Mohamed Khider University of Biskra **Academic Year 2025–2026**
Faculty of Medicine
1st Year Medicine

Series of Tutorials 2
Diffusion, Osmosis ,Surface tension and Medical Applications

Exercise 1: (Qcs)

1. **Osmosis** is:
   a. The movement of solute from the more concentrated medium (hypertonic) to the less concentrated medium (hypotonic).
   b. The movement of water through a semipermeable membrane from the less concentrated medium (hypotonic) to the more concentrated medium (hypertonic).
   c. None of the answers are correct.
2. **Diffusion** is:
   a. The movement of water from the less concentrated medium (hypotonic) to the more concentrated medium (hypertonic).
   b. The movement of solute from the more concentrated medium (hypertonic) to the less concentrated medium (hypotonic).
   c. None of the answers are correct.
3. A **semipermeable membrane** is:
   a. A membrane that allows only the solvent to pass through, but not the solutes.
   b. A membrane that allows only the solutes to pass through, but not the solvent.
   c. None of the answers are correct.
4. A **partially permeable (semi-permeable)** membrane is:
   a. A membrane that allows the solvent and a fraction of the solutes to pass through.
   b. A membrane that allows both solvent and solutes to pass through freely.
   c. None of the answers are correct.
5. **In the electrostatic model**:
   a. Molecules are represented by a set of point charges.

b. Only neutral molecules are present.
c. Only macromolecules are present.
d. None of the proposed answers are correct.

6. The **First Law of Fick**:
   a. Describes the flow (flux) of matter as a function of certain parameters.
   b. States that the molecular flux does not depend on the concentration gradient.
   c. None of the answers are correct.
7. **In the electrophoresis technique**:
   a. Neutral molecules move toward both poles.
   b. A charged particle is subjected to an electromagnetic force.
   c. The equilibrium of the particle moves at a constant speed.
   d. None of the proposed answers are correct.
8. **The Donnan equilibrium**:
   a. Occurs when two macromolecular solutions are separated by a permeable (dialyzing) membrane.
   b. Involves a protein salt (proteinate) that acts as a negatively charged macro-ion.
   c. Results from an equilibrium that does not take into account the electrical neutrality of solutions.
   d. Explains the transport of macromolecules across capillary membranes in the blood.
9. **In Fick's Law, the mass flow of the diffusing substance:**
   a. Requires a concentration gradient (mol/m^3) in the SI system.
   b. Is proportional to the molarity gradient.
   c. Is inversely proportional to the membrane surface area.
   d. None of the proposed answers are correct.
10. **Raoult's laws, which are part of the colligative (not electrical) properties, apply only to:**
    a. Micromolecular solutions.
    b. Colloids.
    c. Macromolecular solutions.
    d. None of the proposed answers are correct.
11. A **strong electrolyte** is:
    a. An electrolyte that dissociates completely in water, such as NaOH, NaCl, or HCl.
    b. An electrolyte that dissociates partially, so its solution contains ions, solute molecules, and solvent molecules.
    c. None of the answers are correct.

12. A **weak electrolyte** is:
    a. An electrolyte that dissociates completely in water, such as NaOH, NaCl, or HCl.
    b. An electrolyte that dissociates partially, such as CH_3COOH or HCOOH, so the solution contains ions, solute molecules, and solvent molecules.
    c. None of the answers are correct.
13. **The types of movement in a solution are:**
    a. Migration, convection, and diffusion.
    b. Migration and diffusion.
    c. Diffusion only.
    d. None of the answers are correct.

Exercise 2:

Calculate the freezing point depression (cryoscopic lowering) **of** decimolar (0.1 M) solutions of glucose and sodium chloride.

Exercise 3:

A solution of hemoglobin with a concentration of 3×10^{-4} mol/L, a membrane with a surface area, S=600 mm^2 until the concentration decreases to 7×10^{-5} mol/L

Given:

Dhemoglobin=6.9×10^{-7} g/s, M=68 kg/mol .

Determine the mass of hemoglobin (in micrograms) that diffused over a distance of **2cm** during **5 minutes**.

Exercise 4:

1. Calculate (in atmospheres) the osmotic pressure of a NaCl solution with a concentration of 9 g/L at 25°C,
   knowing that M(NaCl)=58.5 g/
2. **Calculate (in pascals)** the osmotic pressure of a glucose solution prepared by dissolving 700 mg of glucose (M = 180 g/mol) in 25 mL of water at 20°C.
   (Given: R=8.31 J/mol.K)

Exercise 5:

We dissolve **9 g of urea (CH_4N_2O)** in **200 mL of water**.
a. Calculate the **osmotic pressure** of this solution at **20°C**.

We also prepare a solution of 4.5 g of NaCl in 0.5 L of distilled water.
b. Calculate the osmotic pressure of this solution at the same temperature.

Exercise 6:

A soap bubble of radius, r=2 cm is formed in air, the surface tension of the soap film is $\gamma=2.5\times10^{-2}$ N/m.

1. Using **Pascal's Law**, determine the **difference in pressure** between the inside and the outside of the bubble.
2. Compare this with the case of an **air bubble in water** of the same radius, where the surface tension of water is $\gamma=7.2\times10^{-2}$ N/m.

Exercise 7:

Considering only the effect of gravity: Given distance from head to heart = 45 cm, distance from heart to feet = 130 cm. The mean arterial pressure is:

a .at the level of the feet: 29 kPa
b. at the level of the feet: 27 kPa (26.98)
c. at the level of the head: 20 kPa
d. at the level of the head: 120 mmHg
e. for a person lying down: 192.52 mmHg

Exercise 8:

At a depth of 30 m in the sea:
- Calculate the pressure inside an air bubble of radius 15 µm.
Given: atmospheric pressure $P_0= 10^5$ Pa, water surface tension $\gamma=0.075$ N.m^{-1}.

Exercise 9:

Calculate the surface tension of a soap bubble of radius 10 cm, knowing that the pressure difference between the inside and the outside of the bubble is 1 Pa.