Saitechinfo NEET-JEE Academy

Saitechinfo Centum Cyclic Unit Test

Dual Nature of Electrons | Physics | STD 12 TN State Board
Maximum Marks: 45
Duration: 90 Minutes

Section A

(10 × 1 = 10 marks)
Answer ALL questions.

1. The dual nature of light was proposed by _____.
2. The work function of a material is the _____ energy required to emit an electron.
3. The wavelength of matter waves is given by the equation _____.
4. The particle nature of light explains the _____ effect.
5. The unit of Planck's constant is _____.
6. In the photoelectric effect, the maximum kinetic energy of emitted electrons is determined by the _____ of incident light.
7. De Broglie wavelength for a moving particle is inversely proportional to its _____.
8. The Davisson-Germer experiment confirmed the _____ nature of electrons.
9. Einstein's equation for the photoelectric effect is _____.
10. The phenomenon of quantum tunneling is related to _____ emission.

Section B

(5 × 3 = 15 marks)
Answer any FIVE questions.

1. Derive the expression for the de Broglie wavelength of a particle.
2. Explain the factors affecting the photoelectric effect.
3. Describe the Davisson-Germer experiment and its significance in confirming the wave nature of electrons.
4. Calculate the de Broglie wavelength of an electron moving with a velocity of $5.4 \times 10^6\ \mathrm{m/s}$. (Mass of an electron = $9.1 \times 10^{-31}\ \mathrm{kg}$; Planck's constant = $6.63 \times 10^{-34}\ \mathrm{Js}$).
5. Explain the concept of threshold frequency in the photoelectric effect.
6. What are the laws of the photoelectric effect?

Section C

(4 × 5 = 20 marks)
Answer any FOUR questions.

1. Derive Einstein's photoelectric equation and discuss its implications.

2. The energy of an electron in the third orbit of hydrogen is $-1.51\,\mathrm{eV}$. Calculate the energy of an electron in the first orbit and find the wavelength of light emitted when the electron transitions from the third to the first orbit.
3. Calculate the kinetic energy of an electron emitted from a metal surface with a work function of $2.2\,\mathrm{eV}$ when illuminated by light of wavelength $400\,\mathrm{nm}$. (Planck's constant = $6.63 \times 10^{-34}\,\mathrm{Js}$, speed of light = $3 \times 10^{8}\,\mathrm{m/s}$, 1 eV = $1.6 \times 10^{-19}\,\mathrm{J}$).
4. Discuss the experimental setup and observations of the Davisson-Germer experiment, and explain its significance in validating the de Broglie hypothesis.
5. A proton moves at $2.85 \times 10^{8}\,\mathrm{m/s}$. Calculate its de Broglie wavelength. (Mass of proton = $1.67 \times 10^{-27}\,\mathrm{kg}$; Planck's constant = $6.63 \times 10^{-34}\,\mathrm{Js}$).
