

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

Max. Marks: 44

Questions: 11

Section A (MCQ) — 7 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) $\frac{4\lambda_0}{\left[1 - \frac{2E_0 e t}{m v_0}\right]}$

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- 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 $= 6.63 \times 10^{-34}$ J s, Boltzmann constant $= 1.38 \times 10^{-23}$ J/K, mass of oxygen molecule $= 5.31 \times 10^{-26}$ 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]

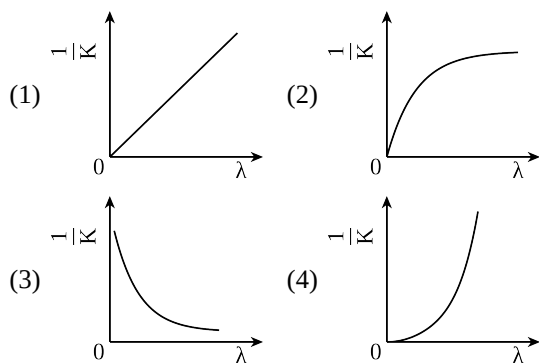
- (1) $\lambda_e = \frac{\sqrt{h\lambda_i}}{\sqrt{2mc}}$
(2) $\lambda_e = \frac{h}{\sqrt{2mc\left(\frac{1}{\lambda_i} - \frac{1}{\lambda_0}\right)}}$
(3) $\lambda_e = \sqrt{\frac{h}{2mc\left(\frac{1}{\lambda_i} - \frac{1}{\lambda_0}\right)}}$
(4) $\lambda_e = \sqrt{\frac{h\lambda_0}{2mc}}$

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- 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]



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

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Section B (Numerical) — 4 questions

- Q.8** 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 $(V_1/V_2) = (9/\alpha)$, then the value of α is _____.

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

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- Q.9** 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]

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- Q.10** 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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- Q.11** 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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ANSWER KEY

Section A (MCQ) — 7 questions

Ques.	1	2	3	4	5	6	7				
Ans.	3	3	1	4	3	4	4				

Section B (Numerical) — 4 questions

Ques.	8	9	10	11							
Ans.	4	2	10	2							