VIDYAPEETH

BATCH CODE: 19-PJ301EA 2025

SUBJECT NAME: CHEMISTRY

CHAPTER NAME:

Atomic Structure

Lecture No. 02

By – Swapnil Sir

Today's Goal

Subtopic

Black body radiation

discovery of → p
→ n

→ Anode Rays ⇒ { proton }

→ Structure → Thomson's model ×
→ Rutherford's Model → { α-particles scattering expo }
→ failure of model { Maxwell, E-M. }
→ Bohr's model { ... electron System }

Black Body Radiation (Plank's hypothesis)

Dual nature (de-Broglie)

Photoelectric Effect

spectrum

Bohr's Atomic Model :⇒ { One electron system } (p+n) = H

(p) = Z ✗

⇒ Quantisation

n = Energy level
or
Shell
or
Orbit

Angular momentum $= n \cdot \frac{h}{2\pi}$

$m v_n r_n = n \cdot \left(\frac{h}{2\pi}\right)$

h = Universal Plank's Constant

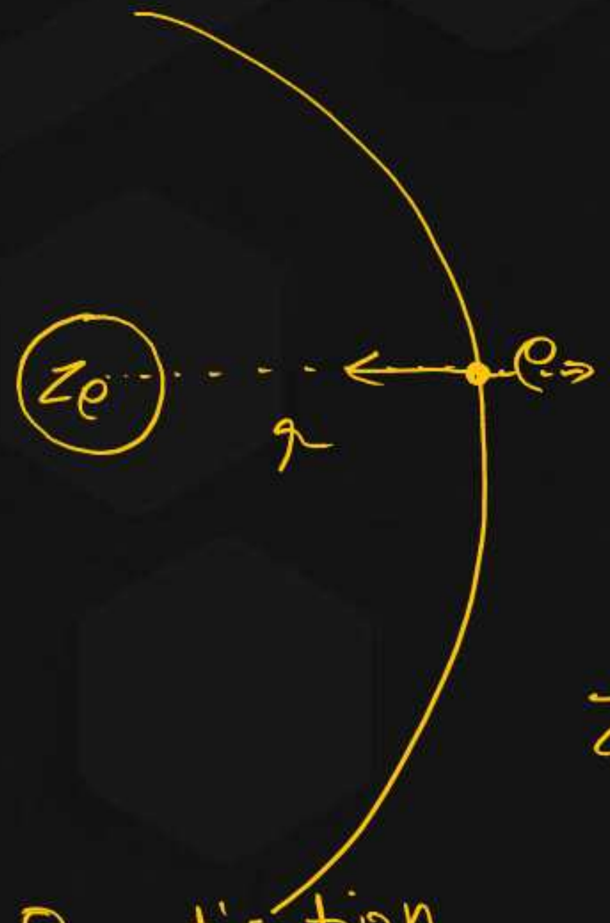
Ist Energy Shell | Ist Shell | Ist orbit

Bohr's orbit (n=1)

n=1 ⇒ $mvr = \frac{h}{2\pi}$

n=2 $m v_2 r_2 = 2 \cdot \left(\frac{h}{2\pi}\right)$

1 | r_n (Radius of n ...) ; Atomic Number Z



$$F_e = \frac{1}{4\pi\varepsilon_0}\frac{Ze\cdot e}{r^2} \quad \text{--- (1)}$$

$$F_c = \frac{mv^2}{r} \quad \text{--- (2)}$$

e ⇒ electron present in it's path.

eq. (1) = eq. (2)

$$\frac{1}{4\pi\varepsilon_0}\cdot\frac{Ze^2}{r^2} = \frac{mv^2}{r}$$

Bohr's Quantisation

$$mvr = n\cdot\frac{h}{2\pi} \quad \text{--- (3)}$$

$$\frac{1}{4\pi\varepsilon_0}\cdot\frac{Ze^2}{r^2} = \frac{m}{r}\times\left(\frac{nh}{2\pi m r}\right)^2$$

$$\Rightarrow \frac{1}{4\pi\varepsilon_0}\cdot Ze^2 = \frac{n^2h^2\cdot m}{4\pi^2\cdot m^2\cdot r} = \frac{n^2h^2}{4\pi^2\cdot m\cdot r}$$

$$\Rightarrow \frac{Ze^2}{\varepsilon_0} = \frac{n^2h^2}{\pi\cdot m\cdot r}$$

$$\pi m r Z\cdot e^2 = n^2\cdot h^2\cdot\varepsilon_0$$

$$r = \frac{n^2}{Z}\left(\frac{h^2\cdot\varepsilon_0}{\pi m e^2}\right) = \frac{n^2}{Z}\cdot K$$

$$r_n = K\cdot\frac{n^2}{Z}$$

$$r_n = K \cdot \frac{n^2}{Z}$$

For H-atom

$Z = 1$, $n = 1$

$$r = K$$

$$r_1 = r_0$$

$$r_0 = 0.529 \, Å$$

Bohr's orbit

$$r_n = r_0 \cdot \frac{n^2}{Z}$$

(II) Energy of n^{th} orbit :->

$$P.E. = -\frac{1}{4\pi\varepsilon_0} \frac{Ze \cdot e}{r}$$

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

$$K.E. = \frac{1}{2}\left(\frac{1}{4\pi\varepsilon_0} \cdot \frac{Ze \cdot e}{r}\right)$$

Total energy = P.E. + K.E.

$$E = \left(-\frac{1}{4\pi\varepsilon_0} \cdot \frac{Ze^2}{r}\right) + \frac{1}{2}\left(\frac{1}{4\pi\varepsilon_0} \cdot \frac{Ze^2}{r}\right)$$

$$E = -\frac{1}{2} \cdot \frac{1}{4\pi\varepsilon_0} \cdot \frac{Ze^2}{r}$$

$$E_T = \frac{1}{2} \cdot (P.E.) = -(K.E.)$$

$$E_n = -\frac{1}{2} \cdot \frac{1}{4\pi\varepsilon_0} \cdot \frac{Ze^2}{r_n}$$

$$E_n = -\frac{1}{2} \cdot \frac{1}{4\pi\varepsilon_0} \cdot \frac{Ze^2 \times \pi m e^2 \cdot Z}{n^2 h^2 \cdot \varepsilon_0}$$

$$E_n = -\frac{Z^2}{n^2}\left(\frac{e^4 \cdot m}{8 \varepsilon_0^2 \cdot h^2}\right)$$

$$E_n = -K \cdot \frac{Z^2}{n^2}$$

$$E_n = -K \cdot \frac{Z^2}{n^2}$$

For H atom

$Z = 1$

$n = 1$ (Bohr's orbit)

$$E_1 = -K$$

$$K = 13.6 \text{ eV}$$

$E_1 = -K$

$E_2 = -\frac{K}{4}$

$E_3 = -\frac{K}{9}$

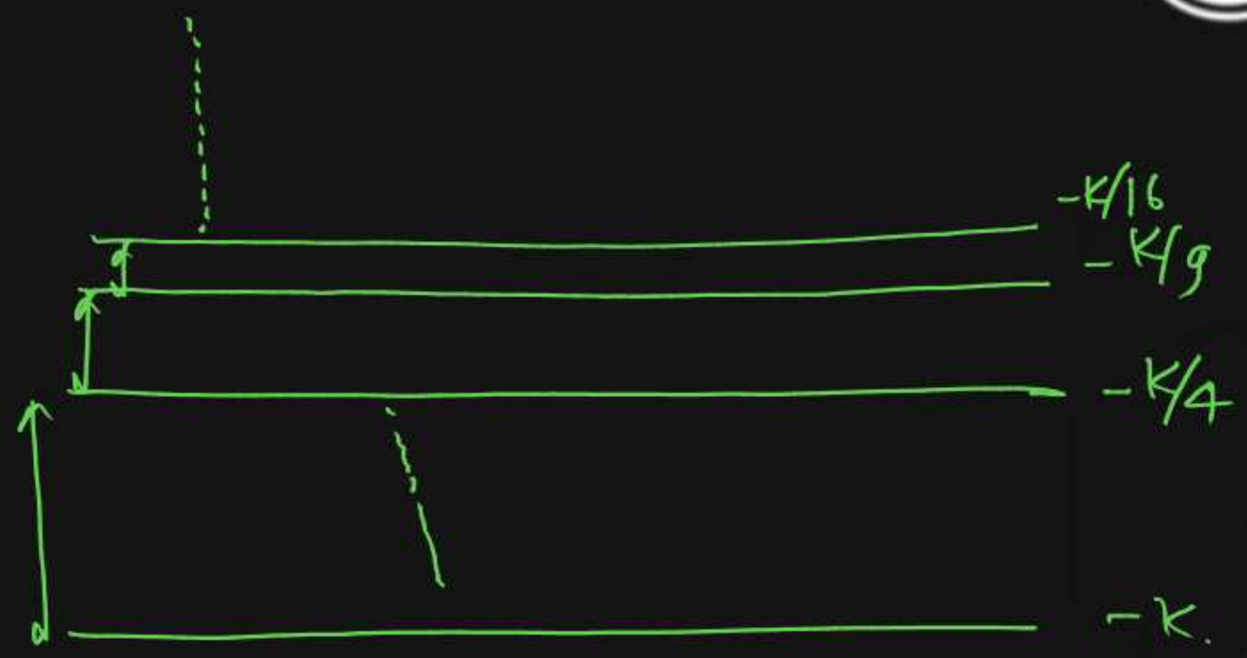
$n \to \infty$

$E_\infty \to 0$

$$I.E. = E_\infty - E_1$$

$= 0 - (-K)$

$= K$



I.P.

#

$$mvr = n \cdot \frac{h}{2\pi}$$

$$v = \frac{n \cdot h}{2\pi \cdot m\left(\frac{n^2}{Z} \cdot K\right)}$$

$$v = \frac{Z}{n}\left(\frac{h}{2\pi \cdot m \cdot K}\right)$$

$$V_n = \frac{Z}{n}(V_0)$$

V_0 = Speed in Bohr's orbit

2.18×10^6 m/sec.

$$T = \frac{2\pi r}{v}$$

$$T = \frac{2\pi \cdot r_0 \cdot n^2/Z}{v_0 \cdot (Z/n)}$$

Time perio

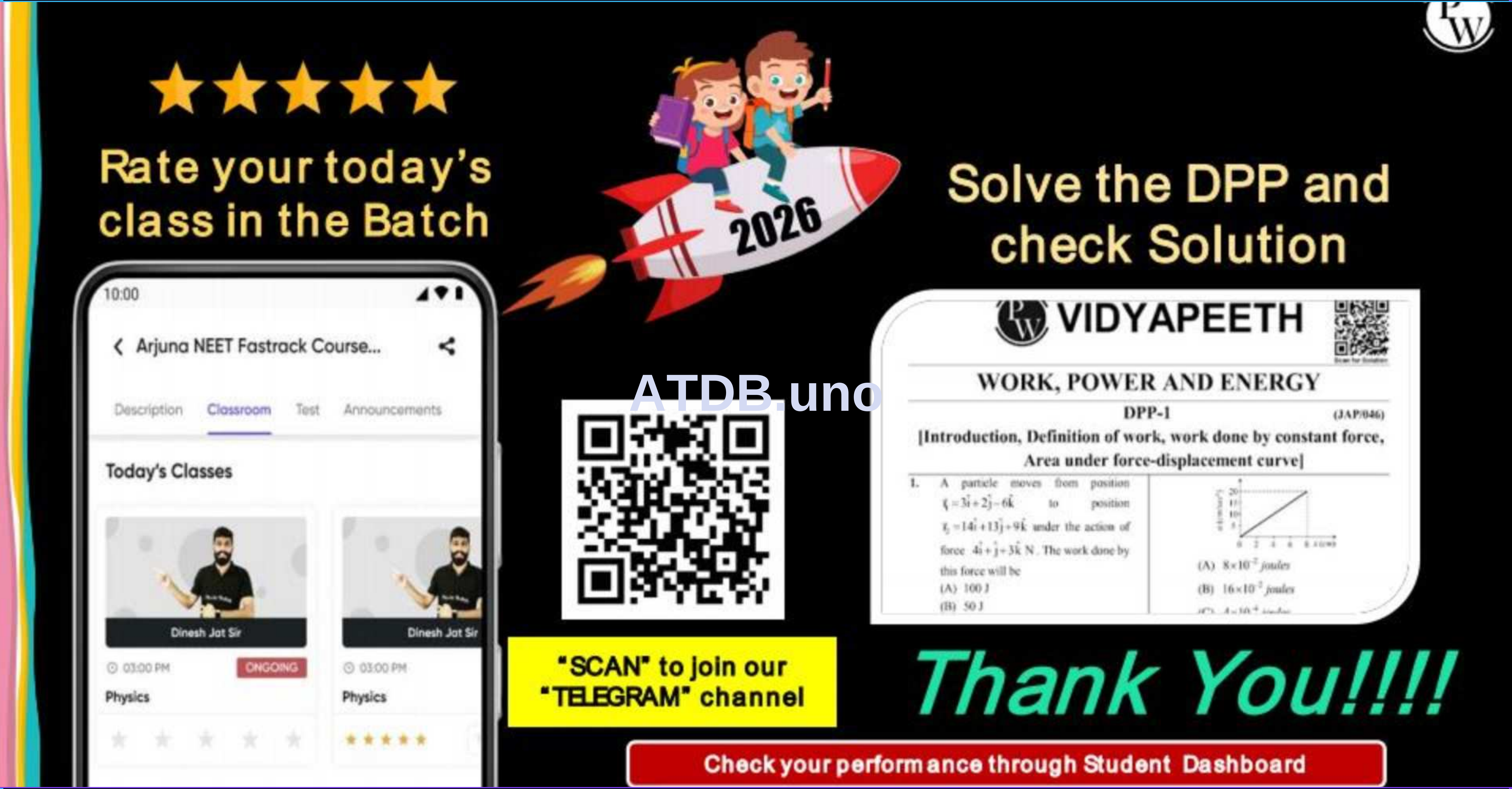
$$T_n = \left(\frac{2\pi \cdot r_0}{V_0}\right) \cdot \frac{n^3}{Z^2}$$

#Pb: find ratio of radius of II orbit of He (Z=2) to III orbit of Li (Z=3)

$$r_2 = r_0\left(\frac{n^2}{Z}\right) = r_0 \cdot \frac{4}{2} = 2r_0$$

$$r_3 = r_0\left(\frac{n^2}{Z}\right) = r_0\left(\frac{9}{3}\right) = 3r_0$$

$$\frac{2}{3}$$


Rate your today's class in the Batch
10:00
Arjuna NEET Fastrack Course...
Description
Classroom
Test
Announcements
Today's Classes
Dinesh Jat Sir
03:00 PM
ONGOING
Physics
Dinesh Jat Sir
03:00 PM
Physics
2026
Solve the DPP and check Solution
VIDYAPEETH
WORK, POWER AND ENERGY
DPP-1
(JAP/046)
[Introduction, Definition of work, work done by constant force, Area under force-displacement curve]
ATDB.uno
"SCAN" to join our "TELEGRAM" channel
Thank You!!!!
Check your performance through Student Dashboard