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ELECTROMOTIVE FORCE AND CONCEPTS OF ELECTRIC POTENTIAL DROP

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SUMMARY

1. *Introduction*

MANY obscurities can be avoided by clear definitions as follows:

1.1. *Single concepts*

1.1.1. Electrostatic, resulting from space charges = electric in a restricted sense (r.s.).

1.1.2. Non-electrostatic = electromotive.

1.2. *Collective concepts*

1.2.1. Electrochemical, concerning an electrode, a cell.

1.2.2. Electric in a wider sense (w.s.), concerning an induction loop.

2. *Applications to a galvanic cell* 1/2/3/4/1′

2.1. *Single concepts*

2.1.1. Electrostatic = electric (r.s.): electric potential drop of the cell or cell voltage $U_{1,\,1'}$ between the terminals 1 and 1′ of the cell.

2.1.2. Non-electrostatic: chemical affinity $A_\zeta = -\Sigma\nu_i.\mu_i$ of the cell reaction ζ. Electromotive force $E_e = A_\zeta/(z.F)$.

2.2. *Collective concepts*

2.2.1. Electrochemical potential of an ion i: $\tilde{\mu}_i = \mu_i + z_i.F.\varphi$.

2.2.2. Electrochemical affinity of the cell reaction: $\tilde{A}_\zeta = -\Sigma\nu_i.\tilde{\mu}_i$. Under equilibrium conditions for a cell on open circuit:

$$\tilde{A} = 0;\ U_{1,\,1'\,rev.} = -E_e = -A_\zeta/(z.F)$$

3. *Applications to an induction loop, adjacent terminals* 1, 2

3.1. *Single concepts*

3.1.1. Electrostatic = electric (r.s.); electric potential drop = voltage between the terminals: $U_{1,\,2}$.

3.1.2. Non-electrostatic: induced electromotive force: $E_{ind} = -d\varphi/dt$.

3.2. *Collective concepts*

3.2.1. Electric (w.s.): $E_w = E_{ind} + U_{1,2}$. Under equilibrium conditions for an induction loop open between the terminals 1 and 2

$$E_w = 0;\ U_{1,2} = -E_{ind} = d\varphi/dt.$$

At closed circuit of the induction loop

$$U_{1,2} = 0;\ E_w = E_{ind} = -d\varphi/dt;\ J = E_{ind}R.$$

4. *Complications concerning Volta potential drops*

The Volta potential drop (=contact potential) *in vacuo* or in air between the terminals 1 and 1′ of a galvanic cell (or between the terminals 1 and 2 of an induction loop) are distinguished from the values of the potential drop (=cell voltage) of the cell $U_{1,1'}$ (or between the open induction loop $U_{1,2}$) because of the surface potentials of the two terminals.