PHYSICS

BOOKS - U-LIKE PHYSICS (HINGLISH)

DUAL NATURE OF RADIATION AND MATTER

Ncert Textbook Exercises

1. Find the

(a) maximum frequency, and

(b) minimum wavelength of X-rays produced by 30kV electrons.

View Text Solution

2. The work function of caesium metal is 2.14 eV. When light of frequency $6 \times 10^{14} Hz$ is incidennt on the metal surface, photoemission of electrons occus. What is the

(a) maximum kinetic energy of the emitted electrons,

(b) stopping potential, and

(c) maximum speed of the emitted photoelectrons ?

View Text Solution

3. The photoelectric cut-off voltage in a certain experiment is 1.5 V. what is the maximum kinetic energy of photoelectrons emitted ?

View Text Solution

4. Monochromatic light of wavelength 632.8nm is produced by a helium-neon laser. The power emitted is 9.42 mW.

(a) Find the energy and momentum of each photon in the light beam.

(b) How many photons per second, on the average, arrive at a target irradiated by this beam ?

(Asume the beam to have uniform cross-section which is less than the target area), and

(c) How fast does a hydrogen atom have to travel in order to have the same momentum a that of the photon ?

View Text Solution

5. The energy flux of sunlight reaching the surface of the earth is $1.388 \times 10^3 W / m^{-2}$. How many photons (nearly) perr square metre are incident on the earth per second ? Assume that the photons in the sunlight have an average wavelength of 550 nm.

View Text Solution

6. In an experiment on photoelectric effect, the slope of the cut-offf voltage versus frequency of incident light is found to be $4.12 \times 10^{-15} V$ s. calculate the value of Planck's constant.

View Text Solution

7. A 100W sodium lamp radiates energyuniformly in all directions. The lamp is located at the centre of a large sphere that absorbs all the sodium light which is incident on it. The wavelength of the sodium light is 589 nm. (a) what is the energy per photon associated with the sodium light? (b) At what rate are the photons delivered to the sphere ?

View Text Solution

8. The threshold frequency for a certain metal is $3.3 \times 10^{14} Hz$. If light of frequency $8.2 \times 10^{14} Hz$ is incident on the metal, predict the cut-off voltage for the photoelectric emission.

View Text Solution

9. The work function for a certain metal is 4.2 eV. Will this metal give photoelectric emission for incident radiation of wavelength 330 nm ?

View Text Solution

10. Light of frequency $7.21 \times 10^{14} Hz$ is incident on a metal surface. Electrons with a maximum speed of $6.0 \times 10^5 m / s$ are ejected from the surface. What is the threshold frequency for photoemission of electrons ?

View Text Solution

11. Light of wavelength 488 nm is produced by an argon laser which is used in the photoelectric effect. When light from this spectral line is incident on the emitter, the stopping (cut-off) potential of photoelectrons is 0.38 V. find the work function of the material from which the emitter is made.

View Text Solution

12. Calculate the

(a) Momentum, and

(b) De-broglie wavelength of the electrons accelerated through a potential difference of 56 V.

View Text Solution

13. What is the

(a) momentum,

(b) speed, and

(c) de-Broglie wavelength of an electro with kinetic energy energy of 120 eV.

View Text Solution

14. The wavelength of light from the spectral emission line of sodium is 589nm. Find the kinetic energy at which

(a) an electron, and

(b) a neutron, would have the same de-broglie wavelength.

View Text Solution

15. What is the de-Broglie wavelength of

(a) a bullet of mass 0.040 kg travelling at the speed of 1.0 km/s,

(b) a ball of mass 0.060 kg moving at a speed of 1.0 m/s, and

(c) a dust particle of mass $1.0 \times 10^{-9} kg$ drifting with a speed of 2.2 m/s ?

View Text Solution

16. 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.

View Text Solution

17. (a) For what kinetic energy of a neutron will the associated de-broglie wavelength be $1.40 \times 10^{-10} m$?

(b) Also find the de-Broglie wavelength of a neutron, in thermal equilibrium with matter, having an average kinetic energy of $\frac{3}{2}kT$ at 300K.

View Text Solution

18. Show that the wavelength of electromagnetic radiation is equal to the de-Broglie wavelength of its quantum (photon).

View Text Solution

19. What is the de-Broglie wavelength of a nitrogen molecule in air at 300 K? Assume the molecule is moving with the root-mean-square speed of molecules at this temperature. [Atomic mass of nitrogen=14.0076 u].

View Text Solution

Additional Exercises

1. (a) Estimate the speed with which electrons emitted from a heated emitter of an evacuated tube impinge on the collector maintained at a potential difference of 500 V with respect to the emitter. Ignore the small initial speeds of the electrons. The specific charge of the electron i.e., its e/m is given to be $1.76 \times 10^{11} C \quad kg^{-1}$.

(b) Use the same formula you employ in (a) to obtain electron speed for an collector potential of 10 MV. do you see what is wrong ? In what way is the formula to be modified ?

View Text Solution

2. Ultraviolet light of wavelength 2271 Å fro a 100 W mercury source irradiates a photocell made of molybdenum metal. If the stopping potential is -1.3V, estimate the work function of the metal. How would the photocell respond to a high intensity

$\left(\text{~}10^5 Wm^{-2}\right)$ red light of wavelength 6328 Å produced bya He-Ne laser ?

View Text Solution

3. Monochromatic radiation of wavelength 640.2 nm $\left(1nm = 10^{-9}m\right)$ fro a neon lamp irradiates photosensitive material made of caesium on tungsten. The stopping voltage is measured to be 0.54 V. the source is replaced by an iron source and its 427.2 nm line irradiates the sae photocell. predict the new stopping voltage.

View Text Solution

4. A mercury lamp is a convenient source for studying frequency dependence of photoelectric emission, since it gives a number of spectral lines ranging from the UV to the red and end of the visible spectrum. In our experiment with rubidium photocell, the following lines from a mercury source were used:

$\lambda_1 = 3650Å, \lambda_2 = 4047Å, \lambda_3 = 4358Å, \lambda_4 = 5461Å, \lambda_5 = 6907Å$

The stopping voltages, respectively, were measured to be:

$V_{01} = 1.28V, V_{02} = 0.95V, V_{03} = 0.74V, V_{04} = 0.16V, V_{05} = 0V$

Determine the value of Planck's constant h, the threshold frequency and work function for the material.

View Text Solution

5. The work function for the following metals is given:

$Na: 2.75eV, K: 2.30eV, Mo: 4.17eV, Ni: 5.15eV.$ Which of these metals will not give photoelectric emission for a radiation of wavelength 3300 Å from a He-Cd laser placed 1 m away from the photocell ? What happens if the laser is brought nearer and placed 50 cm away ?

View Text Solution

6. Crystal diffraction experiments can be performed using X-rays, or electrons accelerated through appropriate voltage. Which probe has greater energy ? (For quantitative comparison, take the wavelength of the probe equal to 1 Å, which is of the order of inter-atomic spacing in the lattice) $\left(m_e = 9.11 \times 10^{-31} kg\right)$.

View Text Solution

7. (a) Obtain the de-Broglie wavelength of a neutron of kinetic energy 150 eV. An electron beam of this energy is suitable for crystal diffraction experment.

Would a neutron beam of the same energy be equally suitable? Explain $\left(m_n = 1.675 \times 10^{-27} kg\right)$

(b) Obtain the de-Broglie wavelength associated with thermal neutrons at room temperatuer $(27^\circ C)$. hence, explain why a fast neutron beam needs to be thermalised with the environment before it can be used for neutron diffraction experiments.

View Text Solution

8. An electron microscope uses electrons accelerated by a voltage of 50 kV. Determine the de-Broglie wavelength associated with the electrons. If other factors (such as numerical aperture, etc.) are taken to be roughly the same, how does the resolving power of an electron microscope compare with that of an optical microscope which uses yellow light ?

View Text Solution

9. Find the typical de-Broglie wavelength associated with a He atom in helium gas at room temperature $(27^{\circ} C)$ and 1atm pressure, and compare it with the mean separation between two atoms under these conditions.

View Text Solution

10. Compute the typical de-Broglie wavelength of an electron in a metal at 27°C and compare it with the mean separation between two electrons in a metal which is given to be about 2×10^{-10}m.

View Text Solution

11. Quarks iinside protons and neutrons are thought to carry fractional charges $[(+2/3)e, (-1/3)e]$. Why do they not show up in Millikan's oil-drop experiment ?

View Text Solution

12. What is so special about the combination e/m ? Why do we not simply talk of e and m separately ?

View Text Solution

13. Why should gases be insulators at ordinary pressures and start conducting at very low pressures?

View Text Solution

14. Every metal has a definite work function. Why do all photoelectrons not come out with the same energy if incident radiatio is monochromatic ? Why is there an energy distribution of photoelectrons ?

View Text Solution

15. The energy and momentum of an electron are related to the frequency and wavelength of the associated matter wave by the relations :

$$E = hv \quad p = \frac{h}{\lambda}.$$

But while the value of λ is physically significant, the value of v (and therefore, the value of the phase speed $v\lambda$) has no physical significance. why?

View Text Solution

Case Based Source Based Integrated Questions

1. Metals have free electrons which are responsible for their conductivity. However, the free electron cannot normally escape out of the metal surface. If an electron attempts to come out of the metal, the metal surface acquires a positive charge and pulls the electron back to the metal. an electron can come out of the metal surface only if it has got sufficient energy to overcome the attractive pull of ions present in metal. thus, a certain minimum amount of energy is required to be given to an electron to pull it out from the surface of the metal. this minimum energy required by an electron to escape from the metal surface is called the work function of the metal. Following table gives the work function (ϕ_0) of some metals:

On the basis of data given in the above table and your understanding of the related concepts answer the following questions:

Q. How is energy equal to work function supplied to a metal in photoelectric emission?

View Text Solution

2. Metals have free electrons which are responsible for their conductivity. However, the free electron cannot normally escape out of the metal surface. If an electron attempts to come out of the metal, the metal surface acquires a positive charge and pulls the electron back to the metal. an electron can come out of the metal surface only if it has got sufficient energy to overcome the attractive pull of ions present in metal. thus, a certain minimum amount of energy is required to be given to an electron to pull it out from the surface of the metal. this minimum energy required by an electron to escape from the metal surface is called the work function of the metal. Following table gives the work function (ϕ_0) of some metals:

On the basis of data given in the above table and your understanding of the related concepts answer the following questions:

Q. What is threshold frequency for photoelectrci emission from a metal ?

View Text Solution

3. Metals have free electrons which are responsible for their conductivity. However, the free electron cannot normally escape out of the metal surface. If an electron attempts to come out of the metal, the metal surface acquires a positive charge and pulls the electron back to the metal. an electron can come out of the metal surface only if it has got sufficient energy to overcome the attractive pull of ions present in metal. thus, a certain minimum amount of energy is required to be given to an electron to pull it out from the surface of the metal. this minimum energy required by an electron to escape from the metal surface is called the work function of the metal. Following table gives the work function (ϕ_0) of some metals:

On the basis of data given in the above table and your understanding of the related concepts answer the following questions:

Q. How is threshold frequency related to work function of a metal?

View Text Solution

4. Metals have free electrons which are responsible for their conductivity. However, the free electron cannot normally escape out of the metal surface. If an electron attempts to come out of the metal, the metal surface acquires a positive charge and pulls the electron back to the metal. an electron can come out of the metal surface only if it has got sufficient energy to overcome the attractive pull of ions present in metal. thus, a certain minimum amount of energy is required to be given to an electron to pull it out from the surface of the metal. this minimum energy required by an electron to escape from the metal surface is called the work function of the metal.

Following table gives the work function (ϕ_0) of some metals:

On the basis of data given in the above table and your understanding of the related concepts answer the following questions:

Q. If radiation of wavelength 300 nm is available, in which metals, out of list given in table, photoelectric emission is possible ?

View Text Solution

5. Metals have free electrons which are responsible for their conductivity. However, the free electron cannot normally escape out of the metal surface. If an electron attempts to come out of the metal, the metal surface acquires a positive charge and pulls the electron back to the metal. an electron can come out of the metal surface only if it has got sufficient energy to overcome the attractive pull of ions present in metal. thus, a certain minimum amount of energy is required to be given to an electron to pull it out from the surface of the metal. this minimum energy required by an electron to escape from the metal surface is called the work function of the metal. Following table gives the work function (ϕ_0) of some metals:

On the basis of data given in the above table and your understanding of the related concepts answer the following questions:

Q. if radiation of wavelength 300 nm be incident on a sodium surface, what is the expected value of stopping potential ?

View Text Solution

6. In 1924, the French physicist Louis de-Broglie, suggested that moving particles of matter should display wave like properties under suitable conditions. His reasoning was that nature was symmetrical and so the two basic physical entities, matter and energy, must have symmetrical character. if radiation shows dual character so should matter. he proposed that the wavelength λ associated with a particle of momentum p is given as:

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

Dual aspect of matter is evident in this relation. whereas wavelength λ is an attribute of a wave, the momentum p is a typical attribute of a particle. the Planck's constant 'h' relates the two attributes. The de-Broglie's hypothesis of matter waves has been basic to the development of medern quantum mechanics. it also led to the field of electron optics. the wave properties of electrons have been utilised in the design of electron microscope which is a great improvement, with higher resolution, over the optical microscope.

Q. Why do not macroscopic particle (e.g. a moving cricket ball) show wave like properties ?

View Text Solution

7. In 1924, the French physicist Louis de-Broglie, suggested that moving particles of matter should display wave like properties under suitable conditions. His reasoning was that nature was symmetrical and so the two basic physical entities, matter and energy, must have symmetrical character. if radiation shows dual character so should matter. he proposed that the wavelength λ associated with a particle of momentum p is given as:

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

Dual aspect of matter is evident in this relation. whereas wavelength λ is an attribute of a wave, the momentum p is a typical attribute of a particle. the Planck's constant 'h' relates the two attributes. The de-Broglie's hypothesis of matter waves has been basic to the development of medern quantum mechanics. it also led to the field of electron optics. the wave properties of electrons have been utilised in the design of electron microscope which is a great improvement, with higher resolution, over the optical microscope.

Q. How can you measure the wave character of particles in subatomic domain?

View Text Solution

8. In 1924, the French physicist Louis de-Broglie, suggested that moving particles of matter should display wave like properties under suitable conditions. His reasoning was that nature was symmetrical and so the two basic physical entities, matter and energy, must have symmetrical character. if radiation shows dual character so should matter. he proposed that the wavelength λ associated with a particle of momentum p is given as:

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

Dual aspect of matter is evident in this relation. whereas wavelength λ is an attribute of a wave, the momentum p is a typical attribute of a particle. the Planck's constant 'h' relates the two attributes. The de-Broglie's hypothesis of matter waves has been basic to the development of medern quantum mechanics. it also led to the field of electron optics. the wave properties of electrons have been utilised in the design of electron microscope which is a great improvement, with higher resolution, over the optical microscope.

Q. An electron is accelerated by applying a potential difference of 100 volt. calculate its de-Broglie wavelength.

View Text Solution

9. In 1924, the French physicist Louis de-Broglie, suggested that moving particles of matter should display wave like properties under suitable conditions. His reasoning was that nature was symmetrical and so the two basic physical entities, matter and energy, must have symmetrical character. if radiation shows dual character so should matter. he proposed that the wavelength λ associated with a particle of momentum p is given as:

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

Dual aspect of matter is evident in this relation. whereas wavelength λ is an attribute of a wave, the momentum p is a typical attribute of a particle. the Planck's constant 'h' relates the two attributes. The de-Broglie's hypothesis of matter waves has been basic to the development of medern quantum mechanics. it also led to the field of electron optics. the wave properties of electrons have been utilised in the design of electron microscope which is a great improvement, with higher resolution, over the optical microscope.

Q. In an electron microscope which property of electron beam is utilised and what is its significance ?

View Text Solution

10. In 1924, the French physicist Louis de-Broglie, suggested that moving particles of matter should display wave like properties under suitable conditions. His reasoning was that nature was symmetrical and so the two basic physical entities, matter and energy, must have symmetrical character. if radiation shows dual character so should matter. he proposed that the wavelength λ associated with a particle of momentum p is given as:

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

Dual aspect of matter is evident in this relation. whereas wavelength λ is an attribute of a wave, the momentum p is a typical attribute of a particle. the Planck's constant 'h' relates the two attributes. The de-Broglie's hypothesis of matter waves has been basic to the development of medern quantum mechanics. it also led to the field of electron optics. the wave properties of electrons have been utilised in the design of electron microscope which is a great improvement, with higher resolution, over the optical microscope.

Q. An electron an a proton both are accelerated by same voltage. which of the two will hae greater value of de-Broglie wavelength and why?

View Text Solution

Multiple Choice Questions

1. If a photon of energy E has velocity c and frequency v, then which of following represents its wavelength

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

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

C. $\frac{hv}{c^2}$

D. hv

Answer: A

View Text Solution

2. The work function 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

View Text Solution

3. Photon of 5.5 eV energy falls on the surface of the metal emitting photoelectrons of maximum kinetic energy 4.0 eV. The stopping voltage required for these electrons are

A. 5.5 V

B. 1.5V

C. 9.5V

D. 4.0V

Answer: D

View Text Solution

4. The work function for metals A,B and C are respectively 1.92 eV, 2.0 eV and 5.0 eV. According to Einstein's equation, the metals which will emit photoelectrons for a radiation of wavelength 4100 Å is/are

A. none of these

B. a only

C. A and B only

D. all the three metals.

Answer: C

View Text Solution

5. 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. velocity

D. angular momentum

Answer: B

View Text Solution

6. An electron is moving with an initial velocity $\overrightarrow{v} = v_0 \hat{i}$ and is in a magnetic field $\overrightarrow{B} = \overrightarrow{B}_0 \hat{j}$. Then its de-Broglie wavelength

A. remains constant

B. increases with time

C. decreases with time

D. increases and decreases periodically.

Answer: A

View Text Solution

7. A proton, a neutron, an electron and an α particle have some 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

View Text Solution

8. A particle of mass 1 mg has the same wavelength as an electron moving with a velocity of $3 \times 10^6 ms^{-1}$. The velocity of the particle is (mass of electron $= 9.1 \times 10^{-31} kg$)

A. $2.7 \times 10^{-21} ms^{-1}$

B. $2.7 \times 10^{-18} ms^{-1}$

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

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

Answer: B

View Text Solution

9. The surface of a metal is illuminated with the light of 400 nm. The kinetic energy of the ejected photo electrons was found to be 1.68 eV. The work function of the metal is $(h_c = 1240 eV . nm)$

A. 1.41 eV

B. 1.51eV

C. 1.68eV

D. 3.09 eV

Answer: A

View Text Solution

10. 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. $\frac{hv}{c^2}$

Answer: A

View Text Solution

11. The number of photoelectrons emitted for light of a frequency v (hiigher than the threshold frequency v_0) is proportional to

A. $v - v_0$

B. threshold frequency (v_0).

C. intensity of light

D. frequency of light (v).

Answer: C

View Text Solution

12. Which of these particles (having the same kinetic energy) has the shortest de-Broglie wavelength ?

A. Electron

B. Alpha-particle

C. Proton

D. Neutron

Answer: B

View Text Solution

13. The potential difference that must be applied to stop the fastest photoelectrons emitted by a nickel surface, having work function 5.01 eV, when ultraviolet light of 200 nm falls on it, must be

A. $-2.4V$

B. $1.2V$

C. $2.4V$

D. $-1.2V$

Answer: D

View Text Solution

14. A source S_1, is producing 10^{15} photons per second of wavelength 5000 Å. Another source S_2 is producing 1.02×10^{15} photons per second of wavelength 5100 Å. Then, (powerr of S_2) is equal to (power of S_1)

A. 1.04

B. 0.98

C. 1.00

D. 1.02

Answer: C

View Text Solution

15. Huygen's wave theory of light cannot explain

A. rectilinear propagation of light

B. total internal reflection of light

C. polarisation of light

D. photoelectric effect.

Answer: D

View Text Solution

16. The threshold wavelength for photoelectric emission from a material is 5200 Å. Photoelectrons will be emitted when the material is illuminated with monochromatic radiation from a

A. 50 W infrared lamp

B. 1 W red coloured laser light.

C. 0.1 W ultraviolet lamp

D. 10 W power sodium lamp.

Answer: C

View Text Solution

17. Work function of a metal is 4.0 eV. Its threshold wavelength will be approximately

A. 4000 Å

B. 3100 Å

C. 2500 Å

D. 3600 Å

Answer: B

View Text Solution

18. UV radiations of 6.2 eV fall on an aluminium surface whose work function is 4.2 eV. The kinetic energy of the fastest electron emitted by the sluminium surface will be

A. $3.2 \times 10^{-19} J$

B. $3.2 \times 10^{-21} J$

C. $3.2 \times 10^{-17} J$

D. $3.2 \times 10^{-34} J$.

Answer: A

View Text Solution

19. The work function of a photoelectric material is 3.3 V. the threshold frequency will be equal to [Given that $h = 6.6 \times 10^{-34} Js$]

A. $8.0 \times 10^{14} Hz$

B. $8.0 \times 10^{34} Hz$

C. $5.0 \times 10^{15} Hz$

D. $5.0 \times 10^{19} Hz$

Answer: A

View Text Solution

20. The maximum kinetic energy of photoelectrons emitted from a surface, when photons of energy 6.0 eV fall on it, is 4.0 eV. The stopping potential is

A. 2V

B. 4V

C. 6V

D. 10V

Answer: B

View Text Solution

21. A photoelectric cell gives zero current when maintained at 2V negative potential. The energy of most energetic photoelectrons is

A. 2eV

B. 2J

C. 4eV

D. 4J

Answer: A

View Text Solution

22. Light of two different frequencies, whose photons have energies 2eV and 5eV respectively, successively illuminates a metal of work function 1.0 eV. The ratio of maximum kinetic energy of the emitted photoelectrons will be

A. $2:5$

B. $1:5$

C. $1:4$

D. $1:2$

Answer: C

View Text Solution

23. Sodium and copper have work functions of 2.3 eV and 4.6 eV respectively. The ratio of their threshold wavelengths is

A. $1 : 2$

B. $2 : 1$

C. $1 : 4$

D. $4 : 1$

Answer: B

View Text Solution

24. In photoelectric effect the maximum kinetic energy of electrons emitted from the metal surface depends upon

A. intensity of incident radiation

B. frequency of incident radiation

C. speed of incident radiation

D. both intensity and frequency of incident radiation

Answer: B

View Text Solution

25. Threshold frequency for photosensitive material is v_0. If photons of frequency $2v_0$ fall on this surface, the electrons come out with a maximum speed of $4 \times 10^6 ms^{-1}$. When photons of frequency $5v_0$ fall on the same surface, the maximum speed of the ejected electrons will be

A. $2 \times 10^7 ms^{-1}$

B. $2 \times 10^6 ms^{-1}$

C. $8 \times 10^6 ms^1$

D. $8 \times 10^5 ms^{-1}$

Answer: C

View Text Solution

26. The wavelength of the matter wave associated with a particle is independent of its

A. mass

B. speed

C. momentum

D. charge

Answer: D

View Text Solution

27. A protom and an alpha particle are both accelerated through a potential difference of 100 V. the ratio of the de-Broglie wavelength associated with the progom to that associated with the alpha particle is

A. $1:1$

B. $\sqrt{2}:1$

C. $2:1$

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

Answer: D

View Text Solution

28. An electron of mass m, when accelerated through a potential difference V, has de-Broglie wavelength λ, the de-Broglie wavelength associated with a protom of mass M and accelerated through the same potential difference V will be

A. $\lambda\frac{m}{M}$

B. $\lambda\sqrt{\frac{m}{M}}$

C. $\lambda\sqrt{\frac{M}{m}}$

D. $\frac{\lambda M}{m}$

Answer: B

View Text Solution

29. The de-Broglie wavelength of a neutron at $27^{\circ}C$ is λ, what will be the corresponding wavelength at $927^{\circ}C$?

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

B. $\frac{\lambda}{3}$

C. $\frac{\lambda}{4}$

D. $\frac{\lambda}{9}$

Answer: A

View Text Solution

30. The wavelength of de-Broglie wave associated with a matter particle is 2Å. The momentum of the particle is

A. $3.3 \times 10^{-24} kg \quad ms^{-1}$

B. $13.2 \times 10^{-24} kg \quad ms^{-1}$

C. $3 \times 10^{-24} kg \quad ms^{-1}$

D. $13.2 \times 10^{24} kg \quad ms^{-1}$.

Answer: A

View Text Solution

Fill In The Blanks

1. In photoelectric emission from a metal, work function ϕ_0 and threshold frequency v_0 are related as _____.

View Text Solution

2. In photoelectric effect stopping potential is the measured of the ____of the photoelectrons and it does not depends upon the _____ of incident radiation.

View Text Solution

3. Light of frequency $v = 1.5v_0$ (where v_0 = threshold frequency) is incident on a photosensitive material and photoelectric current is I. if the frequency of incident light is halved and the intensity of light is doubled then the photoelectric current becomes_____.

View Text Solution

4. Graph plotted between stopping potential V_0 and frequency v, where $v > v_0$, for a photosensitive material is a_____graph whose slope is ____.

View Text Solution

5. In photoelectric effect experiment, the number of photoelectrons emitted by a photosensitive material is proportional to the ___ of incident radiation.

View Text Solution

6. When photons of energy 5 eV fall on the surface of a metal, the emitted photoelectrons are stopped by a cut off potential of 1.6V. The work function of given metal is_____.

View Text Solution

7. If an electron is accelerated by a potential of V volt, the numerical value of de-Broglie wavelength of electron wave can be easily calculated by employing the formula λ=____.

View Text Solution

8. A proton and an alpha particle have same kinetic energy. Their de-Broglie wavelengths are in the ratio____.

View Text Solution

9. Davisson and Germer's experiment proves the concept of _____.

View Text Solution

10. de-Broglie wavelength of a photon is equal to ___.

View Text Solution

11. Matter waves are associated with ___only.

View Text Solution

12. de-Broglie wavelength of an electron wave is 1.227 Å, when the electron is accelerated by a potential difference of ____.

View Text Solution

13. Linear momenta of an electron and a proton are same. The ratio of their de-Broglie wavelengths is ____.

View Text Solution

14. The maximum kinetic energy of emitted photoelectrons from a surface depends on the ___ of incident radiation as well as the ____of the given surface.

View Text Solution

15. Work function for potassium is 2.0 eV. For photoelectric emision from a potassium surface the minimum frequency of incident radiation must be ____.

View Text Solution

True Or False

1. Rest mass of a photon is zero but dynamic mass of a photon is $\frac{E}{c^2}$.

View Text Solution

2. In the process of photoelectric emission all the emitted photoelectric posses the same kinetic energy.

View Text Solution

3. Work function of a aluminium is 4.2 eV. Emission of photoelectron is possible if two photons, each of energy 2.4 eV, are incident on an aluminium plate.

View Text Solution

4. If frequency of radiation incident on a photosensitive surface is doubled, the maximum kinetic energy of emitted photoelectrons also gets doubled.

View Text Solution

5. Ultraviolet radiations are more effective for causing photoelectric emission than visible light.

View Text Solution

6. In photoelectric emission the maximum energy of the photoelectrons increases on increasing the intensity of incident light.

View Text Solution

7. Matter waves are associated with protons but not with neutrons.

View Text Solution

8. de-Broglie wavelength ofa moving particle of kinetic energy K is given by the expression $\lambda = \frac{h}{\sqrt{mK}}$.

View Text Solution

Assertion Reason Type Questions

1. Assertion: The energy (E) and momentum (p) of a photon are related as $p = \frac{E}{c}$.

Reason: The photon behaves as a particle.

A. If both assertion and reason are ture and the reason is the correct explanation of the assertion.

B. If both assertion and reason are true but reason is not the correct explanation of the assertion.

C. If assertion is true but reason is false

D. If the assertion is false but reason is true

Answer: A

View Text Solution

2. Assertion Photoelectric effect demonstrates the wave nature of the light.

Reason: The number of photoelectrons is directly proportional to the intensity of incident light.

A. If both assertion and reason are ture and the reason is the correct explanation of the assertion.

B. If both assertion and reason are true but reason is not the correct explanation of the assertion.

C. If assertion is true but reason is false

D. If the assertion is false but reason is true

Answer: D

View Text Solution

3. Assertion: Kinetic energy of photoelectrons emitted by a photosensitive surface depends upon the frequency of incident photons, provided that it is greater than the threshold frequency.

Reason: Number of photoelectrons depends on the intensity of incident radiation.

A. If both assertion and reason are ture and the reason is the correct explanation of the assertion.

B. If both assertion and reason are true but reason is not the correct explanation of the assertion.

C. If assertion is true but reason is false

D. If the assertion is false but reason is true

Answer: B

View Text Solution

4. Assertion: Though radiation of a single frequency are incident on a metal surface, the energies of emitted photoelectrons are different.

Reason: The energy of electrons emitted from inside the metal surface is lost in collision with other atom is the metal.

A. If both assertion and reason are ture and the reason is the correct explanation of the assertion.

B. If both assertion and reason are true but reason is not the correct explanation of the assertion.

C. If assertion is true but reason is false

D. If the assertion is false but reason is true

Answer: A

View Text Solution

5. Assertion: Resolving power of an electron microscope is extremely high.

Reson: An electron microscope makes use of electron waves whose wavelength is very small.

A. If both assertion and reason are ture and the reason is the correct explanation of the assertion.

B. If both assertion and reason are true but reason is not the correct explanation of the assertion.

C. If assertion is true but reason is false

D. If the assertion is false but reason is true

Answer: A

View Text Solution

Very Short Answer Questions

1. Name the phenomenon which shows the quantum nature of electromagnetic radiation.

View Text Solution

2. Define work function for a given metallic surface.

View Text Solution

3. Define the term "threshold frequency", in the context of photoelectric emission.

View Text Solution

4. Two metals A and B have work functions 2eV and 5eV, respectively. Which metla has a lower threshold wavelength ?

View Text Solution

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

View Text Solution

6. Define intensity of radiation in photon picture of light. Write its SI unit.

View Text Solution

7. State one factor which determines the intensity of light in the photon nature of light.

View Text Solution

8. For a given photosensitive material and with a source of constant frequency of incident radiation, how does the photocurrent vary with the intensity of incident light ?

View Text Solution

9. The stopping potential in an experiment on photoelectric effect is 1.5 V. what is the maximum kinetic energy of the photoelectrons emitted ?

View Text Solution

10. Electrons are emitted from a photosensitive surface when it is illuminated by green light but electron emission does not take place by yellow light. Will the electrons be emitted when the surface is illuminated by (i) red light, and (ii) blue light ?

View Text Solution

11. Why is photoelectric emission not posible at all frequencies ?

View Text Solution

12. Does the 'stopping potential' in photoelectric emission depend upon

(i) the intensity of the incident radiation in a photocell. ?

(ii) The frequency of the incident radiation ?

View Text Solution

13. The maximum kinetic energy of a photoelectron is 3 eV. What is its stopping potential ?

View Text Solution

14.

The given graph shows the variation of photoelectric current (I) versus applied voltage (V) for two different photosensitive materials and for two different intensities of the incident radiation. Identify the pairs of curves that correspond to different materials. but same intensity of incident radiation.

View Text Solution

15. Draw graphs showing variation of photoelectric current with applied voltage for three incident radiations of equal frequency and different intensities. Mark the graph for the radiation of higher intensity.

View Text Solution

16. The figure shows the variation of stopping potential V_0 with the frequency of the incident radiations for two photosensitive metals P and Q. which metal has smaller threshold wavelength ? Justify Your answer.

View Text Solution

17. On the basis of the graphs shown in figure, answer the following questions:

(a) Which physical parameter is kept constant for the three curves ?

(b) Which is the highest frequency among v_1, v_2 and v_3 ?

View Text Solution

18. Ultraviolet radiation of different frequencies v_1 and v_2 are incident on two photosensitive materials having work functions ϕ_1 and $\phi_2 (\phi_1 > \phi_2)$ respectively. The kinetic energy of the emitted electrons is same in both the cases. which one of the two radiations will be of higher frequency ?

View Text Solution

19. State de-Broglie hypothesis.

View Text Solution

20. Write the expression for the de-Broglie wavelength associated with a charge particle having charge 'q' and mass 'm', when it is accelerated by a potential V.

View Text Solution

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

View Text Solution

22. A proton and an electron have same kinetic energy. Which one has greater de-Broglie wavelength and why?

View Text Solution

23. Show graphically, the variation of the de-Broglie wavelength (λ) with the potential (V) through which an electron is accelerated from rest.

View Text Solution

24. Draw a graph showing variation of de-Broglie wavelength with the momentum of an electron.

View Text Solution

25.

Two lines A and B in the plot [figure] show the variation of de-Broglie wavelength λ versus $\frac{1}{\sqrt{V}}$, where V is the accelerating potential difference, for two particles carrying the same charge. which one of the two represents a particle of smaller mass ?

View Text Solution

26. Draw a plot showing the variation of de-Broglie wavelength of electron as a function of its kinetic energy .

View Text Solution

27. de-Broglie wavelength associated with an electron accelerated through a potential difference V is λ. What will be its wavelength when the accelerating potential is increased to 4 V?

View Text Solution

28. Find the ratio of de-Broglie wavelengths associated with two electrons accelerated through 25V and 36V.

View Text Solution

29. With what purpose was famous Davisson-Germer experiment with electrons performed ?

View Text Solution

30. Name the experiment which establishes the wave nature of a particle.

View Text Solution

31. An electron and alpha particle have the same de-Broglie wavelength associated with them. How are their kinetic energies related to each other ?

View Text Solution

32. An electron, an alpha-particle and a proton have the same kinetic energy. Which one of these particles has the largest de-Broglie wavelength ?

View Text Solution

33. Draw a plot showing the variation of photoelectric current versus the intensity of incident radiation on a given photosensitive surface.

View Text Solution

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

View Text Solution

Short Answer Questions

1. What is photoelectric effect ? Draw a neat figure of the experimental arrangement used to study photoelectric effect.

View Text Solution

2. Draw suitable graphs to show the variation of photoelectric current with collector plate potential for

(i) a fixed frequency but different intensities $I_1 > I_2 > I_3$ of radiation.

(ii) a fixed intensity but different frequencies $v_1 > v_2 > v_3$ of radiation.

View Text Solution

3. Write Einsteins's photoelectric equation. Explain the terms (i) threshold frequency, and (ii) stopping potential.

View Text Solution

4. Write Enstein's photoelectric equation. State clearly the three salient features observed in photoelectric effect, which can be explained on the basis of the above equation.

View Text Solution

5. Two monochromatic radiations, blue and vilet, of the same intensity, are incident on a photosensitive surface and cause photoelectric emission. Would (i) the number of electrons emitted per second and (ii) the maximum kinetic energy of the electrons, be equal in the two cases ? Justify your answer.

View Text Solution

6. Describe briefly three experimentally observed features in the phenomenon of photoelectric effect.

View Text Solution

7. (a) Work function of aluminium is 4.2 eV. If two photons each of energy 2.5 eV are incident on its surface. Will the emission of electrons take place ? Justify your answer.

(b) Name the radiation of the electromagnetic spectrum which is used for taking photographs of the sky during night annd foggy condition. give their frequency range.

View Text Solution

8. If light of wavelength 412.5 nm is incident on each of the metals given below, which ones will show photoelectric emission and why ?

View Text Solution

9. Find the frequency of light which ejects electrons from a metal surface stopped by a retarding potential of 3.3 V. if photoelectric emission begins in this metal at a frequency of $8 \times 10^{14} Hz$, calculate the work function (in eV) for this metal.

View Text Solution

10. Monochromatic light of requency 6.0×10^{14} Hz is produced by a laser. The power emitted is $2.0 \times 10^{-3} W$. Calculate the (i) energy of a photon in the light beam, and (ii) number of photons emitted on an average by the source.

View Text Solution

11. Plot a graph showing the variation of stopping potential with the frequency of incident radiation for two different photosensitive materials having work functions W_1 and $W_2 (W_1 > W_2)$. On what factors does the (i) slope and (ii) intercept of the lines depend ?

View Text Solution

12. Plot a graph showing variation of stopping potential (V_0) with the frequency (v) of the incident radiation for a given photosensitive material. Hence, state the significance of the threshold frequency in photoelectric emission.

Using the principle of energy conservation, write the equation relating the energy of incident photon, threshold frequency and the maximum kinetic energy of the emitted photoelectrons.

View Text Solution

13. Radiation of frequency 10^{15} Hz is incident on two photosensitive surfaces P and Q. there is no photoemission from surface P. photoemission occurs from surface Q but photoelectrons have zero kinetic energy. Explain these observations and find the value of work function for surface Q.

View Text Solution

14.

Using the graph showin in figure, for stopping potential versus the incident frequency of photon, calculate planck's constant.

View Text Solution

15. An electron is accelerated through a potential difference of 100 volts. What is the de-Broglie wavelength associated with it ? To which part of the electromagnetic spectrum does this value of wavelength correspond ?

View Text Solution

16. An electron and a proton are moving in the same direction and possess same kinetic energy. Find the ratio of de-Broglie wavelengths associated with these particles.

View Text Solution

17. For what kinetic energy of a neutron, will the associated de-Broglie wavelength be $1.32 \times 10^{-10} m$? Given that mass of a neutron $= 1.675 \times 10^{-27} kg.$

View Text Solution

18. Why is wave theory of electromagnetic radiation not able to explain photo electric effect ? How does photon picture resolve this problem ?

View Text Solution

19. A proton and a deutron are acclerated through the same accelerating potential. Which one of the two has

(a) Greater value of de-Broglie wavelength associated with it, and

(b) Less momentum ?

Given reason to justify your answer.

View Text Solution

20. A photon and a proton have the same de-Broglie wavelength λ. Prove that the energy of the photon is $(2m\lambda c/h)$ times the kinetic energy of the proton.

View Text Solution

21. A proton and an α-particle are accelerated through the same potential, which one of the two has

(i) greater value of de-Broglie wavelength associated with it, and (ii) less kinetic energy. Give reasons to support your answer.

View Text Solution

22. An α-particle and a proton are accelerated through the same potential difference. Find the ratio of their de-Broglie wavelengths.

View Text Solution

23. A proton and an α-particle have the same de-Broglie wavelength. Determine the ratio of

(i) their accelerating potentials (ii) their speeds.

View Text Solution

24. An electron is revolving around the nucleus with a constant speed of $2.2 \times 10^6 ms^{-1}$. Find the de-Broglie wavelength associated with it.

View Text Solution

25. The kinetic energy of a beam of electrons, accelerated through a potential V, equals the energy of a photon of wavelength 5460 nm. Find the de-Broglie wavelength associated with this beam of electrons.

View Text Solution

26. An electron is accelerated through a potential difference of 100 volts. What is the de-Broglie wavelength associated with it ? To which part of the electromagnetic spectrum does this value of wavelength correspond ?

View Text Solution

27. In Davisson and Germer's experiment, state the observations which led to (i) show the wave nature of electrons, and (ii) confirm the de-Broglie relation.

View Text Solution

Long Answer Questions

1. (a) Why photoelectric effect cannot be explained on the basis of wave nature of light ? Give reasons.

(b) Write the basis features of photon picture of electromagnetic radiation on which einstein's photoelectric equation is based.

View Text Solution

2. Draw a plot showing the variation of photoelectric current with collector plate potential for two different frequencies, $v_1 > v_2$, of incident radiation having the same intensity. In which case will the stopping potential be higher ? Justify your answer.

View Text Solution

3. Sketch the graphs showing variation of stopping potential with frequency of incident radiations for two photosensitive materials A and B having threshold frequencies $v_A > v_B$.

(i) In which case is the stopping materials A and B having threshold frequencies $v_A > V_B$.

(i) In which case is the stopping potential more and why?

(ii) Does the slope of the graph depend on the nature of the materials used ? Explain.

View Text Solution

4. Define the term 'work function' of a metal. The threshold frequency of a metal is f_0. When the light of frequency $2f_0$ is incident on the metal plane, the maximum velocity of electrons is v_1. When the frequency of the incident is increased to $5f_0$, the maximum velocity of electrons emitted is v_2. find the ratio of v_1 to v_2.

View Text Solution

5. Explain giving reasons for the following:

(a) Photoelectric current in a photocell increases with the increase in the intensity of the incident radiation.

(b) The stopping potential (V_0) varies linearly with the frequency (v) of the incident radiation for a given photosensitive surface with the slope remaining the same for different surfaces.

(c) Maximum kinetic energy of the photoelectrons is independent of the intensity of incident radiation.

View Text Solution

6. In a plot of photoelectric current versus anode potential, how does

(i) the saturation current vary with anode potential for incident radiations of different frequencies but same intensity?

(ii) the stopping potential vary for incident radiations of different intensities but same frequency ?

(iii) Photoelectric current vary for different intensities but same frequency of incident radiations ?

Justify your answer in each case.

View Text Solution

7. (a) Write Einstein's photoelectric equation. State clearly how this equation is obtained using the photon picture of electromagnetic radiation.

(b) Write the three salient features observed in photoelectric effect which can be explained using this equation.

View Text Solution

8.

The graph show sthe variation of photocurrent for a photosensitive metal. ,br> (a) Identify the variable X on horizontal axis.

(b) What does the point A on the horizontal axis represent ?

(c) Draw this graph for three different values of frequencies of incident radiation v_1, v_2 and $v_3 (v_1 > v_2 > v_3)$ for same intensity.

(d) Draw this graph for three different values of intensities of incident radiation I_1, I_2 and $I_3 (I_1 > I_2 > I_3)$ having same frequency.

View Text Solution

9. (a) Write Einstein's photoelectric equation and mention which important features in photo-electric effect can be explained with the help of this equation.

(b) The maximum kinetic energy of the photoelectrons gets doubled when the wavelength of light incident on the surface changes from λ_1 to λ_2. Derive the expressions for the threshold wavelength λ_0 and work function fo rthe metal surface.

View Text Solution

10. State Einsteins' photoelectric equation explaining the symbols used. Light of frequency v is incident on a photosensitive surface. A graph of the square of the maximum speed of the electrons $\left(v_{\max}^2\right)$ vs v is obtained as shown in figure. Using einstein's photoelectric equation, obtain expression for (i) Planck's constant, (ii) work function of the given photosensitive material in terms of parameeters l,n and mass of the electron m.

View Text Solution

11. Show that the de-Broglie's wavelength of electrons accelerated through a potential V volts can be expressed as $\lambda = \frac{h}{\sqrt{2meV}}$.

What is the de-Broglie wavelength of a 2 kg object moving with a speed of 1 ms^{-1} ?

View Text Solution

12. (a) Show that the de-Broglie wavelength λ of electrons of kinetic energy K is given by the relation

$$\lambda = \frac{h}{\sqrt{2mK}}$$

(b) Calculate the de-Broglie wavelength of an electron beam accelerated through a potential difference of 60 V.

View Text Solution

13. Why are de-Broglie waves associated with a moving football not visible ?

The wavelength λ of a photon and the de-Broglie wavelength of an electron have the same value. Show that energy of the photon is $\frac{2\lambda mc}{h}$ times the kinetic energy of the electron, where m, c and h have their usual meanings.

View Text Solution

14. An electromagnetic wave of wavelength λ is incident on a photosensitive surface of negligible work function. If the photoelectrons emitted from this surface have the de-Broglie wavelength λ_1, prove that $\lambda = \left(\frac{2mc}{h}\right)\lambda_1^2$.

View Text Solution

15. Red light, howsoever bright it is, cannto produce the emission of electrons from a clean zinc surface, but even weak ultraviolet radiation can do so. Why?

X-rays of wavelength λ fall on photosensitive surface, emitting electrons. Assuming that the work function of the surface can be neglected, prove that the de-Broglie wavelength of electrons emitted will be $\sqrt{\frac{h\lambda}{2mc}}$.

View Text Solution

16. (a) Draw a graph showing the variation of de-Broglie wavelength of a particle of charge 'q' and mass 'm' with accelerating potential 'V'.

(b) Proton and deuteron have the same de-Broglie wavelength. Explain which has more kinetic enegy.

View Text Solution

17. (a) A particle is moving three times as fast as an electron. The ratio of the de-Broglie wavelength of the particle to that of the electron is 1.813×10^{-4}. Calculate the particle's mass and identify the particle.

(b) An electron and proton have the same kinetic energy. which of the two will have larger de Broglie wavelength ? Give reason.

View Text Solution

18. (a) State briefly, with what purpose was Davisson and Germer experiment performed and what inference was drawn from this.

(b) Obtain an expression for the ratio of the accelerating potentials required to accelerate a proton and an α-particle to have the same de-Broglie wavelength associated with them.

View Text Solution

19. Draw a schematic diagram of the experimental arrangement used by Davisson and Germer to establish the wave nature of electrons. Explain how the de-Broglie relation was experimentally verified in case of electrons.

View Text Solution

Self Assessment Test Section A Multiple Choice Questions

1. Momentum of a photon is $3.3 \times 10^{-28} kg \quad ms^{-1}$. Its frequency will be

A. $3 \times 10^{3} Hz$

B. $6 \times 10^{13} Hz$

C. $7.5 \times 10^{12} Hz$

D. $1.5 \times 10^{14} Hz$

Answer: D

View Text Solution

2. As the intensity of radiation incident on a photosensitive material increases

A. photoelectric current increases.

B. photoelectric current decreases

C. stopping potential increases

D. maximum kinetic energy of electrons increases

Answer: A

View Text Solution

3. If the energy of a photon corresponding to a wavelength 600 nm is $3.32 \times 10^{-19} J$, then energy of a photon of wavelength 400 nm will be

A. 1.4 eV

B. 4.9 eV

C. 3.1 eV

D. 1.6 eV

Answer: C

View Text Solution

4. The incient light photon involved in the photoelectric emission phenomenon

A. completely disappears.

B. comes out with an increased frequency

C. comes out with a decreased frequency

D. comes out without any change in frequency

Answer: A

View Text Solution

5. The de-Broglie wavelength of a particle moving with a speed of $2.25 \times 10^8 ms^{-1}$ is equal to the wavelength of a given photon. The ratio of kinetic energy of the particle to the energy of the given photon is

A. $\frac{1}{8}$

B. $\frac{3}{8}$

C. $\frac{5}{8}$

D. $\frac{7}{8}$

Answer: B

View Text Solution

6. The de-Broglie wavelength of a particle of charge q and mass m is λ. If its kinetic energy be K, then

A. $\lambda = \frac{h}{\sqrt{mK}}$

B. $\lambda = \frac{h}{\sqrt{mqK}}$

C. $\lambda = \frac{\sqrt{2mK}}{h}$

D. $\lambda = \frac{\sqrt{mqK}}{h}$.

Answer: A

View Text Solution

Self Assessment Test Section A Fill In The Blanks

1. Work function of a certain photosensitive mateiral is 2.5 eV. Threshold frequency for the material is ____Hz.

View Text Solution

2. A deuteron $\left({}_{1}^{2}Hz\right)$ and an alpha particle $\left({}_{2}^{4}He\right)$ are accelerated by applying same potential difference. Ratio of their de-Broglie wavelength will be____.

View Text Solution

Self Assessment Test Section B Very Short Answer Questions

1. Calculate the maximum kinetic energy of electrons emitted from a photosensitive surface of work function 3.2 eV, for the incident radiation of wavelength 300 nm.

View Text Solution

Self Assessment Test Section C Very Short Answer Questions

1. Define the term 'work function' of a metal. The threshold frequency of a metal is f_0. When the light of frequency $2f_0$ is incident on the metal plane, the maximum velocity of electrons is v_1. When the frequency of the incident is increased to $5f_0$, the maximum velocity of electrons emitted is v_2. find the ratio of v_1 to v_2.

View Text Solution

2. (i) In a plot of photoelectric current versus anode potential, how does

(a) the saturation current vary with anode potential for incident radiations of different frequencies but same intensity ?

(b) The stopping potential vary for incident radiations of different intensities but same frequency ?

(c) photoelectric current vary for different intensities but same frequency of incident radiations ?

Justify your answer in each case.

(ii) The work function of caesium is 2.14 eV. find (a) the threshold frequency for caesium, and

(b) The wavelength of the incident light if the photocurrent is brought to zero by a stopping potential of 0.60 V.

View Text Solution

3. (i) Show that the de-Broglie's wavelength of electrons accelerated through a potential V volts can be expressed as

$$\lambda = \frac{h}{\sqrt{meV}}.$$

What is the de-Broglie wavelength of a 2kg object moving with a speed of $1ms^{-1}$?

(ii) Calculate the ratio of the accelerating potential required to accelerate (i) a proton and (ii) an α particle to have the same de-Broglie wavelength associated with them.

[Given: mass of proton $= 1.6 \times 10^{-27} kg$. Mass of α-particle= $6.4 \times 10^{-27} kg$].

View Text Solution