DPP – 3 (PEE)

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/88

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Q 1. A particle of mass 3m at rest decays into two particles of masses m and 2 m having non-zero velocities. The ratio of the de-Broglie wavelengths of the particles $\left(\frac{\lambda_1}{\lambda_2}\right)$ is:

(a) 1/2 (b) 1/4 (c) 2 (d) None

Q 2. The energy of a photon is equal to the kinetic energy of a proton. The energy of the photon is E. Let λ_1 be the de-Broglie wavelength of the proton and λ_2 be the wavelength of the photon. The ratio $\frac{\lambda_1}{\lambda_2}$ is proportional to:

(a) E° (b) $E^{1/2}$ (c) E^{-1} (d) E^{-2}

Q 3. A beam of electron is used in an YDSE experiment. The slit width is d. When the velocity of electron is increased, then

(a) no interference is observed (b) fringe width increases
(c) fringe width decreases (d) fringe width remains same

Q 4. If λ_p and λ_e denote the de-Broglie wavelength of proton and electron after they are accelerated from rest through the same potential difference, then –

(a) $\lambda e = \lambda p$ (b) $\lambda e < \lambda p$ (c) $\lambda e > \lambda p$ (d) $\lambda e = \lambda p/2$

Q 5. The de Broglie wavelength of a bus moving with speed v is λ. Some passengers left the bus at a stopage. Now when the bus moves with twice its initial speed. Now kinetic energy is found to be twice its initial value. What will be the de Broglie wavelength, now-

(a) λ (b) 2λ (c) $\lambda/2$ (d) $\lambda/4$

Q 6. A monochromatic radiation of wavelength λ_1 is incident on a stationary atom as a result of which the wavelength of the photon after the collision becomes λ_2 and the recoiled atom has De Broglie's wavelength λ_3. Then,

(a) $\lambda_3 = \sqrt{\lambda_1 \lambda_2}$

(b) $\lambda_1 = \frac{\lambda_2 \lambda_3}{\lambda_2+\lambda_3}$

(c) $\lambda_1 = \sqrt{\lambda_1^2 + \lambda_2^2}$

(d) $\lambda_3 = \sqrt{\lambda_1^2 + \lambda_2^2}$

Q 7. If E_1, E_2 and E_3 represent respectively the kinetic energies of an electron, an alpha particle and a proton each having same de Broglie wavelength then:

(a) $E_1 > E_3 > E_2$ (b) $E_2 > E_3 > E_1$

(c) $E_1 > E_2 > E_3$ (d) $E_1 = E_2 = E_3$

Q 8. An electron of mass m, when accelerated through a potential difference V has de Broglie wavelength λ . The de Broglie wavelength associated with a proton of mass M when accelerated by same potential difference is

(a) $\lambda\sqrt{\frac{M}{m}}$ (b) $\lambda\sqrt{\frac{m}{M}}$

(c) $\lambda\frac{M}{m}$ (d) $\lambda\frac{m}{M}$

Q 9. A particle is moving in a closed orbit near origin, due to a force which is directed towards origin. The de Broglie wavelength of particle varies from λ_1 to λ_2 cyclically ($\lambda_1 > \lambda_2$). Then

(a) Particle could be moving in a circular orbit with centre at origin.

(b) Particle could be moving in a elliptical orbit with one focus at origin.

(c) When de Broglie wavelength is λ_1 , the particle is nearer to origin than when its value is λ_2.

(d) When de Broglie wavelength is λ_2 , the particle is nearer to origin than when its value is λ_1

Q 10. The ratio of de Broglie wavelengths of proton and an alpha particle will be 1:2, if their

(a) kinetic energies are in ratio 1:8

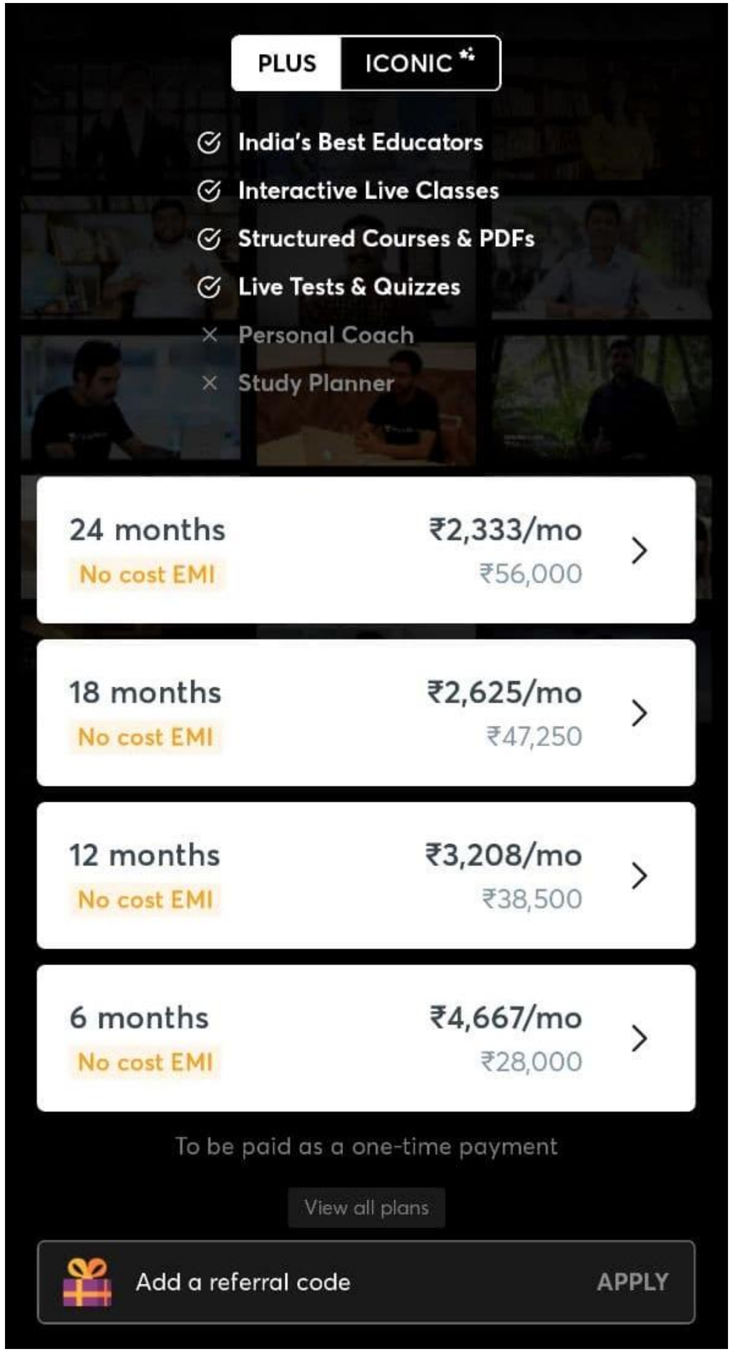
(b) kinetic energies are in ratio 8:1

(c) Speeds are in ratio 1:8

(d) Speeds are in ratio 8:1

Answer Key

Q.1 d	**Q.2 b**	**Q.3 c**	**Q.4 c**	**Q.5 a**
Q.6 b	**Q.7 a**	**Q.8 b**	**Q.9 b, d**	**Q.10 d**



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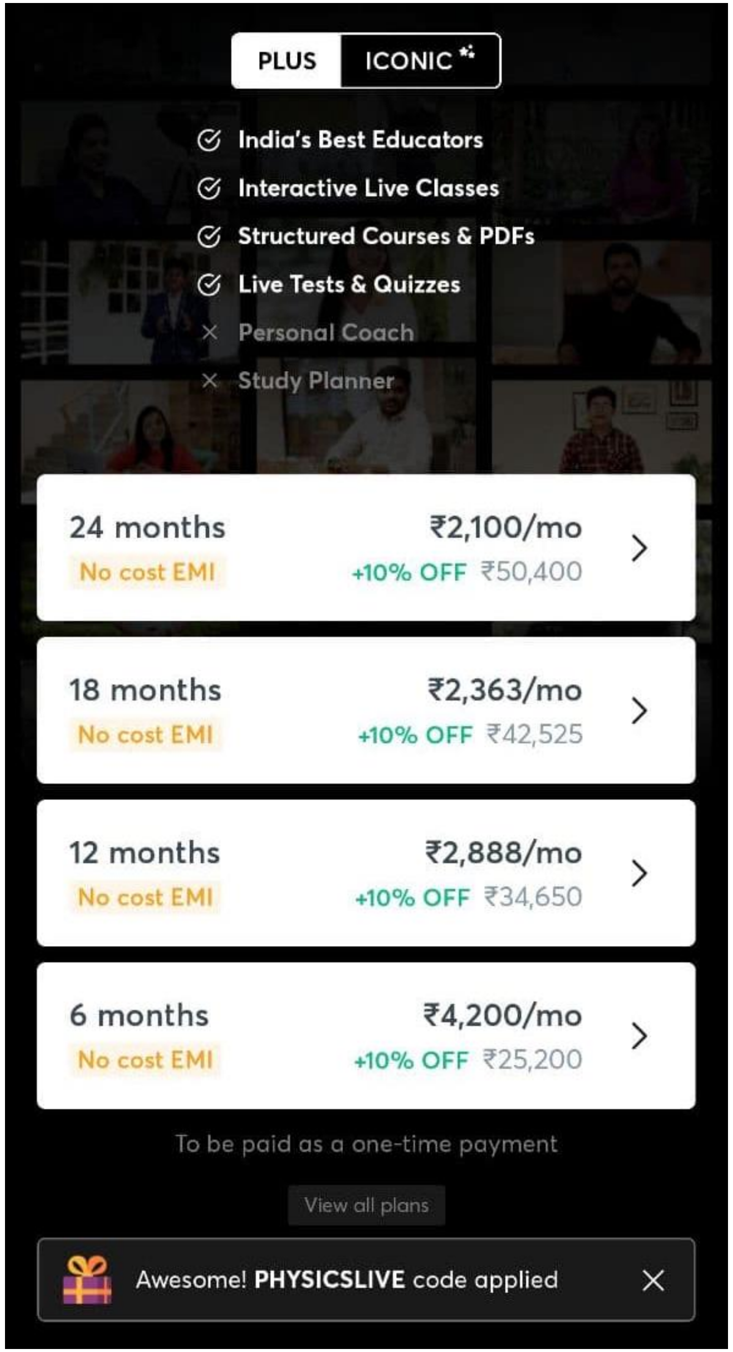

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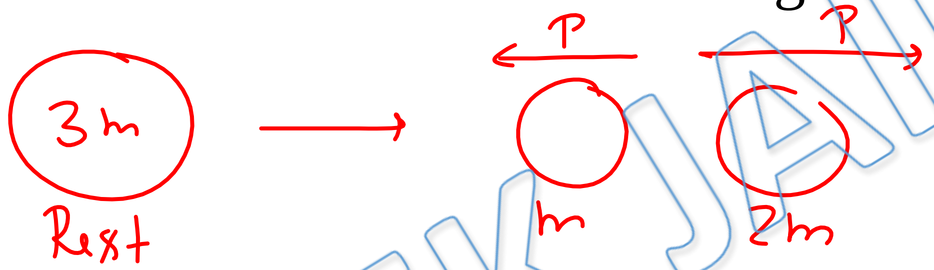
Physics DPP - Solution

DPP- 3 Matter waves

By Physicsaholics Team

Q1) A particle of mass 3m at rest decays into two particles of masses m and 2 m having non-zero velocities. The ratio of the de-Broglie wavelengths of the particles $\left(\frac{\lambda_1}{\lambda_2}\right)$ is :



Initial momentum = 0
final ,, = 0

(a) 1/2 (b) 1/4 (c) 2 (d) None

$\lambda_1 = \frac{h}{p}$

$\lambda_2 = \frac{h}{p}$

Q2) The energy of a photon is equal to the kinetic energy of a proton. The energy of the photon is E. Let λ_1 be the de-Broglie wavelength of the proton and λ_2 be the wavelength of the photon. The ratio $\frac{\lambda_1}{\lambda_2}$ is proportional to:

$$E = \frac{hc}{\lambda_2}$$

$$\lambda_1 = \frac{h}{\sqrt{2mE}}$$

$$\lambda_2 = \frac{hc}{E}$$

$$\frac{\lambda_1}{\lambda_2} = \frac{h}{\sqrt{2mE}} \times \frac{E}{hc} = \frac{1}{c}\sqrt{\frac{E}{2m}} \propto E$$

(a) E° (b) $E^{1/2}$ (c) E^{-1} (d) E^{-2}

Q3) A beam of electron is used in an YDSE experiment. The slit width is d. When the velocity of electron is increased, then

$$\text{Slit width } d = \frac{\lambda D}{d} = \frac{h D}{d\, m v}$$

(a) no interference is observed

(b) fringe width increases

(c) fringe width decreases ✓

(d) fringe width remains same

Q4) If λ_p and λ_e denote the de-Broglie wavelength of proton and electron after they are accelerated from rest through the same potential difference, then -

$$\lambda = \frac{h}{\sqrt{2meV}}$$

(e: same, V: same)

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

$$\frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_p}{m_e}}$$

(a) λe = λp (b) λe < λp (c) λe > λp ✓ (d) λe = λp/2

$m_p > m_e$

$\Rightarrow \lambda_e > \lambda_p$

Q5) The de Broglie wavelength of a bus moving with speed v is λ. Some passengers left the bus at a stopage. Now when the bus moves with twice its initial speed. Now kinetic energy is found to be twice its initial value. What will be the de Broglie wavelength, now-

$\lambda = \frac{h}{p} = \frac{h}{2K/v}$

$\lambda = \frac{hv}{2K}$ → v: 2 times, K: 2 times → λ: same

$K = \frac{1}{2}mv^2 = \frac{1}{2}mv\,v = \frac{pv}{2}$

$P = \frac{2K}{v}$

(a) λ ✓ (b) 2λ (c) λ /2 (d) λ /4

Q6) A monochromatic radiation of wavelength λ_1 is incident on a stationary atom as a result of which the wavelength of the photon after the collision becomes λ_2 and the recoiled atom has De Broglie's wavelength λ_3. Then,

(a) $\lambda_3 = \sqrt{\lambda_1 \lambda_2}$

(b) $\lambda_1 = \frac{\lambda_2 \lambda_3}{\lambda_2 + \lambda_3}$

(c) $\lambda_1 = \sqrt{\lambda_1^2 + \lambda_2^2}$

(d) $\lambda_3 = \sqrt{\lambda_1^2 + \lambda_2^2}$

$$\frac{h}{\lambda_1} = \frac{h}{\lambda_3} + \frac{h}{\lambda_2}$$

$$\lambda = \frac{\lambda_2 \lambda_3}{\lambda_2 + \lambda_3}$$

Q7) If E_1, E_2 and E_3 represent respectively the kinetic energies of an electron, an alpha particle and a proton each having same de Broglie wavelength then:

$$\lambda = \frac{h}{\sqrt{2mE}}$$

same λ $\Rightarrow$ same mE $\Rightarrow$ higher mass, lower E

$m_e < m_p < m_\alpha \Rightarrow E_e > E_p > E_\alpha \Rightarrow E_1 > E_3 > E_2$

(a) $E_1 > E_3 > E_2$ ✓

(b) $E_2 > E_3 > E_1$

(c) $E_1 > E_2 > E_3$

(d) $E_1 = E_2 = E_3$

Q8) An electron of mass m ,When accelerated through a potential difference V has de Broglie wavelength λ . The de Broglie wavelength associated with a proton of mass M when accelerated by same potential difference is

$$\lambda = \frac{h}{\sqrt{2meV}}$$

$$\frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_p}{m_e}}$$

$$\frac{\lambda}{\lambda_p} = \sqrt{\frac{M}{m}}$$

$$\lambda_p = \lambda\sqrt{\frac{m}{M}}$$

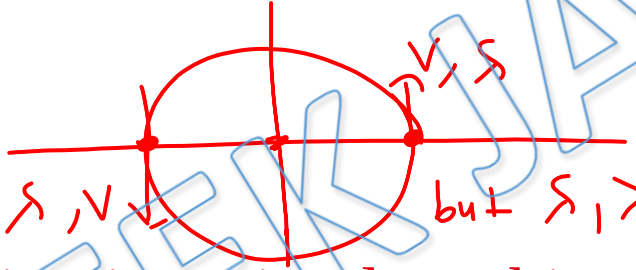
(a) $\lambda\sqrt{\frac{M}{m}}$

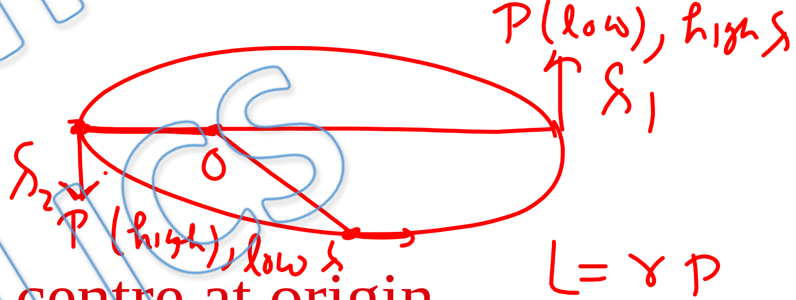
(b) $\lambda\frac{M}{m}$

(c) $\lambda\sqrt{\frac{m}{M}}$ ✓

(d) $\lambda\frac{m}{M}$

Q9) A particle is moving in a closed orbit near origin, due to a force which is directed towards origin. The de Broglie wavelength of particle varies from λ_1 to λ_2 cyclically ($\lambda_1 > \lambda_2$). Then





(a) Particle could be moving in a circular orbit with centre at origin.

(b) Particle could be moving in a elliptical orbit with one focus at origin.

(c) When de Broglie wavelength is λ_1 , the particle is nearer to origin than when its value is λ_2.

(d) When de Broglie wavelength is λ_2 , the particle is nearer to origin than when its value is λ_1

Q10) The ratio of de Broglie wavelengths of proton and an alpha particle will be 1:2 ,if their

(a) kinetic energies are in ratio 1:8

(b) kinetic energies are in ratio 8:1

(c) Speeds are in ratio 1:8

(d) Speeds are in ratio 8:1 ✓

$p \to m \qquad \alpha \to 4m$

$$\frac{\lambda_p}{\lambda_\alpha} = \frac{1}{2}$$

$$\Rightarrow \frac{h}{m V_p} \times \frac{4m V_\alpha}{h} = \frac{1}{2}$$

$$\Rightarrow \frac{V_\alpha}{V_p} = \frac{1}{8} \Rightarrow \frac{V_p}{V_\alpha} = \frac{8}{1}$$

$$\frac{K_p}{K_\alpha} = \frac{\frac{1}{2} m V_\alpha^2}{\frac{1}{2} \times 4m V_p^2} = \frac{1}{4} \times 64 = 16$$

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Chalo Niklo