Alvl P1: energy levels and particles of light(ch3) Cheat Sheet

by MostAncientDream via cheatography.com/168994/cs/42333/

Definitions

Excitation	process of an electron taking in exactly the correct quantity of energy to move to a higher level
ionisation	process of an atom losing an orbital electron and becoming charged
ground state	the most stable energy level that an electron can exist in
energy levels	defined and distinct energies at which electrons can exist in an atom
threshold freq	min freq of photons required for photoelectrons to be emitted from the surface of a metal plate
work function	min energy required to remove an electron from the metal's surface

Fluorescent tube (Exam q)

a fluorescent covered tube with mercury vapour inside.
process:
1. thermonic emission to raise electrons to the surface
> energy has to be equal to or greater than the energy gap between energy levels to interact
2. potential difference is applied (V = w/q) so work is done on the electron to accelerate it across the tube
3. electrons will collide with mercury vapour causing excitation (risk of electron capture however unlikely due to mercurys stability)
> electrons will continue to interact even after a single interaction as the field continues to accelectrate them
4. electrons dexcite, releasing energy certain frequency
5. mercury vapour has small wavelength photons (discrete) of light released in any direction
6. this causes the photon to interact with the phosphorous which must have the exact energy gap
> small wavelength = large energy
7. most of the phosporous energy levels are visible light spectrum, it has fluoresced

Fluorescent tube (Exam q) (cont)

> absorb short, release long wavelength
questions possibly answered:
- how does the fluorescent tube worked
- why is mercury vapour used
- what does the phosphorous do
- do the electrons continue to interact after interacting once

Electron diffraction

electron diffraction is evidence for wave behaviour.
-as an electron passes through a diffraction grating the electron wave spreads out/is diffracted.
-an interferance pattern is produced, bright rins at where maximum intensity occurs/interfere constructively
working out velocity of an electron from an electron gun:
- cathode(-) fires electrons through an anode(+) grating
- there is a potential difference between the cathode/anode known as the **accelerating voltage**
V = E/Q so E = eV (e is Q)
eV (energy) = $1/2mv^2$
and rearrange for v
v = square root(2eV/m)
this can be substituted into de broglie wavelength equation

Equations

photon energy	hf
	hc/lambda
de broglie wavelength	h/p (momentum)
	h/mv
threshold freq	work function/h

By **MostAncientDream**

cheatography.com/mostancientdream/

Published 9th February, 2024.
Last updated 9th February, 2024.

Excitation and ionisation

- when an electron gains energy via a photon, if the photon contains the correct amount of energy for the energy level, an electron will excite to the next energy level
- (if it had enough energy to ionise it becomes a free electron)
- (if it did not have enough energy to get to the next energy level then the photon passes through the atom without interacting)
- the electron is now in an unstable state
- to overcome this the electron will eventually de-excite (return to the energy level) and release a corresponding photon in the process

photons

an atom could have absorbed a singular photon to excite multiple energy levels.
as it dexcites and releases energy this can be in the form of multiple photons.
for example:
if a photon excites an electron 2 energy levels, then when it dexcites it can either go
n=3 > n=1 (with the corresponding energy difference)
or
n=3 > n=2 > n=1

spectrums

Absorption spectrums:
- these look like rainbom bars with black lines vertically across them
black lines > frequencies/wavelengths absorbed
Emission spectrums:
- these look like black bars with single coloured lines vertically across them
coloured line > emitted frequency/wavelength
** you should expect more lines on the emission spectrum as there is more paths it can take per photon absorbed when dexciting

photoelectric effect

photoelectric effect:
light is modelled as photons (~discrete packets of energy)
E = hf
if wave theory was correct then the surface electrons should be liberated with any f of light so long as its bright enough
when surface electrons are liberated from the surface, they have Ek.
it is a 1-1 interaction
- higher intensity **does not equal** Ek max
- 1 photon absorbed by 1 electron
- to measure the Ek set up an excavated tube with metal plates on either side connected to a battery.
- turn up the voltage on the battery until no electrons reach the other plate (the ammeter will read 0)
- this is the **stopping potential (Vs)**
V = E/Q > Vs = Ek/e > Ek max = eVs
(Ek max is electrons liberated from surface)
Graphs:
Ek max - f graph
y = mx +c
into
Ek max = hf - work funtion (always a negative)
the x intercept is the threshold frequency