ARJUNA NEET BATCH

Structure of Atom

LECTURE - 6

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Quick Recap

Planck's Quantum Theory

$E \propto \nu$

$E = \frac{hc}{\lambda}$ $\quad$ $E = nh\nu$

$\Rightarrow h = 6.626 \times 10^{-34}$ Js

$c = 3 \times 10^{8}$ m/s

Black-Body Radiations

$\Rightarrow$  → Red, orange, yellow — — — violet

Fe

$E \uparrow \quad \nu \uparrow \quad \lambda \downarrow$

$\Rightarrow$ **Photoelectric Effect**

$$\boxed{E_i = E_0 + K.E_0}$$

Stopping Potential

$$E_i = E_o + K.E.$$

$$\Rightarrow K.E. = E_i - E_o$$

$$\Rightarrow K.E. \Rightarrow \underline{\underline{q}} \times \underline{\underline{V}}$$

Charge potential diff.

$V_0 \rightarrow$ stopping pot.

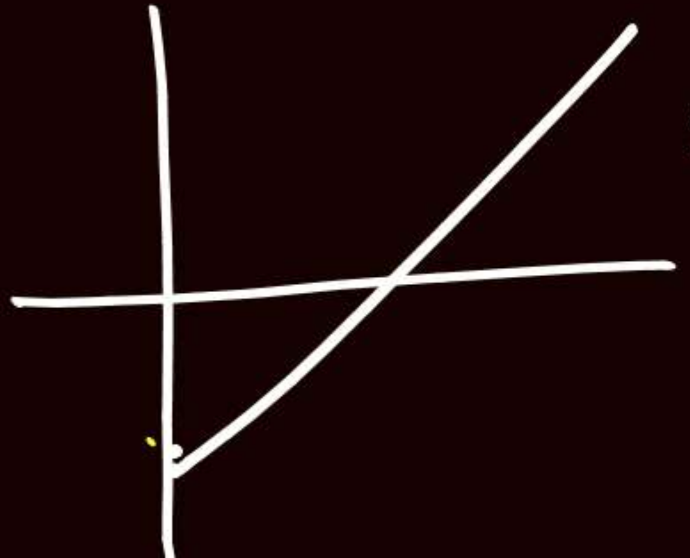
$$K.E. \Rightarrow q \times V_0$$

$$\Rightarrow e \times V_0$$

$$\Rightarrow eV_0 = h\nu_i - h\nu_0$$

$$\Rightarrow \boxed{V_0} = \frac{h\nu_i}{e} - \frac{h\nu_0}{e}$$

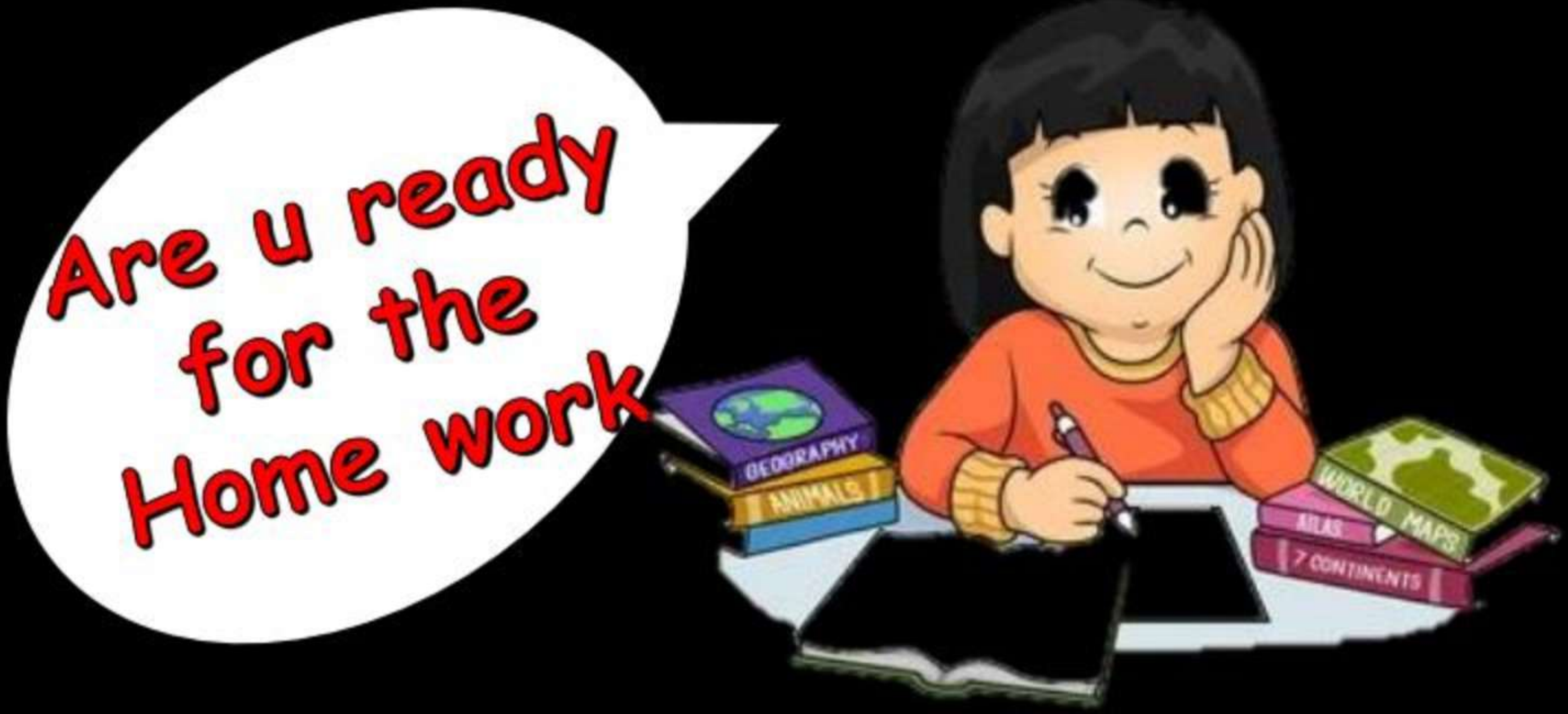
$$\Rightarrow \underline{\underline{Y}} = mx - c$$



Slope $= \frac{h}{e}$

Objective of today's class

SPECTRUM AND ITS TYPES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GEOGRAPHY
ANIMALS
WORLD MAPS
ATLAS
7 CONTINENTS

Q. Find the ratio of slope of plot K.E. v/s ν and v_0 v/s v

$\Rightarrow$ $K.E. = h\nu - h\nu_0$

$y = mx - c$

$m_1 = h$ — (1)

$V_0 = \frac{h}{e}\nu - \frac{h}{e}\nu_0$

$\Rightarrow y = mx - c$

$m_2 = h/e$ — (2)

$\Rightarrow \frac{(1)}{(2)} = \frac{h}{h/e} \Rightarrow \boxed{e : 1}$

Q. Light of frequencies v_1 & v_2 incident on metal surface so that K.E. of $e^{\ominus}$ in first case is double of K.E. in second case. Determined the relation between wavelength.

$$K.E._1 = 2(K.E)_2$$

$$h\nu_1 - h\nu_0 = 2(h\nu_2 - h\nu_0)$$

$$h\nu_1 - h\nu_0 = 2h\nu_2 - 2h\nu_0$$

$$\Rightarrow \cancel{h}\nu_0 = 2\cancel{h}\nu_2 - \cancel{h}\nu_1$$

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

$$\Rightarrow \frac{\cancel{c}}{\lambda_0} = 2\frac{c}{\lambda_2} - \frac{c}{\lambda_1}$$

$$\Rightarrow \boxed{\frac{1}{\lambda_0} = \frac{2}{\lambda_2} - \frac{1}{\lambda_1}}$$

Q. The energy difference between ground state and excited state of an atom is 4.4×10^{-19} J. Find the wavelength in nm correspond to the transition.

$\Rightarrow$ Excited state

ground state

$E = 4.4 \times 10^{-19}$ J

$\lambda = ?$ (nm)

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

$hc \Rightarrow 2 \times 10^{-25}$

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

$$\Rightarrow 4.4 \times 10^{-19} = \frac{2 \times 10^{-25}}{\lambda}$$

$$\Rightarrow \lambda = \frac{2 \times 10^{-25}}{4.4 \times 10^{-19} \times 10^{-9}} \Rightarrow \boxed{450 \text{ nm}}$$

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Q. The amount of energy ~~of energy~~ required to ionize a Na atom is equal to the energy associated with wavelength of 250 nm. Calculate the I.E. of Na in $\boxed{\text{KJ /mol}}$

$$Na \xrightarrow[-e^{\ominus}]{} Na^{+}$$

$E = ?$

$\lambda = 250\,nm$

I.E. → Ionisation energy

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

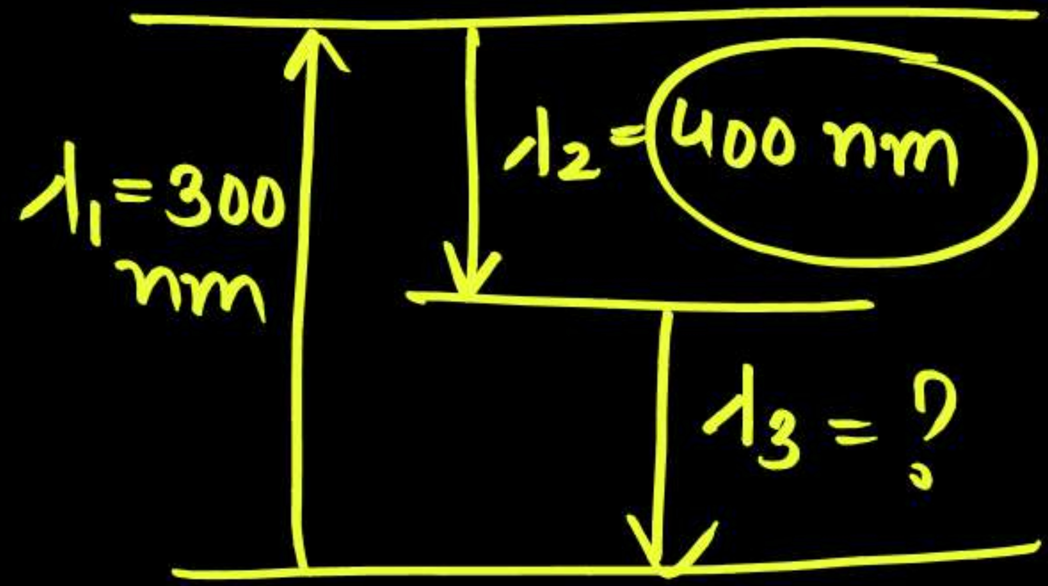
$$\Rightarrow \frac{2 \times 10^{-25}}{250 \times 10^{-9}} \times \frac{1}{1000} \times 6.02 \times 10^{23}$$

$$\Rightarrow \left[\frac{2}{250} \times 6.02\right] \times 10^{-25+\underline{23+9}-3}$$

$$-28 + 32$$

$$\Rightarrow 0.4816 \times 10^{4} \Rightarrow 481.6\ KJ/mole$$

Q. A photon of wavelength 300 nm is absorbed at high energy level from ground state. It emits two photon. Wavelength of one of the photon is 400 nm. Then find the wavelength of other.



$$E_1 = E_2 + E_3$$

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

$$\Rightarrow \frac{\cancel{hc}}{\lambda_1} = \frac{\cancel{hc}}{\lambda_2} + \frac{\cancel{hc}}{\lambda_3}$$

$$\Rightarrow \frac{1}{\lambda_1} = \frac{1}{\lambda_2} + \frac{1}{\lambda_3}$$

$$\Rightarrow \frac{1}{300} = \frac{1}{400} + \frac{1}{\lambda_3}$$

$$\frac{1}{\lambda_3} = \frac{1}{300} - \frac{1}{400}$$

$$\frac{1}{\lambda_3} = \left(\frac{4-3}{1200}\right)$$

$$\boxed{\lambda_3 = 1200\,nm}$$

Q. A certain metal when irradiated with light ($\nu = 3.2 \times 10^{16}$ Hz) emits photo $e^{\ominus}$ with twice K.E. as did photo $e^{\ominus}$ when the same metal is irradiated by light ($\nu = 2.0 \times 10^{16}$ Hz). Calculate threshold frequency of $e^{\ominus}$.

$\nu_1 = 3.2 \times 10^{16}$ Hz

$\downarrow$

emits photo $e^{\ominus}$

$\downarrow$

2 K.E.

$\nu_2 = 2.0 \times 10^{16}$ Hz

$K.E_1 = 2 K.E_2$

$$\Rightarrow \frac{(K.E_1)}{(K.E.)_2} = \frac{h\nu_1 - h\nu_0}{h\nu_2 - h\nu_0}$$

$$\Rightarrow \frac{2\cancel{(K.E.)_2}}{\cancel{(K.E.)_2}} \Rightarrow \frac{2}{1} = \frac{\cancel{h}(\nu_1 - \nu_0)}{\cancel{h}(\nu_2 - \nu_0)}$$

$$\Rightarrow \frac{2}{1} = \frac{3.2 \times 10^{16} - \nu_0}{2.0 \times 10^{16} - \nu_0}$$

$$\Rightarrow 4.0 \times 10^{16} - 2\nu_0 = 3.2 \times 10^{16} - \nu_0$$

$$\Rightarrow 4.0 \times 10^{16} - 3.2 \times 10^{16} = \nu_0$$

$$\Rightarrow 10^{16}(4.0 - 3.2) = \nu_0$$

$$\Rightarrow 10^{16} \times 0.8 = \nu_0$$

$$\boxed{\nu_0 = 8 \times 10^{15}\ Hz}$$

Q. Photo electrons are removed with K.E. 1.864×10^{-21} Joule. When photons of light with energy 4.23×10^{-19} J fall on the metal. What is the minimum energy in KJ required per mole to remove an $e^{\ominus}$ from potassium metal.

$K.E. = 1.864 \times 10^{-21}$ Joule

$\Rightarrow E_i = 4.23 \times 10^{-19}$ J

$E_0 = ?$

Photoelectric Eqn

$$\boxed{E_i = E_0 + K.E.}$$

$$E_0 = E_i - K.E.$$

$$\Rightarrow 4.23 \times 10^{-19}\,J - 1.864 \times 10^{-21}$$

$$\Rightarrow 423 \times 10^{-21} - 1.864 \times 10^{-21}$$

$$\Rightarrow \frac{10^{-21}(423 - 1.864) \times 6.02 \times 10^{23}}{1000}$$

$$\Rightarrow 253.6\ \text{KJ/mole}$$

Q. The energy absorbed by each molecule (A_2) of a substance is 4.4×10^{-19} J and bond energy per molecule is 4.0×10^{-19} J. The kinetic energy of the molecule per atom will be?

A_2 $\underbrace{E_{absorbed} = 4.4}_{E_i^{\circ}} \times 10^{-19}$ J

$E_0 = 4.0 \times 10^{-19}$ J

$\Rightarrow E_i^{\circ} = E_0 + K.E_0$

$\Rightarrow K.E = E_i^{\circ} - E_0$

$A - A$ ← Bond Energy

$\Rightarrow 4.0 \times 10^{-19}$ J

$\Rightarrow K.E. = 4.4 \times 10^{-19} - 4.0 \times 10^{-19}$

$\Rightarrow \dfrac{0.4 \times 10^{-19} \text{ Joule}}{2}$

$(K.E)$ per atom $\Rightarrow 0.2 \times 10^{-19}$ Joule

Q. Light of wavelength 400 nm stickes a metal surface with threshold energy 2.13 eV. Calculate the K.E. of most energetic $e^{\ominus}$.

$\lambda = 400\ nm$

$E_0 = 2.13\ ev$

$\Rightarrow K.E. = E_i - E_0$

$\Rightarrow E = ev$

$\lambda = A^\circ$

$hc = 12400$

$$\lambda = \frac{400 \times 10^{-9}}{10^{-10}}$$

$$\boxed{\lambda = 4000\ A^\circ}$$

$$E_i = \frac{hc}{\lambda} = \frac{124\cancel{00}}{40\cancel{00}}$$

$\Rightarrow \underline{3.1\ eV}$

$K.E. = E_i - E_0$

$\Rightarrow 3.1 - 2.13$

$\Rightarrow \underline{0.97\ eV}$

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Q. The wavelength of incident light is 400 nm. Calculate the no. of metals which can show photoelectric effect from the following:-

Metal	Li	Na	K	Cs	Mg	Ca
ϕ (ev)	3.7	4.2	1.8	0.9	5.2	3.13

$\lambda_i = 400\ nm$ $\quad E_i > E_0$ $\quad \lambda = \dfrac{400 \times 10^{-9}}{10^{-10}} = 4000 A^\circ$

$E_i = \dfrac{hc}{\lambda} \Rightarrow \dfrac{124\cancel{00}}{40\cancel{00}} \Rightarrow 3.1 eV$

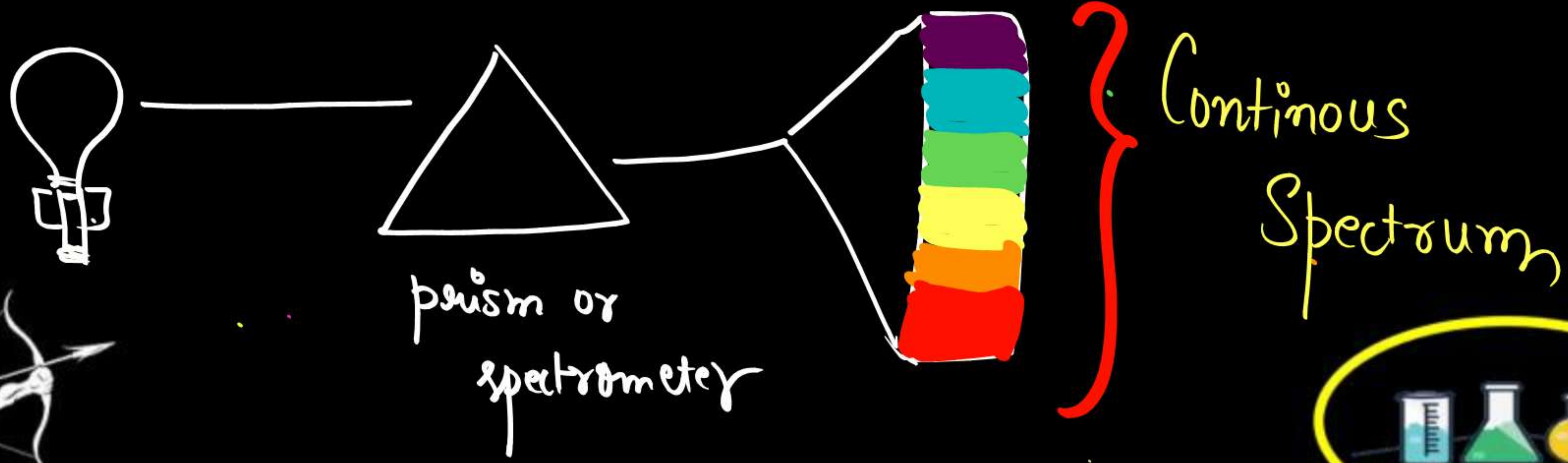
Ans - 2

E_i

SPECTRUM AND ITS TYPES

Separation of given radiation into different frequency and colours into a band is known as **SPECTRUM**.

Absorption spectrum is photographic – ive of Emission spectrum.



Difference between emission and absorption spectra

Excited

	Emission Spectrum	Absorption Spectrum
	Obtained when radiations emitted by the exited substance analysed by a Spectroscope	Obtained when substances absorb energy and the left transmitted light is analysed by a spectroscope.
	Emission spectrum consists of bright coloured line separated by dark space.	Absorption spectrum consists of dark lines and colours opposite to continuous spectrum.

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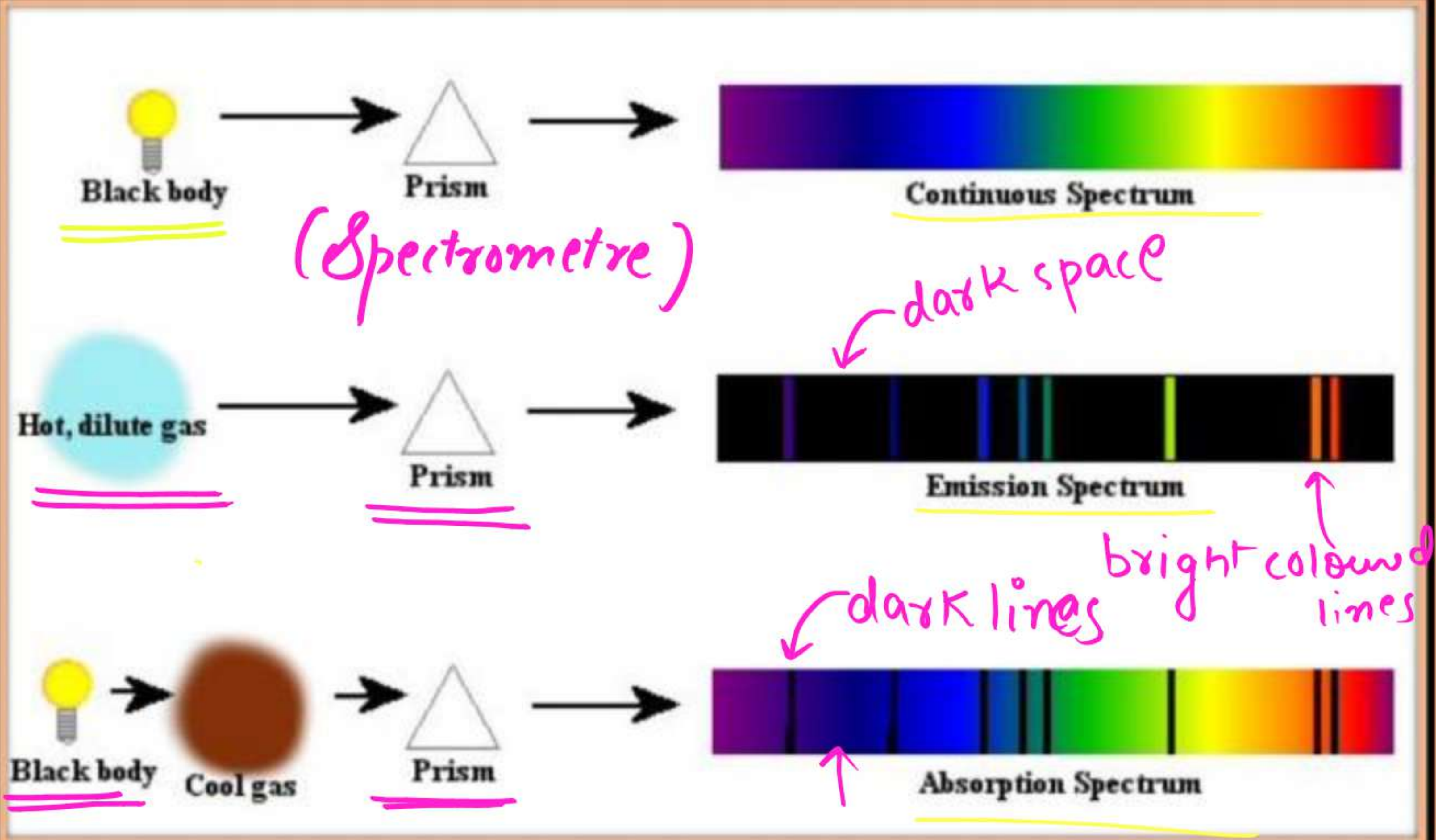

Ois continous

thanks
for watching

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