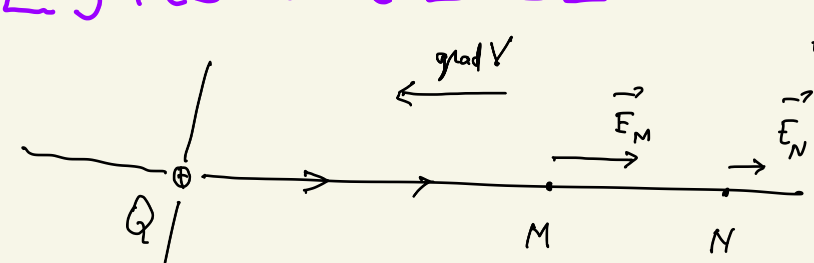
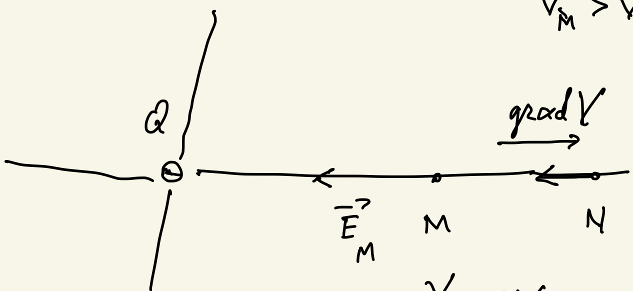
23 Februarie 2022

$\vec{E} = -\operatorname{grad} V$



$V_M = \frac{kQ}{r_M}$ $\qquad V_N = \frac{kQ}{r_N}$

$V_M > V_N$



$V_M < V_N$

$r_M < r_N$

$\frac{1}{r_M} > \frac{1}{r_N}$

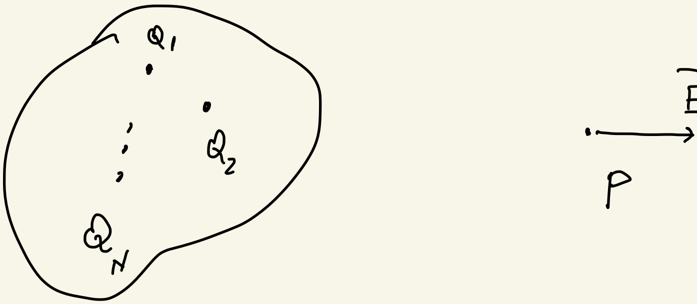
$\frac{k}{r_M} > \frac{k}{r_N}$

$\frac{kQ}{r_M} < \frac{kQ}{r_N}$; $Q < 0$

$V_M < V_N$

De-a lungul unei linii de câmp potențialul electric scade în sensul liniei de câmp.

Câmpul și potențialul create de o distribuție arbitrară de sarcină



$$\vec{E}_P = \vec{E}_{1P} + \vec{E}_{2P} + \dots + \vec{E}_{NP}$$

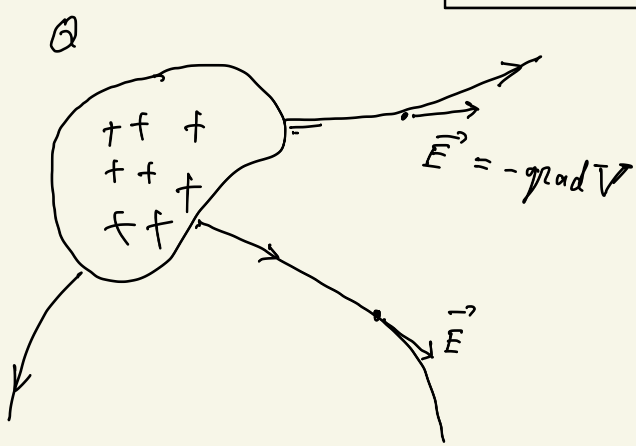
$$= -\text{grad}\, V_{1P} - \text{grad}\, V_{2P} - \dots - \text{grad}\, V_{NP}$$

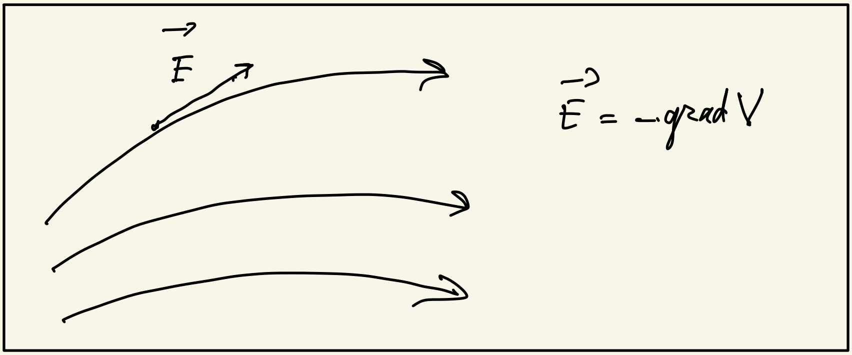
$$= -\text{grad}\left(V_{1P} + V_{2P} + \dots + V_{NP}\right)$$

$$= -\text{grad}\, V_P$$

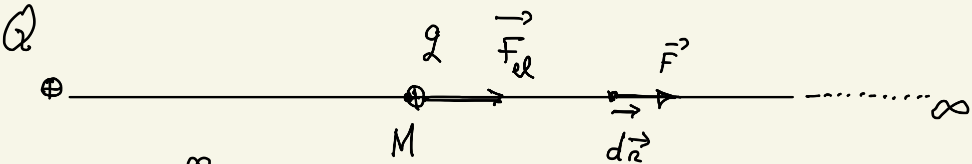
$$V_P = \sum_{i=1}^{N} V_{iP}$$

$$\boxed{\vec{E}_P = -\text{grad}\, V_P}$$



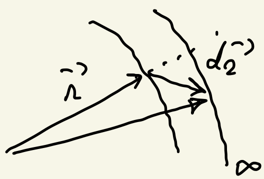


Interpretarea fizică a potențialului electric



$$L^{(M\infty)}_{\vec F_{el}} = \int_M^\infty \vec F_{el}\cdot d\vec r = \int_M^\infty \frac{kQq}{r^3}\,\vec r\, d\vec r = kQq\int_M^\infty \frac{\vec r\, d\vec r}{r^3}$$

$$\vec r\, d\vec r = |\vec r|\cdot|d\vec r|\cdot\cos 0 = r\,dr$$

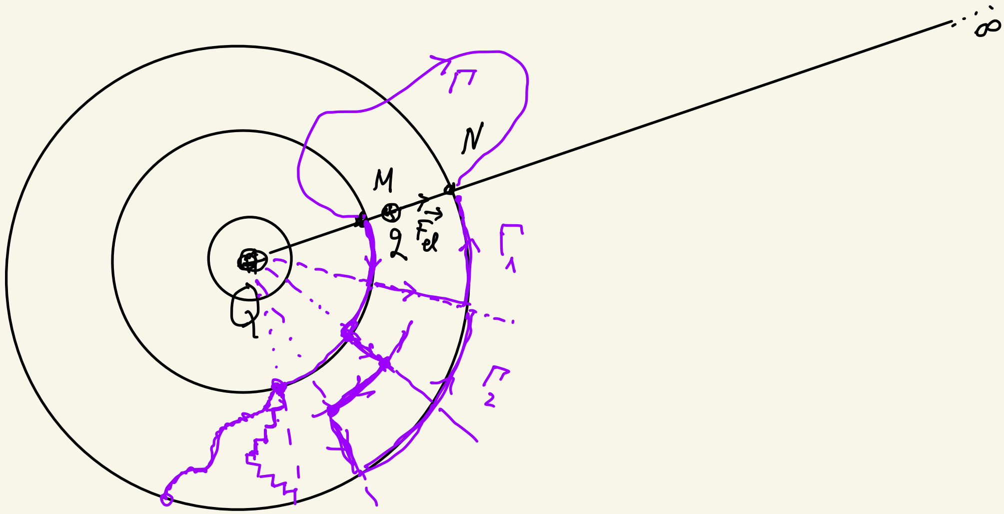


$$L^{(M\infty)}_{\vec F_{el}} = kQq\cdot\int_{r_M}^\infty \frac{r\,dr}{r^3} = kQq\int_{r_M}^\infty \frac{dr}{r^2} = kQq\left(-\frac{1}{r}\right)\Big|_{r_M}^\infty$$

$$= kQq\left(0-\left(-\frac{1}{r_M}\right)\right) = \frac{kQq}{r_M}$$

$$\frac{L_{\vec{F}_{el}}^{(M\infty)}}{q} = \frac{kQ}{r_M} = V_M$$

$$\boxed{V_M = \frac{L_{\vec{F}_e}^{(M\infty)}}{q}}$$



$$L_{\vec{F}_e}^{(MN)} = \int_{r_M}^{r_N} \vec{F}_{el}\cdot d\vec{r} = \int_{r_M}^{\infty} \vec{F}_{el}\, d\vec{r} + \int_{\infty}^{r_N} \vec{F}_{el}\, d\vec{r} = \int_{r_M}^{\infty} \vec{F}_{el}\, d\vec{r} - \int_{r_N}^{\infty} \vec{F}_{el}\, d\vec{r}$$

$$= qV_M - qV_N = q(V_M - V_N)$$

$$\frac{L_{\vec{F}_e}^{(MN)}}{q} = V_M - V_N = U_{MN}$$ ← tensiune electrostatică între punctele M și N.

$$U_{MN} = V_M - V_N \qquad U_{12} = V_1 - V_2$$

$$U_{AB} = V_A - V_B$$

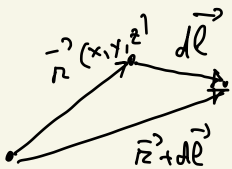
$$\boxed{L_{\vec{F_e}}^{(MN)} = L_{\vec{F_e}}^{(\Gamma)} = \ldots = L_{\vec{F_e}}^{(\Gamma')}}$$

← forța electrică de natură coulombiană are caracter conservativ.

Obs.

$V(x,y,z)$

$$\begin{cases} dV = \frac{\partial V}{\partial x} dx + \frac{\partial V}{\partial y} dy + \frac{\partial V}{\partial z} dz \\ \operatorname{grad} V = + \frac{\partial V}{\partial x} \vec{i} + \frac{\partial V}{\partial y} \vec{j} + \frac{\partial V}{\partial z} \vec{k} \\ \vec{E} = -\operatorname{grad} V \\ d\vec{l} = \vec{i} dx + \vec{j} dy + \vec{k} dz. \end{cases}$$



$$\vec{r} = \vec{i} x + \vec{j} y + \vec{k} z$$
$$\vec{r} + d\vec{l} = (x+dx)\vec{i} + \vec{j}(y+dy) + \vec{k}(z+dz)$$
$$d\vec{l} = dx\,\vec{i} + dy\,\vec{j} + dz\,\vec{k}$$

$$(\operatorname{grad} V) \cdot d\vec{l} = \left(+ \frac{\partial V}{\partial x} \vec{i} + \frac{\partial V}{\partial y} \vec{j} + \frac{\partial V}{\partial z} \vec{k} \right)\left(\vec{i} dx + \vec{j} dy + \vec{k} dz \right)$$

$$= + \frac{\partial V}{\partial x} dx + \frac{\partial V}{\partial y} dy + \frac{\partial V}{\partial z} dz =$$

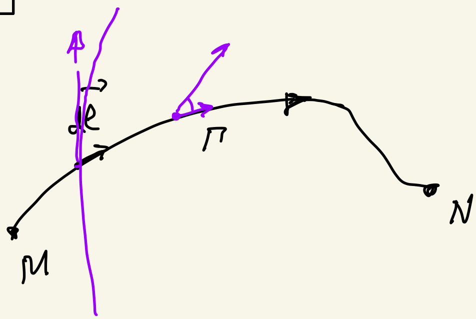
$$= + dV$$

$$\boxed{(\operatorname{grad} V)\, d\vec{l} = + dV}$$

$$-\vec{E}\, d\vec{l} = + dV$$

$$dV = -\vec{E}\, d\vec{l}$$

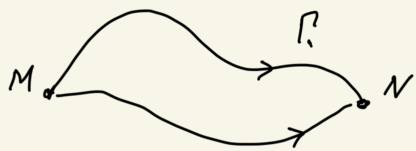
$$\int_M^N dV = -\int_M^N \vec{E}\, d\vec{l}$$



$$V\Big|_M^N = -\int_\Gamma \vec{E}\, d\vec{l}$$

$$V_N - V_M = -\int_\Gamma \vec{E}\, d\vec{l} \quad (-1)$$

$$\boxed{V_M - V_N = \int_\Gamma \vec{E}\, d\vec{l}}$$



obs.

$P(x,y,z)$

$Q(x,y,z)$

$R(x,y,z)$

$$\int_\Gamma P(x,y,z)\,dx + Q(x,y,z)\,dy + R(x,y,z)\,dz.$$

$$\vec{E} = E_x(x,y,z)\,\vec{i} + E_y(x,y,z)\,\vec{j} + E_z(x,y,z)\,\vec{k}$$