

JEE MAIN DUAL NATURE OF RADIATION AND MATTER — WAVE NATURE OF MATTER, DE BROGLIE WAVELENGTH — PYQS

Max. Marks: 72
Questions: 18

Section A (MCQ) — 14 questions

- Q.1** An electron of mass m is moving in an electric field $\vec{E} = -2E_0\hat{i}$ ($E_0 = \text{constant} > 0$), with an initial velocity $\vec{V} = v_0\hat{i}$ ($v_0 = \text{constant} > 0$). If $\lambda_0 = \frac{h}{4mv_0}$, its de Broglie wavelength at time t is _____.
($e = \text{charge of electron}$)

[JEE Main 2026 (Online) 5th April Morning Shift]

- | | |
|--|--|
| (1) $\frac{4\lambda_0}{\left[1 - \frac{E_0 e t}{2m v_0}\right]}$ | (2) $\frac{4\lambda_0}{\left[1 + \frac{E_0 e t}{2m v_0}\right]}$ |
| (3) $\frac{4\lambda_0}{\left[1 + \frac{2E_0 e t}{m v_0}\right]}$ | (4) $\frac{4\lambda_0}{\left[1 - \frac{2E_0 e t}{m v_0}\right]}$ |

Scan or tap for the full solution



- Q.2** An electron is travelling with a velocity v in free space and when it enters a medium, its velocity is reduced by 20%. The de Broglie wavelength of electron in the medium is $\alpha\lambda_0$, where λ_0 is its de Broglie wavelength in free space. The value of α is _____.
[JEE Main 2026 (Online) 5th April Evening Shift]

- (1) 1.20 (2) 1.0 (3) 1.25 (4) 0.75

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- Q.3** The de Broglie wavelength associated with an electron accelerated through a potential difference V is λ_e and the de Broglie wavelength associated with a proton accelerated through the same potential difference is λ_p . If their corresponding masses are m_e and m_p , respectively, then the ratio of their de Broglie wavelengths $\left(\frac{\lambda_e}{\lambda_p}\right)$ is _____.
[JEE Main 2026 (Online) 4th April Evening Shift]

- | | |
|------------------------------|--------------------------------------|
| (1) $\sqrt{\frac{m_p}{m_e}}$ | (2) $\sqrt{\frac{m_e}{m_p}}$ |
| (3) $\frac{m_p}{m_e}$ | (4) $\left(\frac{m_p}{m_e}\right)^2$ |

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- Q.4** The de Broglie wavelength of an oxygen molecule at 27°C is $x \times 10^{-12}$ m. The value of x is (take Planck's constant = 6.63×10^{-34} J s, Boltzmann constant = 1.38×10^{-23} J/K, mass of oxygen molecule = 5.31×10^{-26} kg)

[JEE Main 2026 (Online) 23rd January Morning Shift]

- (1) 24 (2) 30 (3) 20 (4) 26

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- Q.5** A photoemissive substance is illuminated with a radiation of wavelength λ_i so that it releases electrons with de-Broglie wavelength λ_e . The longest wavelength of radiation that can emit photoelectron is λ_0 . Expression for de-Broglie wavelength is given by:
(m : mass of the electron, h : Planck's constant and c : speed of light)

[JEE Main 2025 (Online) 7th April Evening Shift]

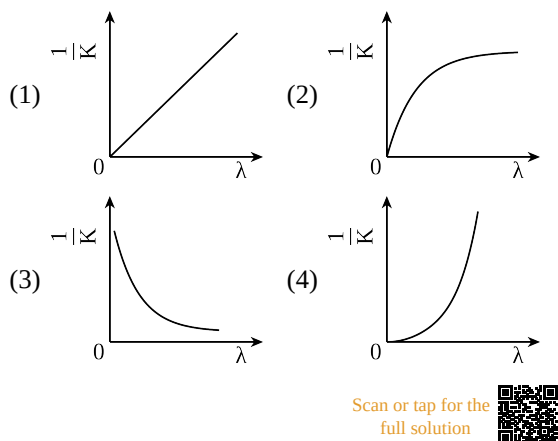
- (1) $\lambda_e = \frac{\sqrt{h\lambda_i}}{\sqrt{2mc}}$
- (2) $\lambda_e = \frac{h}{\sqrt{2mc\left(\frac{1}{\lambda_i} - \frac{1}{\lambda_0}\right)}}$
- (3) $\lambda_e = \sqrt{\frac{h}{2mc\left(\frac{1}{\lambda_i} - \frac{1}{\lambda_0}\right)}}$
- (4) $\lambda_e = \sqrt{\frac{h\lambda_0}{2mc}}$

Scan or tap for the full solution



- Q.6** If λ and K are de Broglie wavelength and kinetic energy, respectively, of a particle with constant mass, the correct graphical representation for the particle will be :

[JEE Main 2025 (Online) 29th January Morning Shift]



- Q.7** A proton of mass ' m_p ' has same energy 'E' as that of a photon of wavelength ' λ '. If the proton is moving at non-relativistic speed, then ratio of its de Broglie wavelength to the wavelength of photon is

[JEE Main 2025 (Online) 28th January Morning Shift]

- (1) $\frac{1}{c} \sqrt{\frac{E}{m_p}}$ (2) $\frac{1}{c} \sqrt{\frac{2E}{m_p}}$
 (3) $\frac{1}{2c} \sqrt{\frac{E}{m_p}}$ (4) $\frac{1}{c} \sqrt{\frac{E}{2m_p}}$

Scan or tap for the full solution 

- Q.8** An electron of mass ' m ' with an initial velocity $\vec{v} = v_0 \hat{i}$ ($v_0 > 0$) enters an electric field $\vec{E} = -E_0 \hat{k}$. If the initial de Broglie wavelength is λ_0 , the value after time t would be

[JEE Main 2025 (Online) 24th January Morning Shift]

- (1) $\frac{\lambda_0}{\sqrt{1 - \frac{e^2 E_0^2 t^2}{m^2 v_0^2}}}$ (2) λ_0
 (3) $\frac{\lambda_0}{\sqrt{1 + \frac{e^2 E_0^2 t^2}{m^2 v_0^2}}}$ (4) $\lambda_0 \sqrt{1 + \frac{e^2 E_0^2 t^2}{m^2 v_0^2}}$

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- Q.9** A sub-atomic particle of mass 10^{-30} kg is moving with a velocity 2.21×10^6 m/s. Under the matter wave consideration, the particle will behave closely like ($h = 6.63 \times 10^{-34}$ J.s)

[JEE Main 2025 (Online) 23rd January Morning Shift]

- (1) X-rays (2) Infra-red radiation
 (3) Gamma rays (4) Visible radiation

Scan or tap for the full solution 

- Q.10** A proton, an electron and an alpha particle have the same energies. Their de-Broglie wavelengths will be compared as :

[JEE Main 2024 (Online) 9th April Morning Shift]

- (1) $\lambda_p > \lambda_e > \lambda_\alpha$ (2) $\lambda_\alpha < \lambda_p < \lambda_e$
 (3) $\lambda_e > \lambda_\alpha > \lambda_p$ (4) $\lambda_p < \lambda_e < \lambda_\alpha$

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- Q.11** A proton and an electron are associated with same de-Broglie wavelength. The ratio of their kinetic energies is:

(Assume $h = 6.63 \times 10^{-34}$ J s, $m_e = 9.0 \times 10^{-31}$ kg and $m_p = 1836$ times m_e)

[JEE Main 2024 (Online) 8th April Morning Shift]

- (1) $1 : \frac{1}{1836}$ (2) $1 : \sqrt{1836}$
 (3) $1 : 1836$ (4) $1 : \frac{1}{\sqrt{1836}}$

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- Q.12** A proton and an electron have the same de Broglie wavelength. If K_p and K_e be the kinetic energies of proton and electron respectively, then choose the correct relation :

[JEE Main 2024 (Online) 8th April Evening Shift]

- (1) $K_p > K_e$ (2) $K_p = K_e$
 (3) $K_p < K_e$ (4) $K_p = K_e^2$

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- Q.13** The de Broglie wavelengths of a proton and an α particle are λ and 2λ respectively. The ratio of the velocities of proton and α particle will be :

[JEE Main 2024 (Online) 1st February Morning Shift]

- (1) 8:1 (2) 1:2 (3) 1:8 (4) 4:1

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- Q.14** The de-Broglie wavelength of an electron is the same as that of a photon. If velocity of electron is 25% of the velocity of light, then the ratio of K.E. of electron and K.E. of photon will be:

[JEE Main 2024 (Online) 29th January Morning Shift]

- (1) $\frac{1}{4}$ (2) $\frac{8}{1}$ (3) $\frac{1}{8}$ (4) $\frac{1}{1}$

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Section B (Numerical) — 4 questions

- Q.15** The de Broglie wavelength for an electron accelerated through the potential difference of V_1 volt is λ_1 . When the potential difference is changed to V_2 volt, the associated de Broglie wavelength is increased by 50%. If $(V_1/V_2) = (\gamma/\alpha)$, then the value of α is _____.

[JEE Main 2026 (Online) 6th April Evening Shift]

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- Q.16** The ratio of de Broglie wavelength of a deuteron with kinetic energy E to that of an alpha particle with kinetic energy $2E$, is $n:1$. The value of n is ____.

(Assume mass of proton = mass of neutron)

[JEE Main 2026 (Online) 28th January Morning Shift]

Scan or tap for the
full solution



- Q.17** A particle having electric charge 3×10^{-19} C and mass 6×10^{-27} kg is accelerated by applying an electric potential of 1.21 V.

Wavelength of the matter wave associated with the particle is $\alpha \times 10^{-12}$ m. The value of α is ____.

(Take Planck's constant = 6.6×10^{-34} J s)

[JEE Main 2026 (Online) 21st January Evening Shift]

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full solution



- Q.18** An electron is released from rest near an infinite non-conducting sheet of uniform charge density ' $-\sigma$ '. The rate of change of de-Broglie wave length associated with the electron varies inversely as n^{th} power of time. The numerical value of n is ____.

[JEE Main 2025 (Online) 8th April Evening Shift]

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full solution



ANSWER KEY

Section A (MCQ) — 14 questions

Ques.	1	2	3	4	5	6	7	8	9	10	11
Ans.	3	3	1	4	3	4	4	3	1	2	3
Ques.	12	13	14								
Ans.	3	1	3								

Section B (Numerical) — 4 questions

Ques.	15	16	17	18							
Ans.	4	2	10	2							