

$F = L\,e$

F = Faraday constant (9.65 x 10^4 coulombs per mole)
L = Avagadros constant (6.022 x 10^{23})
e = charge of an electron (1.60 x 10^{-19} coulombs)

Coulombs

$Q = I\,t$

Q = coulombs (unit of charge)
I = current (c s^{-1})
t = time (s)

Nernst Equation

$$E = E^{\theta} + (0.059/z)\log\frac{[\text{oxidised species}]}{[\text{reduced species}]}$$

E = electrode potential (v)
E^{θ} = standard electrode potential (v)
z = number of electrons transferred
[ ] = concentration (mol dm^{-3})

Electrochemistry *(feasibility)*

$\Delta G^{\theta} = -\,n\,E^{\theta}_{cell}\,F$

ΔG^{θ} = Gibbs free energy (standard)
E_{cell} = cell potential (standard)
n = number of moles
F = Faraday constant

Assorted

Atom Economy

$$\text{Atom Economy} = \frac{\text{relative formula mass of desired product}}{\text{relative formula mass of all reactants (sum of)}} \times 100$$

Percentage Yield

$$\text{Percentage Yield} = \frac{\text{actual yield}}{\text{theoretical mass}} \times 100$$

Relative Atomic Mass A_r

$$A_r = \frac{(\text{Isotope 1 mass} \times \%\ \text{abundance}) + (\text{Isotope 2 mass} \times \%\ \text{abundance})..}{\text{total}\ \%\ \text{abundance}\ (100)}$$

Dilution

$V_i C_i = V_f C_f$

V_i = initial volume
C_i = initial concentration
V_f = final volume (after dilution)
C_f = final concentration (after dilution)