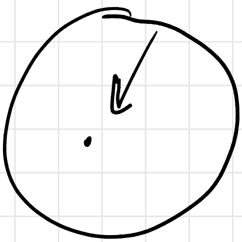
Bohr Atom

- electrons in circular orbits
- Coulomb force = Centripetal force
- Only allowed orbits have $L = n\hbar$

$(n = 1, 2, \dots)$



$$\frac{mv^2}{r} = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r^2}$$

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But $L = mvr \Rightarrow v^2 = \dfrac{L^2}{m^2r^2}$

$$mv^2 = \frac{L^2}{mr^2} = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r}$$

$$r = \frac{4\pi\varepsilon_0}{me^2} L^2 = n^2 \frac{4\pi\varepsilon_0 \hbar^2}{me^2}$$

$$\boxed{r = n^2 a_0}$$

$$\boxed{a_0 = \frac{4\pi\varepsilon_0 \hbar^2}{me^2} = \text{Bohr radius}}$$

$$\boxed{a_0 = 0.5\,\text{Å}}$$

a_0 = radius of tightest orbit $n = 1$

Energy levels

$$KE + PE = E$$

$$\frac{1}{2}mv^2 - \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r} = E$$

we previously had $mv^2 = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r}$

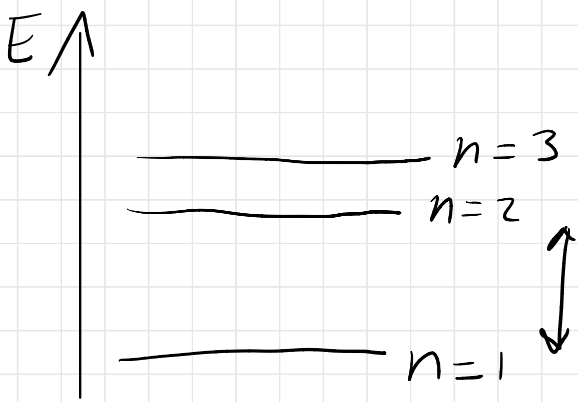
Therefore $E = -\frac{1}{8\pi\varepsilon_0}\frac{e^2}{r}$

$$E = -\frac{1}{8\pi\varepsilon_0}\frac{e^2}{n^2 a_0} = -\frac{1}{n^2}\frac{1}{8\pi\varepsilon_0} e^2 \frac{me^2}{4\pi\varepsilon_0 \hbar^2}$$

$$\boxed{E = -\frac{R}{n^2}}$$

R = Rydberg Constant

$$R = \frac{me^4}{32\pi^2\varepsilon_0^2\hbar^2} = \frac{me^4}{8\varepsilon_0^2 h^2} = 13.6\,\text{eV}$$



$$\Delta E = R\left(\frac{1}{1^2} - \frac{1}{2^2}\right)$$

Transitions between energy levels,
photon of Energy

$$h\nu = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) = \frac{hc}{\lambda}$$

where n_f = final n

n_i = initial level

Discrete "lines"

Lyman series $n_f = 1$

Balmer series $n_f = 2$

Paschen series $n_f = 3$

etc _