

# Derivation of the Equation Nernst-Aibassov in a Magnetic Field

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**Abstract:** The influence of magnetic field on the redox potentials of the Nernst equation. The author offered the new formula Nernst equation in a magnetic field. Our proposed formula takes into account the influence of the magnetic field on the redox processes.

Key words: Nernst equation, magnetic field, redox processes.

### **1. Introduction**

At present, the rapid development of science and technology and equipment allows us to look at the classical equations with new perspectives.

The actual problem is the question of how to lead the Nernst equation in the presence of a strong magnetic field. Addressing these issues is scientific and practical value.

The purpose of the work is to consider how to behave in the Nernst equation under the action of a magnetic field.

## 2. Theory

Nernst equation—an equation that relates the redox potential of the system with active substances included in the electrochemical equations, and standard electrode potentials of redox couples under the influence of a magnetic field [1-7].

#### 2.1 Conclusion Nernst Equation

Nernst studied the behavior of electrolytes by passing an electric current and discovered the law. The law establishes the relationship between the electromotive force (potential difference) and ion concentration. As known, Nernst equation to predict the maximum operating potential, which may be prepared by the electrochemical interaction. Thus, this law relates to the thermodynamics of electrochemical theory in solving problems related to very dilute solutions.

$$E = E^0 + RT/nF \ln a_{Ox}/a_{Red}$$
(1)

where, *E*—electrode potential;  $E^0$ —standard electrode potential, V; *R*—universal gas constant equal, 8.31 J/(mol·K); *T*—absolute temperature, K; *F*—Faraday constant, 96,485.35 mol<sup>-1</sup>; *n*—the number of electrons involved in the process;  $a_{Ox}$  and  $a_{Re}$ —activity respectively oxidized and reduced forms of the substances involved in the half reaction.

If the Nernst formula to substitute the numerical values of the constants R and F, and go from natural logarithms to decimal, when T = 298 K we obtain:

$$E = E^0 + 0.0592/n \, lg \, a_{Ox}/a_{Red} \tag{2}$$

# 3. Results and Discussion

To display the Nernst equation in a magnetic field is necessary to consider the Lorentz force.

Lorentz force—the force with which the electromagnetic field according to the classical (non-quantum) electrodynamics operates on a point charge. Lorentz force called the force acting on moving with velocity v charge q only by the electromagnetic

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field of the electric *E* and magnetic *B* fields.

$$F = q \left( E + \left[ v \, x B \right] \right) \tag{3}$$

The direction of the Lorentz force and the direction of its deviation caused by a charged particle in a magnetic field depend on the sign of the charge Q of the particle. The authors assume that the magnetic field is uniform and the particle electric fields do not work. If a charged particle moves in a magnetic field with velocity v along the lines of magnetic induction, the angle *a* between the vectors *v* and *B* is 0 or p. Then the formula (3) the Lorentz force is equal to zero, i.e. The magnetic field on the particle does not work and it is moving uniformly and rectilinearly.

If a charged particle moves in a magnetic field with the velocity v, perpendicular to the vector B, the Lorentz force F = Q [vB] is constant in magnitude and normal to the trajectory of the particle. According to second Newton's law, this force creates a centripetal acceleration. Hence it follows that the particle will move in a circle, the radius r is determined from the condition QvB = 2mv/r. where, the radius r,

$$r = m/Q \ v/B \tag{4}$$

The period of rotation of the particle, i.e. The time T for which it makes one complete revolution,

$$T = 2\pi r/v$$

Substituting the expression (3), the authors obtain

$$T = 2\pi/B \ m/Q \tag{5}$$

the period of rotation of a particle in a uniform magnetic field is determined only by the reciprocal of the specific charge (Q/m) particles and the magnetic induction field, but does not depend on its velocity (when v << c). This is the basis of cyclic action of charged particle accelerators [8-11].

Thus, the Nernst equation in a magnetic field will be expressed by the Eqs. (6) or (7):

$$E = E^{0} + RT/nF \ln a_{Ox}/a_{Red} + 1/4\pi H dB \quad (6)$$

or

$$E = E^{0} + 0.0592/n \, lg \, a_{Ox}/a_{Red} + 1/4\pi \, H \, dB \quad (7)$$

# 4. Conclusions

The authors offered the new formula Nernst equation in a magnetic field. The proposed formula takes into account the influence of the magnetic field on the redox processes. The authors first discovered that the Nernst Equation in a magnetic field will be of the form:

 $E = E^{0} + 0.0592/n \, lg \, a_{Ox}/a_{Red} + 1/4\pi \, H \, dB$ 

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