Ch. 3

Photoelectric effect

Cathode is a metal like Cs

Wave model

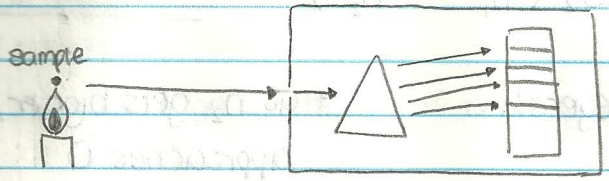
		Prediction	Obs	Photon model
Bright Red	High Amp low freq.	Yes	No	many photons low E
Dim Red	low Amp low freq.	No or delay	No	few photons low E
Bright Blue	high amp high freq.	Yes	Yes	many photons high E.
Dim Blue	low amp high freq.	No	Yes few e- lost	few photons high E.

Observations

- Threshold frequency for each metal
- Below threshold, no e- emitted no matter how bright the light
- Above threshold even very dim light causes emitted e- (but only a few) immediately!
- above threshold, if you include freq. of light it includes KE of emitted e- if you include brightness, it include the amount of e- knocked off

Ch 5. Emission & Absorption Spectra

- glowing of a block when heated = atoms in the block releasing energy.



spectrometer/ spectrograph → determines exact wavelengths emitted.

- sunlight ⟶ gives you a continuous spectrum
- light from an element ⟶ gives you few specific wavelengths (by metal) aka discontinuous or line spectrum

- From prior experiments, you know where λ's fall on the film.
- If film is exposed, at one specific location, you have the λ.

then

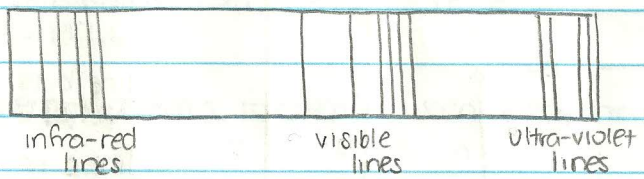
$c = \lambda\nu$ (find ν)

$E = h\nu$ (solve for E after)

$h = 6.625 \times 10^{-34}$ J s.

$c = 2.998 \times 10^{8}$ m/s

Hydrogen Emission Spectrum



line	λ	ν (s^{-1})	energy
1	121.47	2.468×10^{15}	1.635×10^{-18}
2	102.50	2.925×10^{15}	1.938×10^{-18}
3	97.18	3.085×10^{15}	2.044×10^{-18}
⋮	⋮	⋮	⋮
last	91.15	3.289×10^{15}	2.179×10^{-18} *

* = energy released when an electron binds to an H^+ ion

* emission of different frequencies by hydrogen suggests that hydrogen can absorb different amount of energy b/c photons of different frequencies are emitted.

* = energy that a hydrogen atom must absorb in order to remove an electron from an H^+ atom

$H + 2.179 \times 10^{-18}\ J \longrightarrow H^+ + e^-$

Ch. 6: Bohr's Model of the Atom

Bohr's Hypothesis:

He used:

1. knowledge of physics of orbiting objects
2. $E = h\nu$
3. Rutherford's Model

Hypothesis: electrons occupied stable orbits, energy levels, around the nucleus.

- electrons would jump farther from the nucleus when the atom absorbed a quantum of energy. (energy gained, ~~energ~~ electrical potential energy)
- electrons would jump closer to the nucleus when the atom released a quantum of energy. (energy released)

Derived a theoretical equation:

$$E = \frac{2\pi^2 m e^4 z^2}{h^2}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

e = charge

z = charge of nucleus.

$\frac{2\pi^2 m e^4}{h^2}$ equals 2.179×10^{-18} if $z = 1$

* energy/photons is created when electrons move back

Ionization energy: removing an electron from a hydrogen atom.

Bohr's model:

atoms exist in quantized energy states, only certain specific quanta can be absorbed or emitted when atoms are excited or relaxed.

$$E_{final} - E_{initial} = h\nu$$

Hydrogen: $E = 2.179 \times 10^{-18}\left(1 - \frac{1}{n^2}\right)$, $n = 1, 2, 3\ldots$