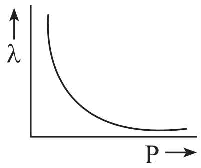
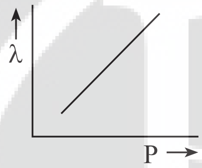
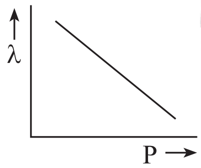
CHAPTER 11 Dual Nature of Radiation and Matter

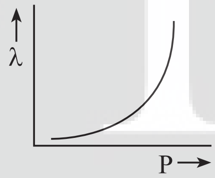
Photoelectric effect

1. The graph which shows the variation of the de-Broglie wavelength (λ) of a particle and its associated momentum (P) is: (*2022*)

a. 

b. 

c. 

d. 

2. The number of photons per second on an average emitted by the source of monochromatic light of wavelength 600 nm, when it delivers the power of 3.3×10^{-3} watt will be: ($h = 6.6 \times 10^{-34}$ Js) (*2021*)

a. 10^{17} b. 10^{16}
c. 10^{15} d. 10^{18}

3. Light of frequency 1.5 times the threshold frequency is incident on a photosensitive material. What will be the photoelectric current if the frequency is halved and intensity is doubled? (*2020*)

a. Four times b. One-fourth
c. Zero d. Doubled

4. When the light of frequency $2\nu_0$ (where ν_0 is threshold frequency), is incident on a metal plate, the maximum velocity of electrons emitted is v_1. When the frequency of the incident radiation is increased to $5\nu_0$, the maximum velocity of electrons emitted from the same plate is v_2. The ratio of v_1 to v_2 is: (*2018*)

a. 4 : 1 b. 1 : 4
c. 1 : 2 d. 2 : 1

5. The photoelectric threshold wavelength of silver is 3250×10^{-10} m. The velocity of the electron ejected from a silver surface by ultraviolet light of wavelength 2536×10^{-10} m is: (*2017-Delhi*)
(Given $h = 4.14 \times 10^{-15}$ eV and $c = 3 \times 10^{8}$ ms^{-1})

a. $\approx 0.6 \times 10^{6}$ ms^{-1} b. $\approx 61 \times 10^{3}$ ms^{-1}
c. $\approx 0.3 \times 10^{6}$ ms^{-1} d. $\approx 6 \times 10^{5}$ ms^{-1}

6. When a metallic surface is illuminated with radiation of wavelength λ, the stopping potential is V. If the same surface is illuminated with radiation of wavelength 2λ, the stopping potential is V/4. The threshold wavelength for the metallic surface is: (*2016-I*)

a. 4λ b. 5λ
c. $\frac{5}{2}\lambda$ d. 3λ

7. Photons with energy 5 eV are incident on a cathode C in a photoelectric cell. The maximum energy of emitted photoelectrons is 2 eV. When photons of energy 6 eV are incident on C, no photoelectrons will reach the anode A, if the stopping potential of A relative to C is: (*2016-II*)

a. – 1 V b. – 3 V
c. + 3 V d. + 4 V

8. A certain metallic surface is illuminated with monochromatic light of wavelength λ. The stopping potential for photo-electric current for this light is $3V_0$. If the same surface is illuminated with light of wavelength 2λ, the stopping potential is V_0. The threshold wavelength for this surface for photoelectric effect is: (*2015*)

a. 4λ b. $\frac{\lambda}{4}$
c. $\frac{\lambda}{6}$ d. 6λ

9. A photoelectric surface is illuminated successively by monochromatic light of wavelength λ and $\lambda/2$. If the maximum kinetic energy of the emitted photoelectrons in the second case is 3 times that in the first case, the work function of the surface of the material is:
(h = Plank's constant, c = speed of light) (*2015 Re*)

a. $\frac{hc}{3\lambda}$ b. $\frac{hc}{2\lambda}$
c. $\frac{hc}{\lambda}$ d. $\frac{2hc}{\lambda}$

10. When the energy of the incident radiation is increased by 20%, the kinetic energy of the photoelectrons emitted from a metal surface increased from 0.5 eV to 0.8 eV. The work function of the metal is: (*2014*)

a. 0.65 eV b. 1.0 eV
c. 1.3 eV d. 1.5 eV

11. For photoelectric emission from certain metal the cut-off frequency is ν. If radiation of frequency 2ν impinges on the metal plate, the maximum possible velocity of the emitted electron will be: (m is the electron mass) (*2013*)

a. $2\sqrt{\frac{h\nu}{m}}$ b. $\sqrt{\frac{h\nu}{(2m)}}$

c. $\sqrt{\frac{h\nu}{m}}$ d. $\sqrt{\frac{2h\nu}{m}}$

Unit Conversion

12. The energy required to break one bond in DNA is 10^{-20} J. This value in eV is nearly. (2020)

a. 0.6 b. 0.06

c. 0.006 d. 6

Wave Nature of Matter (De-Broglie Wavelength)

13. When two monochromatic light of frequency, ν and ν are incident on a photoelectric metal, their stopping potential becomes $V_s/2$ and V_s respectively. The threshold frequency for this metal is: (*2022*)

a. $\frac{3}{2}\nu$ b. 2ν

c. 3ν d. $\frac{2}{3}\nu$

14. An electromagnetic wave of wavelength 'λ' is incident on a photosensitive surface of negligible work function. If 'm' mass is of photoelectron emitted from the surface has de-Broglie wavelength λ_d, then: (*2021*)

a. $\lambda_d = \left(\frac{2mc}{h}\right)\lambda^2$ b. $\lambda = \left(\frac{2mc}{h}\right)\lambda_d^2$

c. $\lambda = \left(\frac{2h}{mc}\right)\lambda_d^2$ d. $\lambda = \left(\frac{2m}{hc}\right)\lambda_d^2$

15. An electron is accelerated from rest through a potential difference of V volt. If the de Broglie wavelength of the electron is 1.227×10^{-2} nm, the potential difference is : (2020)

a. 10^2 V b. 10^3 V

c. 10^4 V d. 10 V

16. The de Broglie wavelength of an electron moving with kinetic energy of 144 eV is nearly, (*2020-Covid*)

a. 102×10^{-4} nm b. 102×10^{-5} nm

c. 102×10^{-2} nm d. 102×10^{-3} nm

17. An electron is accelerated through a potential difference of 10,000 V. Its de Broglie wavelength is, (nearly) : ($m_e = 9 \times 10^{-31}$ kg) (*2019*)

a. 12.2×10^{-13} m b. 12.2×10^{-12} m

c. 12.2×10^{-14} m d. 12.2 nm

18. An electron of mass m with an initial velocity $\vec{V} = V_0\hat{i}\,(V_0 > 0)$ enters an electric field $\vec{E} = -E_0\hat{i}\,(E_0 = \text{constant} > 0)$ at t = 0. If λ_0 is its de-Broglie wavelength initially, then its de-Broglie wavelength at time t is (*2018*)

a. $\lambda_0 t$ b. $\lambda_0\left(1 + \frac{eE_0}{mVf_0}t\right)$

c. $\frac{\lambda_0}{\left(1 + \frac{eE_0}{mV_0}t\right)}$ d. λ_0

19. The de-Broglie wavelength of a neutron in thermal equilibrium with heavy water at a temperature T (Kelvin) and mass m, is: (*2017-Delhi*)

a. $\frac{h}{\sqrt{3mkT}}$ b. $\frac{2h}{\sqrt{3mkT}}$

c. $\frac{2h}{\sqrt{mkT}}$ d. $\frac{h}{\sqrt{mkT}}$

20. An electron of mass m and a photon have same energy E. The ratio of de-Broglie wavelengths associated with them is (c being velocity of light) (*2016-I*)

a. $\frac{1}{c}\left(\frac{E}{2m}\right)^{\frac{1}{2}}$ b. $\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

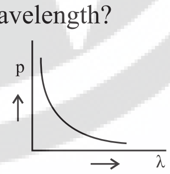
c. $c(2mE)^{\frac{1}{2}}$ d. $\frac{1}{c}\left(\frac{2m}{E}\right)^{\frac{1}{2}}$

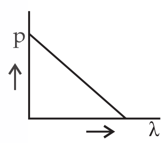
21. Electrons of mass m with de-Broglie wavelength λ fall on the target in an X-ray tube. The cutoff wavelength (λ_0) of the emitted X-ray is: (*2016-II*)

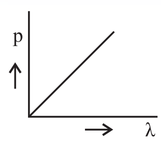
a. $\lambda_0 = \frac{2m^2c^2\lambda^2}{h^2}$ b. $\lambda_0 = \lambda$

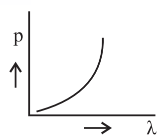
c. $\lambda_0 = \frac{2mc\lambda^2}{h}$ d. $\lambda_0 = \frac{2h}{mc}$

22. Which of the following figures represent the variation of particle momentum and the associated de-Broglie wavelength? (*2015*)

a. 

b. 

c. 

d. 

23. If the kinetic energy of the particle is increased to 16 times its previous value, the percentage change in the de-Broglie wavelength of the particle is (*2014*)

a. 25 b. 75

c. 60 d. 50

24. The wavelength λ_e of an electron and λ_p of a photon of same energy E are related by: (*2013*)

a. $\lambda_p \propto \frac{1}{\sqrt{\lambda_e}}$ b. $\lambda_p \propto \lambda_e^2$

c. $\lambda_p \propto \lambda_e$ d. $\lambda_p \propto \sqrt{\lambda_e}$

Parameters of Photon (Momentum, Pressure and Energy)

25. Light of wavelength 5000 nm is incident on a metal with work function 2.28 eV. The de-Broglie wavelength of the emitted electron is: (*2015 Re*)

a. $\leq 2.8 \times 10^{-12}$ m
b. $< 2.8 \times 10^{-10}$ m
c. $< 2.8 \times 10^{-9}$ m
d. $\geq 2.8 \times 10^{-9}$ m

Davisson and Germer Experiment

26. The wave nature of electrons was experimentally verified by. **[RC]** (*2020-Covid*)

a. Hertz
b. Einstein
c. Davisson and Germer
d. de-Broglie

Answer Key

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
a	b	c	c	a,d	d	b	a	b	b	d	b	None	b	c	d	b
18	19	20	21	22	23	24	25	26								
c	a	a	c	a	b	b	d	c								