The Bohr Model of the Atom

Built upon the Rutherford model

Postulates of the Bohr model:

① Electrons can only exist in certain places that have a discrete energy → "electron energy states" or "stationary states" or "electron energy levels"

② Electrons do not radiate energy when they are in their discrete energy states.

③ Electrons can "jump" or transition between energy states.

absorbs energy → higher energy state
releases (emits) energy → lower energy state.

The energy absorbed or emitted is equal to the energy difference between the two energy states.

④ Electrons normally exist in the lowest possible energy states.

Energy emitted in an electron transition within an atom

- When the electron transitions from a high energy level to a lower one it releases energy equal to the energy difference between the two levels.

* Quantum of Energy → the smallest amount of energy that can be released in this atomic process.

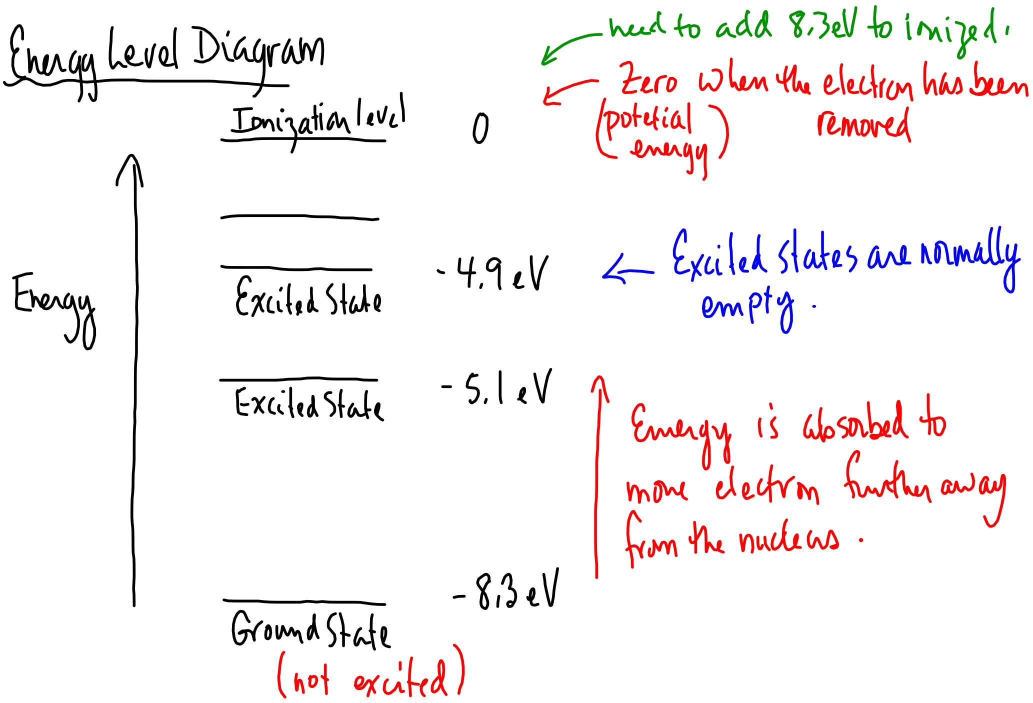
- Quantization of Energy → electron energies in atoms can only exist in discrete amounts.

- Energy is no emitted as a continuous wave but in "packets" or "bundles" called photons.

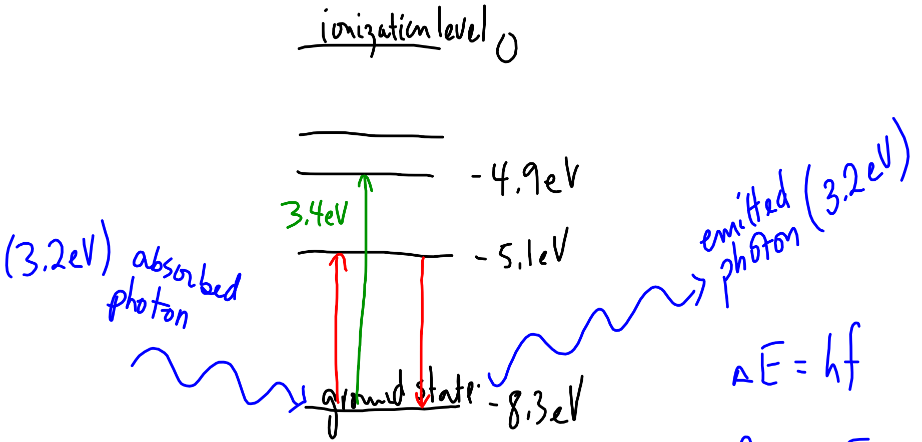
- The energy emitted by the atom in one electron transition is emitted as a signle photon of electromagnetic radiation (light)

- Each photon has an energy of hf where h is Planck's Constant ($h = 6.63 \times 10^{-34}$ J·s) and f is the frequency of the radiation.

Energy Level Diagram



Absorption of a photon



$\Delta E = hf$

$f = \frac{\Delta E}{h}$

$f = \frac{(3.2\,eV)(1.6\times10^{-19}\,\frac{J}{eV})}{6.63\times10^{-34}\,Js}$

$f = 7.7\times10^{11}\,Hz$

Universal wave equation ($v = \lambda f$) → $c = \lambda f$

$\lambda = \frac{c}{f}$

$\lambda = \frac{3.0\times10^{8}\,ms^{-1}}{7.7\times10^{11}\,s^{-1}}$

$\lambda = 3.88\times10^{-4}\,m$

(visible → $4.0\times10^{-7}\,m$ to $7.5\times10^{-7}\,m$

400nm to 750nm

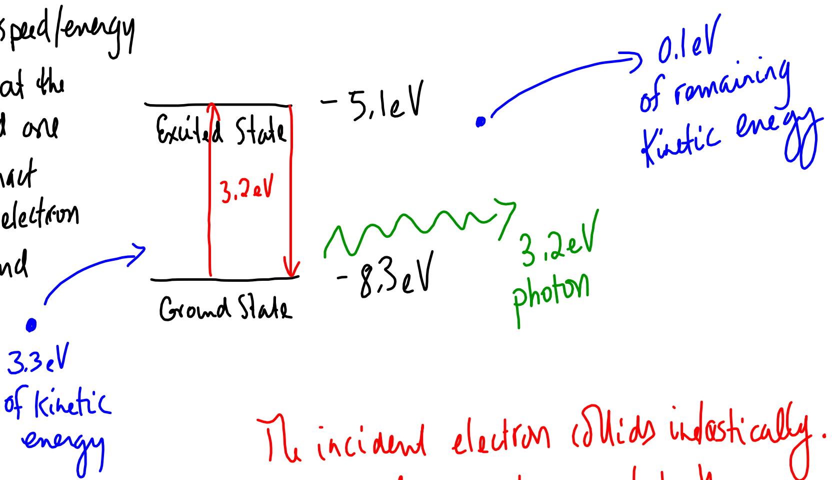
Energy Level Diagrams.

- The ionization level is taken as zero energy.
- The energy states are negative in energy since energy must be added to remove the electron from the atom.
- The wavelength of light emitted or absorbed in a transition from nth to mth level:

$$\Delta E = E_n - E_m = hf = \frac{hc}{\lambda}$$

Excitation by Electrons

Fire high speed/energy electrons at the atom and one may interact with an electron in the ground state.



The incident electron collides inelastically and transfers just enough to the ground state electron and emerges with the remaining energy.

If the incident electron does not have enough energy, then it collides elastically with the electron in the atom and emerges with no loss in energy.

Excitation by Photons

- a photon must have the exact energy. It cannot lose part of its energy.