

# PRAYAS

## JEE 2025

ATDB.uno

Lecture - 02

Physics

modern physics (Debroglie wavelength)  
matter wave

By- Saleem Ahmed Sir





# Topics *to be covered*

1

Debroglie Wavelength

2

Matter wave

3

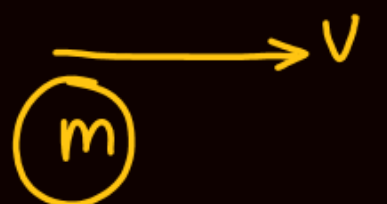
4

ATDB.uno

photon

$$p = \frac{h}{\lambda}$$

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



$$\lambda_d = \lambda = \frac{h}{mv} = \frac{h}{p}$$

ATDB.uno

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

$$p = \frac{h\nu}{c}$$

$$\textcircled{m} \xrightarrow{v}$$

$$\lambda_d = \frac{h}{mv}$$

$$\textcircled{2\text{kg}} \xrightarrow{10\text{m/s}}$$

$$\lambda = \frac{h}{mv} = \frac{6.6 \times 10^{-34}}{2 \times 10}$$

$$= 3.3 \times 10^{-35} \text{ m}$$

$$\textcircled{e^-} \xrightarrow{10\text{mm/s}}$$

$$\lambda = \frac{6.6 \times 10^{-34}}{9.1 \times 10^{-31} \times 10 \times 10^{-3}} = \underline{\underline{.07\text{m}}}$$

$$\lambda_d = \frac{h}{mv} = \frac{h}{\sqrt{2m(k \cdot \epsilon)}}$$

$$\lambda_d = \frac{h}{mv} = \frac{h}{\sqrt{2m(k \cdot \epsilon)}}$$

$$\textcircled{m} \xrightarrow{v}$$

$$p = mv$$

$$KE = \frac{1}{2}mv^2 = \frac{p^2}{2m}$$

$$p = \sqrt{2m(k \cdot \epsilon)}$$

## Matter Wave



\* If a particle of mass  $m$  is moving with speed  $v$  then de Broglie wavelength associated with this particle is given by

$$\lambda = \frac{h}{mv}$$

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

$$\lambda_d = \frac{h}{mv} = \frac{h}{p} = \frac{h}{\sqrt{2m(K.E.)}}$$

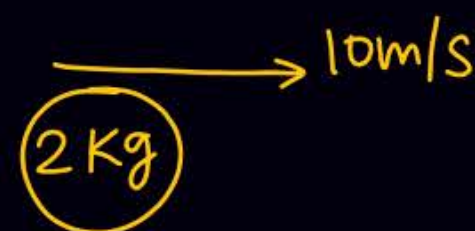
$$p = \sqrt{2m(K.E.)}$$

\* If light shows dual aspects (particle as well as wave), so matter (particle) wave associated with moving particle is called matter wave. Should also have wave nature (De Broglie)





Q

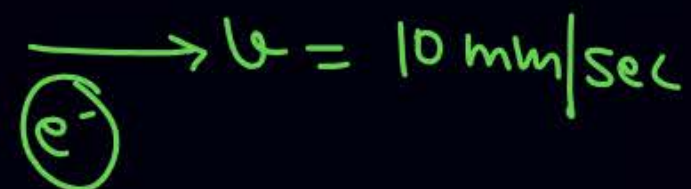


$$\lambda_d = \frac{h}{mv} = \frac{6.6 \times 10^{-34}}{2 \times 10} = 3.3 \times 10^{-35} \text{ m}$$

↳ Insignificant data

This deBroglie hypothesis is more significant for subatomic particles -  $e^-$ ,  $p^+$ , neutron - -

ATDB.uno

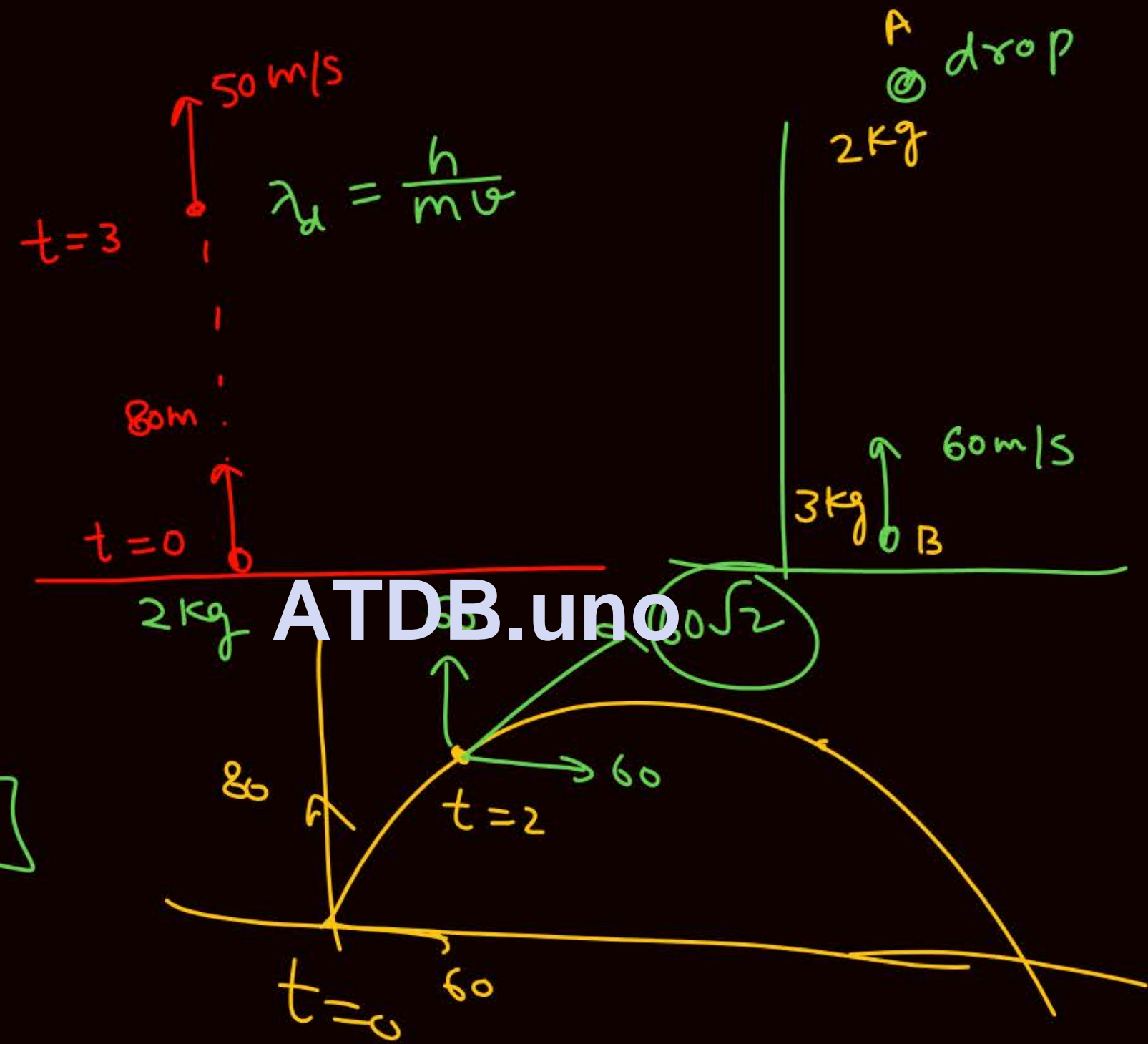
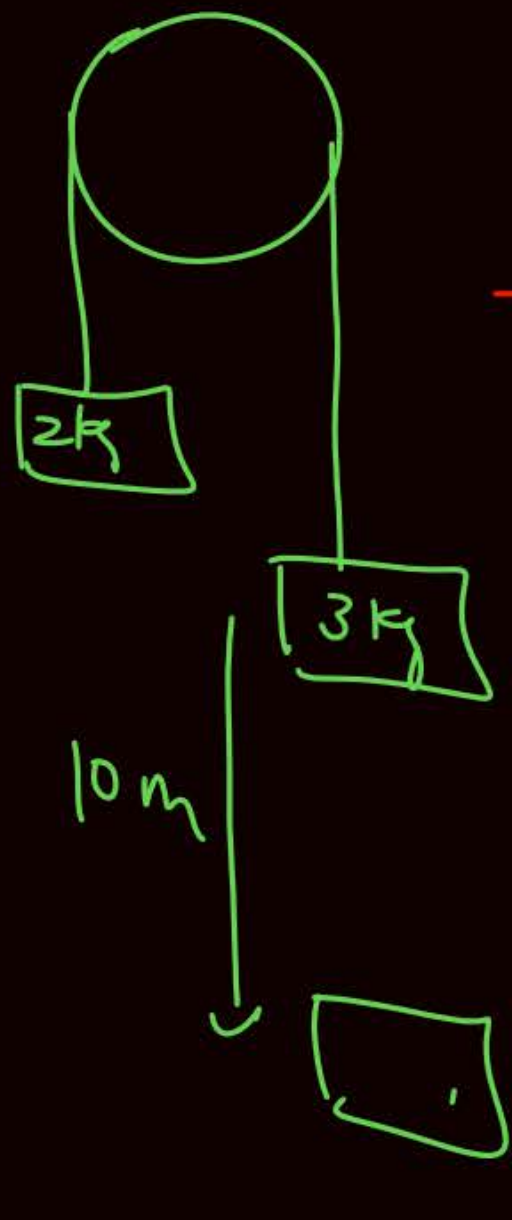


$$\lambda_d = \frac{h}{mv} = \frac{6.6 \times 10^{-34}}{9.1 \times 10^{-31} \times 10 \times 10^{-3}} \approx \underline{\underline{.074 \text{ m}}}$$



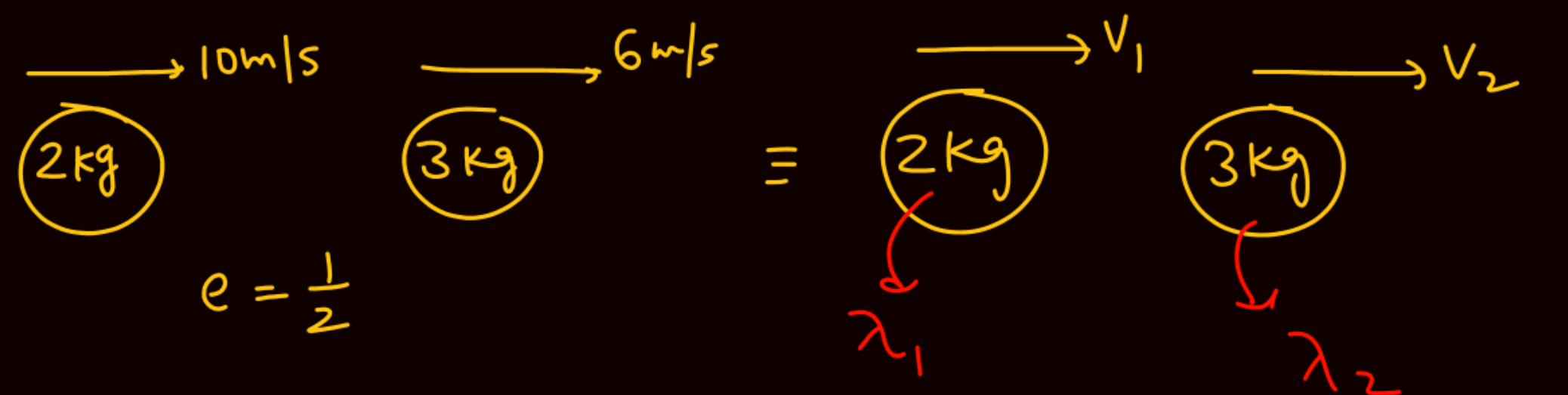
$$\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2m(K.E)}}$$

①



$$\frac{\lambda_A}{\lambda_B} = \frac{m_B v_B}{m_A v_A}$$

$$= \frac{3 \times 10}{2 \times 50}$$



ATDB.uno =

$i = v_d e n A$

Rest  $10\text{kg}$   $v_2$   $4\text{kg}$   $6\text{kg}$   $\lambda_1 v_1$

$v_d = \frac{i}{e n A}$

$\lambda_d = \frac{h}{m_e v_d}$

$0 = 6v_1 - 4v_2$

$6v_1 = 4v_2$

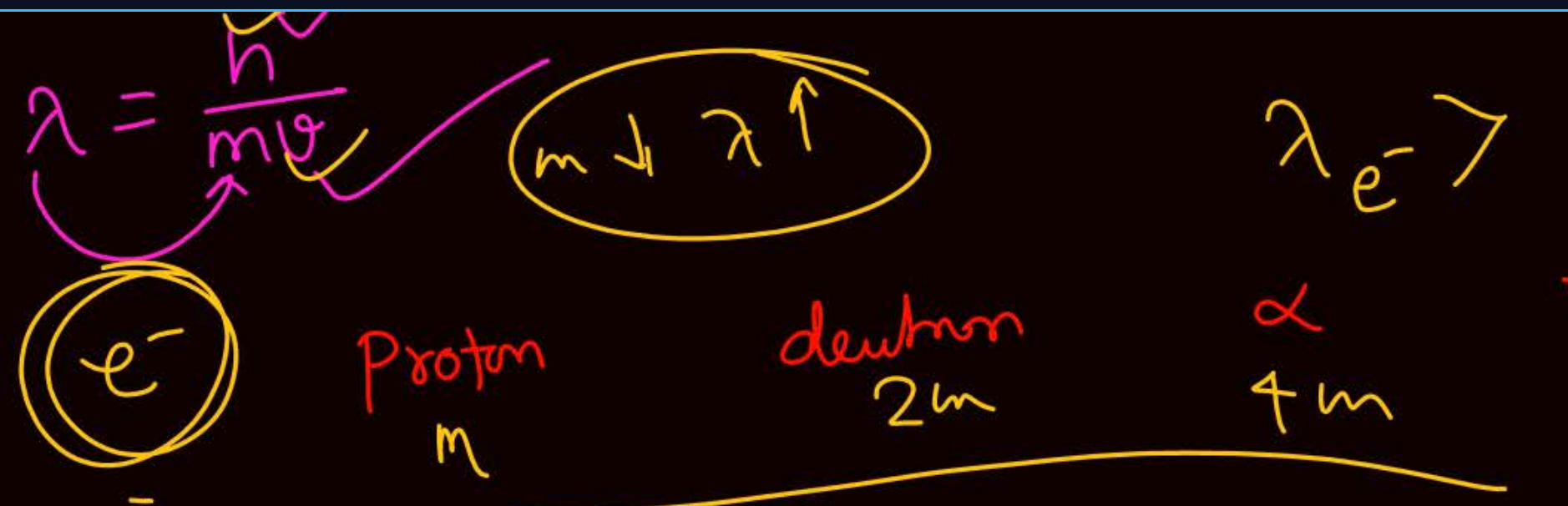
$\frac{\lambda_1}{\lambda_2} = \frac{m_2 v_2}{m_1 v_1} = \frac{4v_2}{6v_1} = 1$

$\lambda_1 = \lambda_2$

ATDB.uno

	mass	charge
proton	$m$	$+e$
deuteron	$2m$	$+e$
$\alpha$	$4m$	$+2e$

ATDB.uno



$\equiv$  Same velocity

$\lambda_p : \lambda_d : \lambda_\alpha$

$\frac{1}{m_p} : \frac{1}{m_d} : \frac{1}{m_\alpha}$

$\lambda_\alpha : \lambda_p : \lambda_d$

$\frac{1}{4m} : \frac{1}{m} : \frac{1}{2m}$

1 : 4 : 2

$\frac{1}{m} : \frac{1}{2m} : \frac{1}{4m}$

4 : 2 : 1

ATDB.uno

## बैराम Qms (1)



Q If  $\alpha$  particle, proton & deuteron are moving with same velocity  
find ratio of de Broglie w/l

$$\lambda_{\alpha} : \lambda_p : \lambda_d$$

$$\lambda = \frac{h}{mv}$$

$$\textcircled{1} \quad \lambda_{\alpha} : \lambda_p : \lambda_d \Rightarrow \frac{1}{4m} : \frac{1}{m} : \frac{1}{2m}$$

$$\Rightarrow 1 : 4 : 2$$

	mass	Charge
Proton $\Rightarrow$	$m$	$+e$
deuteron $\Rightarrow$	$2m$	$+e$
$\alpha$ $\Rightarrow$	$4m$	$+2e$

रनारा

$$\textcircled{2} \quad \lambda_{\alpha} : \lambda_d : \lambda_p \Rightarrow \frac{1}{4m} : \frac{1}{2m} : \frac{1}{m} \Rightarrow 1 : 2 : 4$$

SKC



\* अगर मैं किसी चार्ज  $q$  को Rest से  $\Delta V$  pot-diff से accelerate करवाऊँ तो उसकी Final K.E.  $q \Delta V$  होगी

$$(KE)_f = q \Delta V \rightarrow \text{pot. Diff.}$$

ATDB.uno



Q If  $e^-$ , proton, deuteron,  $\alpha$  particle are accelerated from rest by potential diff  $\Delta V$ . Find  $\lambda_d$  of them

Sol<sup>n</sup>

$$(KE)_f = q \Delta V$$

$$\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2m(KE)}} = \frac{h}{\sqrt{2mq\Delta V}} = \sqrt{\frac{h^2}{2mq\Delta V}}$$



for  $e^- \Rightarrow \lambda_{e^-} = \sqrt{\frac{(6.6 \times 10^{-34})^2}{2 \times 9.1 \times 10^{-31} \times 1.6 \times 10^{-19} \times \Delta V}} = \sqrt{\frac{150}{\Delta V}} \text{ \AA}$

(करीब Next page)

RM

If charge is accelerated by potential difference $R_m$ 

$$\text{for } e^- \Rightarrow \lambda = \sqrt{\frac{150}{V}} \text{ \AA}$$

$$\lambda = \frac{h}{mu} = \frac{h}{\sqrt{2m(K.E)}} = \frac{h}{\sqrt{2mq\Delta V}}$$

$$\text{for } p^+ \Rightarrow \lambda = \sqrt{\frac{0.81}{V}} \text{ \AA}$$

$$\text{or } \frac{h}{\sqrt{2mqV}}$$

$$\text{for deuteron} \Rightarrow \lambda = \sqrt{\frac{0.01}{V}} \text{ \AA}$$

ATDB.uno

$$\text{for } \alpha \text{ particle} \Rightarrow \lambda = \sqrt{\frac{0.0102}{V}} \text{ \AA}$$

Q If an electron is accelerated from rest by potential diff 50 volt

$$\lambda_d = ?$$

Sol<sup>n</sup>

$$\lambda = \sqrt{\frac{150}{V}} = \sqrt{\frac{150}{50}} = \sqrt{3} \text{ \AA}$$

ATDB.uno





Q If an electron is accelerated by potential diff 50 volt

$$\lambda_d = ?$$

Sol<sup>n</sup>

$$\lambda_d = \sqrt{\frac{150}{V}} = \sqrt{\frac{150}{50}} = \sqrt{3} \text{ \AA}$$

ATDB.uno



Q If (KE) of electron is 50 eV. If this electron is accelerated by pot. diff of 30 volt. find  $\lambda_d = ?$

Sol<sup>n</sup>

$$\lambda_1 = \sqrt{\frac{150}{\Delta V_{eff}}} = \sqrt{\frac{150}{80}} \text{ \AA}$$

$$\lambda_2 = \sqrt{\frac{150}{\Delta V_{eff}}} = \sqrt{\frac{150}{20}} \text{ \AA}$$

ATDB.uno



$$\Delta U = q \Delta V = e 80 = \underline{80 \text{ eV}}$$

$$\lambda = \sqrt{\frac{150}{80}}$$

$e, p^+, d, \alpha$  = are acc. from rest with same pot diff.

$$\lambda_{e^-} \quad \lambda_{p^+} \quad \lambda_d \quad \lambda_\alpha$$

$$\lambda = \frac{h}{\sqrt{2m \cdot q \Delta V}}$$

ATDB.uno

$$\lambda \propto \frac{1}{\sqrt{mq}}$$



वैशर्म Ques (2)

JEE 25

$$\lambda = \frac{h}{\sqrt{2m q \Delta V}}$$

Q If proton, deuteron, alpha particle are accelerated by same potential diff  $\Delta V$  from rest

find  $\lambda_p : \lambda_d : \lambda_\alpha$

ATDB.uno



वेराम Qms (2)

JEE 25

$$\lambda = \frac{h}{\sqrt{2mq\Delta V}}$$

Q If proton, deuteron, alpha particle are accelerated by same potential diff  $\Delta V$  from rest

find

$$\lambda_p : \lambda_d : \lambda_\alpha$$

ATDB.uno

$$\lambda_p : \lambda_d : \lambda_\alpha \equiv \frac{1}{\sqrt{me}} : \frac{1}{\sqrt{2me}} : \frac{1}{\sqrt{4m \cdot 2e}}$$

$$\lambda \propto \frac{1}{\sqrt{mq}}$$

$$\equiv 1 : \frac{1}{\sqrt{2}} : \frac{1}{2\sqrt{2}}$$

$$\equiv 2\sqrt{2} : 2 : 1$$



Q ① For what K.E. of a neutron will the associated de-broglie wavelength is  $1.4 \text{ \AA}$

$$m_n = 1.66 \times 10^{-27} \text{ kg}$$

$$\lambda = \frac{h}{\sqrt{2m(K.E.)}}$$

$$K.E. = \frac{h^2}{\lambda^2 2m}$$

② Find the debroglie w/l of neutron in thermal equilibrium of matter, having avg kinetic Energy of  $\frac{3}{2} kT$  at  $300\text{K}$ .

given  $k = 1.38 \times 10^{-23} \text{ J/Kg}$

$$m_n = 1.66 \times 10^{-27} \text{ kg}$$



Q ① For what k.e. of a neutron will the associated de-broglie wavelength is  $1.4 \text{ \AA}$

$$m_n = 1.66 \times 10^{-27} \text{ kg}$$

Sol<sup>n</sup>  $\lambda = \frac{h}{\sqrt{2m(\text{k.E})}} \Rightarrow \text{k.E} = \frac{h^2}{\lambda^2 \cdot 2m} = \frac{(6.6 \times 10^{-34})^2}{(1.4 \times 10^{-10})^2 \times 2 \times 1.66 \times 10^{-27}} = 6.735 \times 10^{-21} \text{ J}$

② Find the debroglie w/l of neutron in thermal equilibrium of matter, having avg kinetic energy of  $\frac{3}{2} kT$  at  $300 \text{ K}$ . given  $k = 1.38 \times 10^{-23} \text{ J/Kg}$

$$m_n = 1.66 \times 10^{-27} \text{ kg}$$

$$E = \frac{3}{2} \times 1.38 \times 10^{-23} \times 300 = 6.2 \times 10^{-21} \text{ J}$$

$$\lambda = \frac{h}{\sqrt{2mE}} = \checkmark = 1.46 \times 10^{-10} \text{ m}$$

Debroglie wavelength of a gas molecule

At temp  $T$ , K.E. of a gas molecule =  $\frac{3}{2} kT$   $\xrightarrow{\text{Boltzmann Const}}$

**ATDB.uno**

$$\lambda_{\text{gas molecule}} = \frac{h}{\sqrt{3mKT}}$$

$$\lambda = \frac{h}{\sqrt{2m(\text{KE})}} = \frac{h}{\sqrt{2m \cdot \frac{3KT}{2}}}$$

A particle moving with kinetic energy  $E$  has de Broglie wavelength  $\lambda$ . If energy  $\Delta E$  is added to its energy, the wavelength become  $\lambda/2$ . Value of  $\Delta E$ , is:

**(JEE Main-2020)**

**A**  $2E$

**B**  $E$

**C**  $3E$

**D**  $4E$

ATDB.uno

Ans : (C)

An electron of mass  $m$  and magnitude of charge  $|e|$  initially at rest gets accelerated by a constant electric field  $E$ . The rate of change of de-Broglie wavelength of this electron at time  $t$  ignoring relativistic effects is:

**(JEE Main-2020)**

**A**  $\frac{-h}{|e|Et^2}$

**B**  $\frac{|e|Et}{h}$

**C**  $\frac{h}{|e|Et^2}$

**D**  $-\frac{h}{|e|Et}$

ATDB.uno

Ans : (A)

A particle is moving 5 times as fast as an electron. The ratio of the de-Broglie wavelength of the particle to that of the electron is  $1.878 \times 10^{-4}$ . The mass of the particle is close to:

**(JEE Main-2020)**

- A**  $4.8 \times 10^{-27}$  kg
- B**  $1.2 \times 10^{-28}$  kg
- C**  $9.1 \times 10^{-31}$  kg
- D**  $9.7 \times 10^{-28}$  kg

ATDB.uno

Ans : (D)

An electron (mass  $m$ ) with initial velocity  $\vec{v} = v_0\hat{i} + v_0\hat{j}$  is in an electric field  $\vec{E} = -E_0\hat{k}$ . If  $\lambda_0$  is initial de-Broglie wavelength of electron, its de-Broglie wavelength at time  $t$  is given by:

**(JEE Main-2020)**

**A** 
$$\frac{\lambda_0\sqrt{2}}{\sqrt{1 + \frac{e^2 E^2 t^2}{m^2 v_0^2}}}$$

**B** 
$$\frac{\lambda_0}{\sqrt{2 + \frac{\sqrt{e^2 E^2 t^2}}{m^2 2 + v_0^2}}}$$

**C** 
$$\frac{\lambda_0}{\sqrt{1 + \frac{e^2 E^2 t^2}{2m^2 v_0^2}}}$$

**D** 
$$\frac{\lambda_0}{\sqrt{1 + \frac{\sqrt{e^2 E_0^2 t^2}}{m^2 v_0^2}}}$$

ATDB.uno

Ans : (C)

Particle  $A$  of mass  $m_A = m/2$  moving along the  $x$ -axis with velocity  $v_0$  collides elastically with another particle  $B$  at rest having mass  $m_B = m/3$ . If both particles move along the  $x$ -axis after the collision, the change  $\Delta\lambda$  in de-Broglie wavelength of particle  $A$ , in terms of its de-Broglie wavelength ( $\lambda_0$ ) before collision is:

**(JEE Main-2020)**

**A**  $\Delta\lambda = 4\lambda_0$

**B**  $\Delta\lambda = \frac{5}{2}\lambda_0$

**C**  $\Delta\lambda = 2\lambda_0$

**D**  $\Delta\lambda = \frac{3}{2}\lambda_0$

ATDB.uno

Ans : (A)

An electron, a doubly ionized helium ion ( $\text{He}^{++}$ ) and a proton are having the same kinetic energy. The relation between their respective de-Broglie wavelengths  $\lambda_e$ ,  $\lambda_{\text{He}^{++}}$  and  $\lambda_p$  is:

**(JEE Main-2020)**

**A**  $\lambda_e < \lambda_p < \lambda_{\text{He}^{++}}$

**B**  $\lambda_p < \lambda_{\text{He}^{++}} = \lambda_p$

**C**  $\lambda_e > \lambda_{\text{He}^{++}} > \lambda_p$

**D**  $\lambda_e > \lambda_p > \lambda_{\text{He}^{++}}$

ATDB.uno

Ans : (D)



Given below are two statements:

**Statement-I:** Two photons having equal linear momenta have equal wavelengths.

**Statement-II:** If the wavelength of photon is decreased, then the momentum and energy of a photon will also decrease.

In the light of the above statements, choose the correct answer from the options given below.

**(JEE Main-2021)**

ATDB.uno

**A**

Both Statement I and Statement II are true

**B**

Statement I is false but Statement II is true

**C**

Both Statement I and Statement II are false

**D**

Statement I is true but Statement II is false

Ans : (D)

The de Broglie wavelength of a proton and  $\alpha$ -particle are equal. The ratio of their velocities is:  
(JEE Main-2021)

**A** 4 : 3

**B** 4 : 1

**C** 4 : 2

**D** 1 : 4

$$\lambda = \frac{h}{mv}$$

ATDB.uno

Ans : (B)

An  $\alpha$  particle and a proton are accelerated from rest by a potential difference of 200 V. After this, their de Broglie wavelengths are  $\lambda_\alpha$  and  $\lambda_p$  respectively. The ratio  $\lambda_p/\lambda_\alpha$  is:

**(JEE Main-2021)**

**A** 3.8

**B** 8

**C** 7.8

**D** 2.8

$$\lambda = \frac{h}{\sqrt{2mq\Delta V}}$$

ATDB.uno

Ans : (D)

An electron of mass  $m_e$  and a proton of mass  $m_p = 1836 m_e$  are moving with the same speed. The ratio of their de Broglie wavelength  $\frac{\lambda_{\text{electron}}}{\lambda_{\text{proton}}}$  will be:

(JEE Main-2021)

- A** 1836
- B** 1
- C** 918
- D** 1/1836

$$\lambda = \frac{h}{m v}$$
$$\frac{\lambda_1}{\lambda_2} = \frac{m_2 v_2}{m_1 v_1}$$

$$\frac{\lambda_e}{\lambda_p} = \frac{m_p}{m_e} = \underline{1836}$$

ATDB.uno

Ans : (A)

The de-Broglie wavelength associated with an electron and a proton were calculated by accelerating them through same potential of 100 V. What should nearly be the ratio of their wavelengths? ( $m_p = 1.00727 u$ ,  $m_e = 0.00055u$ )

**(JEE Main-2021)**

- A** 1860 : 1
- B**  $(1860)^2 : 1$
- C** 41.4 : 1
- D** 43 : 1

ATDB.uno

Ans : (D)

A particle is travelling 4 times as fast as an wavelength of a particle to that of electron is 2 : 1, the mass of the particle is :-electron. Assuming the ratio of de-Broglie  
**(JEE Main-2021)**

- A** 1/16 times the mass of  $e^-$
- B** 8 times the mass of  $e^-$
- C** 16 times the mass of  $e^-$
- D** 1/8 times the mass of  $e^-$

ATDB.uno

Ans : (D)

A proton and an  $\alpha$ -particle, having kinetic energies  $K_p$  and  $K_\alpha$ , respectively, enter into a magnetic field at right angles. The ratio of the radii of trajectory of proton to that of  $\alpha$ -particle is 2 : 1. The ratio of  $K_p : K_\alpha$  is : **(JEE Main-2021)**

**A** 1 : 8

**B** 8 : 1

**C** 1 : 4

**D** 4 : 1

$$r = \frac{mv}{qB}$$

ATDB.uno

Ans : (D)

An electron of mass  $m_e$  and a proton of mass  $m_p$  are accelerated through the same potential difference. The ratio of the de-Broglie wavelength associated with the electron to that with the proton is :-

**(JEE Main-2021)**

**A**  $\frac{m_p}{m_e}$

**B** 1

**C**  $\sqrt{\frac{m_p}{m_e}}$

**D**  $\frac{m_e}{m_p}$

ATDB.uno

Ans : (C)



What should be the order of arrangement of de-Broglie wavelength of electron ( $\lambda_e$ ), an  $\alpha$ -particle ( $\lambda_\alpha$ ) and proton ( $\lambda_p$ ) given that all have the same kinetic energy?  
(JEE Main-2021)

**A**

$$\lambda_e = \lambda_p = \lambda_\alpha$$

**B**

$$\lambda_e < \lambda_p < \lambda_\alpha$$

**C**

$$\lambda_e > \lambda_p > \lambda_\alpha$$

**D**

$$\lambda_e = \lambda_p > \lambda_\alpha$$

**ATDB.uno**

Ans : (C)

An electron (of mass  $m$ ) and a photon have the same energy  $E$  in the range of a few eV. The ratio of the de-Broglie wavelength associated with the electron and the wavelength of the photon is ( $c =$  speed of light in vacuum) **(JEE Main-2020)**

**A**  $\left(\frac{E}{2m}\right)^{1/2}$

**B**  $\frac{1}{c} \left(\frac{E}{2m}\right)^{1/2}$

**C**  $c(2mE)^{1/2}$

**D**  $\frac{1}{c} \left(\frac{2E}{m}\right)^{1/2}$

ATDB.uno

Ans : (B)

A particle of mass  $4M$  at rest disintegrates into two particles of mass  $M$  and  $3M$  respectively having non zero velocities. The ratio of de- Broglie wavelength of particle of mass  $M$  to that of mass  $3M$  will be: **(JEE Main-2021)**

**A** 1 : 3

**B** 3 : 1

**C**  $1 : \sqrt{3}$

**D** 1 : 1

ATDB.uno

Ans : (D)

A particle of mass  $9.1 \times 10^{-31}$  kg travels in a medium with a speed of  $10^6$  m/s and a photon of a radiation of linear momentum  $10^{-27}$  kg m/s travels in vacuum. The wavelength of photon is \_\_\_\_\_ times the wavelength of the particle.

**(JEE Main-2021)**

ATDB.uno

Ans : (910)



A moving proton and electron have the same de-Broglie wavelength. If  $K$  and  $P$  denote the K.E. and momentum respectively. Then choose the correct option:

**(JEE Main-2021)**

**A**

$$K_p < K_e \text{ and } P_p = P_e$$

**B**

$$K_p = K_e \text{ and } P_p = P_e$$

**C**

$$K_p < K_e \text{ and } P_p < P_e$$

**D**

$$K_p > K_e \text{ and } P_p = P_e$$

**ATDB.uno**

Ans : (A)

The ratio of de-Broglie wavelengths of proton and deuteron accelerated by potential  $V_p$  and  $V_d$  is  $1 : \sqrt{2}$ . Then the ratio of  $V_p$  to  $V_d$  will be **(JEE Main-2022)**

**A** 1 : 1

**B**  $\sqrt{2} : 1$

**C** 2 : 1

**D** 4 : 1

ATDB.uno

Ans : (D)



An  $\alpha$  particle and a proton are accelerated from rest through the same potential difference. The ratio of linear momenta acquired by above two particles will be :  
**(JEE Main-2022)**

**A**

$$\sqrt{2} : 1$$

**B**

$$2\sqrt{2} : 1$$

**C**

$$4\sqrt{2} : 1$$

**D**

$$8 : 1$$

**ATDB.uno****Ans : (B)**

A proton, a neutron, an electron and an  $\alpha$ -particle have same energy. If  $\lambda_p$ ,  $\lambda_n$ ,  $\lambda_e$  and  $\lambda_\alpha$  are the de-Broglie's wavelength of proton, neutron, electron and  $\alpha$  particle respectively, then choose the correct relation from the following:

**(JEE Main-2022)**

**A**  ~~$\lambda_p = \lambda_n > \lambda_e > \lambda_\alpha$~~

**B**  $\lambda_\alpha < \lambda_n < \lambda_p < \lambda_e$

**C**  ~~$\lambda_e < \lambda_p = \lambda_n > \lambda_\alpha$~~

**D**  ~~$\lambda_e = \lambda_p = \lambda_n = \lambda_\alpha$~~

$$\lambda = \frac{h}{\sqrt{2m(K.E.)}}$$

ATDB.uno

Ans : (B)

An  $\alpha$  particle and a carbon 12 atom has same kinetic energy  $K$ . the ratio of their de-Broglie wavelength ( $\lambda_a : \lambda_{C_{12}}$ ) is : **(JEE Main-2022)**

**A**  $1 : \sqrt{3}$

**B**  $\sqrt{3} : 1$

**C**  $3 : 1$

**D**  $2 : \sqrt{3}$

ATDB.uno

Ans : (B)

The de-Broglie wavelength for an electron and a photon are  $\lambda_e$  and  $\lambda_p$  respectively. For the same kinetic energy of electron and photon. Which of the following presents the correct relation between the de-Broglie wavelength of two?  
**(JEE Main-2022)**

**A**  $\lambda_p \propto \lambda_e^2$

**B**  $\lambda_p \propto \lambda_e$

**C**  $\lambda_p \propto \sqrt{\lambda_e}$

**D**  $\lambda_p \propto \sqrt{\frac{1}{\lambda_e}}$

ATDB.uno

Ans : (A)

is place  $\frac{1}{2}$  m away, the number of electrons emitted by photocathode would- [AIEEE - 2005]

- (A) decrease by a factor of 4  
(B\*) increase by a factor of 4  
(C) decrease by a factor of 2  
(D) increase by a factor of 2

किसी फोटोसेल को 1 m दूर रखे किसी छोटे चमकीले स्रोत द्वारा प्रदीप्त किया जाता है। जब इसी प्रकाश स्रोत को  $\frac{1}{2}$  m दूरी पर रखते हैं, तो फोटोकैथोड द्वारा उत्सर्जित इलेक्ट्रॉनों की संख्या-

- (A) 4 के गुणक द्वारा घट जाएगी  
(B) 4 के गुणक द्वारा बढ़ जाएगी  
(C) 2 के गुणक द्वारा घट जाएगी  
(D) 2 के गुणक द्वारा बढ़ जाएगी

**Ans. (B)**

**Statement-2 :** by debroglie hypothesis,  $p = h/\lambda$  for both the electron and the photon.

- (A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.  
(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.  
(C) Statement-1 is true, statement-2 is false.  
(D) Statement-1 is false, statement-2 is true.

**कथन-1 :** यदि किसी इलेक्ट्रॉन तथा फोटोन की तरंगदैर्घ्य समान हो तो उनकी ऊर्जा समान होती है।

**कथन-2:** दे ब्राग्ली परिकल्पना के अनुसार इलेक्ट्रॉन तथा फोटॉन के लिए  $p = h/\lambda$  होता है।

- (A) कथन-1 सत्य है, कथन-2 असत्य है।  
(B) कथन-1 सत्य है, कथन-2 सत्य है; कथन-2 कथन-1 का सही व्याख्या करता है।  
(C) कथन-1 सत्य है, कथन-2 सत्य है; कथन-2 कथन-1 की सही व्याख्या नहीं करता है  
(D) कथन-1 असत्य है, कथन-2 सत्य है।

**Ans. (D)**

17. A particle of mass  $4m$  at rest decays into two particles of masses  $m$  and  $3m$  having non-zero velocities. The ratio of the de-Broglie wavelengths of the particles 1 and 2 is

विरामावस्था में स्थित एक  $4m$  द्रव्यमान का एक कण  $m$  तथा  $3m$  द्रव्यमान तथा अशून्य वेग वाले दो कणों में क्षयित होता है। इन कणों 1 तथा 2 की डी-ब्रोग्ली तरंगदैर्घ्य का अनुपात होगा

(A)  $\frac{1}{2}$

(B)  $\frac{1}{4}$

(C) 2

(D) 1

Ans. (D)

ATDB.uno

**18.** A free particle with initial kinetic energy  $E$  and de–broglie wavelength  $\lambda$  enters a region in which it has potential energy  $U$ . What is the particle's new de–Broglie wavelength?

एक मुक्त कण प्रारम्भिक गतिज ऊर्जा  $E$  तथा डी-ब्रोग्ली तरंगदैर्घ्य  $\lambda$  के साथ एक ऐसे क्षेत्र में प्रवेश करता है जहां इसकी स्थितिज ऊर्जा  $U$  है। कण की नई डी-ब्रोग्ली तरंगदैर्घ्य क्या होगी ?

(A)  $\lambda(1-U/E)^{-1/2}$

(B)  $\lambda(1-U/E)$

(C)  $\lambda(1-E/U)^{-1}$

(D)  $\lambda(1+U/E)^{1/2}$

**Ans. (A)**

**ATDB.uno**

1. An  $\alpha$ -particle and a proton are accelerated from rest by a potential difference of 100 V. After this, their de Broglie wavelengths are  $\lambda_{\alpha}$  and  $\lambda_p$ , respectively. The ratio  $\lambda_p/\lambda_{\alpha}$ , to the nearest integer, is

**(IIT-JEE 2010)**

**ATDB.uno**

10. A particle  $A$  of mass  $m$  and initial velocity  $v$  collides with a particle  $B$  of mass  $m/2$  which is at rest. The collision is head on, and elastic. The ratio of the de-Broglie wavelengths  $\lambda_A$  to  $\lambda_B$  after the collision is

$$(1) \quad \frac{\lambda_A}{\lambda_B} = \frac{2}{3}$$

$$(2) \quad \frac{\lambda_A}{\lambda_B} = \frac{1}{2}$$

$$(3) \quad \frac{\lambda_A}{\lambda_B} = \frac{1}{3}$$

$$(4) \quad \frac{\lambda_A}{\lambda_B} = 2$$

**(JEE Main 2017)**

## Homework

— Try ques attached in the ppt

ATDB.uno



# THANK YOU

ATDB.uno

