PHYSICS

BOOKS - NCERT PHYSICS (HINGLISH)

DUAL NATURE OF RADIATION AND MATTER

Dual Nature Of Radiation And Matter

1. A particle is droped from a height H. The de-broglie wavelength of the particle as a function of height is proportional to

A. H

B. $H^{1/2}$

C. H^{0}

D. $H^{-1/2}$

Answer:

Watch Video Solution

2. The wavelength of a photon needed to remove a proton from a nucleus which is bound to the nucleus with 1MeV energy is nearly

A. 1.2 nm

B. 1.2×10^{-3} nm

C. 1.2×10^{-6}nm

D. 1.2×10 nm

Answer:

Watch Video Solution

3. Consider a beam of electrons (each electron with energy E_0) incident on a metal surface kept in an evacuated chamber. Then

A. no electrons will be emitted only photons can emit electrons

B. electrons can be emitted but all with an energy, E_o

C. electrons can be emitted with any energy, with a maximum of $E_o - \phi$ (ϕ is the work function)

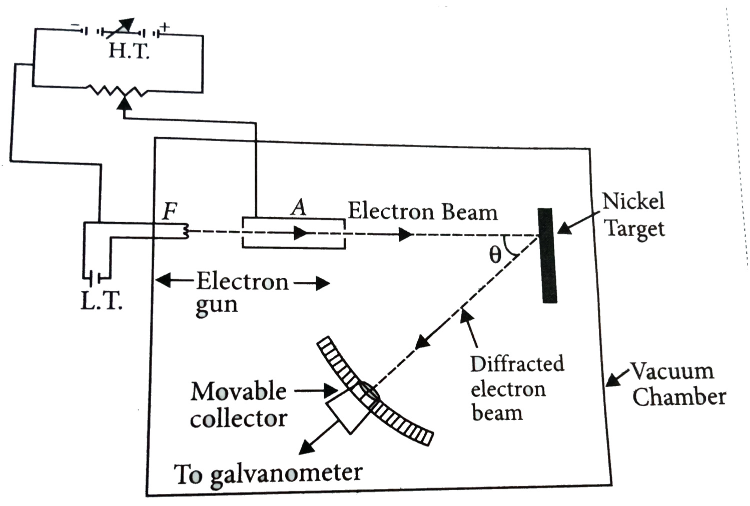
D. electrons can be emitted with any energy, with a maximum of E_o

Answer:

Watch Video Solution

Watch Video Solution

4. Consider figure. Suppose the voltage applied to A is increased. The diffracted beam will have the maximum at a value of θ that



A. will be larger than the earlier value

B. will be the same as the earlier value

C. will be less than the earlier value

D. will depend on the target

Answer:

Watch Video Solution

5. A proton, a neutron, an electron and an α-particle have same energy. Then their de-Broglie wavelengths compare as

A. $\lambda_p = \lambda_n > \lambda_e > \lambda_\alpha$

B. $\lambda_\alpha < \lambda_p = \lambda_n > \lambda_e$

C. $\lambda_e < \lambda_p = \lambda_n > \lambda_\alpha$

D. $\lambda_e = \lambda_p = \lambda_n = \lambda_\alpha$

Answer: B

Watch Video Solution

6. An electron is moving with an initial velocity $\overrightarrow{v} = v_0\hat{i}$ and is in a magnetic field $\overrightarrow{B} = B_0\hat{j}$. Then it's de-Broglie wavelength

A. remains constant

B. increases with time

C. decreases with time

D. increases and decreases periodically

Answer:

Watch Video Solution

7. An electron (mass m) with an initial velocity $v = v_0\hat{i}(v_0 > 0)$ is in an electric field $E = -E_0\hat{l}\,(E_0 = \text{constant} > 0)$. Its de-Broglie wavelength at time t is given by

A. $\dfrac{\lambda_0}{\left(1 + \frac{eE_o}{m}\frac{t}{v_0}\right)}$

B. $\lambda_0\left(1+\frac{eE_0t}{mv_0}\right)$

C. λ_0

D. $\lambda_0 t$

Answer:

Watch Video Solution

8. An electron (mass m) with an initial velocity $\overrightarrow{v}=v_0\hat{i}$ is in an electric field $\overrightarrow{E}=E_0\hat{j}$. If $\lambda_0=h/mv_0$. It's de-broglie wavelength at time t is given by

A. λ_0

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

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

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

Answer:

Watch Video Solution

9. Relativistic corrections become necessary when the expression for the kinetic energy $\frac{1}{2}mv^2$, becomes comparable with mc^2, where m is the mass of the particle. At what de-broglie wavelength will relativistic corrections become important for an electron?

A. $\lambda = 10nm$

B. $\lambda = 10^{-1}nm$

C. $\lambda = 10^{-4}nm$

D. $\lambda = 10^{-6}nm$

Answer:

Watch Video Solution

10. Two particles A_1 and A_2 of masses $m_1, m_2(m_1 > m_2)$ have the same de-broglie wavelength. Then

A. their momentaa are the same

B. their energies are the same

C. energy of A_1 is less than the energy of A_2

D. energy of A_1 is more than the energy of A_2

Answer: C

Watch Video Solution

11. The de-broglie wavelength of a photon is twice the de-broglie wavelength of an electron. The speed of the electron is $v_e = \frac{c}{100}$. Then

A. $\frac{E_e}{E_p} = 10^{-4}$

B. $\frac{E_e}{E_p} = 10^{-2}$

C. $\frac{p_e}{m_e c} = 10^{-2}$

D. $\frac{p_e}{m_e c} = 10^{-4}$

Answer: C

Watch Video Solution

12. Photons absorbed in matter are converted to heat. A source emitting n photons/ sec of frequency ν is used to convert 1kg of ice at $0^\circ C$ to water at $0^\circ C$. Then, the time T taken for the conversion

A. decreases with increasing n, with v fixed

B. decreases with n fixed, v increasing

C. remains constant with n and b changing such that nv= constant

D. increases when the product nv increases

Answer:

Watch Video Solution

13. A particle moves in a closed orbit around the origin, due to a force which is directed towards the origin. The de-broglie wavelength of the particles varies cyclically between two values $\lambda_1, \lambda_2 with \lambda_1 > \lambda_2$. Which of the following statements are true?

A. The particle could be moving in a circular orbit with origin as centre

B. The particle could be moving in an elliptic orbit with orbit with origin as its focus

C. When the de-Broglie wavelength is λ_1, the particle is nearer the origin that when its value is λ_2

D. When the de-Broglie wavelength is λ_2, the particle is nearer the origin than when its value if λ_1

Answer:

Watch Video Solution

14. A proton and an α-particle are accelerated, using the same potential difference. How are the de-Broglie wavelengths λ_p and λ_a related to each other?

Watch Video Solution

15. (i) In the explanations of photoelectric effect, we assume one photon of frequency ν collides with an electron and transfer its energy. This leads to the equation for the maximum energy $E_{\max}$ of the emitted electron as $E_{\max} = h\nu - \phi_0$ Where

ϕ_0 is the work function of the metal. if an electron absorbs 2 photons (each of frequency v) what will be the maximum energy for the emitted electron?

(ii) Why is this fact (two photon absorption) not taken into consideration in our discussion of the stopping potential?

Watch Video Solution

16. There are materials which absorb photon of shorter wavelength and emit photons of longer wavelength. Can there be stable substances which

absorb photons of larger wavelength and emit light of shorter wavelength.

Watch Video Solution

17. Do all the electrons that absorb a photon come out as photoelectrons?

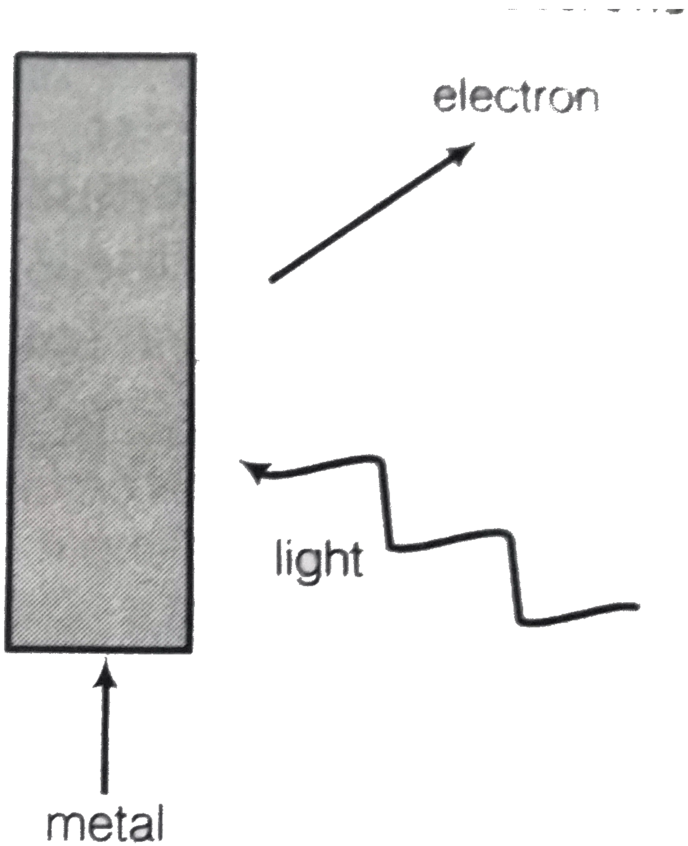
Watch Video Solution

18. There are two sources of light, each emitting with a power of $100W$. One emits X-rays of wavelength $1nm$ and the other visible light at

$500nm$. Find the ratio of number of photons of X-rays to the photons of visible light of the given wavelength?

Watch Video Solution

19. Consider figure for photoemission. How would you reconcile with momentum-conservation? Note light (photons) have momentum in a different direction than the emitted electrons.



Watch Video Solution

20. Consider a metal exposed to light of wavelength 600nm. The maximum energy of the electrons doubles when light of wavelength 400nm is used. Find the work function in eV.

Watch Video Solution

21. Assuming an electron is confined to a $1nm$ wide region, find the wavelength in momentum using Heisenberg Uncertainty principal $(\Delta x \Delta p \approx h)$. You can assume the uncertainty in position Δx and $1nm$. Assuming $p \cong \Delta p$, find the energy of the electron in electron volts.

Watch Video Solution

22. Two monochromatic beam A and B of equal intensity I, hit a screen. The number of photons hitting the screen by beam A is twice that by beam B. Then what inference can you make about their frequencies?

Watch Video Solution

23. Two particles A and B of de-broglie wavelength λ_1 and λ_2 combine to from a particle C. The process conserves momentum. Find the de-Broglie wavelength of the particle C. (The motion is one dimensional).

Watch Video Solution

24. A neutron beam of energy E scatters from atoms on a surface with a spacing d=0.1nm. The first maximum of intensity in the reflected beam occurs at $\theta = 30^{\circ}$. What is the kinetic energy of E of the beam in eV?

Watch Video Solution

25. Consider a thn target (10^{-2} m square, 10^{-3} m thinkness) of sodium, which produces a photocurrent of 100 μA when a light of intensity 100 $W/m^2 (\lambda = 660 nm)$ falls on it. Find the probability that a photoenectron is produced when a photon strikes a sodium atom.

$$\left[\text{Taken density of Na} = 0.97 kg/m^3\right]$$

Watch Video Solution

26. Consider an electron in front of metallic surface at a distance d (treated as an infinite plane surface). Assume the force of attraction by the plate is given as $\frac{1}{4}\frac{q^2}{4\pi \in_0 d^2}$.

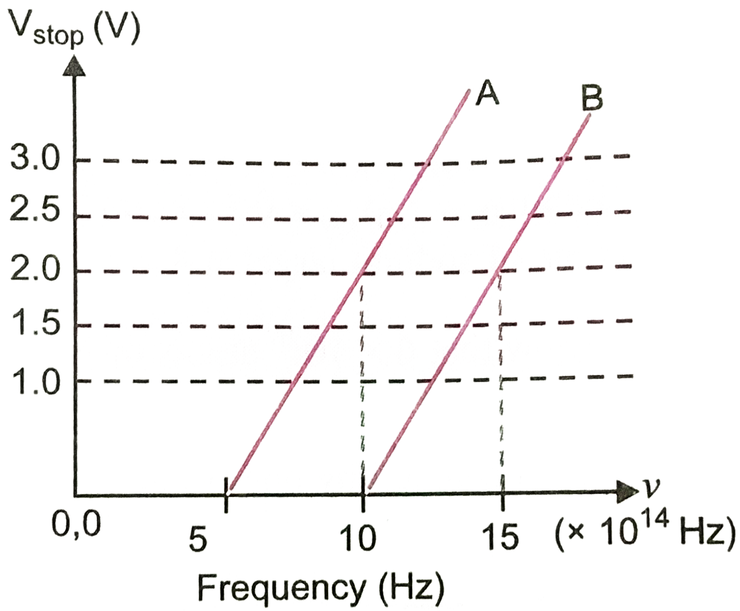
Calculate work in taking the charge to an infinite distance from the plate. Taking d=0.1nm, find the work done in electron volts. [Such a force law is not valid for d lt 0.1nm].

Watch Video Solution

27. A student performs an experiment on photoelectric effect, using two materials A and B. A plot of $V_{s}\top$ vs ν is given in fig.

(i) Which material A or B has a higher work function?

(ii) Given the electric charge of an electron $= 1.6 \times 10^{-19} C$, find the value of h obtained from the experiment for both A and B. Comment on whether it is consistent with Einstein's theory.



Watch Video Solution

28. A particle A with a mass m_A is moving with a velocity v and hits a particle B (mass m_B) at rest (one dimensional motion). Find the change in the de-Broglie wavelength of the particle A. Treat the collision as elastic.

Watch Video Solution

29. Consider a $20W$ bulb emitting light of wavelength 5000Å and shinning on a metal surface kept at a distance $2m$. Assume that the metal surface has work function of $2eV$ and that each atom on the metal surface can be treated as a circular disk of radius 1.5Å.

(i) Estimate no. of photons emitted by the bulb per second. [Assume no other losses] (ii) Will there be photoelectric emission? (iii) How much time would be required by the atomic disk to receive energy equal to work function $2eV$? (iv) How many photons would atomic disk receive within time duration calculated in (iii) above? (v) Can you explain how photoelectric effect was observed instantaneously? [Hint : Time calculated in part (iii) is from classical consideration and you may further take the target of surface area say $1cm^2$ and estimate what would happen?]

Watch Video Solution