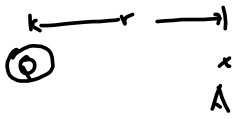
Electric Potential Due to a Point Charge

$V = \frac{PE_e}{q}$



$V = \frac{\frac{KQq}{r}}{q} = \frac{KQ}{r}$

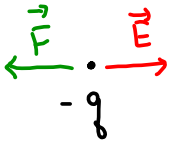
Scalar (but sign of charge matters

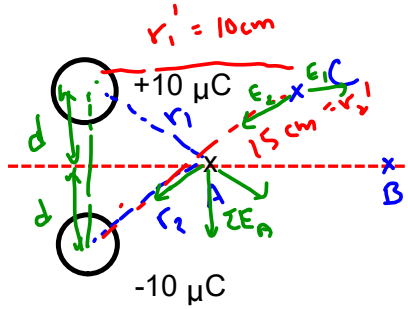
Contrast

$|\vec{E}| = \frac{|\vec{F}|}{q} = \frac{\frac{KQq}{r^2}}{q} = \frac{KQ}{r^2}$

but $\vec{E}$ is a vector

$\vec{E} = \frac{KQ}{r^2}\hat{r}$ for a point charge (sign matters)





$r_1' = 10\,cm$

$r_1 = r_2 = r$

What is V_A?

$$V_A = \sum_{i=1}^{2} V_i = \frac{KQ_1}{r_1} + \frac{KQ_2}{r_2}$$

$$= \frac{K(+10\,\mu C)}{r} + \frac{K(-10\,\mu C)}{r}$$

$$V_C = \frac{KQ_1}{r_1'} + \frac{KQ_2}{r_2'}$$

$$= 9.0\times10^9 \left(\frac{10\times10^{-6}\,C}{0.10\,m} + \frac{-10\times10^{-6}}{0.15\,m} \right) = \text{☺}$$

$$= 9.0\times10^4 \left(\frac{1}{0.10} - \frac{1}{0.15} \right)$$

$$= +3.0\times10^5\ V$$

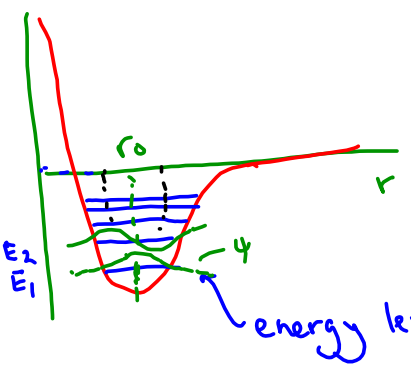
How much work is required to move a $-10\,nC$ charge from point C to point A?

$$W = q\Delta V = (-10\times10^{-9}\,C)(0 - 3.0\times10^5\,V)$$

$$= 3.0\times10^{-3}\,J$$

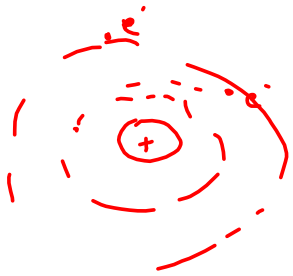
Potential Wells

Potential well for H.



energy levels

r_0 = radius of H atom



orbital electrons are bound to the nucleus

Solutions to the Schroedinger equation

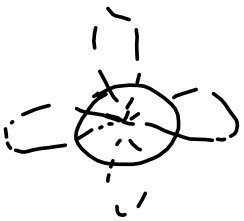
$H\psi = E\psi$

psi → ψ is a wavefunction

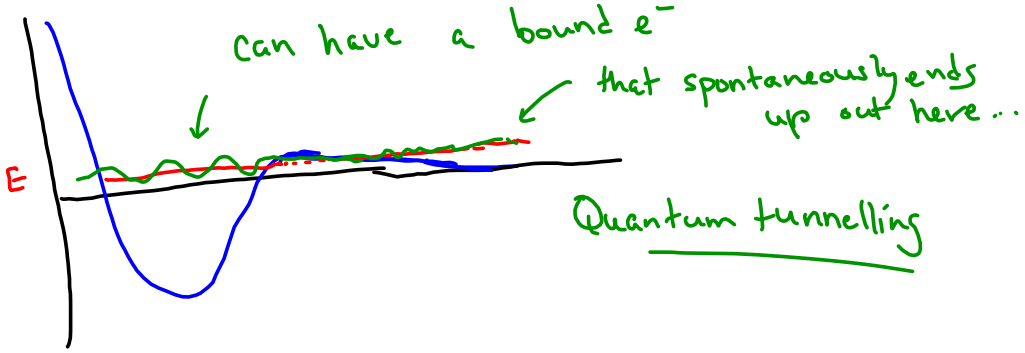
ψ^2 is a probability function

H is the Hamiltonian operator.

E is an energy state.



Sometimes the well looks like this:



Quantum tunnelling

Heisenberg's uncertainty principle

$\Delta x \Delta p \geq \frac{\hbar}{2}$ (h = planck's const = 6.626×10^{-36} Js)

$\hbar = \frac{h}{2\pi}$

For energy

$\Delta E \Delta t \leq \frac{\hbar}{2}$

Light $E_\gamma = hf = \frac{hc}{\lambda}$

$p_\gamma = \frac{h}{\lambda}$