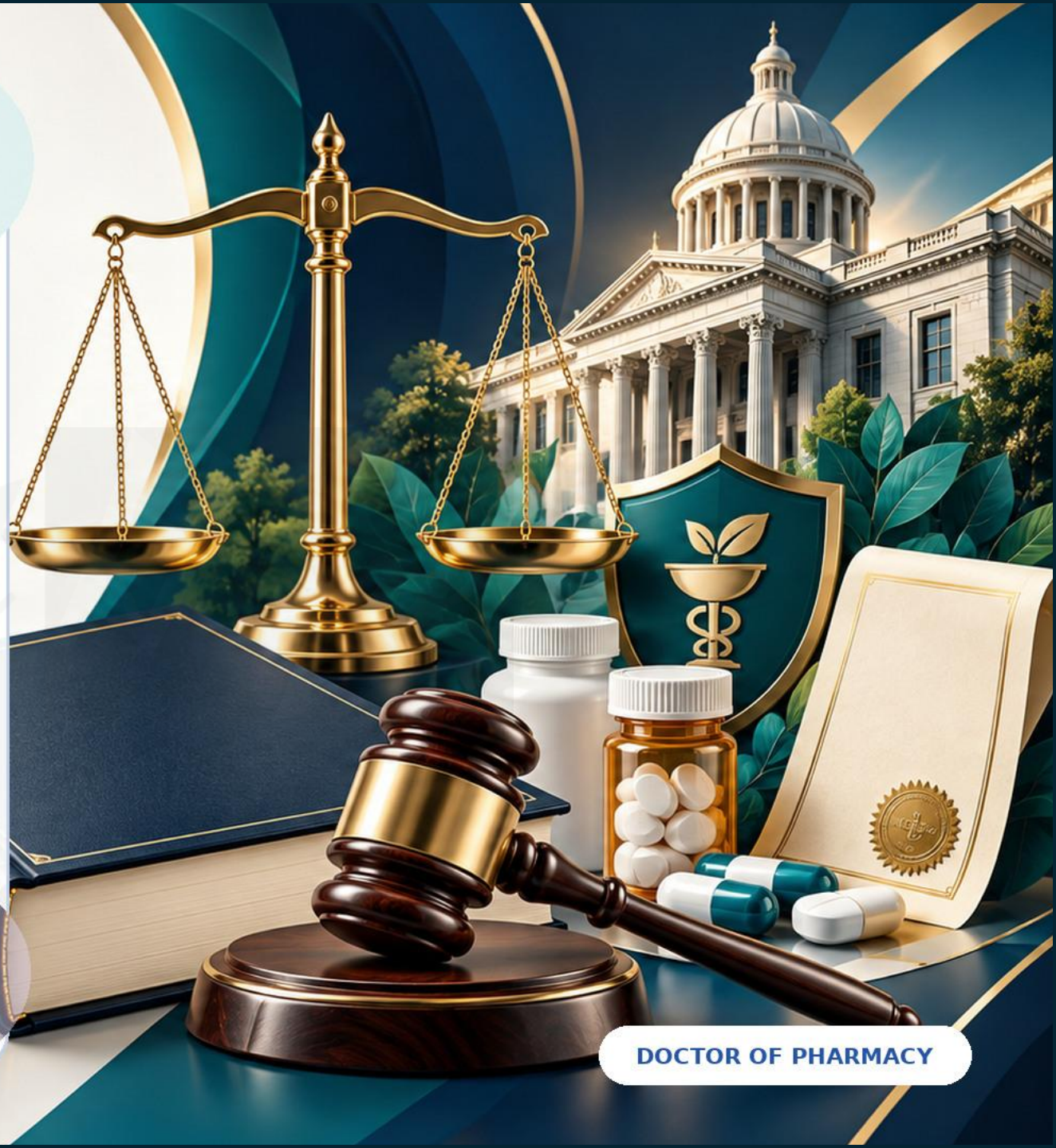
PHARM.D • YEAR 3

Pharmaceutical Analysis

CHAPTER 3.2

Conductometry

PPT CHAPTER COVER

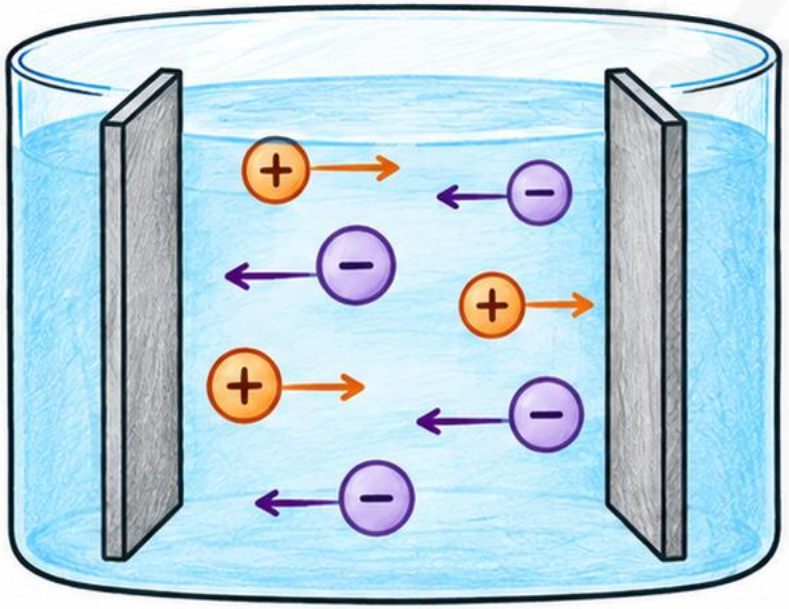


DOCTOR OF PHARMACY

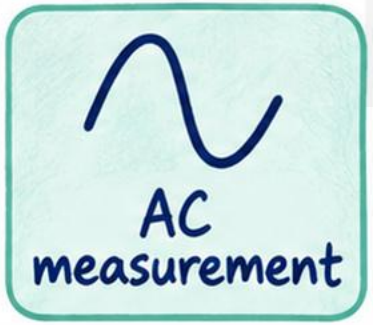
CONDUCTOMETRY: PRINCIPLE

What it Measures

- Conductometry measures a solution's ability to carry electrical current through moving ions.
- Both the number of ions and their mobilities matter.



Conductivity cell
(two separated plates)



Effect of Chemical Reactions

- Chemical reactions can change ion concentration or replace one ion with another, changing the signal.



What it Reflects

- Conductometry measures overall ionic behaviour rather than a unique individual ion.

Applications

- It supports direct conductivity measurements and suitable titrations.

Conductance, Resistance and Conductivity

Conductance and resistance

- Conductance G is the reciprocal of resistance R:

$$G = \frac{1}{R}$$

- Its unit is siemens, S.
- Conductance depends on the measuring cell.

Conductivity and cell geometry

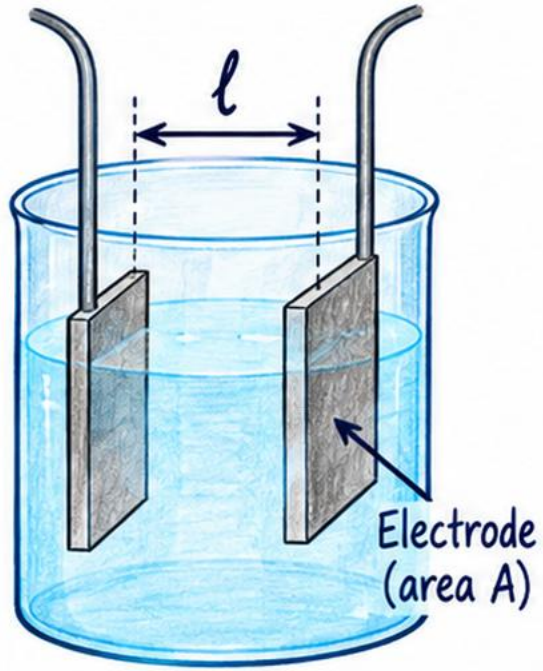
- Conductivity K corrects conductance for cell geometry:

$$K = G \times K_{cell}$$

- For ideal parallel electrodes:

$$K_{cell} = \frac{l}{A}$$

- where l is the electrode spacing and A is the electrode area.
- Conductivity units include S/m, mS/cm and µS/cm.
- Conductivity describes the solution under stated conditions.

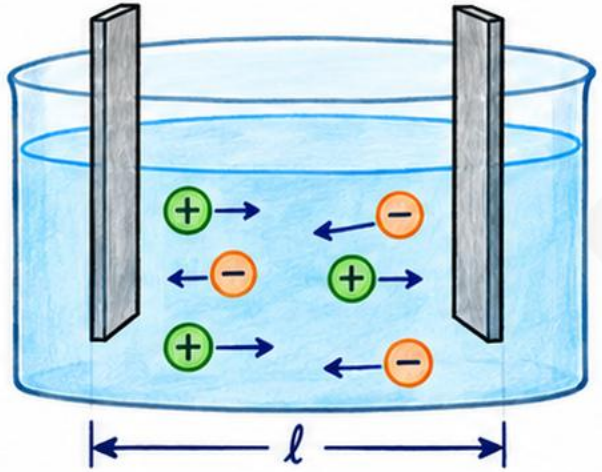


Conductivity cell
(with parallel electrodes)

MOLAR AND EQUIVALENT CONDUCTIVITY

Conductivity (κ)

Conductivity (κ) is the ability of a solution to conduct electric current.



Cell constant (cell factor)

$$K_{cell} = \frac{\ell}{A}$$

ℓ = distance between electrodes
A = electrode area

Conductance (G) and resistance (R) are related by $G = \frac{1}{R}$

Conductivity is obtained from

$$\kappa = K_{cell} \times G$$

Molar conductivity (Λm)

Molar conductivity is conductivity divided by molar concentration.

$$\Lambda_m = \frac{\kappa}{c}$$

In SI units, $\Lambda_m = \frac{\kappa}{c}$ gives

$$\frac{S \cdot m^2}{mol}$$

when κ is S/m and c is mol/m³.

For κ in S/cm and c in mol/L,

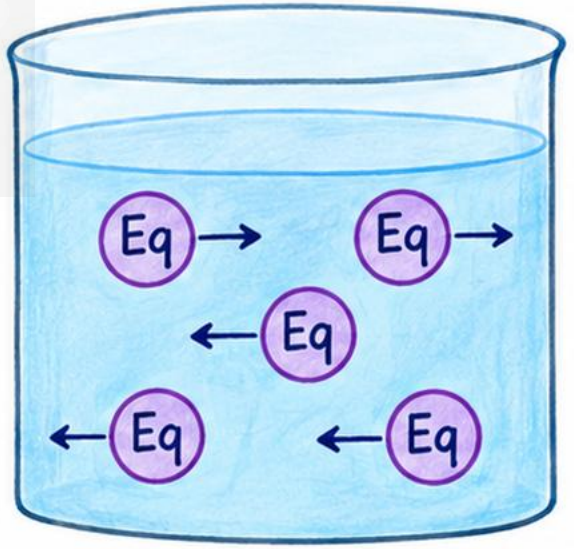
$$\Lambda_m = \frac{1000\ \kappa}{c}$$

in $\frac{S \cdot cm^2}{mol}$

Equivalent conductivity (Λeq)

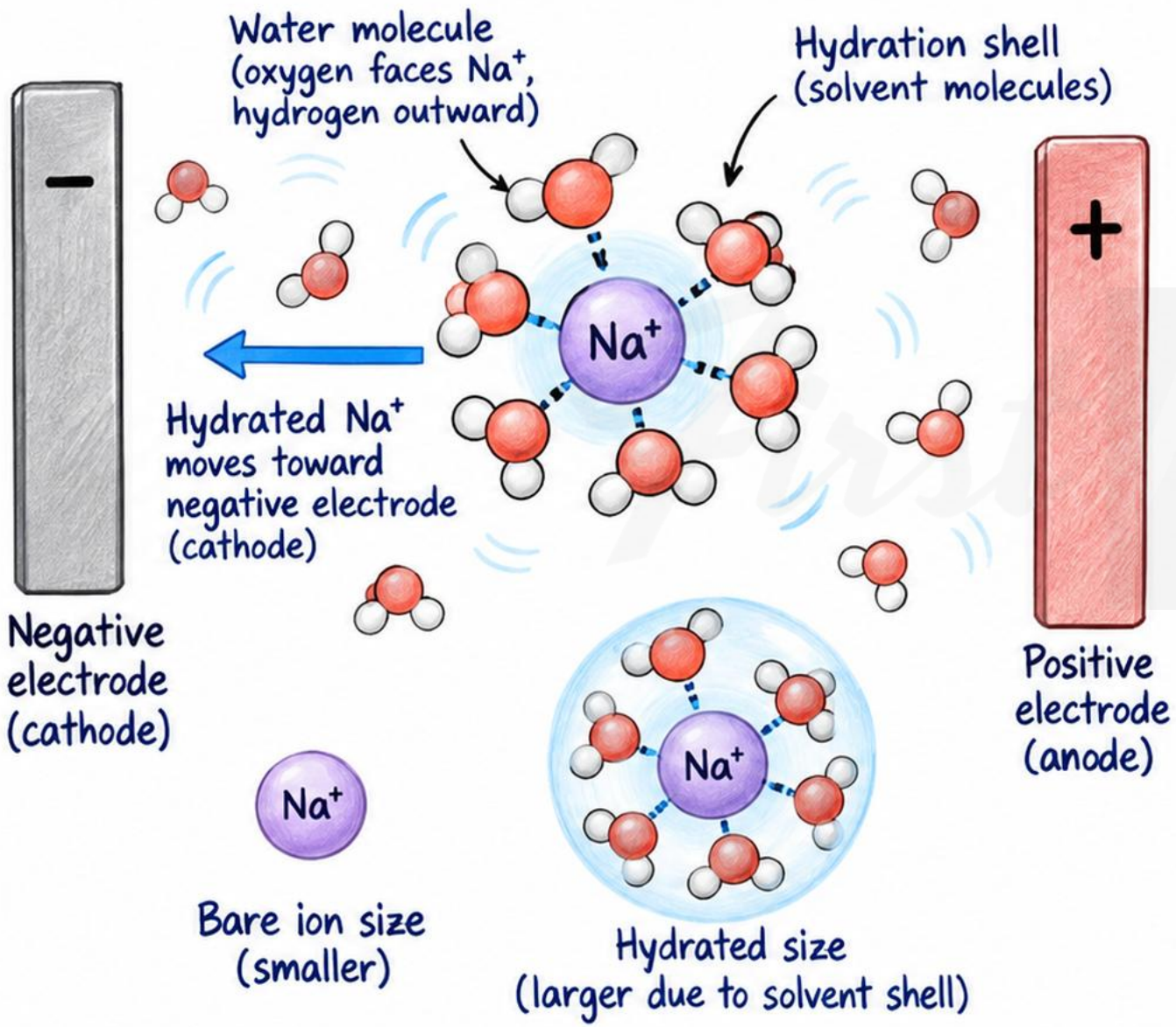
Equivalent conductivity uses concentration in equivalents/L instead of mol/L.

The reaction-dependent equivalent basis must be stated.



Concentration in equivalents/L

Ion Mobility and Solution Effects



Key Points

- Ion charge, size, hydration and solvent properties influence mobility.
- Highly hydrated ions may move more slowly than their bare size suggests.
- Cations and anions contribute differently to total conductivity.
- Temperature changes mobility and usually increases aqueous conductivity as it rises.
- Electrolyte dissociation and ion-ion interactions also matter, so concentration alone does not fully predict the signal.

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