

### Number of moles

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

$n$  - number of moles [mol]

$m$  - mass [g]

$M$  - molar mass [g mol<sup>-1</sup>]

### Number of moles for gases

$$n = \frac{V}{V_m}$$

$n$  - number of moles [mol]

$V$  - volume [dm<sup>3</sup>]

$V_m$  - molar volume

Note:

$V_m = 22.4$  OR  $22.7$  dm<sup>3</sup> mol<sup>-1</sup> depending on how your curriculum defines STP (standard temperature and pressure)

$V_m = 24$  dm<sup>3</sup> mol<sup>-1</sup> at RTP (room temperature and pressure)

### Molar concentration

$$c = \frac{n}{V_{\text{solution}}}$$

$c$  - concentration [mol dm<sup>-3</sup>]

$n$  - number of moles [mol]

$V_{\text{solution}}$  - volume of solution [dm<sup>3</sup>]

### Ideal gas law

$$pV = nRT$$

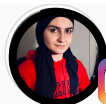
$p$  - pressure [Pa]

$V$  - volume [m<sup>3</sup>]

$n$  - number of moles [mol]

$R$  - gas constant [8.314 J mol<sup>-1</sup> K<sup>-1</sup>]

$T$  - temperature [K]



### Heat released or absorbed

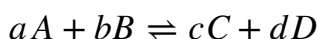
$$Q = mc\Delta T$$

$Q$  - amount of heat [J]

$c$  - specific heat capacity [for water:  $4.18 \text{ J g}^{-1} \text{ K}^{-1}$ ]

$\Delta T$  - temperature change [K or  $^{\circ}\text{C}$ ]

### The equilibrium constant $K_c$



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

[ ] - concentration at equilibrium [ $\text{mol dm}^{-3}$ ]

Note:

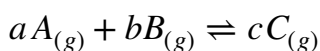
Acid dissociation constant  $K_a$  and base dissociation constant  $K_b$  can be written in the same way as  $K_c$ .

For example, dissociation constant of a weak acid:



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

### The equilibrium constant $K_p$ (for gases)



$$K_p = \frac{p(C)^c}{p(A)^a \cdot p(B)^b}$$

$p()$  - partial pressure [Pa, or kPa, or atm]

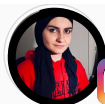
Partial pressure

$$p(A) = \chi(A) \cdot p_{total}$$

$p(A)$  - partial pressure of gas A

$\chi(A)$  - mole fraction of gas A

$p_{total}$  - total pressure



Mole fraction

$$\chi(A) = \frac{n(A)}{n_{total}}$$

$n(A)$  - number of moles of gas A

$n_{total}$  - total number of moles of gases

pH

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

$[H^+]$  - concentration of  $H^+$  ions [ $\text{mol dm}^{-3}$ ]

The amount of charge

$$Q = It$$

$Q$  - quantity of charge [C]

$I$  - current [A]

$t$  - time [s]

Nernst equation for a metal dipping into a solution of its salt

$$E = E^0 + \frac{2.3RT}{zF} \log_{10}[ion]$$

$E$  - electrode potential [V]

$E^0$  - standard electrode potential [V]

$R$  - gas constant [ $8.314 \text{ J mol}^{-1} \text{ K}^{-1}$ ]

$T$  - temperature [K]

$z$  - number of electrons involved in the reaction

$F$  - Faraday constant [ $96500 \text{ C mol}^{-1}$ ]

$[ion]$  - ion concentration [ $\text{mol dm}^{-3}$ ]

Nernst equation for a system with two ions

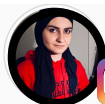
$$E = E^0 + \frac{2.3RT}{zF} \log_{10} \frac{[oxidized]}{[reduced]}$$

$E$  - electrode potential [V]

$E^0$  - standard electrode potential [V]

$R$  - gas constant [ $8.314 \text{ J mol}^{-1} \text{ K}^{-1}$ ]

$T$  - temperature [K]



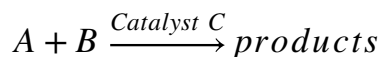
$z$  - number of electrons transferred

$F$  - Faraday constant [96500 C mol<sup>-1</sup>]

[*oxidized*] - concentration of oxidized form [mol dm<sup>-3</sup>]

[*reduced*] - concentration of reduced form [mol dm<sup>-3</sup>]

## Rate constant



$$r = k[A]^x[B]^y[C]^z$$

$r$  - reaction rate

$k$  - rate constant

[ ] - concentration [mol dm<sup>-3</sup>]

$x, y, z$  - orders of reaction with respect to A, B, C

## Entropy

$$\Delta S_{total} = \Delta S_{surr} + \Delta S_{reaction}$$

$\Delta S_{total}$  - total entropy change

$\Delta S_{surr}$  - entropy change of surroundings

$\Delta S_{reaction}$  - entropy change of reaction

$$\Delta S_{surr} = - \frac{\Delta H}{T}$$

$\Delta S_{surr}$  - entropy change of surroundings [J mol<sup>-1</sup> K<sup>-1</sup>]

$\Delta H$  - enthalpy change of reaction [J mol<sup>-1</sup>]

$T$  - temperature [K]

## Gibbs free energy

$$\Delta G = \Delta H - T\Delta S_{reaction}$$

$\Delta G$  - Gibbs free energy [J mol<sup>-1</sup>]

$\Delta S_{reaction}$  - entropy change of reaction [J mol<sup>-1</sup> K<sup>-1</sup>]

$\Delta H$  - enthalpy change of reaction [J mol<sup>-1</sup>]

$T$  - temperature [K]

