

MDS Exam Problem (ECE201)

- (1) Phosphate buffered saline (PBS) is a buffer solution commonly used in biological research. It is a water-based salt solution containing sodium phosphate, sodium chloride and, in some formulations, potassium chloride and potassium phosphate. The osmolarity and ion concentrations of the solutions match those of the human body (isotonic).

The most common composition of PBS (1X) has the following components:

Salt	Concentration (mmol/L) or (mM)
NaCl	137
KCl	2.7
Na ₂ HPO ₄	10
KH ₂ PO ₄	1.8

The above buffer solution may give the approximate ionic concentration of 10 mM HPO₄⁻², 157 mM Na⁺, 4.5mM K⁺, and 139.7mM Cl⁻.

- Calculate the ionic strength of the buffer.
- Calculate the Debye length for 1X (undiluted) PBS and PBS that is 10 times diluted by deionized water.
- Assuming a quantum dot (10nm diameter) with a surface charge density of -10^{-7} C/cm² is in the 1X PBS buffer, find the potential at the surface of the particle and at 1nm from the surface of the gold nanoparticle.
- Answer (b) assuming the same quantum dot is in 10 times diluted PBS.
- Discuss in which buffer (1X PBS or 10-times diluted PBS) there is a greater chance for quantum dots to form aggregates.