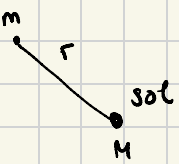
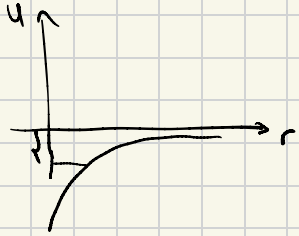
Potensiell energi i gravitasjonsfelt

$$U(r) = -G\frac{mM}{r} = m\left(-G\frac{M}{r}\right)$$



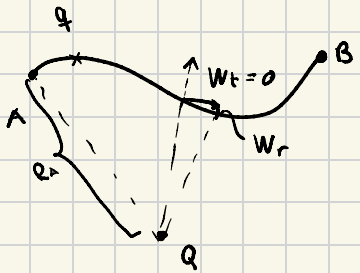


Elektriske krefter er?

$$\vec{F} = q\vec{E}(\vec{r})$$

$$W_{AB} = \int_A^B \vec{F}\cdot d\vec{l}$$

$$= q\int_A^B \vec{E}\cdot d\vec{l} = q\underbrace{\int_{R_A}^{R_B} \frac{Q}{4\pi\epsilon_0}\frac{dR}{R^2}}_{V_{AB}}$$

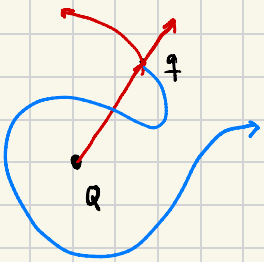


TEST

a) C_a null arbeid

b) C_b negativt arbeid

c) C_c positivt arbeid

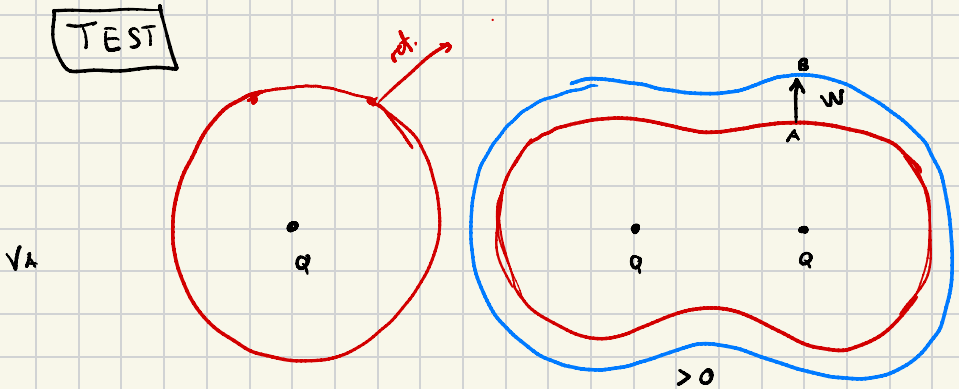


Potensial for elektriske krefter

$$U_A = \int_A^{ref} \underbrace{\vec{F}}_{q\vec{E}} \cdot d\vec{l} = q \int_A^{ref} \vec{E} \cdot d\vec{l} = q\, V_A$$

V_A : potensial, (skalarpotensial)

TEST



$$W = \int_A^{ref} \vec{F} \cdot d\vec{l}; \quad \int_A^{ref} \vec{E} \cdot d\vec{l} = \underbrace{\int_A^B \vec{E} \cdot d\vec{l}}_{>0} + \int_B^{ref} \vec{E} \cdot d\vec{l}$$

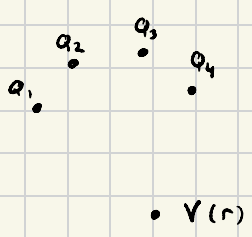
Egenskaper til potensialet

$$V(\vec{r}) = \int_{\vec{r}}^{ref} \vec{E} \cdot d\vec{l}$$

a) avhenger ikke av bane

b) Superposisjon

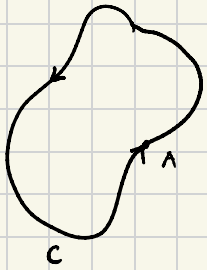
$$V(\vec{r}) = \sum_{i=1}^{4} V_i(\vec{r})$$



c)

$$\oint \vec{E}\, d\vec{l} = 0 = V_A - V_A$$

$$\Sigma_i \Delta V_i = 0$$



d) $\nabla \times \vec{E} = 0$

e) Kun forskjeller som betyr noe

Newton grav lov

$$\vec{F} = -G \frac{mM}{R^2} \hat{R}$$

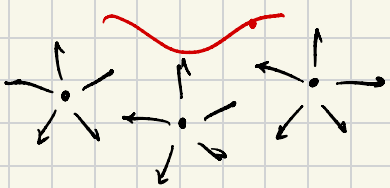
$$U = -G \frac{mM}{R}$$

Coulombs lov

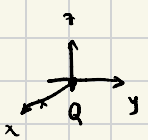
$$\vec{F} = \frac{qQ}{4\pi\epsilon_0} \frac{\hat{R}}{R^2}$$

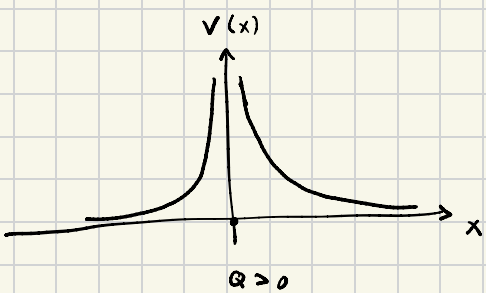
$$U = qV = q \frac{Q}{4\pi\epsilon_0} \frac{1}{R}$$

$\vec{E}(r)$



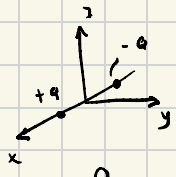
TEST

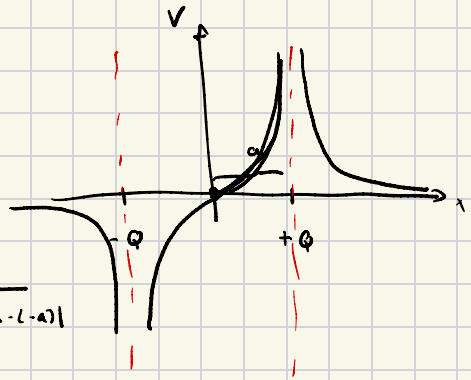




$$V(r) = \frac{Q}{4\pi\epsilon_0 r} = \frac{Q}{4\pi\epsilon_0 |x|}$$

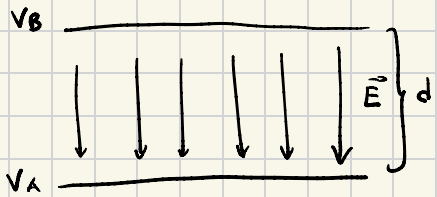
$V(x) = ?$ $\quad Q = 2C$





$$V(x) = \frac{Q}{2\pi|x-a|} + \frac{-Q}{4\pi\epsilon_0|x-(l-a)|}$$

TEST



$V_B = ?$

$$V_B = \int_B^{ref} \vec{E}\cdot d\vec{l}$$

$$V_B = \underbrace{\int_B^A \vec{E}\cdot d\vec{l}}_{E\cdot d} + \underbrace{\int_A^{ref} \vec{E}\cdot d\vec{l}}_{V_A}$$

$$\therefore V_B = E\cdot d + V_A$$

Felt og potensial

$$\vec{E}(\vec{r}) \longrightarrow V(r) = \int_r^{ref} \vec{E}\cdot d\vec{l}$$

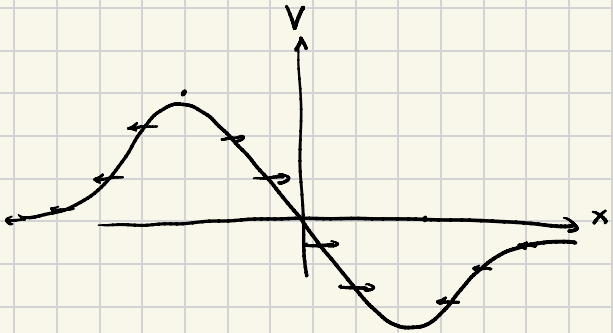
$$\vec{E} = \frac{\vec{F}}{q} = \frac{-\nabla U}{q} = -\nabla\left(\frac{U}{q}\right) = -\nabla V$$

TEST

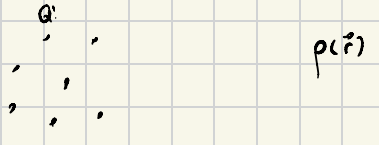
$E_x = ?$

$\vec{E} = -\nabla V$

$E_x = -\frac{\partial V}{\partial x}$



Metode



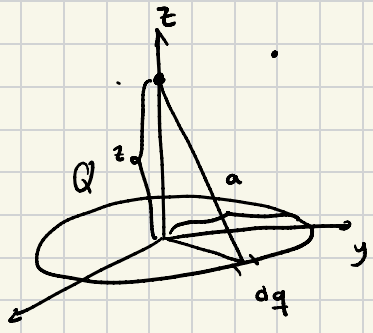
Hvordan finne V

(A) Gitt $Q_i, \vec{r}_i$ $\Rightarrow V(\vec{r}) = \sum \frac{Q_i}{4\pi\epsilon_0 R_i}$

$\rho(\vec{r})$ $\Rightarrow V(\vec{r}) = \int_V \frac{\rho_v(\vec{r}')\, dv'}{4\pi\epsilon_0 R}$

(B) Kjenner $\vec{E}(\vec{r})$ $\Rightarrow V(\vec{r}) = \int_r^{ref} \vec{E} \cdot d\vec{l}$

Eksempel : Ringladning



Finn V(z)

$dV = \frac{dq}{4\pi\epsilon_0 R}$ $\quad dq = \rho_l \cdot dl$

$R = \sqrt{z^2 + a^2}$

$V = \int \frac{dq}{4\pi\epsilon_0 R} = \frac{1}{4\pi\epsilon_0 R} \underbrace{\int dq}_{Q}$

$V(z) = \frac{Q}{4\pi\epsilon_0} \frac{1}{\sqrt{z^2 + a^2}}$