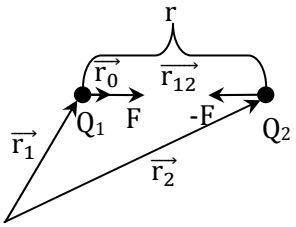
Elektrostatické pole

⊖ ⊕

-e +e 1,602.10^{-19}C (skalární veličina – množství náboje, který přenese 1A za 1s)



$F = k.\frac{Q_1.Q_2}{r^2}$ $\left[F_g = \varkappa.\frac{m_1.m_2}{r^2}\right]$

$\frac{1}{4\pi\varepsilon}$ → permitivita prostředí $[F.m^{-1}]$

$\varepsilon = \varepsilon_0.\varepsilon_r$ $\varepsilon_0 = 8{,}85.10^{-12} F.m^{-1}$

Coulombův zákon

$$F = \frac{1}{4\pi\varepsilon_0\varepsilon_r}.\frac{Q_1.Q_2}{r^2}$$

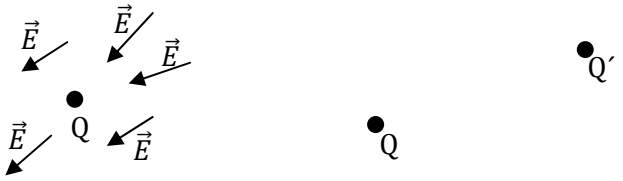
$$\vec{F} = \frac{1}{4\pi\varepsilon_0\varepsilon_1}.\frac{Q_1.Q_2}{|r_2 - r_1|^3}.(\vec{r_1} - \vec{r_2})$$

$$\vec{F} = \frac{1}{4\pi\varepsilon_0\varepsilon_r}.\frac{Q_1.Q_2}{r^3}.\vec{r} \qquad \frac{\vec{r}}{r} = \vec{r_0}$$

$$\vec{F} = \frac{1}{4\pi\varepsilon_0\varepsilon_r}.\frac{Q_1.Q_2}{r^2}.\vec{r_0}$$

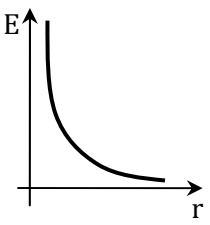
Intenzita elektrického pole

$$\vec{E} = \frac{\vec{F}}{Q} \Rightarrow \vec{F} = Q.\vec{E}$$

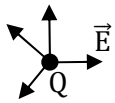


$$F = \frac{1}{4\pi\varepsilon_0\varepsilon_r}.\frac{Q.Q'}{r^2}$$

$$E = \frac{F}{Q'} = \frac{\frac{1}{4\pi\varepsilon_0\varepsilon_r}.\frac{Q.Q'}{r^2}}{Q'} \Rightarrow \boxed{E = \frac{1}{4\pi\varepsilon_0\varepsilon_r}.\frac{Q}{r^2}}$$



$$E = \frac{1}{4\pi\varepsilon_0\varepsilon_r}.\frac{Q}{r^2}.\overrightarrow{r_0} \quad [V.m^{-1}]$$



siločáry
intenzita je tečna k siločáře

$$[E] = \frac{N}{C} = \frac{J}{m.C} = \frac{C.V}{C.m} = \frac{V}{m} = \boxed{V.m^{-1}}$$

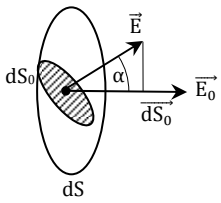
$A = F.d$

$J = N.m \quad N = \frac{J}{m}$

$eV = J = C.V$

Gaussova věta

- Vektor el. indukce do el. pole

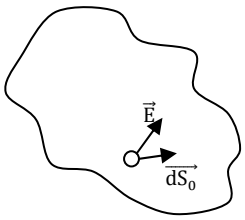


$$\vec{E}.\overrightarrow{dS} = E.\underbrace{dS.\cos\alpha}_{dS_0} = E.dS_0 = E_0.dS$$

$\varphi = \frac{s}{r}[rad]$ – úhel na kružnici

$\Omega = \frac{S}{r^2} = \frac{4\pi r^2}{r^2} = 4\pi[srad]$ – prostorový úhel

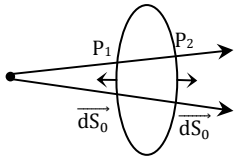
$dS_0 = d\Omega.r^2$



$$\oiint_S \vec{E}.\overrightarrow{dS} = \oiint_S \sum_{i=1}^{n} \overrightarrow{E_i}.\overrightarrow{dS} = \oiint_S \sum_{i=1}^{n} E_i.dS_0 = \int_0^{4\pi} \sum \frac{1}{4\pi\varepsilon_0\varepsilon_r}.\frac{Q_i}{r_i^2}.r_i^2.d\Omega$$

$$= \int_0^{4\pi} \sum \frac{Q_i}{4\pi\varepsilon_0\varepsilon_r}.d\Omega = \frac{\sum Q_i}{4\pi\varepsilon_0\varepsilon_r}\int_0^{4\pi} d\Omega = \frac{\sum Q_i}{4\pi\varepsilon_0\varepsilon_r}.4\pi = \boxed{\frac{Q}{\varepsilon}}$$

$$\oiint_S \vec{E}.\overrightarrow{dS} = \frac{Q}{\varepsilon}/\varepsilon \Rightarrow \boxed{\oiint \vec{D}.\overrightarrow{dS} = Q} \quad div\vec{D} = \rho = \vec{\nabla}.\vec{D}$$



$$\iint_{P_1} E.dS = -\iint_{P_2} E.dS$$

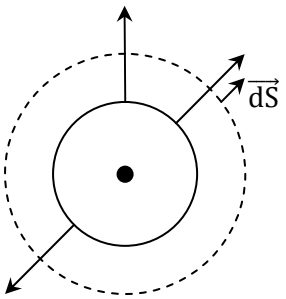
Užití Gaussovy věty

<u>Bod</u>

$$E = \frac{1}{4\pi\varepsilon_0\varepsilon_r}.\frac{Q}{r^2}$$

Koule

$$\oiint_S \vec{E}.\overrightarrow{dS} = \frac{Q}{\varepsilon}$$



$$\oiint_S \underbrace{E}_{\text{konst.}} . dS = \frac{Q}{\varepsilon}$$

$$E.\underbrace{\oiint_S dS}_{} = \frac{Q}{\varepsilon}$$

$$E.4\pi r^2 = \frac{Q}{\varepsilon} \Rightarrow E = \frac{Q}{4\pi\varepsilon_0\varepsilon_r r^2}$$

Válec

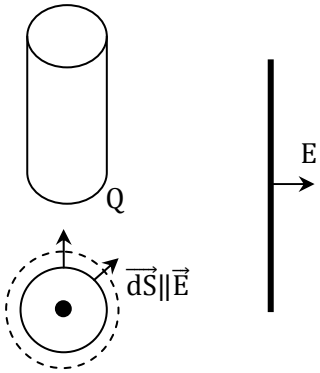
$$\oiint_S \vec{E}.\overrightarrow{dS} = \frac{Q}{\varepsilon}$$

$$\oiint_S E.dS = \frac{Q}{\varepsilon}$$

$$E.\oiint_S dS = \frac{Q}{\varepsilon}$$

$$E.2\pi r.l = \frac{Q}{\varepsilon} \qquad \tau = \frac{Q}{l}[C.m^{-1}]$$

$$E = \frac{1}{2\pi\varepsilon}.\frac{Q}{l.r}$$



Plocha

$$\sigma = \frac{Q}{S}[C.m^{-2}]$$

$$\oiint_S \vec{E}.\overrightarrow{dS} = \frac{Q}{\varepsilon}$$

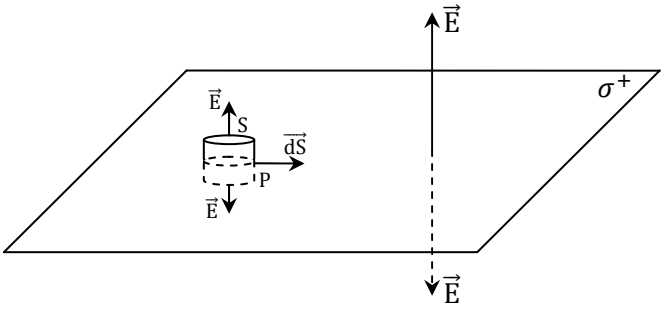
$$\underbrace{\iint_P E.dS}_{0} + 2.\iint_S E.dS$$

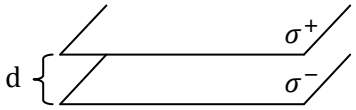
$$2.\iint E.dS = \frac{Q}{\varepsilon}$$

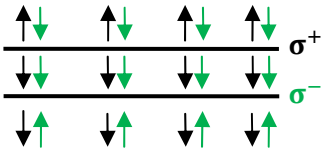
$$2.E.\iint dS = \frac{Q}{\varepsilon}$$

$$2.E.S = \frac{Q}{\varepsilon}$$

$$E = \frac{1}{2}.\frac{Q}{\varepsilon.S} = \frac{\sigma}{2.\varepsilon}$$







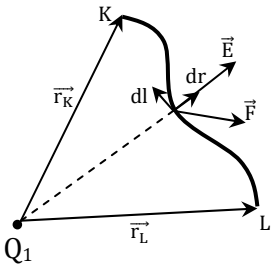
$$E_1 = \frac{\sigma}{2\varepsilon}$$

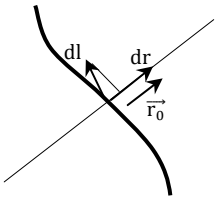
$$E_2 = \frac{\sigma}{2\varepsilon}$$

$$E = E_1 + E_2 = \boxed{\frac{\sigma}{\varepsilon}}$$

Práce v elektrickém poli

$$A = \int \vec{F}.\overrightarrow{dr}$$





$$F = \frac{1}{4\pi\varepsilon_0\varepsilon_r}.\frac{Q_1.Q_2}{r^2} \qquad \vec{F} = Q_2.\vec{E}$$

$$A = \int_K^L Q_2.\vec{E}.\overrightarrow{dl} = Q_2.\int_K^L \vec{E}.\overrightarrow{dl} = Q_2\int \frac{1}{4\pi\varepsilon_0\varepsilon_r}.\frac{Q_1}{r^2}.\overrightarrow{r_0}.\overrightarrow{dl} = Q_2\int \frac{Q_1}{4\pi\varepsilon_0\varepsilon_r}.\frac{1}{r^2}.dr = \frac{Q_2.Q_1}{4\pi\varepsilon_0\varepsilon_r}\int \frac{dr}{r^2}$$

$$= \frac{Q_1Q_2}{4\pi\varepsilon_0\varepsilon_r}.\left[-\frac{1}{r}\right]_K^L$$

$$\boxed{A = \frac{Q_1Q_2}{4\pi\varepsilon_0\varepsilon_r}.\left(\frac{1}{r_L} - \frac{1}{r_K}\right)}$$

$$\boxed{A = \oint F.dl = 0}$$