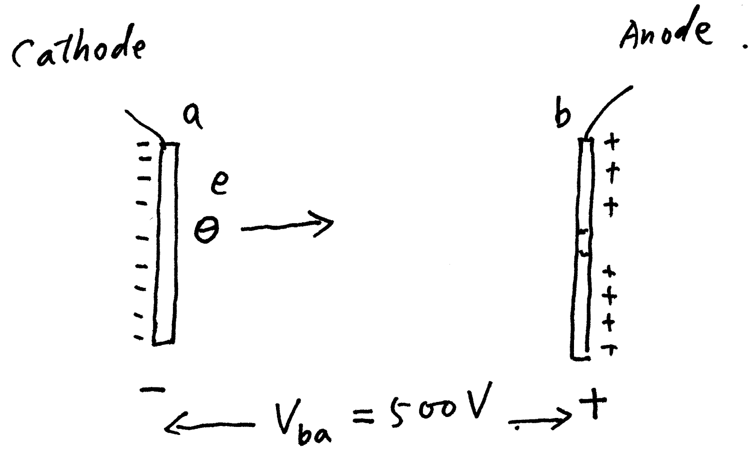
e.g. 23-2. Electron in CRT.



$V_{ba} = V_b - V_a = 5000\,V$.

$q = -1.6 \times 10^{-19}\,C$

$m = 9.1 \times 10^{-31}\,Kg$.

a). $\Delta U = q \cdot \Delta V = q\,V_{ba}$

$= -1.6 \times 10^{-19} \times 5000$

$= -8.0 \times 10^{-16}\,J$

b). conservation of mechanical energy.

$$(K+U)_i = (K+U)_f.$$

OR: $\Delta(K+U) = 0$

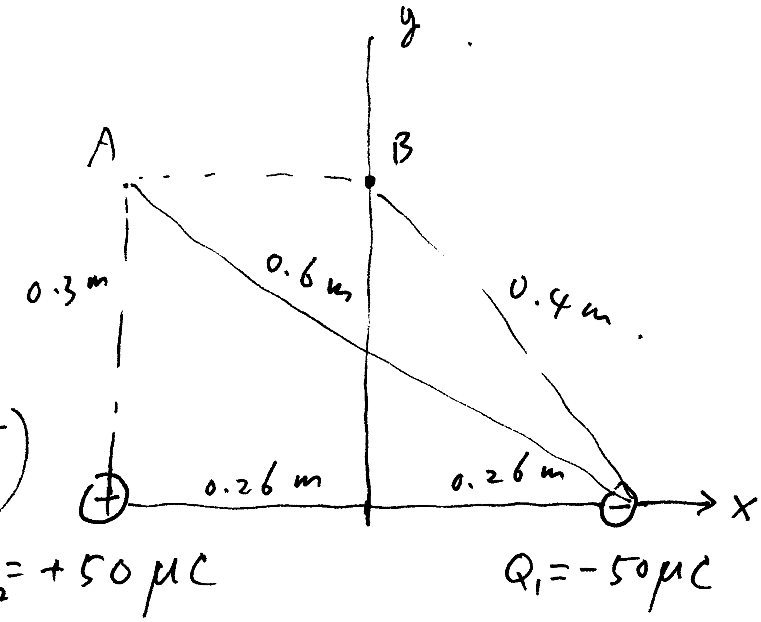
$\Delta K = -\Delta U$.

$\frac{1}{2} m v^2 - 0 = 8.0 \times 10^{16}$

$v^2 = \frac{2 \times 8.0 \times 10^{16}}{m}$

$v = \sqrt{\frac{2 \times 8 \times 10^{16}}{9.1 \times 10^{-31}}} = 4.2 \times 10^7\,m/s.$

e.g. 23-7. Potential above 2 charges



a). $U_A = U_{A1} + U_{A2}$

$$= \frac{1}{4\pi\varepsilon_0}\left(\frac{Q_2}{0.3} + \frac{Q_1}{0.6}\right)$$

$$= \frac{1}{4\pi\varepsilon_0}\left(\frac{5\times10^{-5}}{0.3} - \frac{5\times10^{-5}}{0.6}\right)$$

$$= \frac{1}{4\pi\varepsilon_0}\,\frac{5\times10^{-5}}{0.6}$$

$$= 7.5\times10^{5}\ V$$

$$\left(\frac{1}{4\pi\varepsilon_0} = 9\times10^{9} = k\right)$$

b). $U_B = \frac{1}{4\pi\varepsilon_0}\left(\frac{Q_2}{0.4} + \frac{Q_1}{0.4}\right)$

$$= \frac{1}{4\pi\varepsilon_0}\,\frac{1}{0.4}\left(5\times10^{-5} - 5\times10^{-5}\right)$$

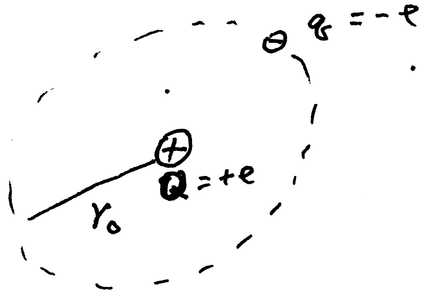
$$= 0$$

Note: $U = 0$ doesn't mean $\vec{E} = 0$!

It means no work is needed to bring a charge from infinity to point B. (e.g. along the perpendicular bisector) e.g. 23-12.

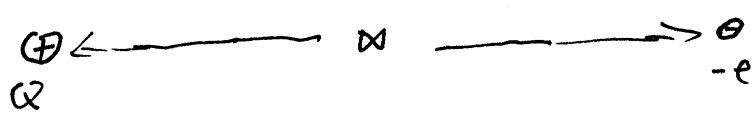
Disassembling a Hydrogen atom.

initial:



(lower energy)

final:



(higher energy)

Initial potential energy: $U_i = \frac{Q \cdot q}{4\pi\varepsilon_0 r_0} = -\frac{e^2}{4\pi\varepsilon_0 r_0} = -27.2\,eV$ $= -27.2 \times (1.60\times10^{-19})\,J$

Initial kinetic energy: $K_i = \frac{1}{2}mv^2$, $\quad \frac{e^2}{4\pi\varepsilon_0 r_0^2} = m\frac{v^2}{r_0}$

$= \frac{e^2}{8\pi\varepsilon_0 r_0}$ $\quad mv^2 = \frac{e^2}{4\pi\varepsilon_0 r_0}$

Initial Mechanical energy: $K_i + U_i = -\frac{e^2}{4\pi\varepsilon_0 r_0} + \frac{e^2}{8\pi\varepsilon_0 r_0}$

$= -\frac{e^2}{8\pi\varepsilon_0 r_0}$

$= -13.6\,eV$.

Final Mechanical Energy: $K_f + U_f = 0 + 0 = 0$.

Energy (work) needed: $(K_f + U_f) - (U_i + K_i) = 13.6\,eV$.

ionization energy for hydrogen.