PHYSICS

BOOKS - FULL MARKS PHYSICS (TAMIL ENGLISH)

DUAL NATURE OF RADIATION AND MATTER

Example

1. For the photoelectric emission from cesium, show that wave theory prodicts that

(i) maximum kinetic energy of the photoelectrons $(K_{\max})$ depends on the intensity I of the incident light

(ii) $K_{\max}$ does not depend on the frequency of the incident light and

(iii) the time interval between the incidence of light and the ejection of photoelectrons is very long.

(Given : The work function for cesium is 1.90 eV and the power absorbed per unit area is

$1.60 \times 10^{-6} Wm^{-2}$ which produces a measurable photocurrent in cesium.)

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2. A radiation of wavelength 300 nm is incident on a silver surface. Will photoelectrons be observed ?

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3. When light of wavelength 2200 $\mathring{A}$ falls on Cu, photo electrons are emitted from it. Find (i) the threshold wavelength and (ii) the stopping potential. Given : the work function for Cu is ϕ_0 = 4.7 eV.

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4. The work function of potassium is 2.2 eV. UV light of wavelength 3000 $\mathring{A}$ and intensity 2 Wm^{-2} is incident on the potassium surface.

(i) Determine the maximum kinetic energy of the photo electrons (ii) If 40% of incident photons produce photo electrons, how many electrons are emitted per second if the area of the potassium surface is 2 cm^2 ?

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5. Light of wavelength 390 nm is directed at a metal electrode. To find the energy of electrons ejected, an opposing potential difference is established between it and

another electrode. The current of photoelectrons from one to the other is stopped completely when the potential difference is 1.10 V. Determine (i) the work function of the metal and (ii) the maximum wavelength of light that can electrons from this metal.

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6. Calculate the momentum and the de Broglie wavelength in the following cases :

(i) an electron with kinetic energy 2 eV.

(ii) a bullet of 50g fired from rifle with a speed of 200 m/s

(iii) a 4000 kg car moving along the highways at 50 m/s

Hence show that the wave nature of matter is important at the atomic level but is not really relevant at macroscopic level.

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7. Find the de Broglie wavelength associated with an alpha particle which is accelerated through a potential difference of 400 V. Given that the mass of the proton is 1.67×10^{-27} kg.

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8. A proton and an electron have same de Broglie wavelength. Which of them moves

faster and which possesses more kinetic energy ?

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9. Calculate the cut-off wavelength and cutoff frequency of x-rays from an x-ray tube of accelerating potential 20,000 V.

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Textual Evaluation Solved Multiple Choice Questions

1. The wavelength λ_e of an electron and λ_p of a photon of same energy E are related by.....

A. $\lambda_p \propto \lambda_e$

B. $\lambda_p \propto \sqrt{\lambda_e}$

C. $\lambda_p \propto \frac{1}{\sqrt{\lambda_e}}$

D. $\lambda_p \propto \lambda_e^2$

Answer: D

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2. In an electron microscope, the electrons are accelerated by a voltage of 14 kV. If the voltage is changed to 224 kV, then the de Broglie wavelength associated with the electrons would.....

A. increase by 2 time

B. decrease by 2 times

C. decrease by 4 times

D. increase by 4 times

Answer: C

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3. A particle of mass 3×10^{-6} g has the same wavelength as an electron moving with a velocity $6 \times 10^{6} ms^{-1}$. The velocity of the particle is.....

A. $1.82 \times 10^{-18} ms^{-1}$

B. $9 \times 10^{-2} ms^{-1}$

C. $3 \times 10^{-31} ms^{-1}$

D. $1.82 \times 10^{-15} ms^{-1}$

Answer: D

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4. 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 $\frac{V}{4}$. The threshold wavelength for the metallic surface is.....

A. 4λ

B. 5λ

C. $\frac{5}{2}\lambda$

D. 3λ

Answer: D

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5. If a light of wavelength 330 nm is incident on a metal with work function 3.55 eV, the electrons are emitted. Then the wavelength of

the emitted electron is (Take h = 6.6×10^{-34} Js).....

A. $< 2.75 \times 10^{-9} m$

B. $\geq 2.75 \times 10^{-9} m$

C. $\leq 2.75 \times 10^{-12} m$

D. $< 2.5 \times 10^{-10} m$

Answer: A

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6. A photoelectric surface is illuminated successively by monochromatic ligth of wavelength λ and $\frac{\lambda}{2}$. If the maximum kinetic energy of the emitted photoelectrons in the second case is 3 times that in the first case, the work function at the surface of material is.....

A. $\frac{hc}{\lambda}$

B. $\frac{2hc}{\lambda}$

C. $\frac{hc}{3\lambda}$

D. $\frac{hc}{2\lambda}$

Answer: D

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7. In photoelectric emission, a radiation whose frequency is 4 times threshold frequency of a certainn metal is incident on the metal. The an the maximum possible velocity of the emitted electron will be.....

A. $\sqrt{\frac{hv_0}{m}}$

B. $\sqrt{\frac{6hv_0}{m}}$

C. $2\sqrt{\frac{hv_0}{m}}$

D. $\sqrt{\frac{hv_0}{2m}}$

Answer: B

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8. Two radiations with photon energies 0.9 eV and 3.3 eV respectively are falling on a metallic surface successively. If the work function of the

metal is 0.6 eV, then the ratio of maximum speeds of emitted electrons will be.....

A. $1:4$

B. $1:3$

C. $1:1$

D. $1:9$

Answer: B

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9. A light source of wavelength 520 nm emits 1.04×10^{15} photons per second while the second source of 460 nm produces 1.38×10^{15} photons per second. Then the ratio of power of second source to that of first source is.....

A. 1.00

B. 1.02

C. 1.5

D. 0.98

Answer: C

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10. The mean wavelength of light from sun is taken to be 550 nm and its mean power is 3.8×10^{26} W. The number of photons received by the human eye per second on the average from sunlight is of the order of.....

A. 10^{45}

B. 10^{42}

C. 10^{54}

D. 10^{51}

Answer: A

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11. The threshold wavelength for a metal surface whose photoelectric work function is 3.313 eV is.....

A. 4125 Å

B. 3750 Å

C. 6000 Å

D. 2062.5 Å

Answer: B

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12. A light of wavelength 500 nm is incident on a sensitive plate of photoelectric work function 1.235 eV. The kinetic energy of the

photo electrons emitted is be (Take h = 6.6×10^{-34} Js)

A. 0.58 eV

B. 2.48 eV

C. 1.24 eV

D. 1.16 eV

Answer: C

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13. Photons of wavelength λ are incident on a metal. The most energetic electrons ejected from the metal are bent into a circular arc of radius R by a perpendicular magnetic field having magnitude B. The work function of the metal is.....

A. $\frac{hc}{\lambda} - me_e + \frac{e^2B^2R^2}{2m_e}$

B. $\frac{hc}{\lambda} + 2m_e\left[\frac{eBR}{2m_e}\right]^2$

C. $\frac{hc}{\lambda} - m_ec^2 - \frac{e^2B^2R^2}{2m_e}$

D. $\frac{hc}{\lambda} - 2m_e\left[\frac{eBR}{2m_e}\right]^2$

Answer: D

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14. The work functions for metals A,B and Care 1.92 eV, 2.0 eV and 5.0 eV respctively. The metals which will emit photoelectrons for a radiation of wavelength 4100Å is / are

A. A only

B. both A and B

C. all these metals

D. none

Answer: B

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15. Emission of electrons by the absorption of heat energy is callled.....emission.

A. photoelectric

B. field

C. thermionic

D. secondary

Answer: C

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Textual Evaluation Solved Short Answer Questions

1. Why do metals have a large number of free electrons ?

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2. Define work function of a metal. Give its unit.

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3. What is photoelectric effect ?

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4. How does photocurrent vary with the intensity of the incident light ?

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5. Give the definition of intensity of light and its unit.

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6. How will you define threshold frequency ?

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7. What is a photo cell ? Mention the different types of photocells.

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8. Write the expression for the de Broglie wavelength associated with a charged particle of charge q and mass m, when it is accelerated through a potential V.

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9. State de Broglie hypothesis.

10. Why we do not see the wave properties of a baseball ?

11. A proton and an electron have same kinetic energy. Which one has greater de Broglie

wavelength. Justify.

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12. Write the relationship of de Broglie wavelength λ associated with a particle of mass m in terms of its kinetic energy K.

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13. Name an experiment which shows wave nature of the electron. Which phenomenon

was observed in this experiment using an electron beam?

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14. An electron and an alpha particle have same kinetic energy. How are the de Broglie wavelengths associated with them related ?

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Textual Evaluation Solved Long Answer Questions

1. What do you mean by electron emission ? Explain briefly various methods of electron emission.

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2. Briefly discuss the observations of Hertz, Hallwachs and Lenard. Hertz observation:

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3. Explain the effect of potential difference on photoelectric current.

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4. Explain how frequency of incident light varies with stopping potential.

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5. List out the laws of photoelectric effect.

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6. Explain why photoelectric effect cannot be explained on the basis of wave nature of light.

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7. Explain the quantum concept of light.

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8. Obtain Einstein's photoelectric equation with necessary explanation.

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9. Explain experimentally observed facts of photoelectric effect with the help of Einstein's explanation.

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10. Give the construction and working of photo emissive cell.

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11. Derive an expression for De Broglie wavelength.

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12. Write about electron microscope.

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13. Discuss the Davisson and Germer experiment.

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Textual Evaluation Solved Numerical Problems

1. How many photons per second emanate from a 50 mW laser of 640 nm ?

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2. Calculate the maximum kinetic energy and maximum velocity of the photoelectrons emitted when the stopping potential is 81V for the photoelectric emission experiment.

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3. Calculate the energies of the photons associated with the following radiation :

violet light of 413 nm

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4. A 150 W lamp emits light of mean wavelength of 5500Å. If the efficiency is $12\,\%$, find out the number of photons emitted by the lamp in one second.

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5. How many photons of frequency $10^{14}Hz$ will make up 19.86 J of energy ?

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6. What should be the velocity of the electron so that its momentum equals of 4000Å wavelength photon.

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7. When a light of frequency $9 \times 10^{14} Hz$ is incident on a metal surface, photoelectrons are emitted with a maximum speed of

$8 \times 10^5 ms^{-1}$. Determine the threshold frequency of the surface.

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8. When a 6000Å light falls on the cathode of a photo cell and produced photoemission. If a stopping potential of 0.8 V is required to stop emission of electron, then determine the frequency of the light

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9. A 3310 $\mathring{A}$ photon liberates an electron from a material with energy 3×10^{-19} J while another 5000 $\mathring{A}$ photon ejects an electron with energy 0.972×10^{-19}J from the same material. Determine the value of Planck's constant and the threshold wavelength of the material.

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10. At the given point of time, the earth receives energy from sun at $4calcm^{-2}min^{-1}$

.Determine the number of photons received on the surface of the Earth per cm^2 per minute. (Given : Mean wavelength of sun light $= 5500\text{Å}$)

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11. UV light of wavelength 1800Å is incident on a lithium surface whose threshold wavelength 4965Å. Determine the maximum energy of the electron emitted.

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12. Calculate the de Broglie wavelength of a proton whose kinetic energy is equal to $81.9 \times 10^{-15} J$. (Given : mass of proton is 1836 times that of electron) .

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13. A deuteron and an alpha particl are accelerated with the same potential. Which one of the two has

greater value of de Broglie wavelength associated with it and i

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14. An electron is accelerated through a potential difference of 81V. What is the de Broglie wavelength associated with it? To which part of electromagnetic spectrum does this wavelength corresspond ?

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15. The ratio between the de Broglie wavelength associated with protons, accelerated through a potential of 512 V and that of alpha particles accelerated through a potential of X volts is found to be one. Find the value of X.

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Additional Questions Multiple Choice Questions

1. The maximum kinetic energy of photoelectrons emitted from a surface when photons of energy 3 eV fall on it is 4 eV. The stopping potential, in volt, is.....

A. 2

B. 4

C. 6

D. 10

Answer: B

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2. If an electron and proton are propagating in the form of waves having the same λ, it implies that they have the same

A. energy

B. momentum

C. velocity

D. angular momentum

Answer: B

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3. An electron of mass m and charge e is accelerated from rest through a potential difference V in vacuum. Its final velocity will be

A. $\sqrt{\frac{2eV}{m}}$

B. $\sqrt{\frac{eV}{m}}$

C. $\frac{eV}{2m}$

D. $\frac{eV}{m}$

Answer: A

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4. The work funciton of a substance is 4.0 eV. The longest wavelength of light that can cause photoelectron emission from this substance is approximately

A. 540 nm

B. 400 nm

C. 310 nm

D. 220 nm

Answer: C

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5. Sodium and copper have work functions of 2.3eV and 4.5 eV respectively, then the ratio of the wavelengths is nearest to

A. $1:2$

B. $4:1$

C. $2:1$

D. $1:4$

Answer: C

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6. The surface of a metal is illuminated with the light of 400 nm. The kinetic energy of the ejected photoelectrons was found to be 1.68 eV. The work function of the metal is (hc = 1240 eV nm)

A. 3.09 eV

B. 1.42 eV

C. 1.51 eV

D. 1.68 eV

Answer: B

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7. 4 eV is the energy of the incident photon and the work function is 2 eV. The stopping potential will be

A. 2V

B. 4V

C. 6V

D. $2\sqrt{2}$ V

Answer: A

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8. A light having wavelength 300 nm falls on a metal surface work function of metal is 2.54 eV. What is stopping potential ?

A. 1.4 V

B. 2.59 V

C. 1.60 V

D. 1.29 V

Answer: A

9. If the K.E. of free electron doubles, its de-Broglie wavelength changes by the factor

A. $\frac{1}{2}$

B. 2

C. $\frac{1}{\sqrt{2}}$

D. $\sqrt{2}$

Answer: C

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10. If the kinetic energy of a particle is increased by 16 times, the percentage change in the de-Broglie wavelength of the particle is

A. 25

B. 75

C. 60

D. 50

Answer: B

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11. When a proton is accelerated through 1V, then its kinetic energy will be

A. 1 eV

B. 13.6 eV

C. 1840 eV

D. 0.54 eV

Answer: A

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12. The kinetic energy of an electron, which is accelerated in the potential difference of 100 volts, is

A. 416.6 cal

B. 6.636 cal

C. 1.602×10^{-17} J

D. 1.6×10^{4} J

Answer: C

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13. Kinetic energy of emitted electron depends upon

A. frequency

B. intensity

C. nature of atmosphere surrounding the electron

D. none of these

Answer: A

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14. The work function of photometal is 6.626 eV. What is the threshold wavelength ?

A. 3921 Å

B. 1875 Å

C. 1867 Å

D. 4433 Å

Answer: B

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15. The number of photo-electrons emitted for light of a frequency v (higher than the threshold frequency v_0) is proportional to

A. Threshold frequency (v_0)

B. Intensity of light

C. Frequency of light (v)

D. $v - v_0$

Answer: B

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16. The speed of an electron having a wavelength of 10^{-10} m is

A. $7.25 \times 10^6 ms^{-1}$

B. $6.26 \times 10^6 ms^{-1}$

C. $5.25 \times 10^6 ms^{-1}$

D. $4.24 \times 10^6 ms^{-1}$

Answer: A

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17. If an electron and a photon propagate in the form of waves having the same wavelength, it implies that they have the same

A. energy

B. momentum

C. angular momentum

D. velocity

Answer: B

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18. Electron volt (eV) is a unit of

A. energy

B. potential

C. current

D. charge

Answer: A

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19. Photon of frequency v has a momentum associated with it. If c is the velocity of light, the momentum is

A. $\frac{hv}{c}$

B. $\frac{v}{c}$

C. hvc

D. $\frac{h}{c^2}$

Answer: A

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20. The time taken by a photoelectron to come out after photon strikes is approximately

A. 10^{-14} s

B. 10^{-10} s

C. 10^{-16} s

D. 10^{-1} s

Answer: B

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21. Cathode rays consist of

A. photons

B. electrons

C. protons

D. α-particles

Answer: B

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22. The momentum of photon whose frequency is f is

A. $\frac{hf}{c}$

B. $\frac{hc}{f}$

C. $\frac{h}{f}$

D. $\frac{c}{hf}$

Answer: A

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23. The energy of photon of wavelength λ is

A. $\frac{hc}{\lambda}$

B. $h\lambda c$

C. $\frac{\lambda}{hc}$

D. $\frac{h\lambda}{c}$

Answer: A

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24. The ratio of the energy of a photon with $\lambda = 150$ nm to that with $\lambda = 300$ nm is

A. 2

B. $\frac{1}{4}$

C. 0.2

D. $\frac{1}{2}$

Answer: A

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25. Photons of 5.5 eV energy fall on the surface of the metal emitting photoelectrons of maximum kinetic energy 4.0 eV. The stopping voltage required for these electrons is

A. 5.5 V

B. 1.5 V

C. 9.5 V

D. 4.0 V

Answer: D

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26. The wavelength of photon is proportional to (where v = fequency)

A. v

B. $\sqrt{v}$

C. $\frac{1}{\sqrt{v}}$

D. $\frac{1}{v}$

Answer: D

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27. What is the energy of a photon whose wavelength is 6840 $\mathring{A}$?

A. 1.81 eV

B. 3.6 eV

C. $-13.6eV$

D. 12.1 eV

Answer: A

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28. Momentum of photon of wavelength λ is

A. $\frac{h}{\lambda}$

B. zero

C. $\frac{h\lambda}{c^2}$

D. $\frac{h\lambda}{c}$

Answer: A

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29. The momentum of a photon of energy 1 MeV is kg m/s will be

A. 5×10^{-22}

B. 0.33×10^{6}

C. 7×10^{-24}

D. 10^{-22}

Answer: A

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30. If a proton and electron have the same de-Broglie wavelength, then

A. momentum

B. angular momentum

C. energy

D. velocity

Answer: A

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31. Photoelectric effect can be explained by

A. corpusular theory of light

B. wave nature of light

C. Bohr's theory

D. quantum theory of light

Answer: D

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32. Which of the following waves can produce photoelectric effect ?

A. ultrasound

B. infrared

C. radiowaves

D. X-rays

Answer: D

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33. Which light when falls on a metal will emit photoelectons ?

A. uv radiation

B. infrared radiation

C. radio waves

D. microwaves

Answer: A

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34. In photoelectric effect, the KE of electrons emitted from the metal surface depends upon

A. intensity of light

B. frequency of incident light

C. velocity of incident light

D. both intensity and velocity of light

Answer: B

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35. In photoelectric effect, electrons are ejected from metals, if the incident light has a certain minimum

A. wavelength

B. frequency

C. amplitude

D. angle of incidence

Answer: B

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36. Number of ejected photoelectrons increases with increases

A. a) in intensity of light

B. b) in wavelength of light

C. c) in frequency of light

D. d) never

Answer: A

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37. By photoelectric effect, Einstein proved

A. $E = hv$

B. $K.E. = \frac{1}{2}mv^2$

C. $E = mc^2$

D. $E = \frac{-Rhc^2}{n^2}$

Answer: A

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38. A photocell employs photoelectric effect to convert

A. Change in the frequency of light into a change in the electric current.

B. Change in the frequency of light into a change in electric voltage

C. Change in the intensity of illumination into a change in photoelectric current

D. Change in the intensity of illumination into a change in the work function of the photo cathode

Answer: C

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39. When ultraviolet rays incident on metal plate there photoelectric effect does not occur, it occurs by incident of

A. infrared rays

B. X-rays

C. radio waves

D. microwaves

Answer: B

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40. The threshold frequency for photoelectric effect on sodiune corresponds to a wavelength of 5000 $\mathring{A}$. Its function is

A. 4×10^{-19} J

B. 1 J

C. 2×10^{-19} J

D. 3×10^{-19} J

Answer: A

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41. The photoelectric work function for a metal surface is 4.125 eV. The cut off wavelength for this surface is

A. 3000 Å

B. 2062.5 Å

C. 4125 Å

D. 6000 Å

Answer: A

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42. Ultraviolet radiations of 6.2 eV falls on an aluminium surface. Kinetic energy of fastest electrons emitted is (work function = 4.2 eV)

A. 3.2×10^{-21} J

B. 3.2×10^{-19} J

C. 7×10^{-25} J

D. 9×10^{-32} J

Answer: B

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43. The de-Broglie wavelength of a tennis ball of mass 60g moving with a velocity of 10

ms^{-1} is approximately (planck's constant, $h = 6.63 \times 10^{-34}$ Js)

A. 10^{-33} m

B. 10^{-31} m

C. 10^{-16} m

D. 10^{-25} m

Answer: A

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44. The wavelength of de-Broglie wave is 3 μm, then its momentum $\left(h = 6.63 \times 10^{-34} Js\right)$ is

A. $3.315 \times 10^{-28} \text{kg ms}^{-1}$

B. $2.21 \times 10^{-28} \text{kg ms}^{-1}$

C. $4.97 \times 10^{-28} \text{kg ms}^{-1}$

D. $9.9 \times 10^{-28} \text{kg ms}^{-1}$

Answer: A

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45. What is de-Broglie wavelength of electron having energy 10 KeV ?

A. 0.12 Å

B. 1.2 Å

C. 12.2 Å

D. none of these

Answer: A

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46. Which one of the following property does not support wave theory of light ?

A. Light obeys laws of reflection and refraction

B. Light waves get polarised

C. Light shows photoelectric effect

D. Light shows interference

Answer: C

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47. de-Broglie wavelength λ associated with neutrons is related with absolute temperature T as

A. $\lambda \propto T$

B. $\lambda \propto \frac{1}{T}$

C. $\lambda \propto \frac{1}{\sqrt{T}}$

D. $\lambda \propto T^2$

Answer: C

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48. As the intensity of incident light increases

A. kinetic energy of emitted photoelectrons increases

B. photoelectric current decreases

C. photoelectric current increases

D. kinetic energy of emitted photoelectrons decreases

Answer: C

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49. The de Broglie wave corresponding to a particle of mass m and velocity v has a wavelength associated with it

A. $\frac{h}{mv}$

B. hmv

C. $\frac{mh}{v}$

D. $\frac{m}{hv}$

Answer: A

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50. If particles are moving with same velocity, then which has maximum de-broglie wavelength ?

A. Proton

B. α-particle

C. Neutron

D. β-particle

Answer: D

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51. The dual nature of light is exhibited by

A. A) diffraction and photoelectric effect

B. B) photoelectric effect

C. C) refraction and interference

D. D) diffraction and reflection

Answer: A

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52. If the momentum of a particle is doubled, then its de-Broglie wavelength will

A. remain unchanged

B. become four time

C. become two times

D. become half

Answer: D

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53. Moving with the same velocity, which of the following has the longest de-Broglie wavelength ?

A. β-particle

B. α-particle

C. proton

D. neutron

Answer: A

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54. What is the de-Broglie wavelength of the α -particle accelerated through a potential difference of V volt ? (mass of α-particle = 6.6455×10^{-27} kg)

A. $\frac{0.287}{\sqrt{V}}$ Å

B. $\frac{12.27}{\sqrt{V}}$ Å

C. $\frac{0.101}{\sqrt{V}}$ Å

D. $\frac{0.202}{\sqrt{V}}$ Å

Answer: C

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55. A proton and an α-particle are accelerated through the same potential difference. The ratio of de-Broglie wavelength of proton to the de-Broglie wavelength of alpha particle will be

A. $1:2$

B. $2\sqrt{2}:1$

C. $2:1$

D. $1:1$

Answer: B

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56. Proton and α-particle have the same de-Broglie wavelength. What is same for both of them ?

A. Time period

B. Energy

C. Frequency

D. Momentum

Answer: D

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57. The shortest wavelength of X-ray emitted from an X-ray tube depends upon.

A. the current in the tube

B. the voltage applied to the tube

C. the nature of the gas in the tube

D. the atomic number of the target material

Answer: B

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58. An X-ray tube operates on 30 kV. The minimum wavelength emitted is $h = 6.6 \times 10^{-34}$ Js, c = 3×10^{8} m/s, e = 1.6×10^{-19}C.

A. 6.6 Å

B. 0.133 Å

C. 1.2 Å

D. 0.4 Å

Answer: D

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59. The potential difference between the cathode and the target in a coolidge tube is

120 kV. What can be the minimum wavelength (in Å) of the X-rays emitted by this tube ?

A. 0.4 Å

B. 0.3 Å

C. 0.2 Å

D. 0.1 Å

Answer: D

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60. The work function for Al, K and Pt is 4.28 eV, 2.30 eV and 5.65 eV respectively. Their respective threshold frequencies would be

A. $pt > AL > K$

B. $Al > pt > K$

C. $K > AL > pt$

D. $Al > K > pt$

Answer: A

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61. Among the following four spectral regions, the photons has the highest energy in

A. Infrared

B. Violet

C. Red

D. Blue

Answer: B

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Additional Questions Short Answer Questions

1. Define electron volt. Express it value in joule.

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2. What are photoelectrons ?

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3. Define the term 'stopping potential ' in relation to photoelectric effect.

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4. Give some important uses of photo-cells.

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5. Why is a photo-cell also called an electric eye ?

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6. On what principle is an electron microscope based ?

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7. Write a note on characteristic x-ray spectra :

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Additional Questions Long Answer Questions

1. Describe an experimental arrangement to study photoelectric effect.

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2. Write the characteristics of photons.

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3. Briefly explain the nature of light.

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4. Derive de-Broglie wave equation (wavelength) for a material particle.

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5. Explain the production of x-rays.

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6. Write a note on continuous x-ray spectra.

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7. Write down the applications of X-rays.

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Additional Questions Additional Numerical Problems

1. If a light of wavelength 4950 $\mathring{A}$ is viewed as a continuous flow of photons, what is the energy of each photon in eV ? (Given $h = 6.6 \times 10^{-34}$Js, c $=3 \times 10^{8} ms^{-1}$)

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2. Monochromatic light of frequency $6.0 \times 10^{14} Hz$ is produced by a laser. The power emitted is 2.0×10^{-3}W. (a). What is the energy of a photon in the light beam? (b)

How many photons per second, on an average are emitted by the source?

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3. Light of wavelength 5000Å falls on a sensitive plate with photoelectric work function of 1.9 eV. The K.E. of the photo electron emitted will be

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4. If photoelectrons are to be emitted from a potassium surface with a speed $6 \times 10^{6} ms^{-1}$, what frequency of radiation must be used ? (Threshold frequency for potassium is 4.22×10^{14} Hz, h = 6.6×10^{-34} Js, $m_e = 9.1 \times 10^{-31}$ kg)

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5. The photoelectric cut-off voltage in a certain experiment 1.5 V. What is the maximum kinetic

energy of photoelectrons emitted ?

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6. What is the

a. momentum, b. speed, and

c. de Broglie wavelength of an electron with kinetic energy of 120 eV.

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7. An electron and a photon each have a wavelength of 1.00 nm. Find

a. their momenta,

b. the energy of the photon, and

c. the kinetic energy of electron.

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8. Find the ratio of de-Broglie wavelengths associated with two electron beams

accelerated through 25 V and 36 V respectively.

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9. A proton and an alpha particle, both initially at rest, are accelerated so as to have the same kinetic energy. What is the ratio of their de-Broglie wavelength ?

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10. Light of two different frequencies whose photons have energies 1 eV and 2.5 eV respectively illuminate a metallic surface whose work function is 0.5 eV successively. Find the ratio of maximum speeds of emitted electrons.

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