Conductance of electrolytic solution

Difference between electronic & electrolytic conductors

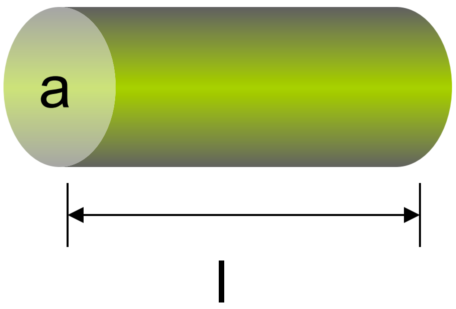
Electronic conductors	Electrolytic conductors
(1) Flow of electricity take place without the decomposition of substance.	(1)Flow of electricity takes place by the decomposition of the substance.
(2) Conduction is due to the flow of electron	(2) Flow of electricity is due to the movement of ions
(3) Conduction decreases with increase in temperature	(3) Conduction increases with increase in temperature

Resistance

Resistance refers to the opposition to the flow of current.

For a conductor of uniform cross section(a) and length(l); Resistance R,

$$R \propto l \quad \text{and} \quad R \propto \frac{l}{a} \qquad \therefore R = \rho \frac{l}{a}$$



Where ρ is called resistivity or specific resistance.

Conductance

The reciprocal of the resistance is
called conductance. It is denoted by C.

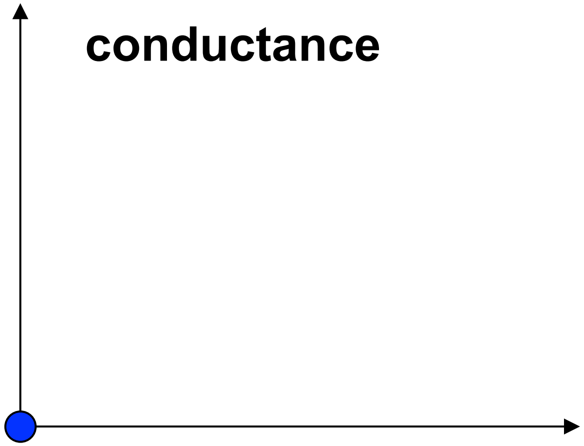
$$C=1/R$$

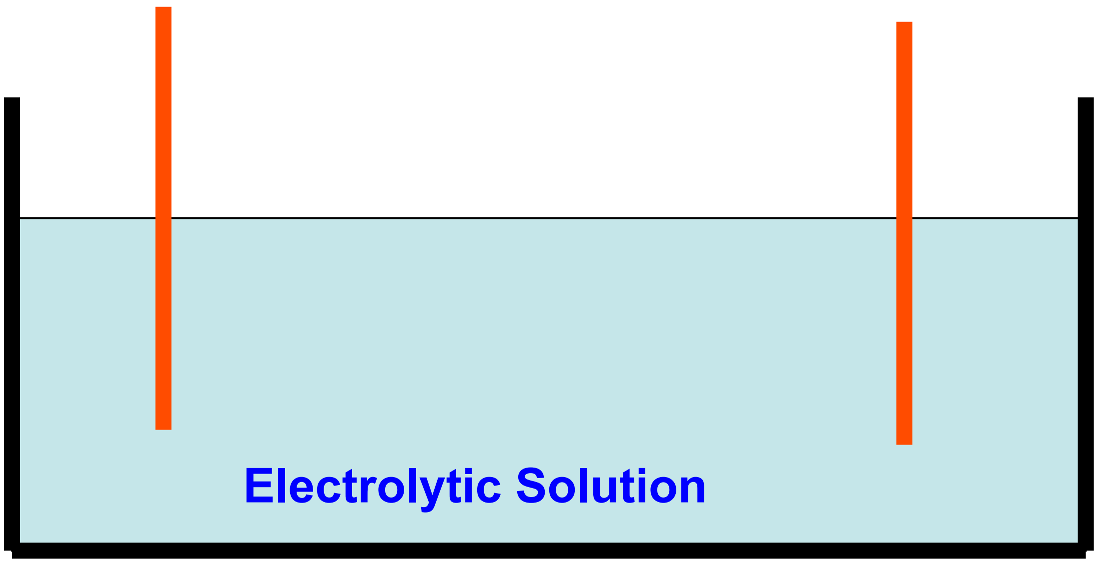
Conductors allows electric current to pass through them.
Examples are metals, aqueous solution of
acids, bases and salts etc.

Unit of conductance is ohm^{-1} or mho or Siemen(S)

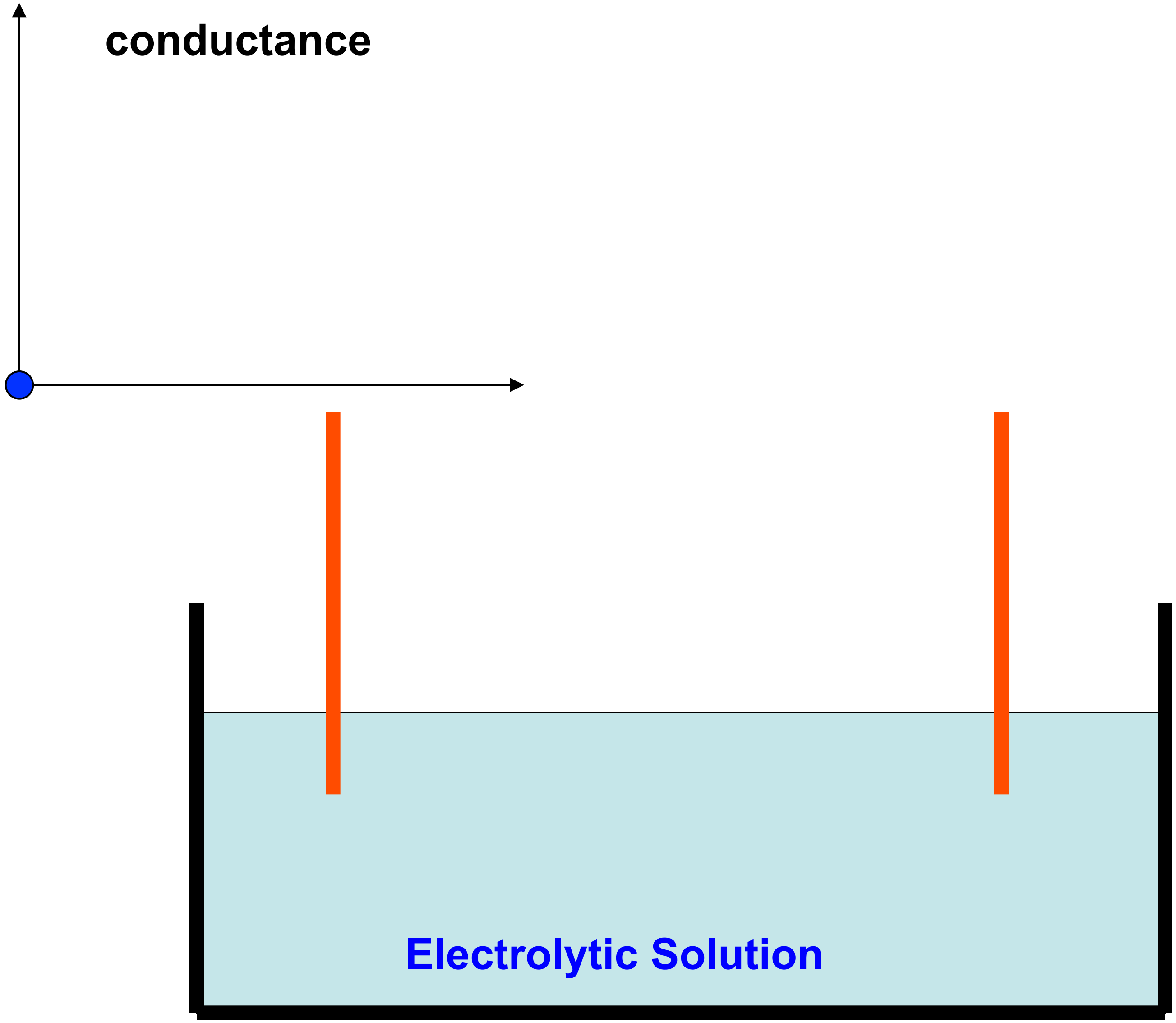
Insulators do not allow the electric current to pass through them.

Examples are pure water, urea, sugar etc.

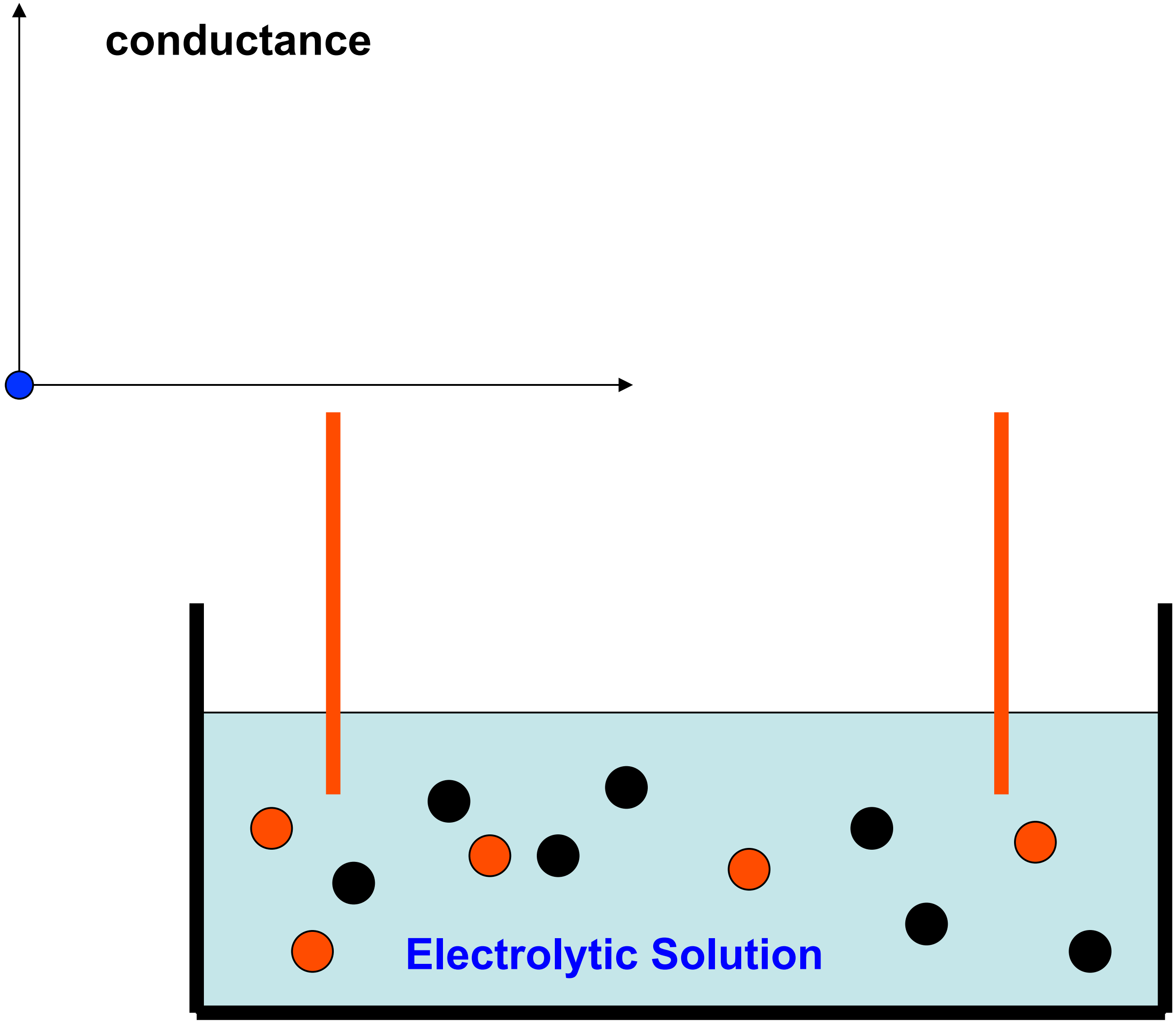




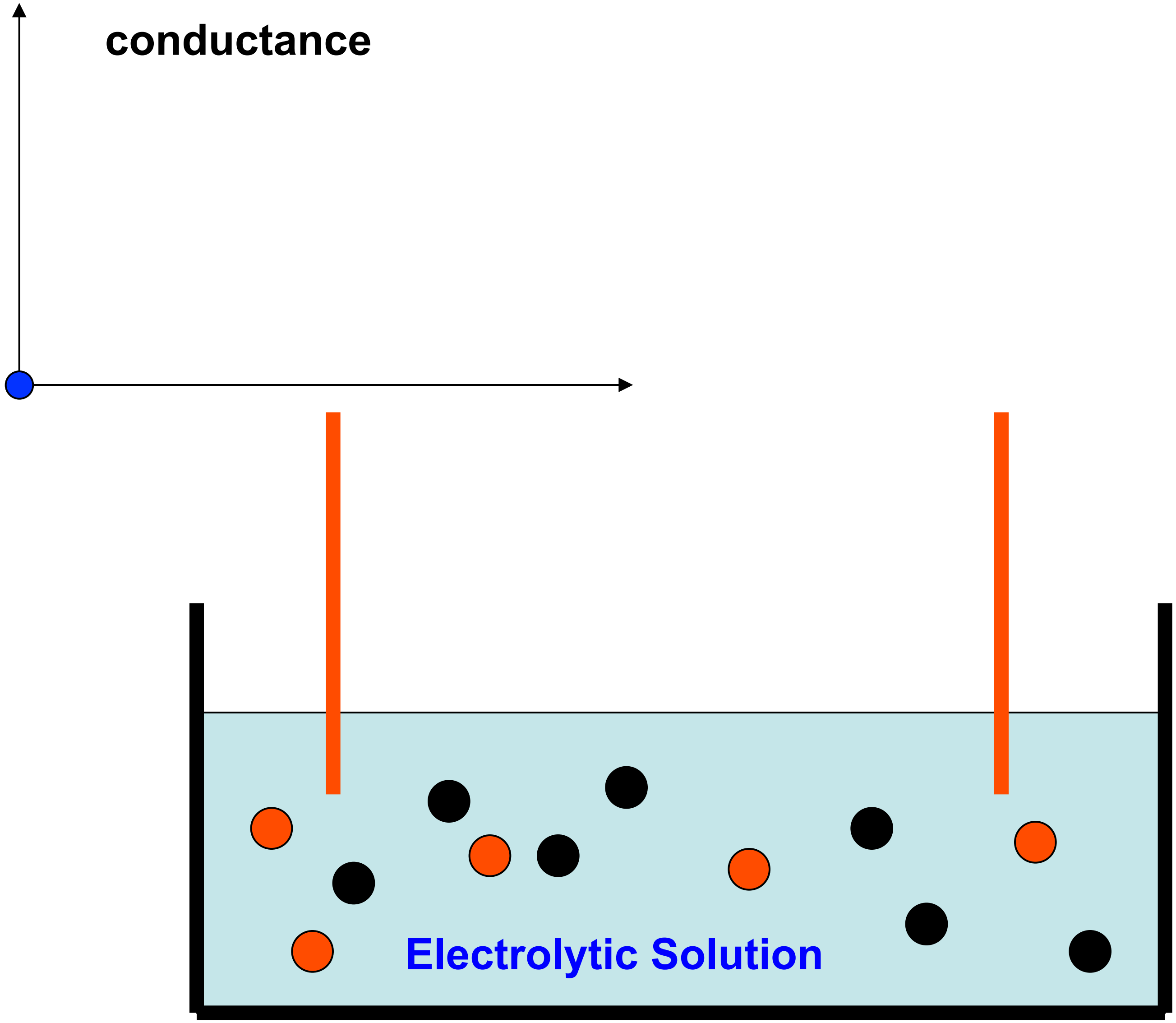
The conductivity increases with the decrease of the electrodes distance



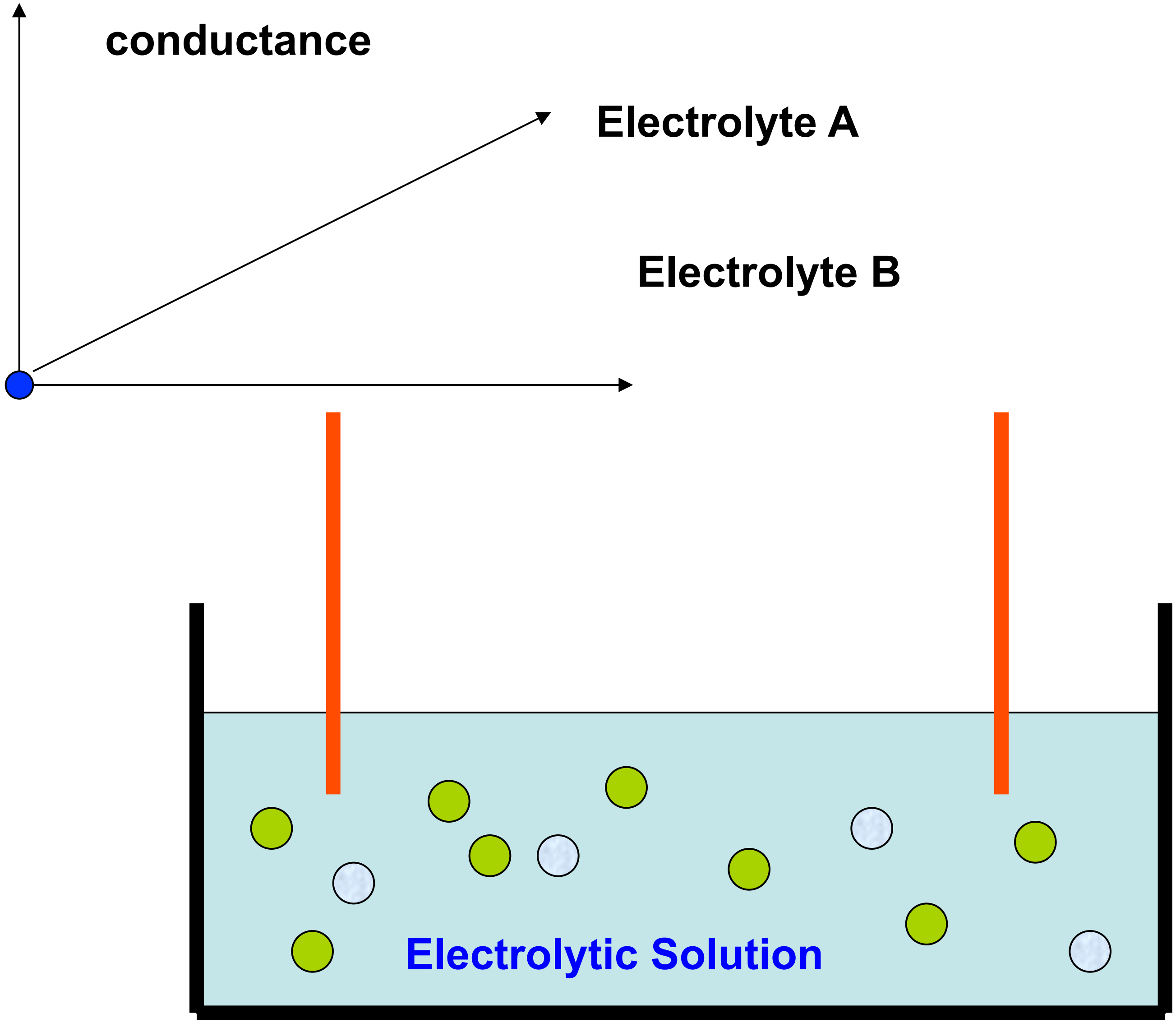
The conductivity increases with the increase of the electrodes surface



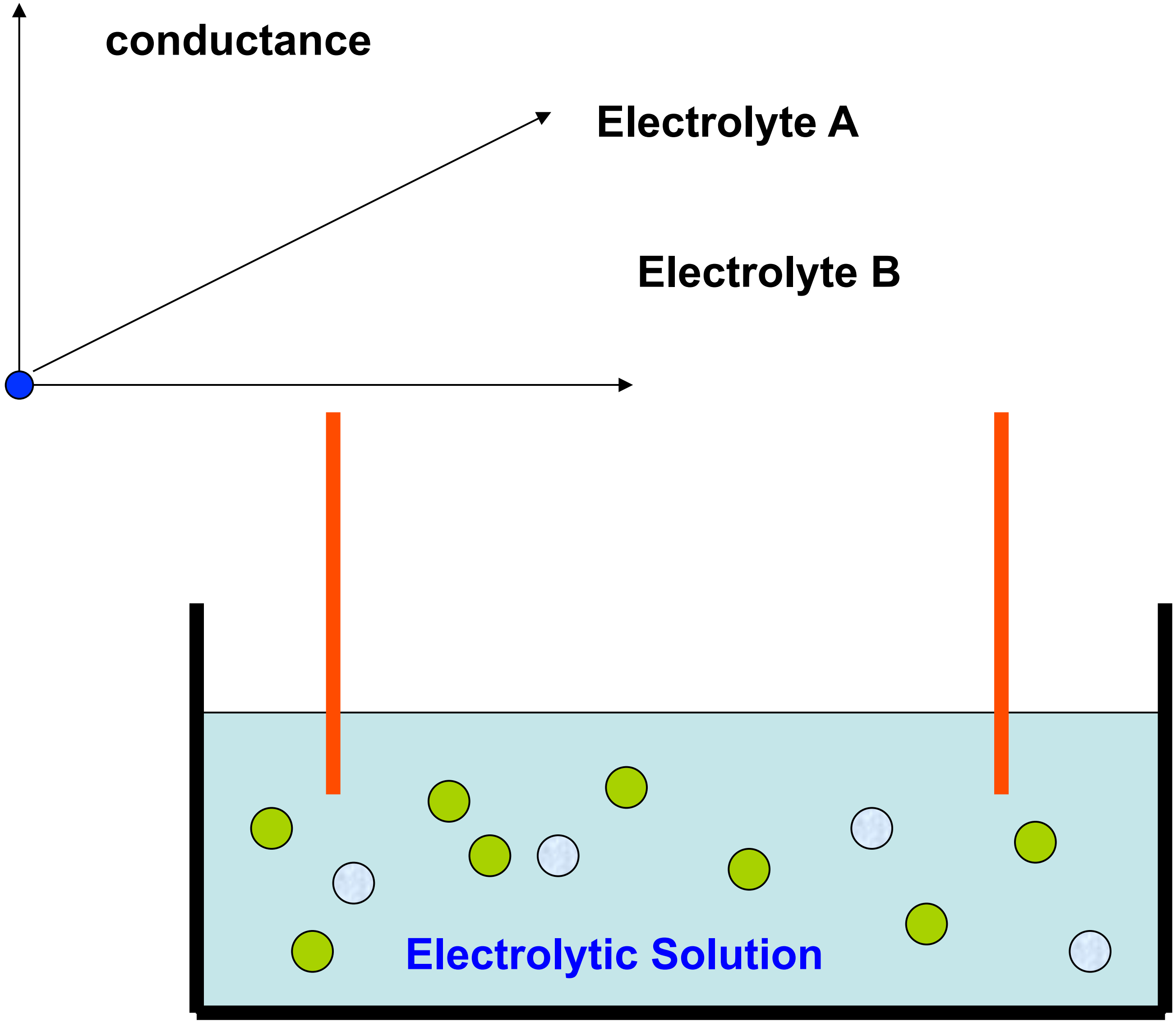
The conductivity increases with the increase of the analytes concentration



The conductivity changes with the electrolyte nature



The conductivity changes with the electrolyte nature


conductance
Electrolyte A
Electrolyte B
Electrolytic Solution

Specific Conductivity

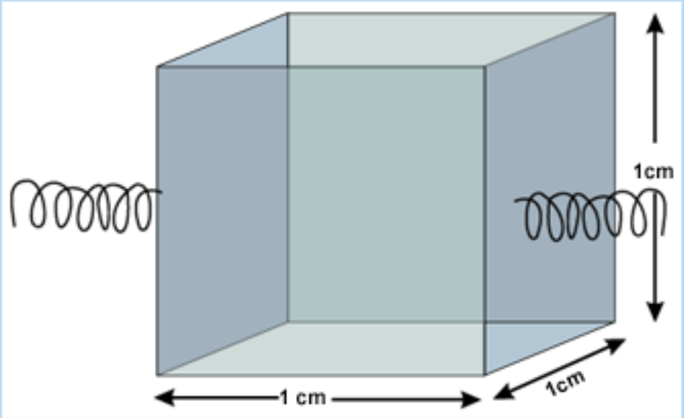
Specific conductance $\kappa = \frac{1}{\rho}$

Conductance of unit volume of cell is specific conductance.

But $\rho = \frac{a}{l} R$

$$\therefore K = \frac{l}{a.R}$$

$$K = \left(\frac{\ell}{a}\right) \text{ x Conductance}$$



Specific conductance

Unit of specific conductance is $ohm^{-1}cm^{-1}$
SI Unit of specific conductance is **Sm^{-1}** where S is Siemen

Equivalent Conductance

It is the conductance of one gram equivalent of the electrolyte dissolved in V cc of the solution.

Equivalent conductance is represented by

$$\lambda$$

Mathematically, $\lambda = k \times V$

$$\lambda = k \times \frac{1000}{\text{Normality}}$$

Where, κ = Specific conductivity

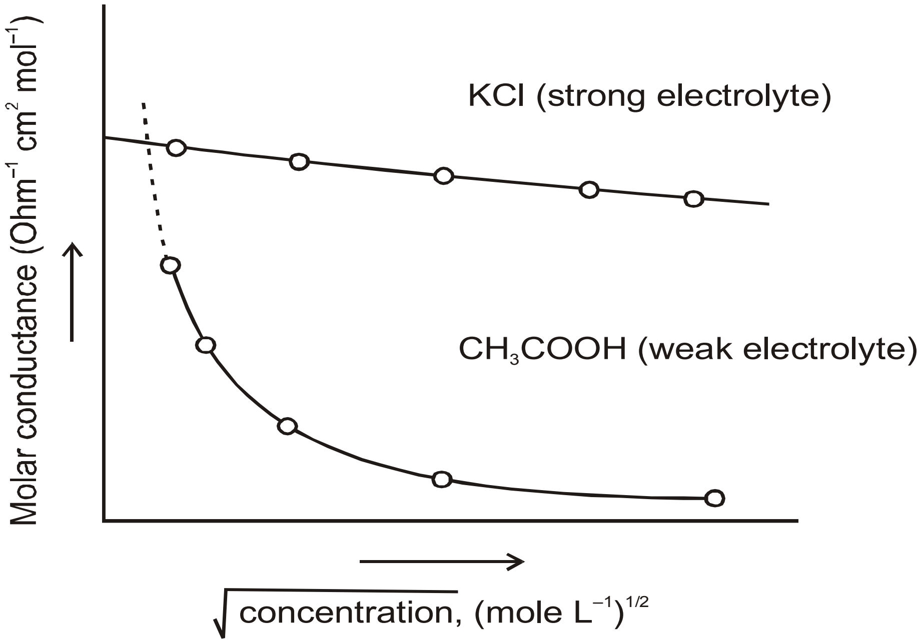
V = Volume of solution in cc. containing one gram equivalent of the electrolyte.

Effect of Dilution on Conductivity

Specific conductivity decreases on dilution.

Equivalent and molar conductance both increase with dilution and reaches a maximum value.

The conductance of all electrolytes increases with temperature.



Kohlrausch's Law

"Limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte."

$$\lambda_{\infty} = \lambda_a + \lambda_c$$

Where λ_a and λ_c are known as ionic conductance of anion and cation at infinite dilution respectively.

Legge di migrazione indipendente degli ioni (legge di Kohlrausch):

$$\Lambda^\circ = \lambda^\circ_+ + \lambda^\circ_-$$

- Λ°: *conducibilità equivalente a diluizione infinita di un elettrolita*
- λ°_+: *conducibilità equivalente a diluizione infinita del catione*
- λ°_-: *conducibilità equivalente a diluizione infinita dell'anione*

Conducibilità equivalente di alcuni ioni a 25°C (S · cm^2/eq)

cationi	λ°_+	anioni	λ°_-
H^+	*349,8*	OH^-	*198,5*
K^+	*73,5*	SO_4^{2-}	*80,0*
Al^{3+}	*63,0*	PO_4^{3-}	*80,0*
Ca^{2+}	*59,5*	Cl^-	*76,3*
Na^+	*50,1*	NO_3^-	*71,4*
Li^+	*38,7*	AcO^-	*40,9*

Spostamento di ioni H⁺ in un campo elettrico