

## 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. thermionic 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 mercury's stability)  
> electrons will continue to interact even after a single interaction as the field continues to accelerate them
4. electrons deexcite, 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 phosphorous 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 work
- 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 interference pattern is produced, bright rings 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) =  $\frac{1}{2}mv^2$   
and rearrange for v  
 $v = \sqrt{2eV/m}$   
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



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## 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 deexcites 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 deexcites 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 rainbow 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 deexciting

## 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  $E_k$ .  
it is a 1-1 interaction  
- higher intensity **does not equal**  $E_{k \max}$   
- 1 photon absorbed by 1 electron  
- to measure the  $E_k$  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 ( $V_s$ )**  
 $V = E/Q > V_s = E_k/e > E_{k \max} = eV_s$   
( $E_{k \max}$  is electrons liberated from surface)  
Graphs:  
 $E_{k \max} - f$  graph  
 $y = mx + c$   
into  
 $E_{k \max} = hf - \text{work function (always a negative)}$   
the x intercept is the threshold frequency



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