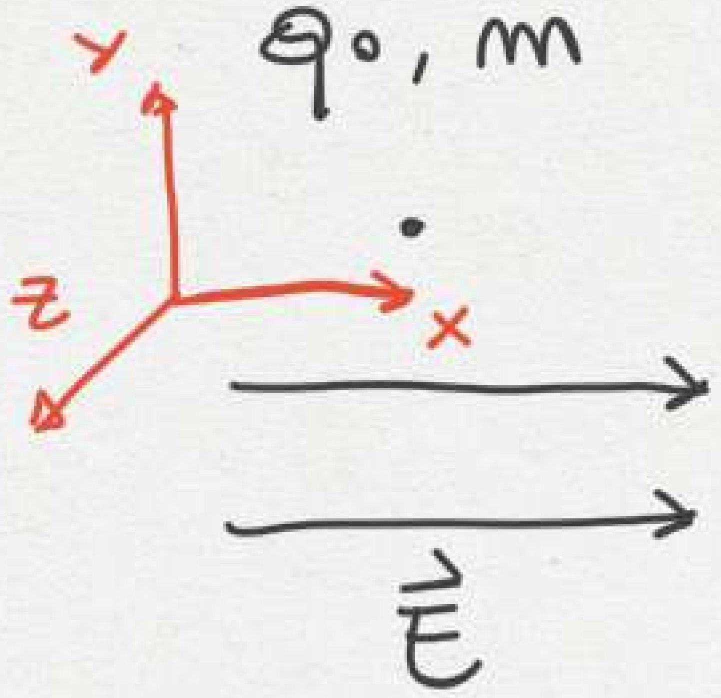


q_0, m $\qquad q_0 > 0$

$$\vec{r}_0 = \vec{r}(0) = (x_0, y_0, z_0)$$

$$\vec{v}_0 = \vec{v}(0) = (v_{x0}, v_{y0}, v_{z0})$$

$$\vec{F} = m\vec{a} = q_0\vec{E} \Rightarrow \vec{a} = \frac{q_0}{m}\vec{E} = \frac{d^2\vec{r}}{dt^2} \parallel \hat{x}$$

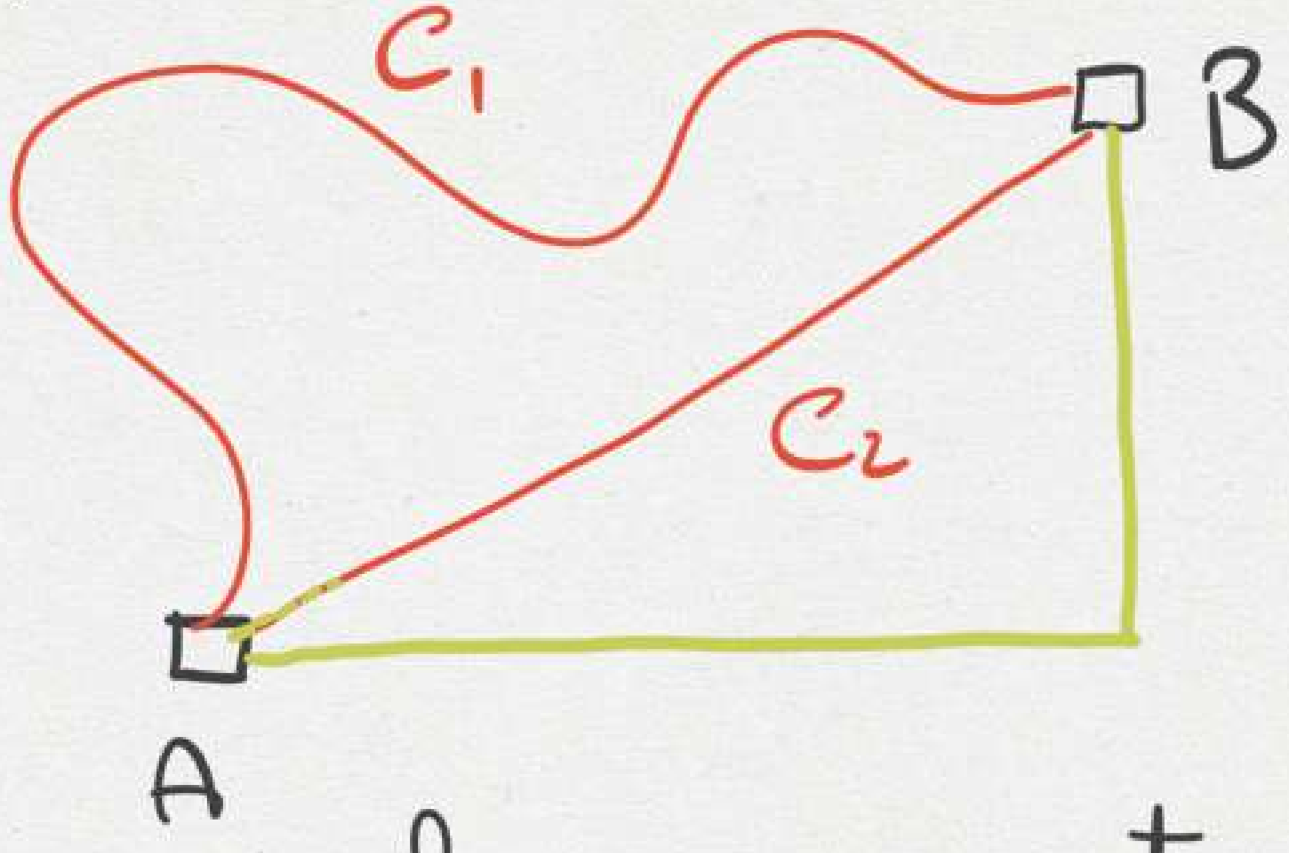
$$\begin{cases} \boxed{x(t) = x_0 + \boxed{v_{0x}t + \frac{1}{2}a_x t^2}} \\ y(t) = y_0 + v_{0y}t \\ z(t) = z_0 + v_{0z}t \end{cases} \qquad \begin{cases} \boxed{v_x(t) = v_{0x} + a_x t} \leftarrow \\ \underline{v_y(t) = v_{0y}} \\ \underline{v_z(t) = v_{0z}} \end{cases}$$

$$U_K(t) = \frac{1}{2}m\vec{v}^2(t) = \overline{\frac{1}{2}mv^2(t)},$$

$$\Delta U_K(t) \equiv U_K(t) - U_K(0) = \frac{1}{2}mv^2(t) - \frac{1}{2}mv_0^2 = \frac{1}{2}m\left[v_x^2(t) + \cancel{v_y^2(t)} + \cancel{v_z^2(t)} - \left(v_{0x}^2 + \cancel{v_{0y}^2} + \cancel{v_{0z}^2}\right)\right] =$$

$$= \frac{1}{2}m\left(\boxed{v_x^2(t)} - v_{x0}^2\right) = \frac{1}{2}m\left(\cancel{v_{0x}^2} + a^2t^2 + 2v_{0x}at - \cancel{v_{0x}^2}\right) = \underbrace{ma}_{F}\underbrace{\left(\boxed{\frac{1}{2}at^2 + v_{0x}t}\right)}_{\Delta s} = F\Delta s$$

$$\Delta U_K = F\Delta s = q_0 E \Delta s = W$$



$$W_{C_1} \geq W_{C_2}$$ per forze non conservative

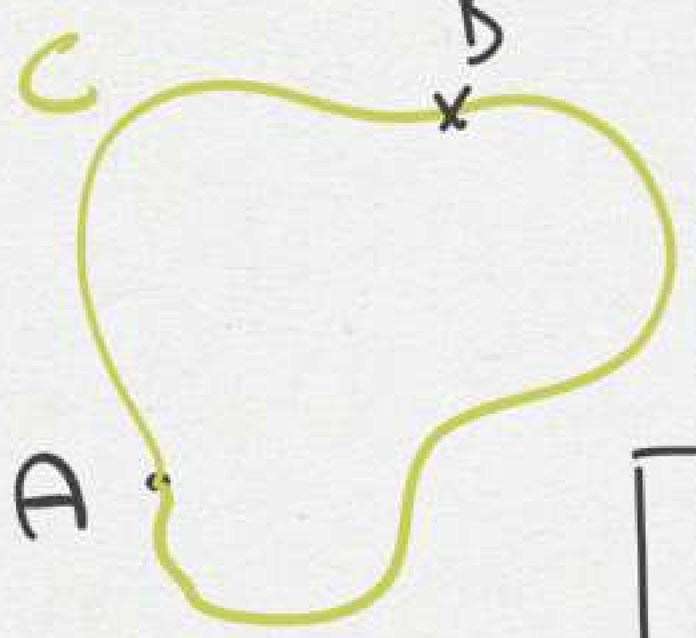
$$W_c = \int_c \vec{F}\cdot d\vec{s}$$

solo se F é conservativa

$$H(x) = -G(x)$$

per forze conservative

$$W_{C_1} = W_{C_2} = W_{C_3} = \dots = \boxed{W_{AB} = \int_A^B \vec{F}\cdot d\vec{s}} = G(A) - G(B) = H(B) - H(A)$$



$$W_c = W_{AB} + W_{BA} = \int_A^B \vec{F}\cdot d\vec{s} + \int_B^A \vec{F}\cdot d\vec{s} = \cancel{\int_A^B \vec{F}\cdot d\vec{s}} - \cancel{\int_A^B \vec{F}\cdot d\vec{s}} = 0$$

$$\boxed{\oint_c \vec{F}\cdot d\vec{s} = 0} \Rightarrow q_0 \oint \vec{E}\cdot d\vec{s} = 0 \Rightarrow \boxed{\oint \vec{E}\cdot d\vec{s} = 0}$$

$$\int_A^B \vec{F}\cdot d\vec{s} = G(A) - G(B)$$

$$\Downarrow$$

$$\int_A^B \vec{E}\cdot d\vec{s} = V(A) - V(B) = -\big(V(B) - V(A)\big), \quad V(\vec{r}) \text{ è detta potenziale elettrostatico}$$

differenza di potenziale (d.d.p.)

$$W_{AB} = q_0 \int_A^B \vec{E}\cdot d\vec{s} = -q_0\big(V(B) - V(A)\big) \equiv -q_0 \Delta V_{AB} = \Delta U_k$$

$$\Delta U_k + \Delta U_e = 0 = W_{AB} + \Delta U_e \implies \boxed{\Delta U_e = -W_{AB} = q_0 \Delta V}$$

per forze conservative

$$\vec{F} \longleftrightarrow q_0 \vec{E}$$

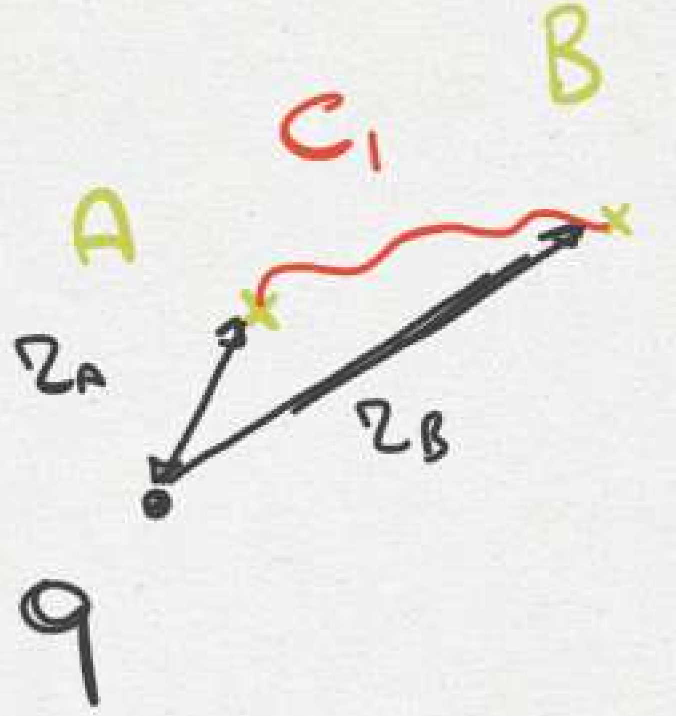
PERCHÉ??

$$\Delta U_e = q_0 \Delta V,$$

$$[\Delta U_e] = [q_0][\Delta V] \Rightarrow [\Delta V] = \frac{J}{C} = V, \quad [\Delta V] = \left[\int \vec{E} \cdot d\vec{s}\right] = [E]\, m \Rightarrow$$

$$[E] = \frac{V}{m} = \frac{N}{C}$$

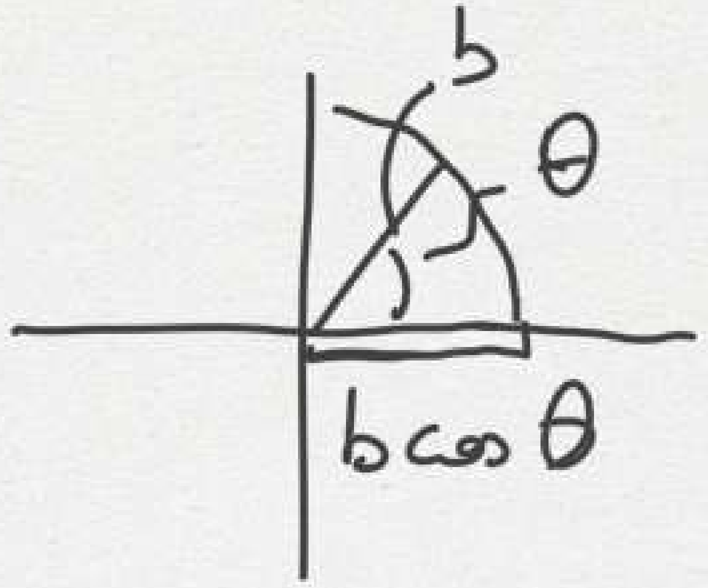
POTENZIALE DI UNA CARICA



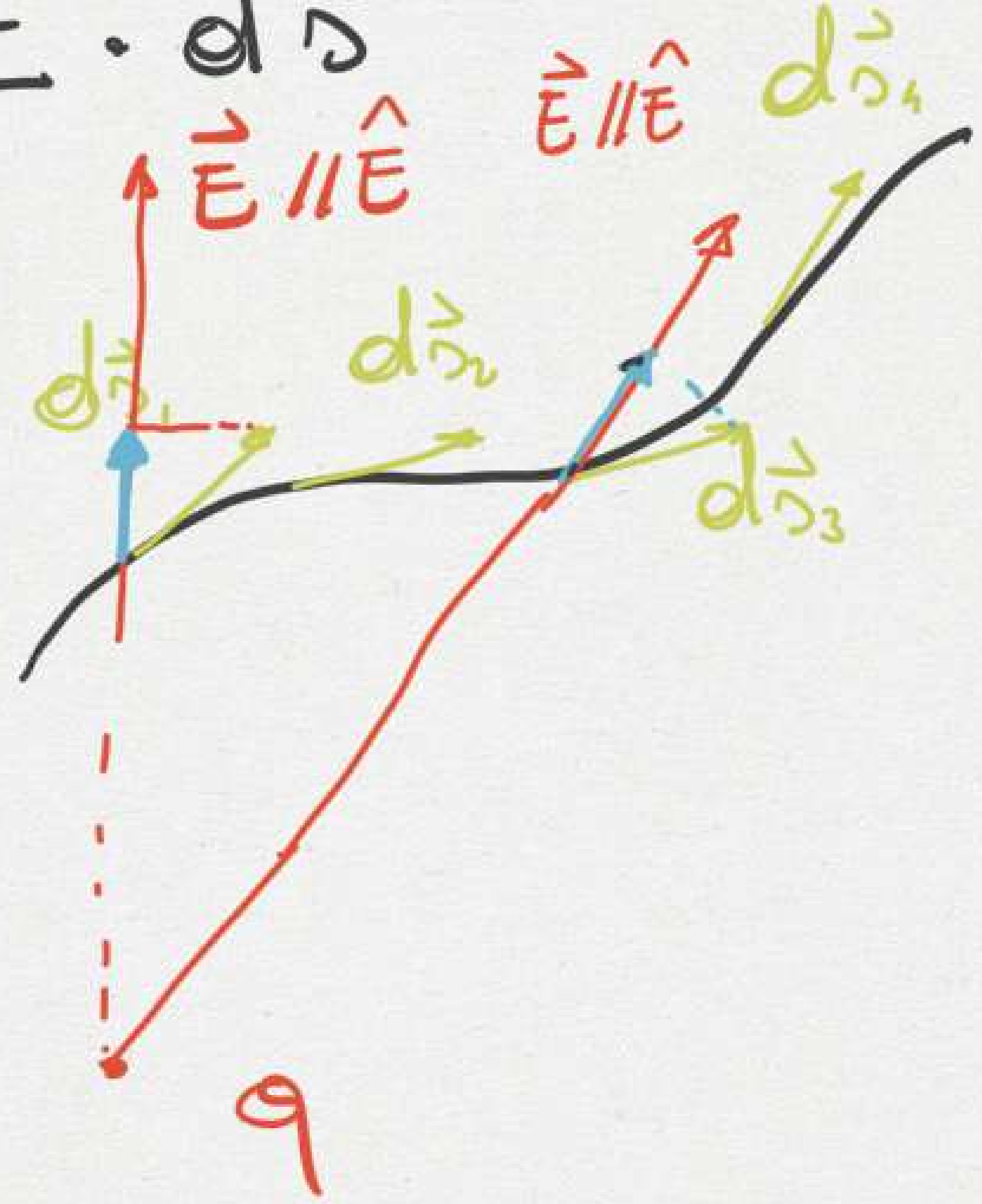
$$\Delta V_{AB} = ?$$

$$\Delta V_{AB} = -\int_{c_1} \vec{E}\cdot d\vec{s}$$

$$\left[\begin{array}{l}\vec{a}\cdot\vec{b} = ab\cos\theta \\ \hat{a}\cdot\vec{b} = b\cos\theta\end{array}\right.$$



$$\vec{E}\cdot d\vec{s}$$



$$\vec{E}\cdot d\vec{s} = E\underbrace{\hat{E}\cdot d\vec{s}}_{\substack{dr \\ \parallel}} = E\left(\hat{E}\cdot d\vec{s}\right) = E\,dr \Rightarrow$$

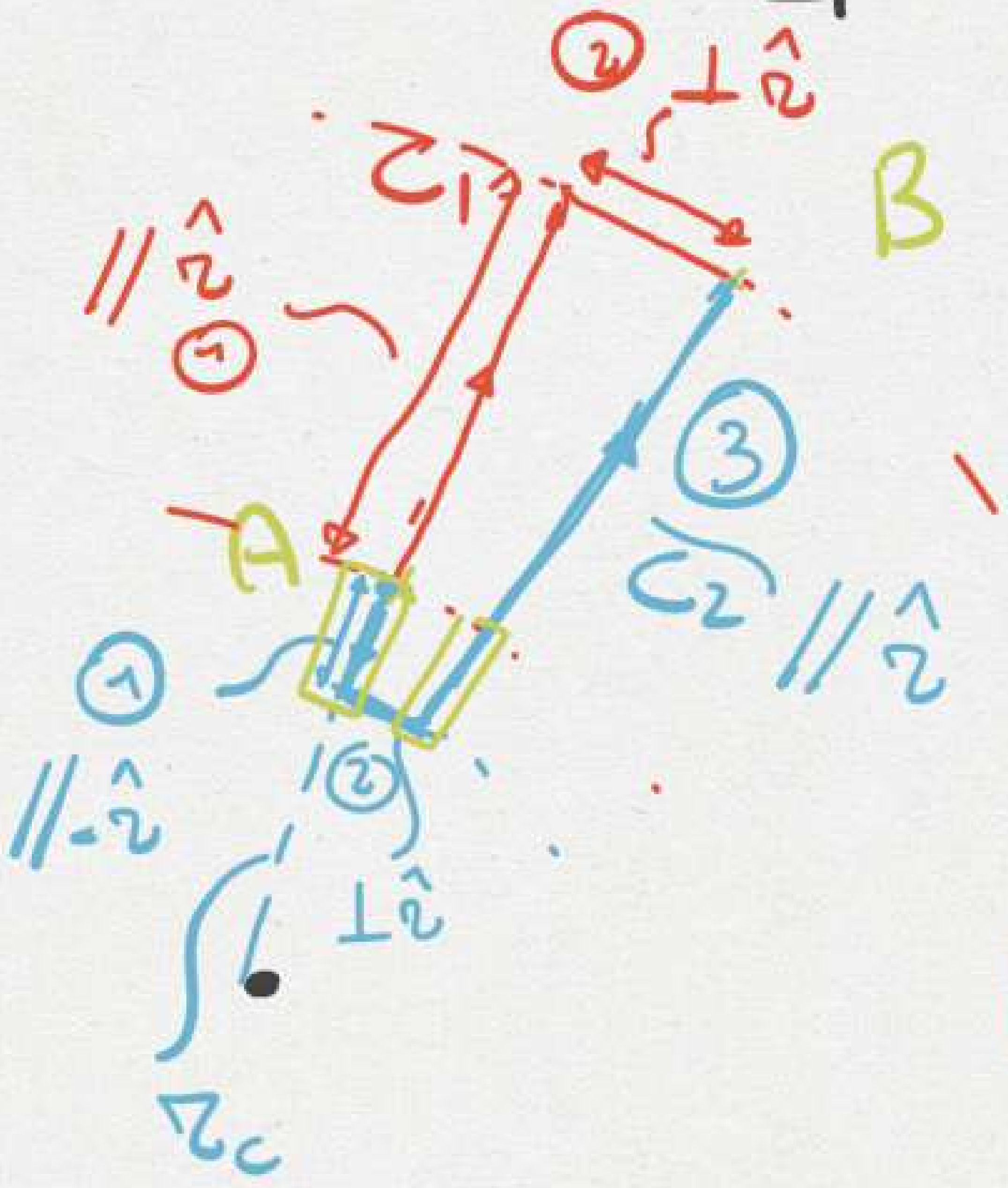
$$\int_{c_1} E(r)\,dr = \underbrace{\int_{c_1} \frac{q}{4\pi\varepsilon_0}\frac{dr}{r^2}} = \int_A^B \frac{q}{4\pi\varepsilon_0}\frac{dr}{r^2} =$$

$$= \frac{q}{4\pi\varepsilon_0}\left(-\frac{1}{r}\right)\Bigg|_A^B = \frac{q}{4\pi\varepsilon_0}\left(\frac{1}{r_A} - \frac{1}{r_B}\right) \Rightarrow$$

$$\Delta V_{AB} = -\frac{q}{4\pi\varepsilon_0}\left(\frac{1}{r_A} - \frac{1}{r_B}\right) = \frac{q}{4\pi\varepsilon_0}\left(\frac{1}{r_B} - \frac{1}{r_A}\right)$$

$$V(\vec{r}) = \frac{q}{4\pi\varepsilon_0}\frac{1}{r}$$

$$\hat{E} = \frac{q}{4\pi\varepsilon_0}\frac{\hat{r}}{r^2}$$

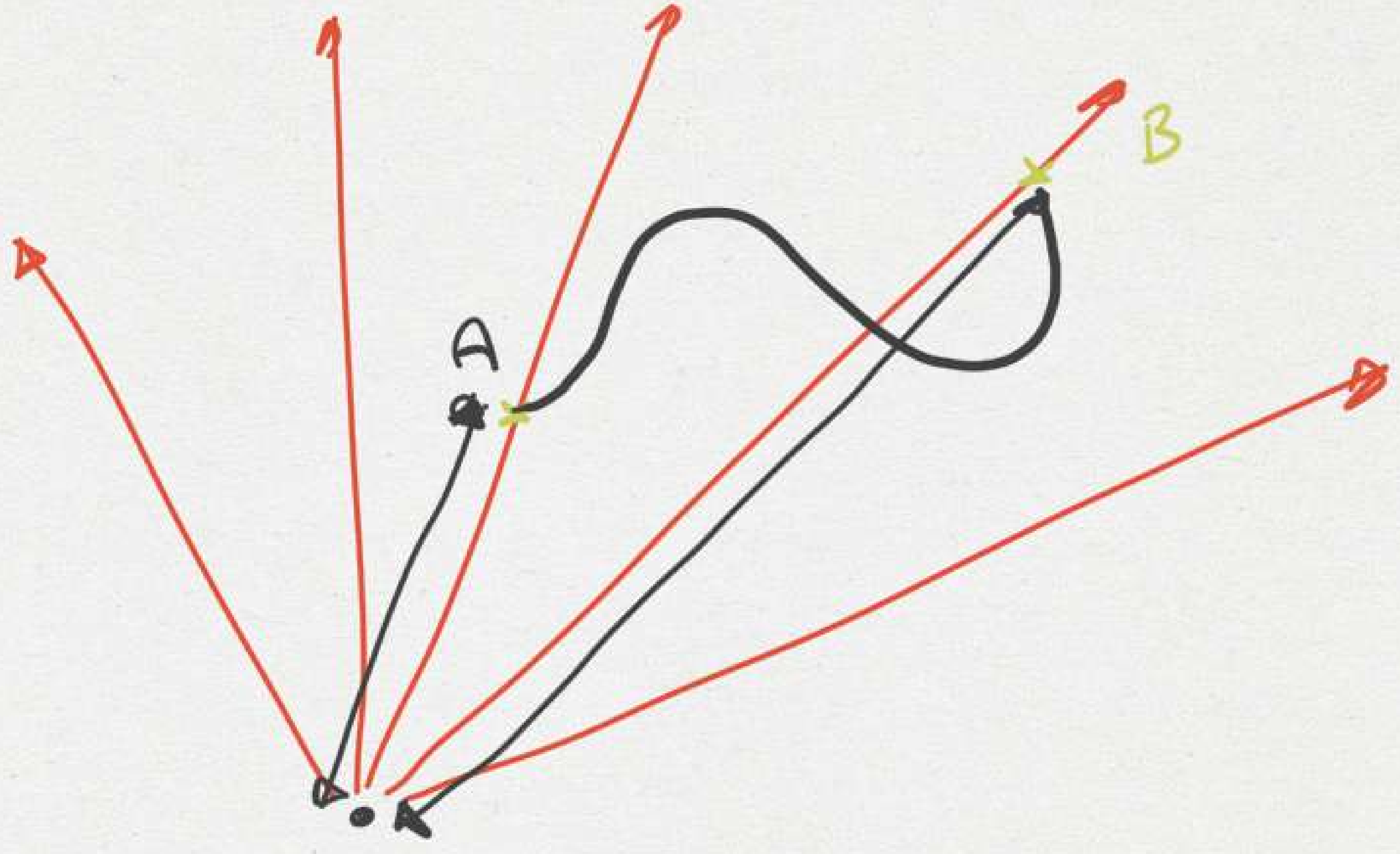


$$\Delta V_{c_1} = \Delta V_{c_2}$$

$$E\hat{E}\cdot d\vec{s} = \begin{cases} ①\ E\,dr = E\hat{E}\cdot d\hat{r} \rightarrow \int_{r_A}^{r_B} E\,dr \\ ②\ 0 \end{cases}$$

$$E\hat{E}\cdot d\vec{s} = \begin{cases} ①\ E\,\hat{r}(-d\hat{r}) = -E\,dr \rightarrow \boxed{\cancel{\int_{r_C}^{r_A} -E\,dr}} \\ ②\ 0 \\ ③\ E\,dr \rightarrow \int_{r_C}^{r_B} E\,dr = \cancel{\int_{r_C}^{r_A} E\,dr} + \int_{r_A}^{r_B} E\,dr \end{cases}$$

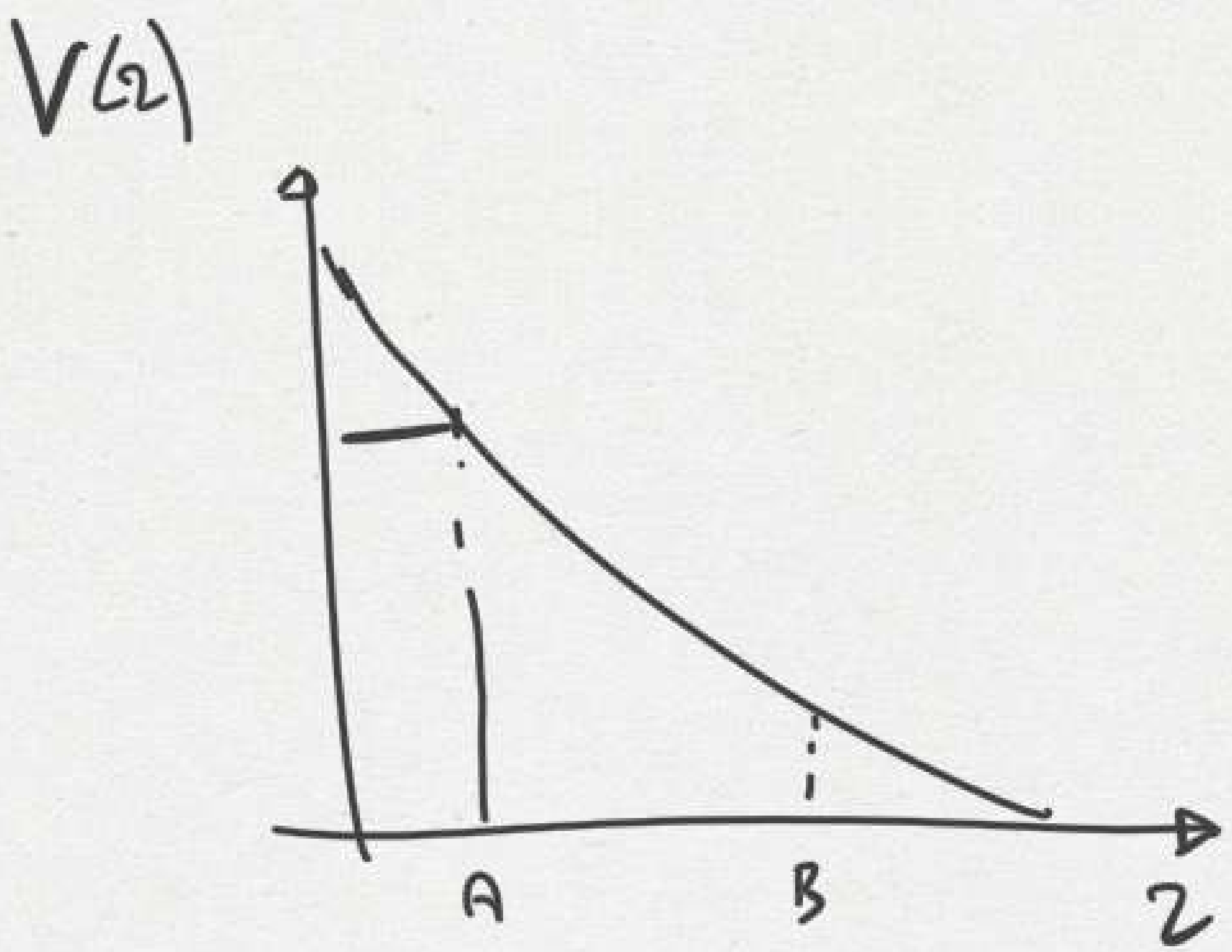
$$\Rightarrow \Delta V_{c_1} = \Delta V_{c_2}$$



$$\Delta V_{AB} = \frac{q}{4\pi\varepsilon_0}\left(\frac{1}{r_A} - \frac{1}{r_B}\right)$$

$$\vec{E} = \sum_i \vec{E}_i$$

$$\int_A^B \vec{E}\cdot d\vec{s} = \int_A^B \sum_i \vec{E}_i \cdot d\vec{s} = \sum_i \int_A^B \vec{E}_i \cdot d\vec{s}$$



$$\boxed{V(A) - V(B) = \int_A^B \vec{E}\cdot d\vec{s} = \frac{q}{4\pi\varepsilon_0}\left(\frac{1}{r_A} - \frac{1}{r_B}\right)}$$

$$\int_A^B \vec{E}\cdot d\vec{s} = V(A) - V(B) = -\left(V(B) - V(A)\right)$$