

Atomic Structure

Fundamental Particles

$$\text{number of neutrons} = \text{mass number} - \text{atomic number}$$

Time of Flight Mass Spectroscopy

Relative atomic mass = (mass of isotope 1 x abundance of isotope 1) + (mass of isotope 2 x abundance of isotope 2)/100

$$E_k = \frac{1}{2}mv^2 \quad \text{where } m = \text{mass of one ion in kg, } v = \text{speed of ion in ms}^{-1}$$

$$v = d/t \quad \text{where } d = \text{distance of tube in m, } t = \text{time taken for ion to reach detector in secs}$$

Amount of Substance

$$\% \text{ atom economy} = M_r \text{ of desired product} / \text{sum of } M_r \text{ of all products} \times 100$$

$$\% \text{ yield} = \text{actual mass} / \text{theoretical mass} \times 100$$

$$\text{moles} = \text{mass} / M_r$$

$$\text{moles} = \text{concentration} \times \text{volume} / 1000 \text{ (dm}^3\text{)}$$

$$\text{moles} = \text{number of particles} / 6.02 \times 10^{23} \text{ (value in data sheet)}$$

$$PV = nRT \text{ (gases) where } v \text{ is in m}^3, T \text{ is in K and } P \text{ is in Pa, } R \text{ (in data sheet)}$$

$$\text{density} = \text{mass} / \text{volume}$$

$$\text{percentage error} = \text{uncertainty in instrument} / \text{value} \times 100$$

Energetics

$$\Delta H = \text{sum of bonds broken} - \text{sum of bonds made (mean bond enthalpies)}$$

$$Q = mc \Delta T \text{ where } m = \text{mass of water, } c = 4.18 \text{ (in data sheet) and } T \text{ is in K}$$

Equilibrium



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

Kinetics (Rates)

$$\text{Rate} = 1/\text{time}$$

$$\text{Rate} = \text{gradient of concentration-time curve}$$

Thermodynamics

$$\Delta S = (\text{sum of entropy of products}) - (\text{sum of entropy of reactants})$$

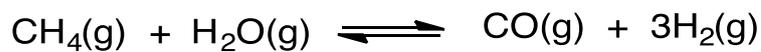
$$\Delta H = (\text{sum of enthalpy of products}) - (\text{sum of enthalpy of reactants})$$

$$\Delta G = \Delta H - T\Delta S_{\text{system}}$$

$$\text{min. temp.} = \Delta H / \Delta S_{\text{system}}$$

Equilibrium

Example:



$$K_p = \frac{p(\text{CO}) \times p(\text{H}_2)^3}{p(\text{CH}_4) \times p(\text{H}_2\text{O})}$$

Mole fraction = moles of one gas / moles of all the gases

Partial Pressure = mole fraction x total pressure

Total Pressure = sum of the partial pressures

Electrode Potentials

$$E_{\text{cell}} = E^\ominus \text{ of the more positive value} - E^\ominus \text{ of the more negative value}$$

or

$$E_{\text{cell}} = E^\ominus \text{ of the species being reduced} - E^\ominus \text{ of the species being oxidised}$$

Acids and Bases

$$\text{pH} = -\log_{10} [\text{H}^+]$$

$$[\text{H}^+] = 10^{-\text{pH}}$$

$$K_w = [\text{H}^+][\text{OH}^-] = 1 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6} \text{ (at room temp) (value in data sheet)}$$

$$K_w = [\text{H}^+]^2 \text{ (pure water)}$$

Half-equivalence point:

$$K_a = [\text{H}^+] \text{ or } \text{p}K_a = \text{pH}$$

Expression and use in buffer calculations:

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

Weak acid calculations:

$$K_a = \frac{[\text{H}^+]^2}{[\text{HA}]}$$

$$\text{p}K_a = -\log_{10} K_a$$

$$K_a = 10^{-\text{p}K_a}$$

Transition Metals

$$\Delta E = h\nu \text{ where } h = 6.63 \times 10^{-34}, \nu = \text{frequency in Hz}$$

$$c = \nu \times \lambda \text{ where } c = \text{speed of light } 3 \times 10^8 \text{ ms}^{-1}, \lambda = \text{wavelength in m}$$

Rates

For $\text{A} + \text{B} \rightarrow \text{C} + \text{D}$

$$\text{rate} = k[\text{A}][\text{B}]$$

Arrhenius:

$$k = A e^{-E_a/RT}$$

$$\ln k = \ln A - E_a/RT \quad (\text{both given in data sheet})$$

Rearranged:

$$E_a = (\ln A - \ln k) \times RT \quad \text{and} \quad T = E_a / (\ln A - \ln k) \times R$$

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