# Formulas

① $E_p$ (Energy of a photon) $= hf$

$$= \frac{hc}{\lambda}$$

② $\Phi$ (work function Energy) $= h\underbrace{f_0}_{\text{threshold frequency}}$

$$= \frac{hc}{\lambda_0}$$

③ $\underset{\text{of photoelectrons}}{K.E_{max}} = E_p - \Phi$

$$= hf - hf_0$$

$$= \frac{hc}{\lambda} - \frac{hc}{\lambda_0}$$

④ $\lambda = \frac{h}{p}$

$\lambda$ → De-broglie wavelength

$h$ → planck's constant

$p$ → momentum

⑤ $E = \frac{P^2}{2m}$ ← mass of particle

← Kinetic energy of particle

⑥ $P = \sqrt{2mE}$

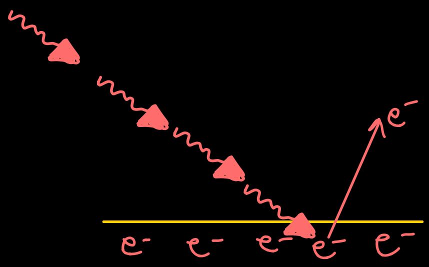
$= \sqrt{2mVq}$

# Photoelectric effect.

- Photoelectric emission is the release of electrons from the surface of a metal when electromagnetic radiation (light) is incident on its surface

$E_p$ (Energy of a photon) $= hf$

$= \frac{hc}{\lambda}$




Important points about photoelectric emmision

① If photoemission takes place, it does so instantaneously

② Photoemission takes place only if the frequency of the incident radiation is above a certain minimum value called thershold frequency, $f_0$.

↳ $\Phi = hf_0$ or $\frac{hc}{\lambda_0}$

③ Different metals have different threshold frequencies

④ Wheather or not emission takes place depends only on ②, it doesnot depend on intensity of the radiation

(5) For a given frequency, the rate of emission is proportional to the intensity of the radiation.

- A photon is the special name given to quantum (discrete packet) of energy when the energy is in form of electromagnetic radiation

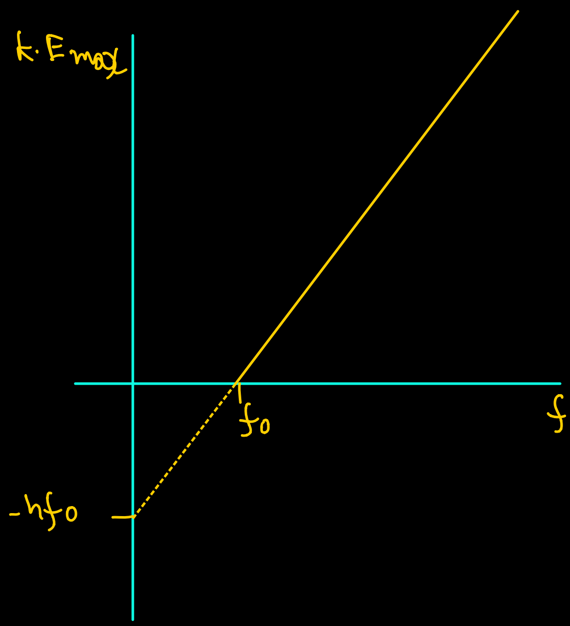
- The work function energy $\Phi$, is the minimum amount of energy necessary for an electron to escape from the surface.

- $K.E_{max} = hf - hf_0$

$y = mx \pm c$

$K.E_{max}$ vs $f$ graph

- gradient $= h$
- y-intercept $= -hf_0$

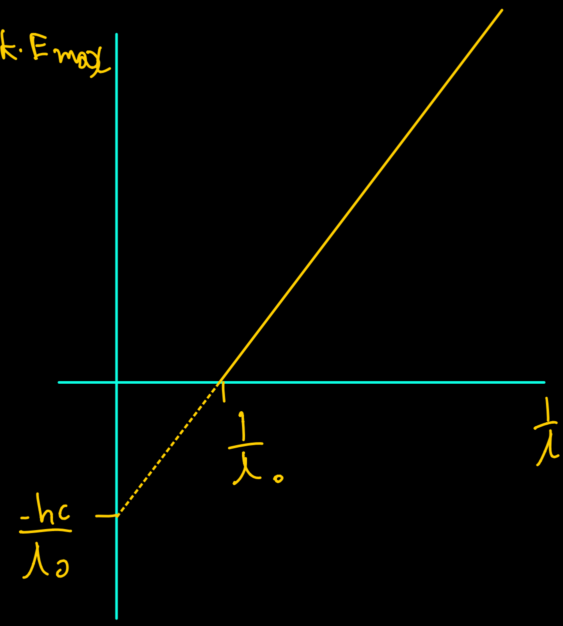



- $K.E_{max} = \dfrac{hc}{\lambda} - \dfrac{hc}{\lambda_0}$

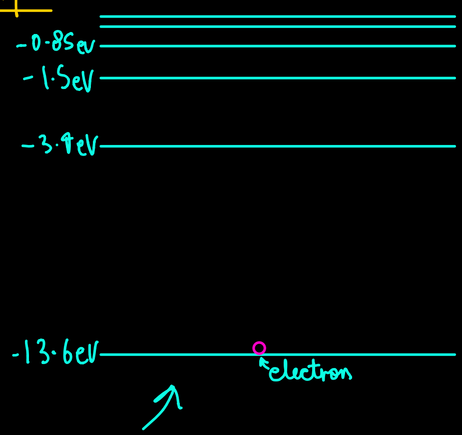
$y = mx \pm c$

$K.E_{max}$ vs $\frac{1}{\lambda}$ graph

- gradient $= hc$
- y-intercept $= -\dfrac{hc}{\lambda_0}$



# de Broglie wavelength




- $\lambda = \dfrac{h}{p}$

de broglie wavelength → $\lambda$ ; $p$ ← momentum of the particle

- Electrons in an atom can only have specific energy levels

- for an electron to jump to a higher energy level it must gain exacly a certain energy and get excited

- After a short time it will return to a lower level, for doing this, it must release energy, which it looses by emmiting a photon of electromagnetic radiation

- The energy of that photon $= E_2 - E_1 = \Delta E$

$E_2$: energy of higher level ; $E_1$: energy of lower level

- $\lambda = \dfrac{hc}{\Delta E}$

$\lambda$: wavelength of emitted radiation

• Each of these Transitions are of a perticular $\lambda$ and f and thus correspond to certain color line in the spectrum thus this can be used to identify presence of a particular element.

• $$\lambda = \frac{h}{P}$$

de broglie wavelength

momentum

used for derivation

$$K.E = \frac{1}{2} m v^2 \times \frac{m}{m}$$

$$K.E = \frac{(mv)^2}{2m}$$

$$P = mv$$

$$\therefore K.E = \frac{P^2}{2m}$$

$$\therefore P = \sqrt{2 \times KE \times m}$$

$$= \sqrt{2 \times mV \times q}$$

$$K.E = \frac{1}{2} m v^2$$

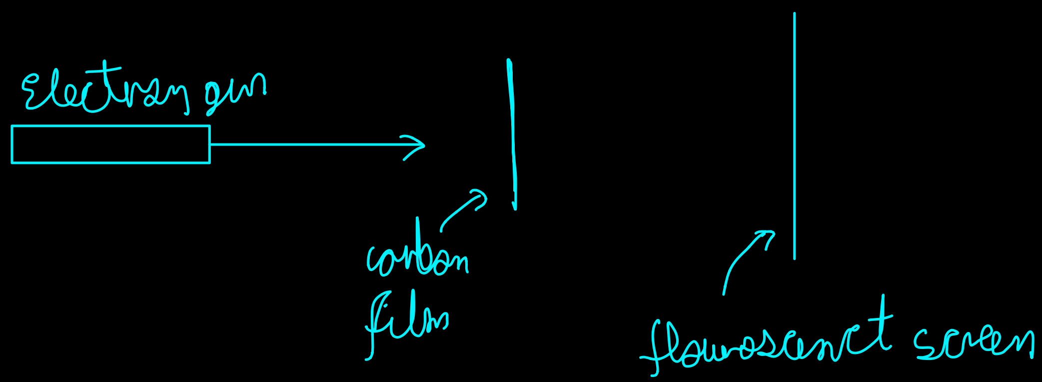
$$K.E = \frac{mv^2}{2} \times \frac{m}{m} = \frac{m^2 v^2}{2m}$$

$$P = mv$$

$$\therefore K.E = \frac{(P)^2}{2m}$$

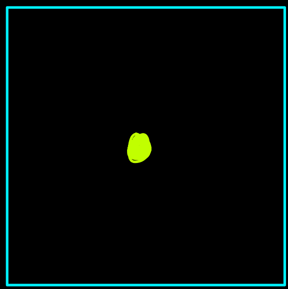
$$P = \sqrt{2 m KE}$$

$$= \sqrt{2 m V q}$$




① Proof of particles behaving like particles

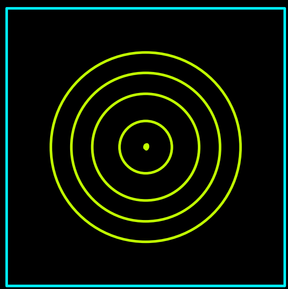
Screen looks like this :



Electrons uniformly distributed

② Proof of particles behaving like waves

Screen looks like this :



Concentric ring shows diffraction pattern.

**(a)** Explain how the line spectrum of hydrogen provides evidence for the existence of discrete electron energy levels in atoms.

Each line in the spectrum, represents photon of a specific energy, a photon is released as a result of this energy change of electron, this specific energy of which photon is released is the change in the descrete level of energy.

[3]

**(c)** The light in a beam has a continuous spectrum of wavelengths from 400 nm to 700 nm. The light is incident on some cool hydrogen gas, as illustrated in Fig. 7.2.

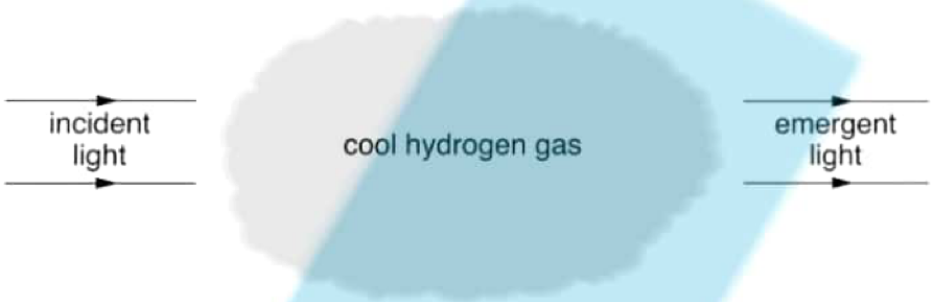



**Fig. 7.2**

Using the values of wavelength in **(b)**, state and explain the appearance of the spectrum of the emergent light.

Two dark lines will be observed in the continouse spectrum, electrons in the gas, absrob photons with energy equal to that of the excitation energy and while deexcitation, the light photons are re emmited in all the directions

[4]