PHYSICS

FOR IIT JEE ASPIRANTS OF CLASS 12 FOR PHYSICS

DUAL NATURE

Example

1. While working with light and X-rays, there is a useful relation between the energy of a photon in electron volts (eV) and the wavelength of the photon in angstom (A^0) .Suppose the wavelength of aphoton is λA. Then energy of the photon is

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2. If wavelength of radiation is $4000\text{Å} = 400 nm$ then the energy of the photon is

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3. A monochromatic source of light operation at 200 W emits 4×10^{20} photons per second. Find the wavelength of the light $(\text{in} 10^{-7} m)$.

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4. A radiation of wavelength 200nm is propagating in the form of a parallel surface. The intensity of the beam is 5mW and its cross-sectional area is 1.0mm^2. Find the pressure exerted by radiation on the metallic surface if the radiation is completely reflected.

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5. The work function of a metal is $3.0eV$.It is illuminated by a light of wave length $3 \times 10^7 m$.Calculate i) threshold frequency, ii)the maximum energy of photoelectrons, iii) the stopping potential. $(h = 6.63 \times 10^{-34} Js$ and $c = 3 \times 10^8 ms^{-1})$

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6. The work function of a photosensitive element is 2ev. Calualate the velocity of a photoelectron when the element is exposed to a light of wavelength $4 \times 10^{3} \overset{0}{A}$.

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7. A metal of work function $4eV$ is cexposed to a radiation of wavelegth $140 \times 10^{-9} m$. Find the stopping potential.

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8. In a photocell bi chromatic light of wave length $2480A^{0}$ and $6000A0$ are incident on a cathode whose workfunction is $4.8eV$.If a uniform magnetic field of $3 \times 10^{-5}T$ exists parallel to the plate, find the radius of the circular path described by the photoelectron. (mass of electron is $9 \times 10^{-31} kg$)

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9. A monochromatic light of wavelength λ is incident on an isolated metalic sphere of radius a. The threshold wavelength is λ_0 which is larger then λ. Find the number of photoelectrons emitted before the emission of photo electrons stops.

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10. A small metal plate of work function ϕ is kept at a distance r from a singly ionised, fixed ion. A monochromatic light beam is incident on the metal plate and photoelectrons are emitted. Find maximum wavelength of the light beam so that some of that electrons may go round the ion along a circle.

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11. A particle of mass m projected horizontally with velocity u. if it makes an angle θ with the horizontal after some time, then at that instant, its be Broglie wavelength is

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12. Electrons are accelerated through a potential difference of $150V$. Calculate the de broglie wavelength.

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13. Find the ratio of de Broglie wavelength of molecules of hydrogen and helium which are at temperatures 27° and $127^{\circ}C$, respectively.

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14. With what velocity must an electron travel so that its momentum is equal to that of a photon with a wavelength of $5000\overset{0}{A}$ $\left(h = 6.6 \times 10^{-34} Js, m_e = 9.1 \times 10^{-31} Kg\right)$

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15. A potential of 10000 V is applied across an x-ray tube. Find the ratio of de-Broglie wavelength associated with incident electrons to the minimum wavelength associated with x-rays.

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16. Photons of energies $4.25eV$ and $4.7eV$ are incident on two metal surfaces A and B respectively.The maximum KE of emitted electrons are respectively T_AeV and $T_B=(T_A-1.5)eV$.The ratio de-Broglie wavelengths of photoelectrons from them is $\lambda_A:\lambda_B=1.2$,then find the work function of A and B

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17. If the uncertainity in the position of proton is $6 \times 10^{8} m$, then the minimum uncertainity in its speed is

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18. The correctness of velocity of an electron moving with velocity $50 ms^{-1}$ is 0.005% . The accuracy with which its position can be measured will be

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CUQ

1. What is a photon? Show that it has zero rest mass or photons can not exist at rest. Explain.

A. zero

B. $1.6 \times 10^{-19} kg$

C. $3.1 \times 10^{-30} kg$

D. $9.1 \times 10^{-31} kg$

Answer: A

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2. The mass of a photon in motion is given its frequency = x)

A. $\frac{hx}{c^2}$

B. hx^3

C. $\frac{(hx)^3}{c^2}$

D. zero

Answer: B

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3. Photoelectric effect supports quantum nature of light because

A. There is minimum frequency of light above which no photo electrons are emitted

B. The maximum kinetic energy of photo electrons depends on both frequency and intensity of light

C. Even when a metal surface is faintly illuminated, the photoelectrons do not leave the surface immediately.

D. The maximum $K.E$ of photo electrons depends only on the frequency of light and not on intensity

Answer: D

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4. Which of the following statement is wrong?

A. Einsteinexplanined photo electric effect with the help of quantum theory

B. Millikan determined the value of planck's constant depending upon the property of photo electric effect

C. The maximum KE of the photoelectrons depends upon the instensity of incident radiation

D. As the frequency of incident photo increases the corresponding stopping potential also increases

Answer: C

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5. In photoelectric emission, the energy of the emitted electron is

A. larger than that of the incident photons

B. smaller than that of the incident photons

C. same at that of the incident photons

D. proportional of the intensity of the incident light

Answer: B

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6. A laser beam of output power 'P' consists only of wavelength λ. If Planck's constant is h and the speed of light is c, then the number of photons emitted per second is

A. $P\lambda / hc$

B. $P\lambda / h$

C. $hc / P\lambda$

D. hc / P

Answer: A

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7. In photoelectric effect, which of the following property of incident light will not affect the stopping potential

A. Frequency

B. Wavelength

C. Energy

D. Intensity

Answer: D

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8. The best suitable metal for photo electric effect is

A. Iron

B. Steel

C. Aluminium

D. Cesium

Answer: D

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9. Photo electric effect can be explained only by assuming that light

A. is a form of transverse waves

B. is a form of longitudinal waves

C. can be polarized

D. consists of quanta

Answer: D

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10. When yellow light is incident on a surface , no electrons are emitted while green light can emit. If red light is incident on the surface , then

A. No electron will be emitted

B. Less electrons will be emitted

C. More electrons will be emitted

D. we can not predict

Answer: A

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11. The energy of a photon is $E = hv$ and the momentum of photon $p = \frac{h}{\lambda}$, then the velocity of photon will be

A. E/P

B. $(E/P)^2$

C. EP

D. $3 \times 10^7 m/s$

Answer: A

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12. The photo electric proves that light consists of

A. Photons

B. Electrons

C. Electromagnetic waves

D. Mechanical waves

Answer: A

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13. Insentity of light incident on a photo sensitive surface is doubled. Then

A. the number of emitted electrons is tripuled

B. the number of emitted electrons is doubled

C. the $K.E.$ of emitted electrons is doubled

D. the momentum of emitted electrons is doubled

Answer: B

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14. A point source of light is used in a photoelectric effect. If the source is removed farther from the emitted metal, the stopping potential

A. will increase

B. will decrease

C. will remain constant

D. will either increase or decrease

Answer: C

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15. If the frequency of light in a photoelectric experiment is doubled the stopping potential will

A. be doubled

B. be halved

C. become more than double

D. become less than double

Answer: C

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16. With the decrease in the wave length of the incident radiation the velocity of the photoelectrons emitted from a given metal

A. remains same

B. increases

C. decreases

D. increases first and then decreases

Answer: B

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17. Sodium surface is illuminated with ultraviolet light and visible radiation successively and the stopping potentials are determined. Then the potential

A. is equal in both the cases

B. greater for ultraviolet light

C. more for visible light

D. varies randomly

Answer: B

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18. In photo electric effect, the slope of the straight line graph between stopping potential and frequency of the incident light gives the ratio of Planck's constant to

A. charge of electron

B. work function

C. photo electric current

D. $K.E.$ of electron

Answer: A

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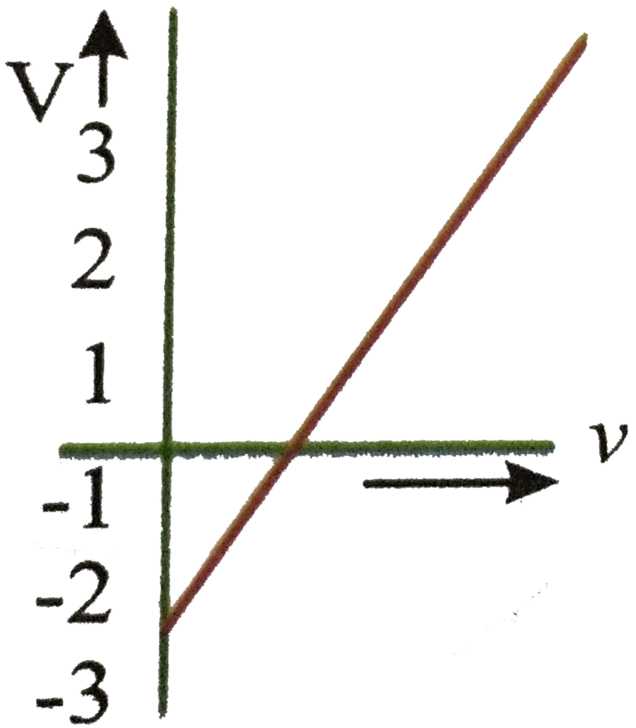
19. From the graph shown, the value of work function if the stopping potential (V), and frequency of the incident light $v$are on y and x-axes respectively is



A. $1eV$

B. $2eV$

C. $3eV$

D. $4eV$

Answer: B

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20. Draw a graph showing the variation of stopping potential with frequency of the incident radiation. What does the slope of the line with frequency axis indicate? What information can be obtained from the values of intercept on the potential axis?

A. $h.e$

B. h/e

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

D. $(e-h)$

Answer: B

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21. In an experiment of photo electric emission for incident light of $4000A^0$,the stopping potentail is $2V$.If the wavelength of incident light is made $300A^0$, then the stopping potential will be

A. Less than 2 volt

B. More than 2 volt

C. 2 volt

D. zero

Answer: B

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22. Light of wavelength λ falls on a metal having work function $h\frac{c}{\lambda_0}$. Photoelectric effect will take place only if

A. $\lambda \geq \lambda_0$

B. $\lambda \geq 2\lambda_0$

C. $\lambda \leq \lambda_0$

D. $\lambda < \frac{\lambda_0}{2}$

Answer: C

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23. Emission of electrons in photoelectric effect is possible, if

A. metal surface is highly polished

B. the incident light is of sufficiently high intensity

C. the light is incident at right angles to the surface

D. the incident light is of sufficiently low wavelength

Answer: D

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24. The work function of a metal

A. is different for different metals

B. is the same for all the metals

C. depends on the frequency of the light

D. depends on the intensity of the incident light

Answer: A

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25. The process of photo electric emission depends on

A. Temperature of incident light

B. Nature of surface

C. Speed of emitted photo electrons

D. Speed of the incident light

Answer: B

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26. The threshold wavelength of lithium is $8000A^0$ When light of a wavelength $9000A^0$ is made to be incident on it, then the photo electrons

A. Will not be emitted

B. Will be emitted

C. Will sometimes be emitted and sometimes not

D. Data insufficient

Answer: A

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27. The correct curve between the stopping potential (V) and intensity of incident light (I) is

A.

B.

C.

D.

Answer: B

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28. The photo electrons emitted from the surface of sodium metal are

A. Of speeds from 0 to a certain maximum

B. Of same de Broglie wavelength

C. Of same kinetic energy

D. Of same frequency

Answer: A

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29. The necessary condition for photo electric emission is

A. $h\upsilon \leq h\upsilon_0$

B. $h\upsilon \geq h\upsilon_0$

C. $E_k > h\upsilon_0$

D. $E_k < h\upsilon_0$

Answer: B

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30. At stopping potential, the photo electric current becomes

A. Minimum

B. Maximum

C. Zero

D. Infinity

Answer: C

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31. The stopping potential (V_0)

A. Frequency of incident light

B. Intensity of incident light

C. Number of emitted electrons

D. Number of incident photons

Answer: A

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32. Work function is the energy required

A. to excite an atom

B. to produce X-rays

C. to eject an electron just out of the surface

D. to explode the atom

Answer: C

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33. Threshold wavelenght depends on

A. frequency of incident radiation

B. work function of the substance

C. velocity of electrons

D. energy of electrons

Answer: B

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34. If the work function of a mental is then its threshold wavelenght will be

A. $hc\phi_0$

B. $\frac{c\phi_0}{h}$

C. $\frac{h\phi_0}{c}$

D. $\frac{hc}{\phi_0}$

Answer: D

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35. The work function of a mental is XeV when light of energy $2XeV$ is made to be incident on it then the maximum kinetic energy of emitted photo electron will be

A. $2eV$

B. $2XeV$

C. XeV

D. $3XeV$

Answer: C

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36. If the distance of 100 Watt lamp is increased from a photocell, the saturation current i in the photo cell varies with distance d as

A. $i \propto d^2$

B. $i \propto d$

C. $i \propto \frac{1}{d}$

D. $i \propto \frac{1}{d^2}$

Answer: D

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37. a source of light in placed at a distance $4m$ from a photocell and the stopping potential is then 7.7 volt. If the distence is helved the stopping potential now will be

A. 7.7 volt

B. 15.4 volt

C. 3.85 volt

D. 1.925 volt

Answer: A

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38. A milliammeter in the circuit of a photocell measures

A. number of electrons released per second

B. energy of photon

C. velocity of photoelectrons

D. momentum of the photo electrons

Answer: A

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39. The Einstein photoelectric equation is based upon the conservation of

A. Mass

B. momentum

C. angular momentum

D. energy

Answer: D

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40. The stopping potential of the photocell is independent of

A. wavelength of incident light

B. nature of the metal of photo cathode

C. time for which light is incident

D. frequency of incident light

Answer: C

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41. The maximum energy of emitted photo electrons is measured by

A. the current they produce

B. the potential difference they produce

C. the largest potential difference they can transverse

D. the speed with which they emerge

Answer: C

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42. Three metals have work function in the ratio $2:3:4$ Graphs are drawn for all between the stopping potential and the incident frequency The graphs have slopes in the ratio

A. $2:3:4$

B. $4:3:2$

C. $6:4:3$

D. $1:1:1$

Answer: D

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43. The curve between current (i) and potential difference (V) for a photo cell will be

A.

B.

C.

D.

Answer: D

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44. The Einstein photoelectric equation is based upon the conservation of

A. Charge

B. Energy

C. Momentum

D. Mass

Answer: B

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45. In photo electric effect, the photo electric current

A. increases when the frequency of incident photon increases

B. increases when the frequency of incident photon decreases

C. does not depend upon the photon frequency but depends on the intensity of incident beam

D. depends both on the intensity and frequency of the incident beam.

Answer: C

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46. The photoelectric current can be increased by

A. increases frequency

B. increasing intensity

C. decreasing intensity

D. decreasing wavelength

Answer: B

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47. The thresold wavelength for sodium is $5 \times 10^{-7} m$. Photoemission occurs for light of

A. Wavelength of $6 \times 10^{-7} m$ and above

B. Wavelength of $5 \times 10^{-7} m$ and below

C. Any wavelength

D. All frequencies below $5 \times 10^{14} Hz$

Answer: B

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48. If Planck's constant is denoted by h and the charge by e, experiments on photoelectric effect allow the determination of

A. Only h

B. Only e

C. both h and e

D. Only h/e

Answer: D

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49. The electron behaves as waves because they can

A. be diffracted by a crystal

B. ionise a gas

C. be deflected by magnetic fields

D. be deflected be electric fields

Answer: A

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50. A non-monochromatic light is used in an experiment on photoelectric effect. The stopping potential

A. is related to the mean wavelength

B. is related to the longest wavelength

C. is related to the shortest wavelength

D. is not related to the wavelength

Answer: C

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51. The incident photon involed in the photoelectric effect experiment

A. completely disappears

B. come out with increased frequency

C. come out with a decreased frequency

D. come out with out change in frequency

Answer: A

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52. In a photoelectric experiment , the maximum velocity of photoelectric emitted

A. depends on intensity of incident radiation

B. does not depend on cathode material

C. depends on frequency of incident radiation

D. does not depend on wavelength of incident radiation

Answer: C

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53. The number of photoelectrons emitted for light of a frequency v (higher than the threshold frequency V_0) is proportional to

A. Frequency of light

B. Work function

C. Theshold wavelength

D. Intensity of light

Answer: D

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54. Emission of electrons in photoelectric effect is possible, if

A. metal surface is highly polished

B. the incident light is of sufficiently high intensity

C. the light is incident at right angles to the surface

D. the incident light is of sufficiently low wavelength

Answer: D

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55. When orange light falls on a photo sensitive surface the photocurrent begins to flow. The velocity of emitted electrons will be more whwn surface is hit by

A. red light

B. violet light

C. thermal radiations

D. radio waves

Answer: B

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56. When the amplitude of the light wave incident on a photomental sheet is increased then

A. the photoelectric current increases

B. the photoelectric current remains unchanged

C. the stopping potential increases

D. the stopping potential decreases

Answer: A

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57. Which of the following is dependent on the intensity of incident radiation in a photoelectric experiment

A. work function of the surface

B. amount of photoelectric current

C. stopping potential

D. maximum kinetic energy

Answer: B

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58. According to Einstein's photoelectric equation , the graph between the kinetic energy of photoelectrons ejected and the frequency of incident radiation is

A. a

B. b

C. c

D. d

Answer: D

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59. Which one of the following is true in photoelectric emission

A. photoelectric current is directly proportional to the amplitude of light of given frequency

B. photoelectric current is directly proportional to the intensity of light of given frequency at moderate intensities

C. above the threshold frequency the maximum kinetic energy of photoelectrons is inversely proportional to incident frequency

D. the threshold frequency depends on the intensity of incident light

Answer: B

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60. If the work function of a metal is $'\phi'$ and the frequency of the incident light is $'v'$, there is no emission of photoelectron if

A. $v < W / h$

B. $v > W / h$

C. $v \geq W / h$

D. $v \leq W / h$

Answer: A

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61. Kinetic energy with which the electrons are emitted from the metal surface due to photoelectric effect is

A. Dependent of the intensity of illumination

B. Dependent on the frequency of light

C. Inversely proportional to the intensity of illumination

D. Directly proportional to the intensity of illumination

Answer: B

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62. When ultraviolet radiation is incident on a surface, no photoelectrons are emitted. If another beam causes photoelectrons to be emitted from the surface, it may consist of

(i) radio waves

(ii) infrared rays

(iii) X-rays

(iv) gamma rays

A. radio waves

B. infrared rays

C. visible light rays

D. X-rays

Answer: D

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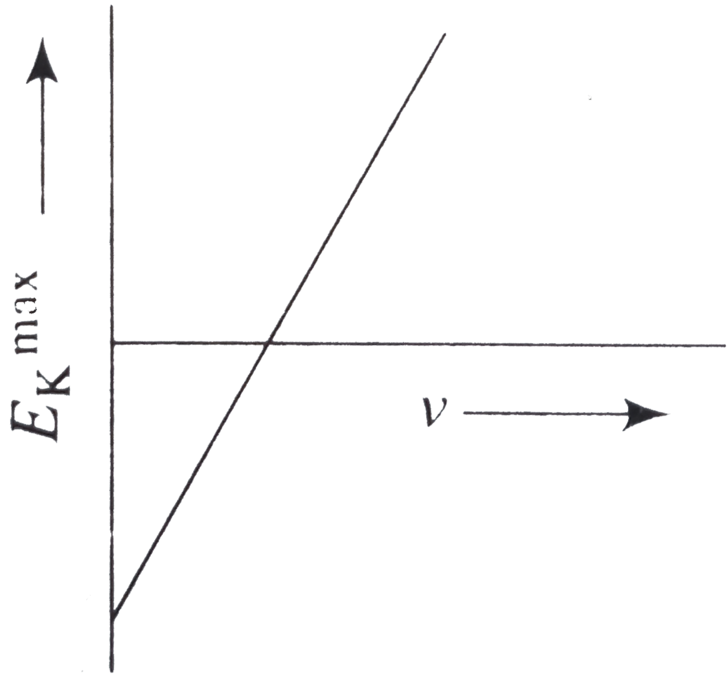

63.

The maximum kinetic energy of the emitted photoelectrons against frequency υ of incident radiation is plotted as shown in Fig. This graph help us in determining the following physical quantities

A. charge on electron

B. work function of emitter

C. Planck's constant

D. ratio of Planck's constant and chargeon electron

Answer: C

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64. Einstein's photoelectric equation states that $E_k = hv - W$, In this equation E_k refers to :

A. kinetic energy of all ejected electrons

B. mean kinetic energy of emitted electrons

C. minimum kinetic energy of emitted electrons

D. maximum kinetic energy of emitted electrons

Answer: D

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65. The function of photoelectric cell is

A. to convert electrical energy into light energy.

B. to convert light energy into electrical energy.

C. to convert mechanical energy into electrical energy

D. to convert DC into AC.

Answer: B

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66. Photo electric effect can be explained only by assuming that light

A. is a form of transverse waves

B. is a form of longitudinal waves

C. can be polarised

D. consists of quanta

Answer: D

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67. When light falls on a photosensitive surface, electrons are emitted from the surface. The kinetic energy of these electrons does not depend on the:

A. Wavelength of light

B. thickness of the surface layer

C. type of material used for the layer

D. Intensity of light

Answer: D

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68. Photoelectric effect is described as the ejection of electrons from the surface of a metal when:

A. it is heated to a high temperature

B. light of a suitable wave length is incident on it

C. electrons of a suitable velocity impinge on it

D. it is placed in a strong electric field

Answer: B

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69. Though quantum theory of light can explain a number of phenomena observed with light , it is necessary to retain the wave-nature of light to explain the phenomena of :

A. photoelectric effect

B. diffraction

C. compton effect

D. black body radiation

Answer: B

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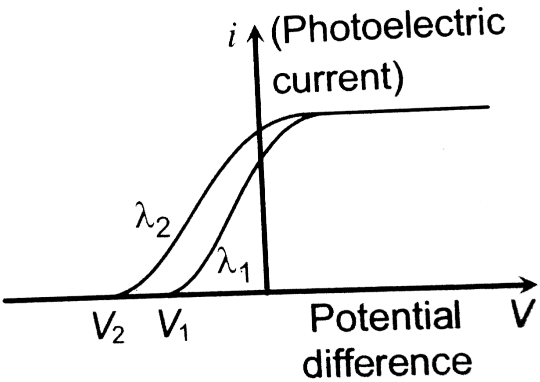
70. In the following diagram if $V_2 > V_1$ then



A. $\lambda_1 = \sqrt{\lambda_2}$

B. $\lambda_1 < \lambda_2$

C. $\lambda_1 = \lambda_2$

D. $\lambda_1 > \lambda_2$

Answer: D

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71. When an X-ray photon collides with an electrons and bounces off, its new frequency

A. is lower than its original frequency

B. is same as its original frequency

C. is higher than its original frequency

D. depends upon the electron's frequency

Answer: A

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72. A point source of light is used in a photoelectric effect. If the source is removed farther from the emitted metal, the stopping potential

A. will increase

B. will decrease

C. will remain constant

D. will either increase or decrease MATTER WAVE

Answer: C

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73. The de - Broglie wavelength λ

A. mass of the particle

B. size of the particle

C. material of the particle

D. shape of the particle

Answer: A

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74. The debroglie wavelength associated with a particle of mass m, moving with a velocity v and energy E isgiven by

A. h / mv^2

B. mv / h^2

C. $h / \sqrt{2mE}$

D. $\sqrt{2mE} / h$

Answer: C

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75. Choose the correct statement

A. Any charged particle in rest is accompanised by matter waves

B. Any uncharged particle in rest is accompanied by matter waves

C. The matter waves are waves of zero amplitude

D. The matter waves are waves of probability amplitude

Answer: D

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76. An electron of charge e and mass m is accelerated from rest by a potential difference V. the de Broglie wavelength is

A. Directly proportional to the square root of potential difference.

B. Inversely proportional to the square root of potential difference.

C. Directly proportional to the square root of electron mass

D. Inversely proportional of the cube root of electron mass

Answer: B

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77. Which of the following particles - neutron, proton, electron and deuteron has the lowest energy if all have the same de Broglie wavelength

A. neutron

B. proton

C. electron

D. deuteron

Answer: D

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78. The momentum of a proton is p. the corresponding wavelength is

A. h/p

B. hp

C. p/h

D. $\sqrt{hp}$

Answer: A

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79. A wave is associated with matter when it is

A. stationary

B. in motion with a velocity

C. in motion with speed of light

D. in motion with speed greater than that of light

Answer: B

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80. An electron of mass $9.1 \times 10^{-31} kg$ and charge $1.6 \times 10^{-19} C$ is accelarted through a potential difference of V volt. The de Broglie wavelength (λ) associated with the electron is

A. $\frac{12.27}{\sqrt{V}} A^0$

B. $\frac{12.27}{V} A^0$

C. $12.27\sqrt{V} A^0$

D. $\frac{1}{12.27\sqrt{V}} A^0$

Answer: A

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81. The de Broglie wavelength of a molecules of thermal energy KT (K is Boltzmann constant and T is absolute temperture) is given by

A. $\frac{h}{\sqrt{2mKT}}$

B. $\frac{h}{2mKT}$

C. $h\sqrt{2mKT}$

D. $\frac{1}{h\sqrt{2mKT}}$

Answer: A

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82. The wavelength of a proton and a photon are same. Then

A. Their velocities are same

B. Their momenta are equal

C. Their energies are same

D. Their speeds are same

Answer: B

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83. If the value Plank's constant is more than its present value. Then de Brolie wavelength associated with a material particle will be

A. More

B. Less electrons will be emitted

C. Same

D. More for lighter particles and less for heavy particles

Answer: A

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84. The wavelength of matter waves does not depend on

A. Momentum

B. Velocity

C. Mass

D. Charge

Answer: D

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85. The wave nature of matter is not observed in daily life because their wave length is

A. Less

B. More

C. In infrated region

D. In ultraviolet region

Answer: A

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86. An electron of mass m and a photon have same energy E. The ratio of de - Broglie wavelengths associated with them is :

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

B. $\sqrt{\frac{E}{2m}}$

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

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

Answer: C

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87. Which of the following figure represents the variation of particle momentum and the associated de - Broglie wavelength ?

A. a

B. b

C. c

D. d

Answer: D

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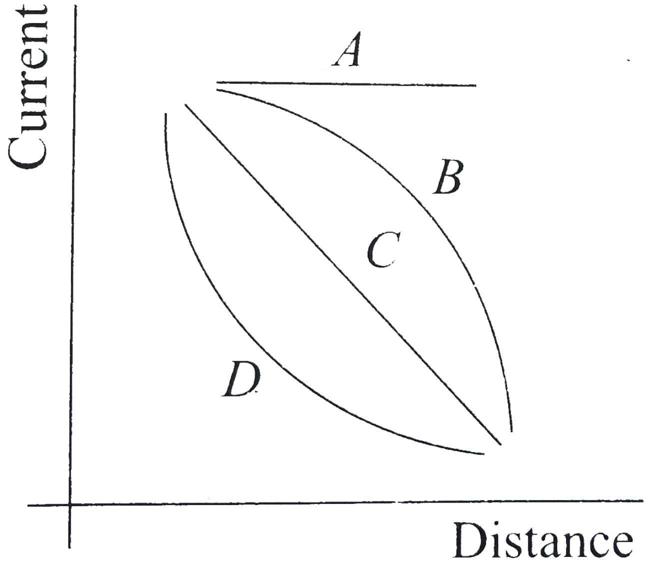
88.



A point source causes photoelectric effect from a small metal plate. Which of the curves in Fig. may represent the saturation photo-current as a function of the distance between the source and the metal?

A. a

B. b

C. c

D. d

Answer: D

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89. Matter waves are:

A. electromagnetic waves

B. mechanical waves

C. either mechanical or electromagnetic waves

D. neither mechanical nor electromagnetic waves

Answer: D

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90. The incorrect statement is

A. Material wave (de-Broglie wave) can travel in vacuum

B. Electromagnetic wave can travel through vacuum

C. The velocity of photon is the same as light passes through any medium

D. Wavelength of de-Broglie wave depends upon velocity

Answer: C

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91. The magnitude of the de-Broglie wavelength (λ) of an electron (e),proton(p),neutron (n) and α particle (a) all having the same energy of Mev, in the incresing order will follow the sequence:

A. $\lambda_e, \lambda_p, \lambda_n, \lambda_\alpha$

B. $\lambda_\alpha, \lambda_n, \lambda_p, \lambda_e$

C. $\lambda_e, \lambda_n, \lambda_p, \lambda_\alpha$

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

Answer: B

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92. Moving with the same velocity . One of the following has the longest deBroglie wavelength

A. β-particle

B. α-particle

C. proton

D. neutron

Answer: A

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93. Debroglie wavelength of a particle at rest position is

A. zero

B. finite

C. infinity

D. cannot be calculated

Answer: C

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94. Debroglie wavelength of proton accelerated by an electric field at a potential difference v is

A. $\frac{0.108}{\sqrt{V}}$

B. $\frac{0.202}{\sqrt{V}}$

C. $\frac{0.286}{\sqrt{V}}$

D. $\frac{0.101}{\sqrt{V}}$

Answer: C

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95. Debroglie wavelength of uncharged particles depends on

A. mass of particle

B. kinetic energy of particle

C. nature of particle

D. All above

Answer: D

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96. Debroglie wavelength of a moving gas molecule is

A. proportional to temperature

B. inversely proportional to temperature

C. independent of temperature

D. inversely proportional to square root of temperature

Answer: D

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97. The particles that can be accelarted by an electric field is

A. proton

B. electron

C. alpha particle

D. all above

Answer: D

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98. If a proton and an electron are confined to the same region, then uncertainity in momentum

A. for proton is more, as compared to the electron

B. for electron is more, as compared to the proton

C. same for both the particles

D. directly proportional to their masses

Answer: C

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99. Which phenomenon best supports the theory that matter has a wave nature?

A. electron momentum

B. electron diffraction

C. photon momentum

D. photon diffraction

Answer: B

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100. The wavelength of de-Broglie wave associated with a thermal neutron of mass m at absolute temperture T is given by (here, k is the Boltzmann constant)

A. $\frac{h}{\sqrt{2mKT}}$

B. $\frac{h}{\sqrt{mkT}}$

C. $\frac{h}{\sqrt{3mkT}}$

D. $\frac{h}{2\sqrt{3mkT}}$

Answer: C

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101. In each of the following question, a statement is given and a corresponding statement or reason is given just below it. In the statement, mark the correct answer as

Assertion (A) :For a fixed incident photon energy, photoelectrons have a wide range of energies ranging from zero to the maximum value $K_{\max}$

Reason (R) : Intially the electrons in the metal are at different energy level.

A. If both Assertion and reason are true and reason is correct explanation of Assertion

B. If both Assertion and Reason are true but Reason is not the correct explantion of Assertion

C. If Assertion is true but Reason is false

D. If both Assertion and Reason are false

Answer: A

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102. In each of the following question, a statement is given and a corresponding statement or reason is given just below it. In the statement, mark the correct answer as

Consider the following statements A and B, identify the correct choice in the given answers.

A) Tightly bound electrons of target material scattered X-ray photon, resulting in the compton effect.

B) Photoelectric effect takes palce with free electrons.

A. If both Assertion and reason are true and reason is correct explanation of Assertion

B. If both Assertion and Reason are true but Reason is not the correct explantion of Assertion

C. If Assertion is true but Reason is false

D. If both Assertion and Reason are false

Answer: D

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103. The frequency and intensity of a light source are both doubled. Consider the following statements

A. The saturation photocurrent remains almost the same

B. The maximum kinetic energy of the photoelectrons is double

A. If both Assertion and reason are true and reason is correct explanation of Assertion

B. If both Assertion and Reason are true but Reason is not the correct explantion of Assertion

C. If Assertion is true but Reason is false

D. If both Assertion and Reason are false

Answer: B

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104. In each of the following questions, a statement is given and a corresponding statement or reason is given just below it. In the statements, mark the correct answer as

A proton and electron both have energy $50Ev$.

Statement-I:Both have different wavelengths

Statement -II: Wavelength depends on energy and not on mass.

A. Statement I is true,Statemetn II is true, statement II is a correct explanation of statement I.

B. Statement I is true, Statement II is true,Statement II is NOT a correct explanation for statement I.

C. Statement I is true, Statement II is false

D. Statement I is false, Statement II is true

Answer: C

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105. In each of the following questions, a statement is given and a corresponding statement or reason is given just below it. In the statement, mark the correct answer as

Statement-I: Though light of a single frequency (monochromic light) is incident ona metal, the energies of emitted photoelectrons are different

Statement-II: The energy of electrons just after they absorb photons incident on the metal surface may be lost in collision with other atoms in the metal before the electron is ejected out of the metal.

A. Statement I is true,Statemetn II is true, statement II is a correct explanation of statement I.

B. Statement I is true, Statement II is true,Statement II is NOT a correct explanation for statement I.

C. Statement I is true, Statement II is false

D. Statement I is false, Statement II is true

Answer: A

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106. Some questions (Assertion-Reason Type) are given below. Each question contains Statement I (Assertion) and statement II(reason). Each question has 4 choices (a),(b),(c) and (d) out of which only one is correct. So select the correct choise.

a. Statement I is True, Statement II is True,Statement II is a correct explanation for Statement I

b. Statement I is True, Statement II is True, Statement II is NOT a correct ecplanation for Statement I

c. Statement I is True, Statement II is False .

d. Statement I is false, Statement II is True.

3. Statement I: The de Broglie wavelength of a molecule (in a sample of ideal gas) varies inversely as the square root of absolute temperature.

Statement II: The de Broglie wavelength of a molecule (in sample of ideal gas) depends on temperature.

A. Statement I is true,Statemetn II is true, statement II is a correct explanation of statement I.

B. Statement I is true, Statement II is true,Statement II is NOT a correct explanation for statement I.

C. Statement I is true, Statement II is false

D. Statement I is false, Statement II is true

Answer: B

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107. This question has statement - 1 and statement - 2 of the four choice given after the statements choose the one that best describes the two statements

statement - 1 : A metallic surface is irradiated by a monochromatic light of frequency $v > v_0$ (the threshold frequency). The maximum kinetic energy and the stopping potential are $K_{\max}$ and V_0 respectively if the frequency incident on the surface is doubled , both the $K_{\max}$ and V_0 are also doubled

statement - 2 : The maximum kinetic energy and the stopping potential of photoelectron emitted from a surface are linearly dependent on the frequency of incident light

A. Statement I is true,Statemetn II is true, statement II is a correct explanation of statement I.

B. Statement I is true, Statement II is true,Statement II is NOT a correct explanation for statement I.

C. Statement I is true, Statement II is false

D. Statement I is false, Statement II is true

Answer: C

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108. Statement-1: Davisson-Germer experiment established the wave nature of electron

Statement-2: If electrons have wave nature, they can interfere show differaction.

A. Statement I is true,Statemetn II is true, statement II is a correct explanation of statement I.

B. Statement I is true, Statement II is true,Statement II is NOT a correct explanation for statement I.

C. Statement I is true, Statement II is false

D. Statement I is false, Statement II is true

Answer: A

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Level I C W

1. The frequency of a photon associated with an energy of $3.31 eV$ is (given $h = 6.62 \times 10^{-34} Js$)

A. $0.8 \times 10^{15} Hz$

B. $1.6 \times 10^{15} Hz$

C. $3.2 \times 10^{15} Hz$

D. $8.0 \times 10^{15} Hz$

Answer: A

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2. A radiation of wave length $2500A^0$ is incident on a metal plate whose work function is $3.5eV$. Then the potential required to stop the fastest photo electrons emitted by the surface is $\left(h = 6.63 \times 10^{-34} Js \& c = 3 \times 10^8 m/s\right)$

A. $1.86V$

B. $3.00V$

C. $1.46V$

D. $2.15V$

Answer: C

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3. The work function of a metal is $2.5eV$. The maximum kinetic energy of the photoelectrons emitted if a radiof wavelength $3000A^0$ falls on it is $(h = 6.63 \times 10^{-34} Js \& c = 3 \times 10^8 m/s)$

A. $1.12 \times 10^{-19} J$

B. $4.8 \times 10^{-19} J$

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

D. $2.61 \times 10^{-19} J$

Answer: D

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

A. $220nm$

B. $310nm$

C. $540nm$

D. $400nm$

Answer: B

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5. A laser used to weld detached retinas emits light with a wavelength of 652 nm in pulses that are 20.0ms in duration. The average power during each pulse is 0.6 W. then,

A. $7.5 \times 10^{15} eV, 2.7 eV$

B. $6.5 \times 10^{16} eV, 2.9 eV$

C. $6.5 \times 10^{16} eV, 2.7 eV$

D. $7.5 \times 10^{16} eV, 1.9 eV$

Answer: D

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6. Electrons ejected from the surface of a metal, when light of certain frequency is incident on it, are stopped fully by a retarding potential of 3 volts. Photo electric effect in this metallic surface begains at a frequency $6 \times 10^{14} s^{-1}$. The frequency of the incident light in s^{-1} is $\left[h = 6x10^{-34} J - \sec,\right.$ charge on the electron = $1.6 \times 10^{-19} C]$

A. 7.5×10^{13}

B. 13.5×10^{13}

C. 14×10^{14}

D. 7.5×10^{15}

Answer: C

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7. The threshold wavelength for emission of photoelectrons from a metal surface is $6 \times 10^{-7} m$.The work function of the material of the metal surface is.

A. $3.3 \times 10^{-19} J$

B. $6.67 \times 10^{-19} J$

C. $1.23 \times 10^{-19} J$

D. $2.37 \times 10^{-19} J$

Answer: A

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8. The maximum velocity of an electron emitted by light of wavelength λ incident on the surface of a metal of work function ϕ, is

Where h = Planck's constant , m = mass of electron and c = speed of light.

A. $\left[\frac{2(hc+\lambda\phi)}{m\lambda}\right]^{1/2}$

B. $\frac{2(hc-\lambda\phi)}{m}$

C. $\left[\frac{2(hc-\lambda\phi)}{m\lambda}\right]^{1/2}$

D. $\left[\frac{2(hc\lambda-\phi)}{m\lambda}\right]^{1/2}$

Answer: C

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9. The work function of nickle is $5eV$. When light of wavelength $2000A^0$ falls on it, emits photoelectrons in the circuit. The the potential difference necessary to stop the fastest electrons emitted is (given $h = 6.67 \times 10^{-34} Js$)

A. $1.0V$

B. $1.75V$

C. $1.2V$

D. $0.75V$

Answer: C

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10. If an electron and a proton have the same KE, the ratio of the de Broglie wavelengths of proton and electron would approximately be

A. $1:1837$

B. $43:1$

C. $1837:1$

D. $1:43$

Answer: D

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11. If electron is having a wavelength of $100A^0$ then momentum is $(gmcms^{-1})$ units

A. 6.6×10^{-32}

B. 6.6×10^{-29}

C. 6.6×10^{-25}

D. 6.6×10^{-21}

Answer: D

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12. The de Broglie wavelength of an electron and the wavelength of a photon are same. The ratio between the energy of the photon and the momentum of the electron is

A. h

B. c

C. $1/h$

D. $1/c$

Answer: B

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13. A proton and an alpha - particle are accelerated through same potential difference. Then, the ratio of de-Broglie wavelength of proton and alpha-particle is

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

B. $2:1$

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

D. $4:1$

Answer: C

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14. Ratio of debroglie wavelengths of uncharged particle of mass m at $27^0 C$ to $127^0 C$ is nearly

A. 1.16

B. 0.16

C. 1.33

D. 0.8

Answer: A

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15. A particle is projected horizantally with a velocity $10\frac{m}{s}$. What will be the ratio of de-Broglie wavelengths of the particle, when the velocity vector makes an angle 30^0 and 60^0 with the horizontal

A. $\sqrt{3} : 1$

B. $1 : \sqrt{3}$

C. $2 : \sqrt{3}$

D. $\sqrt{3}:2$

Answer: A

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16. A positron and a proton are accelerated by the same accelerating potential. Then the ratio of the associated wavelengths of the positron and the proton will be [M =mass of proton, m=mass of positron]

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

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

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

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

Answer: B

Watch Video Solution

Level Ii C W

1. If light of wavelength λ_1 is allowed to fall on a metal , then kinetic energy of photoelectrons emitted is E_1. If wavelength of light changes to λ_2 then kinetic energy of electrons changes to E_2. Then work function of the metal is

A. $\dfrac{E_2\lambda_1 - E_1\lambda_2}{\lambda_1}$

B. $\dfrac{E_1\lambda_1 - E_2\lambda_2}{\lambda_1 + \lambda_2}$

C. $\dfrac{E_1\lambda_1 + E_2\lambda_2}{\lambda_1 - \lambda_2}$

D. $\dfrac{E_2\lambda_2 - E_1\lambda_1}{\lambda_1 - \lambda_2}$

Answer: D

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2. Light of wavelength λ strikes a photo - sensitive surface and electrons are ejected with kinetic energy is to be increased to $2E$, the wavelength must be changed to λ' where

A. $\lambda' = \dfrac{\lambda}{2}$

B. $\lambda' = \lambda 2$

C. $\dfrac{\lambda}{2} < \lambda' < \lambda$

D. $\lambda' > \lambda$

Answer: C

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3. Ultraviolet light of wavelength 300nn and intensity $1.0Wm^{-2}$ falls on the surface of a photosensitive material. If one per cent of the incident photons produce photoelectrons, then the number of photoelectrons emitted per second from an area of 1.0 cm^2 of the surface is nearly

A. 9.61×10^{14}

B. 4.12×10^{13}

C. 1.51×10^{12}

D. 2.13×10^{11}

Answer: C

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4. Light rays of wavelength $6000A^{\circ}$ and of photon intensity $39.6was/m^2$ is incident on a metal surface. If only one percent of photons incident on the surface of electons emitted per second unit area from the surface will be [Planck constant =$6.64 \times 10^{-34} J - S$,Velocity of light = $3 \times 10^8 ms^{-1}$]

A. 12×10^{18}

B. 10×10^{18}

C. 12×10^{17}

D. 12×10^{15}

Answer: C

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5. Ligth of wavelength $4000A^{\circ}$ is incident on a metal surface of work function $2.5eV$. Given $h = 6.62 \times 10^{-34} Js$, $c = 3 \times 10^{8} m/s$, the maximum KE of photoelectrons emitted and the corresponding stopping potential are respectively

A. $0.6eV, 0.6V$

B. $2.5eV, 2.5V$

C. $3.1eV, 3.1V$

D. $0.6eV, 0.3V$

Answer: A

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6. The kinetic energy of an electron is E when the incident wavelength is λ To increase ti KE of the electron to 2E, the incident wavelength must be

A. 2λ

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

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

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

Answer: C

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7. A photon of energy $15eV$ collides with $H-$ atom. Due to this collision, $H-$ atom gets ionized. The maximum kinetic energy of emitted elecrtron is:

A. $1.4eV$

B. $5eV$

C. $15eV$

D. $13.6eV$

Answer: A

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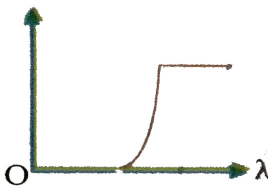
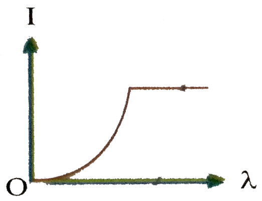
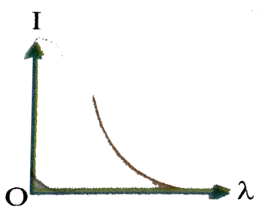
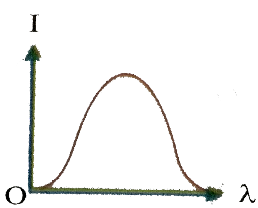
8. The anode vollage of a photocell is kept fixed . The wavelength $\lambda$of the light falling on the cathode varies as follows

A. 

B. 

C. 

D. 

Answer: C

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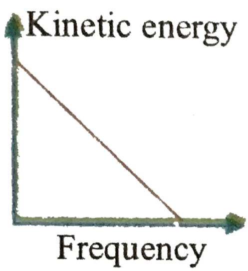
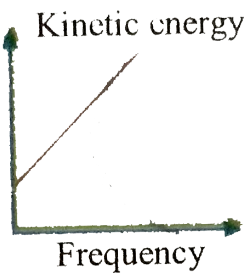
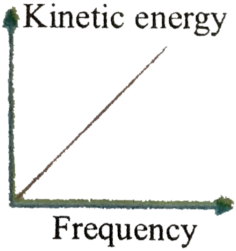
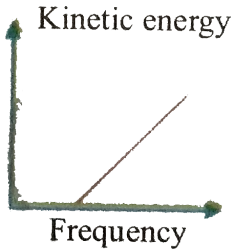
9. According to Einstein's photoelectric equation, the graph between the kinetic energy of photoelectrons ejected and the frequency of incident radiation is

A. 

B. 

C. 

D. 

Answer: D

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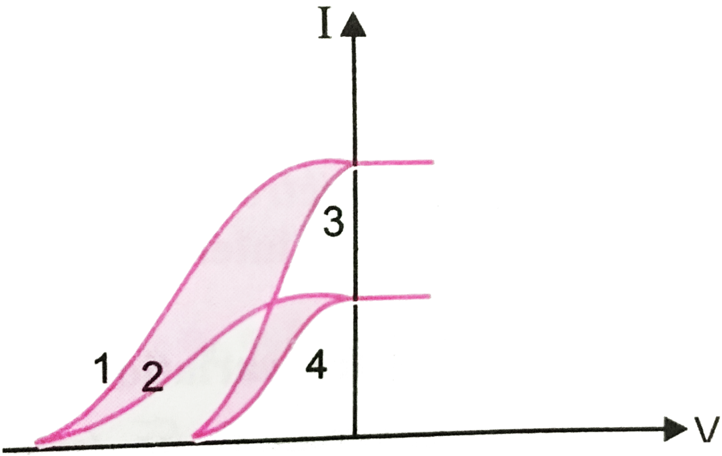
10. The graph of Fig. shows the variation of photoelectric current (I) versus applied voltage (V) for the two different photosensitive materials for two different intensities of the incident radiation. Identify the pairs of curves that correspond to different materials but same intensity of incident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



A. Curve 1 and 3,Curve 2 and 4

B. Curve 1 and 2,Curve 3 and 4

C. Curve 1 and 4,Curve 2 and 3

D. Curve 1 only,Curve 2 and 4

Answer: A

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11. A proton when accelerated through a potential difference of V volt has a wavelength λ associated with it. An alpha-particle in order to have the same λ must be accelerated through a potential difference of

A. $V/8$ volt

B. $V/4$ volt

C. V volt

D. $2V$ volt

Answer: A

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12. An electron of mass m and charge e initially at rest gets accelerated by a constant electric field E. The rate of change of de-Broglie wavelength of this electron at time t ignoring relativistic effects is

A. $\frac{-h}{eEt^2}$

B. $\frac{-eEt}{E}$

C. $\frac{-mh}{eEt^2}$

D. $\frac{-h}{e.E}$

Answer: A

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13. If the velocity of a particle is increased three times, then the percentage decrease in its de Broglie wavelength will be

A. 33.3%

B. 66.6%

C. 99.9%

D. 22.2%

Answer: B

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14. If the momentum of an electron is changed by p, then the de - Broglie wavelength associated with it changes by $0.5\,\%$. The initial momentum of electron will be

A. $p_m / 200$

B. $p_m / 100$

C. $200 p_m$

D. $100 p_m$

Answer: C

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15. When the mass of an electron becomes equal to thrice its rest mass, its speed is

A. $\frac{2\sqrt{2}}{3}c$

B. $\frac{2}{3}c$

C. $\frac{1}{3}c$

D. $\frac{1}{4}c$

Answer: A

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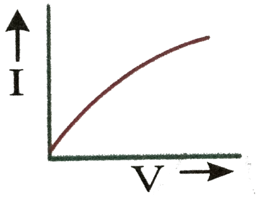
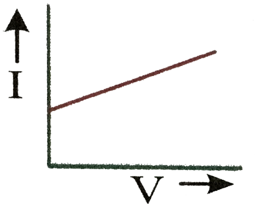
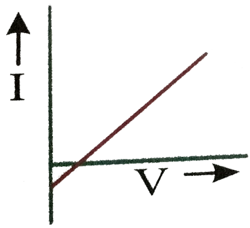
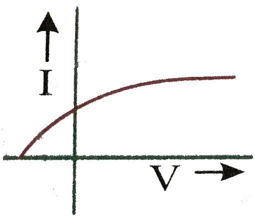
16. Which of the following graphs correctly represents the variation of particle momentum with associated de Broglie wavelength?

A. 

B. 

C. 

D. 

Answer: D

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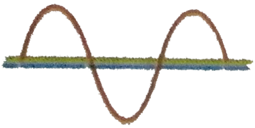
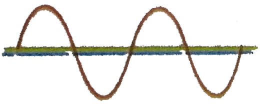
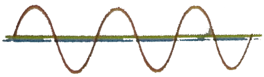
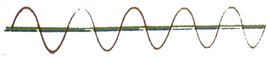
17. The de Broglie wave present in fifth Bohr orbit is:

A. 

B. 

C. 

D. 

Answer: D

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18. The correctness of velocity of an electron moving with velocity $50ms^{-1}$ is 0.005% . The accuracy with which its position can be measured will be

A. $4634 \times 10^{-3}m$

B. $4634 \times 10^{-5}m$

C. $4634 \times 10^{-6}m$

D. $4634 \times 10^{-8}m$

Answer: B

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19. If the uncertainity in the position of an electron is $10^{-10}m$, then the value of uncertainity in its momentum (in $kg - ms^{-1}$) will be

A. 3.33×10^{-24}

B. 0.53×10^{-24}

C. 6.6×10^{-24}

D. 6.6×10^{-20}

Answer: B

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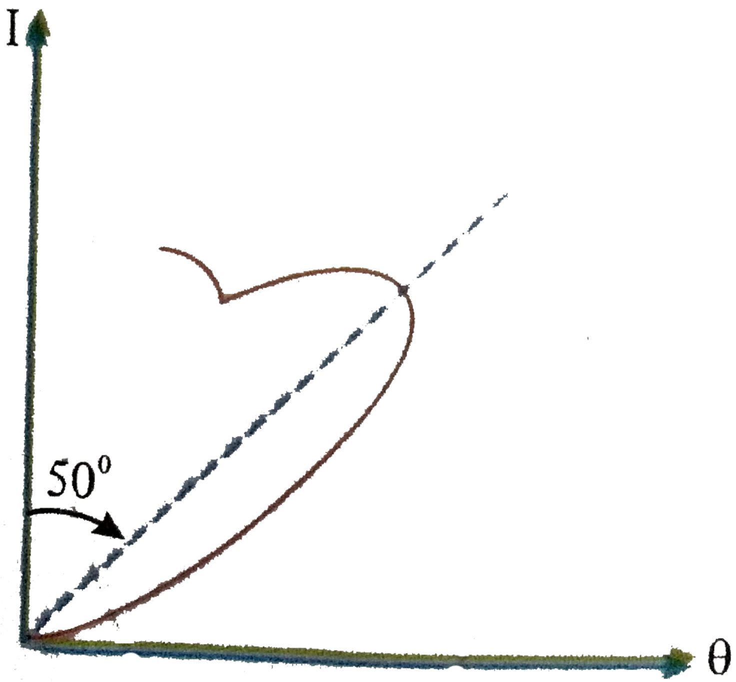
20. $a)$ Name the experiment for which the adjacent graph, showing the variation of intensity of scattered electrons with the angle of scattering (θ) was obtained. $b)$ Also name the important hypothesis that was confirmed by this experiment.



A. $A)$ Davission and Germer experiment

$B)$ de Broglie hypothesis

B. $A)$ Photo electric effect

$B)$ de Broglie hypothesis

C. $A)$ Thermionic emission

$B)$ de Broglie hypothesis

D. $A)$ Photocell

Answer: B

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Level Iii

1. When a surface $1cm$ thick is illuminated with light of wave length λ the stopping potential is V_0, but when the same surface is illuminated by light of wavelength 3λ, the stopping potential is $\frac{V_0}{6}$. The threshold wavelength for matellic surface is:

A. 4λ

B. 5λ

C. 3λ

D. 2λ

Answer: B

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2. A photon of energy $2.5eV$ and wavelenght λ falls on a metal surface and the ejected electron have velocity $'v'$. If the λ of the incident light is decreased by 20% the maximum velocity of the emitted electrons is doubled. The work function of the metal is

A. $2.6eV$

B. $2.23eV$

C. $2.5eV$

D. $2.29eV$

Answer: D

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3. When a metal surface is illuminated by light wavelengths $400nm$ and $250nm$, the maximum velocities of the photoelectrons ejected are v and $2v$ respectively . The work function of the metal is

$(h = \text{Planck's constant}, c = \text{velocity of light in air})$

A. $2hc \times 10^6 J$

B. $1.5hc \times 10^6 J$

C. $hc \times 10^6 J$

D. $0.5hc \times 10^6 J$

Answer: A

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4. A source of light is placed above a sphere of radius $10cm$. How many photoelectrons must be emitted by the sphere before emission of photoelectrons stop? The energy of incident photon is $4.2eV$ and the work function of the metal is $1.5eV$.

A. 2.08×10^{18}

B. 1.875×10^{8}

C. 2.88×10^{18}

D. 4×10^{19}

Answer: B

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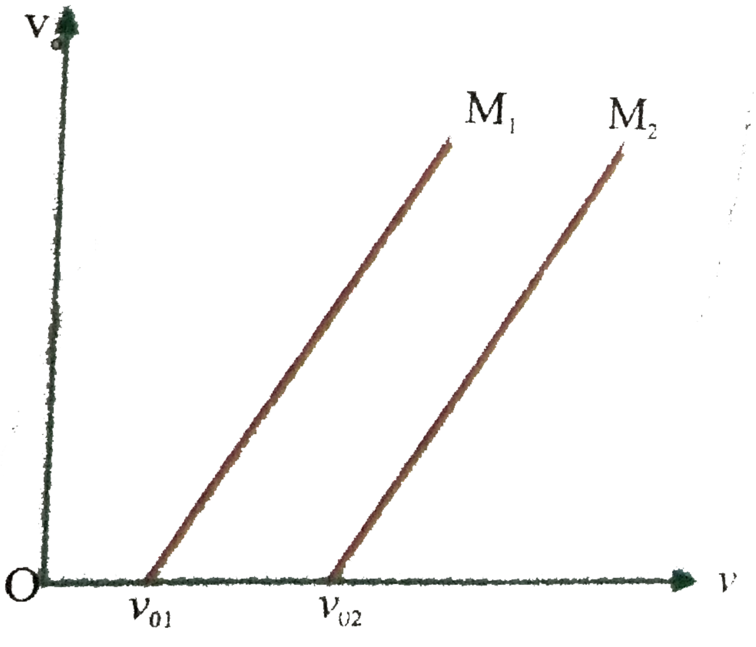
5. Figure show the variation of the stopping potential (V_0) with the frequency (v) of the incident radiations for two different photosensitive matererial M_1 and M_2 What are the values of work functions for M_1 and M_2 respectively



A. hv_{01}, hv_{02}

B. hv_{02}, hv_{01}

C. hv_{01}, hv_{01}

D. hv_{02}, hv_{02}

Answer: A

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6. From the above figure the values of stopping potentials for M_1 and M_2 for a frequency $v_3(> v_{02})$ of the incident radiatioins are V_1 and V_2 respectively. Then the slope of the line is equal to

A. $\dfrac{V_2 - V_1}{v_{02} - v_{01}}$

B. $\dfrac{V_1 - V_2}{v_{02} - v_{01}}$

C. $\dfrac{V_2}{v_{02} - v_{01}}$

D. $\frac{V_1}{v_{02} - v_{01}}$

Answer: B

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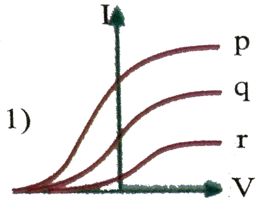
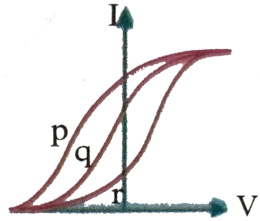
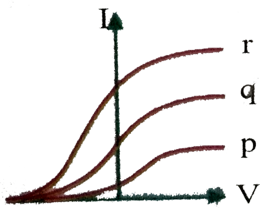
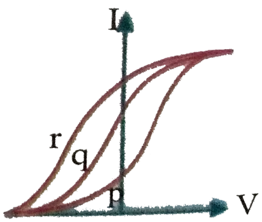
7. Photoelectric effect experiments are performed using three different metal plates p, q and r having work function $\phi_p = 2.0eV, \phi_e = 2.5eV$ and $\phi_r = 3.0eV$ respectively A light beam containing wavelength of $550nm, 450nm$ and $350nm$ with equal intensities illuminates each of the plates . The correct $I - V$ graph for the experiment is [Take hc = 1240 eV nm]

A. 

B. 

C. 

D. 

Answer: A

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8. An electron accelerated under a $p.d.$ Of V volt has a certain wavelength λ. Mass of the proton is 2000 times the mass of an electron. If the proton has to have the same wavelength λ, then it will have to be accelerated under $p.d$. of (volts)

A. 100

B. 2000

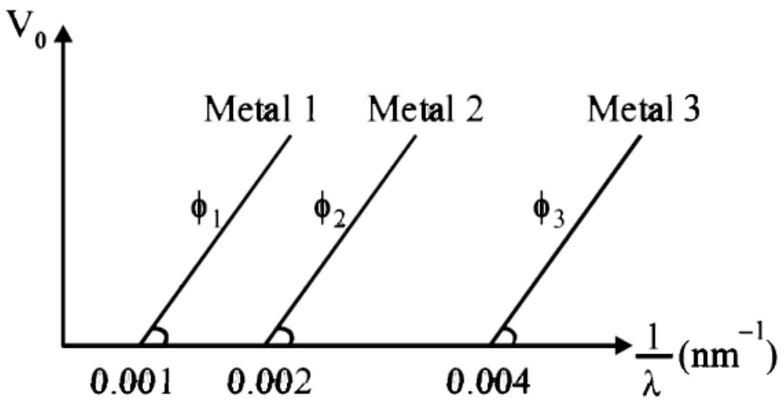
C. $V/2000$

D. $\sqrt{2000}$

Answer: C

Watch Video Solution

9. The graph between the stopping potential (V_0) and $\left(\frac{1}{\lambda}\right)$ is shown in the figure ϕ_1, ϕ_2 and ϕ_3 are work function , which of the following is /are correct



A. $\phi_1 : \phi_2 : \phi_3 = 1 : 2 : 3$

B. $\phi_1 : \phi_2 : \phi_3 = 4 : 2 : 1$

C. $\tan\theta$ is directly proportional to hc/e, where h is Planck 's constant and c is the speed of light

D. ultraviolet light can be used to emit photoelectrons from metal 2 and metal 3 only.

Answer: C

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10. For certain photosensitive material, a stopping potential of $3.0V$ is required for light of wavelength $300nm$, $2.0V$ for $400nm$ and $1.0V$ for $600nm$. The work function of the material is `(nearly)

A. $2.5eV$

B. $1.5eV$

C. $2.0eV$

D. $1.0eV$

Answer: D

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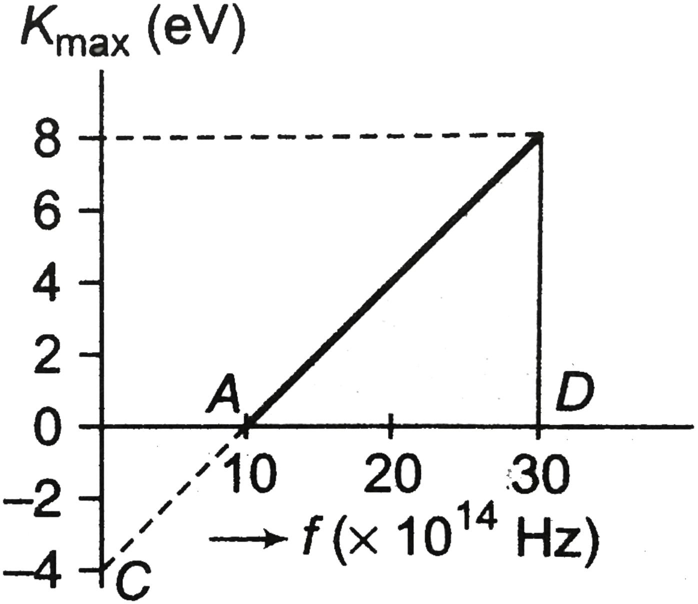
11. A graph regarding photoelectric effect is shown between the maximum kinetic energy of electrons and the frequency of the incident light. On the basis of data as shown in the graph, calculate (a) threshold frequency , (b) work- function, (c) planck's constant



A. $2eV$

B. $4eV$

C. $4.2eV$

D. $2.5eV$

Answer: B

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12. Light described at a place by the equation $E = (100V/M) \times \left[\sin\left(5 \times 10^{15} s^{-1}\right)t + \sin\left(8 \times 10^{15} s^{-1}\right)t\right]$ falls on a metal surface having work fucntion $2.0eV$. Calculate the maximum kinetic energy of the similar having work function $1.9eV$

A. $3.27eV$

B. $5eV$

C. $1.27eV$

D. $2.5eV$

Answer: A

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13. The electric field associated with a light wave is given by $E = E_0 \sin\left[\left(1.57x10^7 m^{-1}(x - ct)\right]\right.$. Find the stopping potential when this light is used in an experiment on photoelectric affect with a metal having work - function 1.9 eV.

A. $1.2V$

B. $1.1V$

C. $2V$

D. $2.1V$

Answer: A

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14. A photocell is illuminated by a small bright source places 1 m away when the same source of light is placed $\frac{1}{2}$ m away. The number of electron emitted by photocathode would be

A. increase by factor of 2

B. decrease by a factor of 2

C. increase by a factor of 4

D. decrease by a factor of 4

Answer: C

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15. Photoelectric effect supports quantum nature of light because

(a) there is a minimum frequency of light below which no photo electrons are emitted

(b) the maximum kinetic energy of photo electrons depends only on the frequency of light and not on its intensity

(c) even when the metal surface is faintly illuminated, the photo electrons leave the surface immediately

(d) electric charge of the photo electrons is quantised

A. there is a minimum frequency of light below which no photoelectrons are emitted

B. the maximum kinetic energy of photoelectrons depend only on the frequency of light and not on its intensity.

C. even when the metal surface is family illuminated, the photoelectrons leave the surface immediately

D. electric charge of the photoelectrons is quantized.

Answer: A::B::C

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16. If the wavelength of light in an experiment on photoelectric effect is doubled,

(i) the photoelectric emission will not take place

(ii) the photoelectric emission may or may not take place

(iii) the stopping potential will increase

(iv) the stopping potential will decrease

A. the photoelectric emission will not take place

B. the photoelectric emission may or many not take place

C. the stopping potential will increase

D. the stopping potential will decrease

Answer: B::D

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17. Intensity and frequency of incident light both are doubled.

Then, what is the effect on stopping potential and saturation current.

A. The saturation photocurrent gets doubled.

B. The saturation photocurrent remains almost the same

C. the maximum KE of the photoelectrons is more than doubled.

D. the maximum KE of the photoelectrons get doubled.

Answer: A::C

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18. In which of the following cases the heavier of the two particles has a smaller de-Broglie wavelength ? The two particles

A. move with same speed

B. move with the same linear momentum

C. move with the same kinetic energy

D. have fallen through the same height

Answer: A::C::D

Watch Video Solution

19. When a monochromatic point source of light is at a distance

of 0.2 m from a photoelectric cell, the cut off voltage and

the saturation current

are respectively 0.6 V and 18.0 mA. If the same source is

placed 0.6 m away

from the photoelectric cell, then

(a) the stopping potential will be 0.2 V

(b) the stopping potential will be 0.6 V

(c) the saturation current will be 6.0 mA

(d) the saturation current will be 2.0 mA

A. the stopping potential will be $0.2V$

B. the stopping potential will be $0.6V$

C. the stopping potential will be $6.0V$

D. the stopping potential will be $2.0V$

Answer: B::D

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20. In a photoelectric experiment, the wavelength of the incident light is decreased from $6000A$ to $4000A$. While the intensity of radiations remains the same,

A. the cut-off potential will increase

B. the cut-off potential will decrease

C. the photoelectric current will increase

D. the kinetic energy of the emitted photoelectrons will increase

Answer: A::D

Watch Video Solution

21. Photoelectric threshold of silver is $\lambda = 3800A$. Ultraviolet light of $\lambda = 2600A$ is incident of a silver surface. Calculate:

a. the value of work function in joule and in eV.

b. maximum kinetic energy of the emitted photoelectrons.

c. the maximum velocity of the photoelectrons.

(Mass of the electrons $= 9.11 \times 10^{-31}$).

A. 1.77

B. 3.27

C. 5.69

D. 2.32

Answer: B

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22. Photoelectric threshold of silver is $\lambda = 3800A$. Ultraviolet light of $\lambda = 2600A$ is incident of a silver surface. Calculate:

a. the value of work function in joule and in eV.

b. maximum kinetic energy of the emitted photoelectrons.

c. the maximum velocity of the photoelectrons.

(Mass of the electrons $= 9.11 \times 10^{-31}$).

A. 1.51

B. 2.36

C. 3.85

D. 4.27

Answer: A

Watch Video Solution

23. Photoelectric threshold of silver is $\lambda = 3800A$. Ultraviolet light of $\lambda = 2600A$ is incident of a silver surface. Calculate:

a. the value of work function in joule and in eV.

b. maximum kinetic energy of the emitted photoelectrons.

c. the maximum velocity of the photoelectrons.

(Mass of the electrons $= 9.11 \times 10^{-31}$).

A. 72.89×10^{8}

B. 57.89×10^{8}

C. 42.93×10^{8}

D. 68.26×10^{8}

Answer: A

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24. A 100 W point source emits monochromatic light of wavelength $6000A$

Q. Calculate the total number of photons emitted by the source per second.

A. 5×10^{20}

B. 8×10^{20}

C. 6×10^{21}

D. 3×10^{20}

Answer: D

Watch Video Solution

25. A 100 W point source emits monochromatic light of wavelength $6000A$

Q. Calculate the photon flux (in SI unit) at a distance of 5m from the source. Given $h = 6.6 \times 10^{34}$J s and $c = 3 \times 10^8 ms^{-1}$

A. 10^{15}

B. 10^{18}

C. 10^{20}

D. 10^{22}

Answer: B

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26. 1.5 mW of 400 nm light is directed at a photoelectric cell. If 0.1% of the incident photons produce photoelectrons, find the current in the cell.

A. $0.59\mu A$

B. $1.16\mu A$

C. $0.48\mu A$

D. $0.79\mu A$

Answer: C

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27. Statement - 1 : When ultraviolet light is incident on a photocell , its stopping potential is V_0 and the maximum kinetic energy of the photoelectrons is $K_{\max}$ when the ultraviolet light is replaces by X- rays both V_0 and $K_{\max}$ increase

Statement - 2 : Photoelectrons are emitted with speeds ranging from zero to a maximum value became of the range of frequencies present in the incident light

A. Statement I is true, Statement II is true, statement II is a correct explanation of statement I.

B. Statement I is true, Statement II is true, statement II is Not a correct explanation for statement I.

C. Statement I is false, Statement II is true

D. Statement I is true, Statement II is false

Answer: D

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Ncert Based Ques

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

A. H

B. $H^{1/2}$

C. H^{0}

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

Answer: D

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

A. $1.2 nm$

B. $1.2 \times 10^{-3} nm$

C. $1.2 \times 10^{-6} nm$

D. $1.2 \times 10 nm$

Answer: B

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

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

B. electrons can be emitted by all with an energy, E_0.

C. electrons can be emitted with any energy, with a maximum of $E_0 - \phi(\phi$ is the work function).

D. electrons can be emitted with any energy, with a maximum of E_0.

Answer: D

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4. In Davisson-Germer electron diffraction arrangement if suppose the voltage applied to accelerated electrons is increased, the value of the angles at which diffracted beam have the maximum intensity

A. will be larger than the earlier value.

B. will be the same as the earlier value.

C. will be less than the earlier value.

D. will depend on the target.

Answer: C

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

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

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

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

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

Answer: B

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

A. Remains constant

B. Increases with time

C. Decreases with time

D. Increases and decreases perdiocally.

Answer: A

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7. An electron of mass m with an initial velocity $\vec{v} = v_0\hat{}$(i) $(v_0 > 0)$ enters an electric field $\vec{E} = -E_0\hat{i}$ $(E_0 = cons\tan t > 0)$ at $t = 0$. If λ_0 is its de - Broglie wavelength initially, then its de - Broglie wavelength at time t is

A. $\dfrac{\lambda_0}{\left(1 + \frac{eE_0}{m}\frac{t}{v_0}\right)}$

B. $\lambda_0\left(1 + \dfrac{eE_0 t}{m v_0}\right)$

C. λ_0

D. $\lambda_0 t$

Answer: A

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

A. λ_0

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

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

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

Answer: C

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

A. $\lambda = 10nm$

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

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

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

Answer: C::D

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

A. their momenta are the same.

B. their energies are the same.

C. Energy of A_1 is less than eht energy of A_2

D. Energy of A_1 is more than eht energy of A_2

Answer: A::C

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

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

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

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

D. $\frac{P_e}{m_e C} = 10^{-4}$

Answer: B::C

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

A. decreases with increasing n, with v fixed.

B. decreases with n fixed, v increasing.

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

D. increase when the product nv increases

Answer: A::B::C

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

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

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

C. When the de Broglie wave length is λ_1 the particle is nearer the origin that when its value is λ_2

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

Answer: B::D

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

A. $\sqrt{2}$

B. $\sqrt{3}$

C. $\sqrt{8}$

D. $\sqrt{10}$

Answer: C

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15. (i) In the explanations of photoelectric effect, we assume one photon of frequency ν collides with an electron and transfer its energy. This leads to the equation for the maximum energy $E_{\max}$ of the emitted electron as $E_{\max} = h\nu - \phi_0$ Where ϕ_0 is the work function of the metal. if an electron absorbs 2 photons (each of frequency v) what will be the maximum energy for the emitted electron?

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

A. $2hv - \phi_0$

B. $2(hv - \phi_0)$

C. $2hv$

D. None

Answer: A

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16. Which of the following is correct statement

A. There are materials which absorb photons of shorter wavelength and emit photons of longer wavelength

B. There are substances which absorb photons of large wavelength and emit light of shorter wavelength.

C. For all the electrons that absorb a photon come out as photoelectrons

D. In photoelectric emission photon may have momentum in a different direction than the emitted electrons.

Answer: A::D

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17. There are two source of light, each emitting with a power fo $100W$, One emits X-rays of wavelength $1nm$ and the other visible light at $5400nm$. Find the ratio of number of photons of $X - rays$ to the photos of visible light of the given wavelength?

A. $1/100$

B. $1/200$

C. $1/300$

D. $1/500$

Answer: D

Watch Video Solution

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

A. $0.5eV$

B. $1.8eV$

C. $1.02eV$

D. $2.5eV$

Answer: C

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

A. $1.6meV$

B. $3.8meV$

C. $0.16meV$

D. $0.38meV$

Answer: D

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

A. 2

B. 3

C. 4

D. 5

Answer: A

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

A. $\lambda_A + \lambda_B$

B. $\lambda_A - \lambda_B$

C. $\frac{\lambda_A \lambda_B}{\lambda_A + \lambda_B}$

D. $\frac{\lambda_A \lambda_B}{\lambda_A - \lambda_B}$

Answer: D

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

A. $0.11eV$

B. $0.18eV$

C. $0.21eV$

D. $0.24eV$

Answer: C

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

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

A. 0.75

B. 7.5×10^{-2}

C. 7.5×10^{-13}

D. 7.5×10^{-21}

Answer: D

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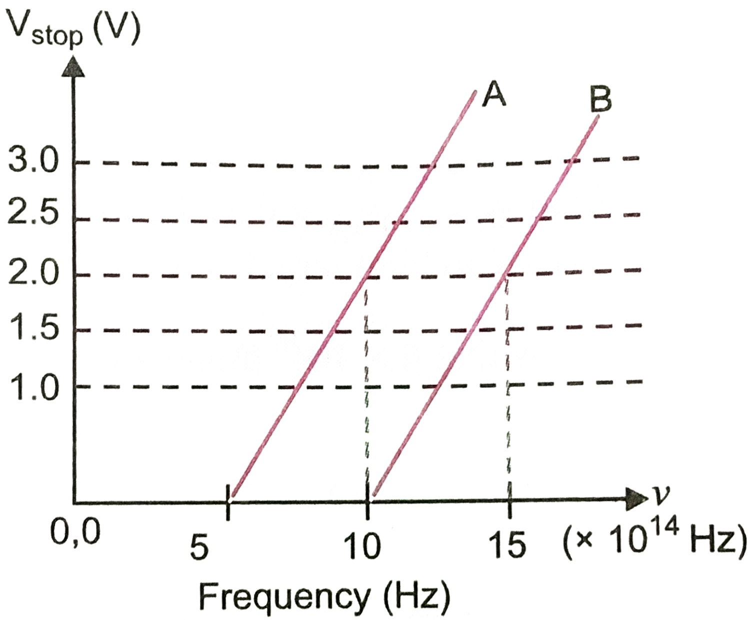
24. A student performs an experiment on photoelectric effect, using two materials A and B. A plot of $V_{s\top}$ vs ν is given in fig.

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

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



A. $8.83 \times 10^{-34} Js$

B. $8.34 \times 10^{-34} Js$

C. $8 \times 10^{-34} Js$

D. $8.5 \times 10^{-34} Js$

Answer: C

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

A. $\frac{h}{m_A v}\left[\frac{m_A+(m_B)}{m_A-(m_B)}-1\right]$

B. $\frac{h}{m_A v}\left[\frac{m_A-(m_B)}{m_A+(m_B)}-1\right]$

C. $\frac{h}{m_A v}\left[\frac{m_A(m_B)}{m_A+(m_B)}-1\right]$

D. $\frac{h}{m_A v}\left[\frac{m_A(m_B)}{m_A-(m_B)}-1\right]$

Answer: A

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

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

A. The number of photons emitted by the bulb per second. [Assume no other losses] is $5 \times 10^{19} s^{-1}$

B. There will be photoelectric emission

C. Time required by the atomic disk to receive energy equal to work function $(2eV)$ is $11.4s$

D. The number of photons would atomic disk receive within time duration calculated in (iii) above is 2

Answer: A::B::C

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Level V

1. When stopping potential is applied in an experiment on photoelectric effect, no photo current is observed. This means that

A. the emission of photoelectrons is stopped

B. the photoelectrons are emitted but are reabsorbed by the emitter metal

C. the photoelectrons are accumulated near the collector plate

D. the photoelectrons are dispersed from the sides of the apparatus.

Answer: B

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2. Two separate monochromatic light beams A and B of the same intensity (energy per unit area per unit time) are falling normally on a unit area of a metallic surface. Their wavelength are λ_A and λ_B respectively. Assuming that all the the incident light is used in ejecting the photoelectrons, the ratio of the number of photoelectrons from beam A to that from B is

A. $\left(\frac{\lambda_A}{\lambda_B}\right)$

B. $\left(\frac{\lambda_B}{\lambda_A}\right)$

C. $\left(\frac{\lambda_A}{\lambda_B}\right)^2$

D. $\left(\frac{\lambda_B}{\lambda_A}\right)^2$

Answer: A

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3. When a centimeter thick surface is illuminated with light of wavelength λ, the stopping potential is V. When the same surface is illuminated by light of wavelength 2λ, the stopping potential is $\frac{V}{3}$. Threshold wavelength for the metallic surface is

A. $\frac{4\lambda}{3}$

B. 4λ

C. $6\lambda 1$

D. $\frac{8\lambda}{3}$

Answer: B

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4. When monochromatic radiation of intensity I falls on a metal surface, the number of photoelectrons and their maximum kinetic are N and T respectively. If the intensity of radiation is 2 I, the number of emitted electrons and their maximum kinetic energy are respectively.

A. both n and $K_{\max}$ are doubled

B. both n and $K_{\max}$ are halved

C. n is doubled but $K_{\max}$ remains the same

D. $K_{\max}$ is doubled but n remains the same

Answer: C

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5. The frequency and intensity of a light source are both doubled. Consider the following statements

A. The saturation photocurrent remains almost the same

B. The maximum kinetic energy of the photoelectrons is double

A. Both (i) and (ii) are true

B. (i) is true but (ii) is false

C. (i) is false but (ii) is true

D. Both (i) and (ii) are false

Answer: B

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6. The work function for sodium surface is 2.0eV and that for aluminium surface is 4.2eV. The two metals are illuminated with appropriate radiations so as to cause protoemission. Then

A. Both aluminium and sodium will have the same threshold frequency

B. The threshold freqency of aluminium will be more than that of sodium

C. The threshold freqency of aluminium will be less than that of sodium

D. The threshold wavelength of aluminium will be more than that of sodium

Answer: B

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7. A point source of light is used in a photoelectric effect. If the source is removed farther from the emitted metal, the stopping potential

A. will increase

B. will decrease

C. will remain constant

D. will either increase or decrease

Answer: C

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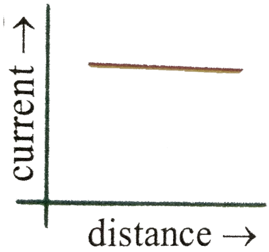
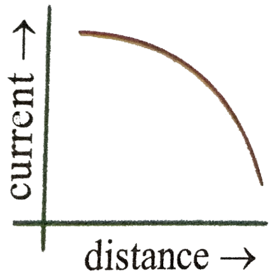
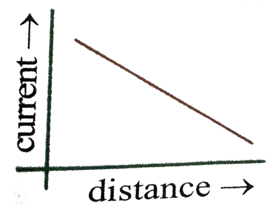
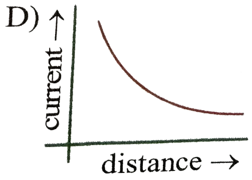
8. A point source causes photoelectric effect from a small metal plate. Which of the following curves may represent the saturation photocurrent as a function of the distance between the source and the metal?

A. 

B. 

C. 

D. 

Answer: D

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9. We may state that the energy E of a photon of frequency ν is $E = h\nu$, where h is a plank's constant. The momentum p of a photon is $p = h / \lambda$ where λ is the wavelength of the photon. From the above statement one may conclude that the wave velocity of light is equal to

A. $3 \times 10^{8} ms^{-1}$

B. $\frac{E}{p}$

C. Ep

D. $\left(\frac{E}{p}\right)^2$

Answer: B

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10. A particle of mass M at rest dacays into two particle of masses m_1 and $m_2$having non zero velocity . The ratio of the de Broglie wavelength . The ratio of the de Broglie wavelength of the particle $\lambda,_1 / \lambda_2$ is

A. $\frac{m_1}{m_2}$

B. $\frac{m_2}{m_1}$

C. $1:1$

D. $\sqrt{\frac{m_2}{m_1}}$

Answer: C

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11. Let p and E denote the linear momentum and energy of a photon. If the wavelength is decreased,

A. both p and E increase

B. p increases and E decreases

C. p decreases and E increases

D. both p and E decrease

Answer: A

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12. The wavelength λ of de Broglie waves associated with an electron (mass m, charge) accelerated through a potential difference of V is given by (h is planck's constant):

A. $\lambda = h / mV$

B. $\lambda = h / 2meV$

C. $\lambda = h / \sqrt{meV}$

D. $\lambda = h / \sqrt{2meV}$

Answer: D

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13. Two particles of masses m and $2m$ have equal kinetic energies. Their de Broglie wavelengths area in the ratio of:

A. $1:1$

B. $1:2$

C. $1:\sqrt{2}$

D. $\sqrt{2}:1$

Answer: D

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14. The wavelength of de-Broglie wave associated with a thermal neutron of mass m at absolute temperature T is given by (here, k is the Boltzmann constant)

A. $\frac{h}{\sqrt{mKT}}$

B. $\frac{h}{\sqrt{2mKT}}$

C. $\frac{h}{\sqrt{3mKT}}$

D. $\frac{h}{2}\sqrt{mKT}$

Answer: C

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15. A proton and an electron are accelerated by the same potential difference, let λ_e and λ_p denote the de-Broglie wavelengths of the electron and the proton respectively

A. $\lambda_e = \lambda_p$

B. $\lambda_e < \lambda_p$

C. $\lambda_e > \lambda_p$

D. λ_e and λ_p depends on the accelerating potential difference.

Answer: C

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16. Photoelectric effect supports quantum nature of light because

(a) there is a minimum frequency of light below which no photo electrons are emitted

(b) the maximum kinetic energy of photo electrons depends only on the frequency of light and not on its intensity

(c) even when the metal surface is faintly illuminated, the photo electrons leave the surface immediately

(d) electric charge of the photo electrons is quantised

A. there is a minimum frequency below which no photoelectrons are emitted

B. the maximum kinetic energy of photoelectrons depend only on the frequency of light and not on its intensity.

C. even when the metal surface is faintly illuminated the photoelectrons (if $n^3 n_{th}$) leave the surface immediately

D. electric charge of the photoelectrons is quantized

Answer: A::B::C

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17. When photons of energy $4.25eV$ strike the surface of metal A, the ejected photoelectrons have maximum kinetic energy T_A eV and De-broglie wavelength λ_A. The maximum energy of photoelectron liberated from another metal B by photon of energy 4.70 eV is $T_B = (T_A - 1.50)eV$ if the de Brogle wavelength of these photoelectrons is $\lambda_B = 2\lambda_A$, then

A. the work function of A is $2.25eV$

B. the work function of B is $4.20eV$

C. $T_A = 2.00eV$

D. $T_B = 2.75 eV$

Answer: B::C::D

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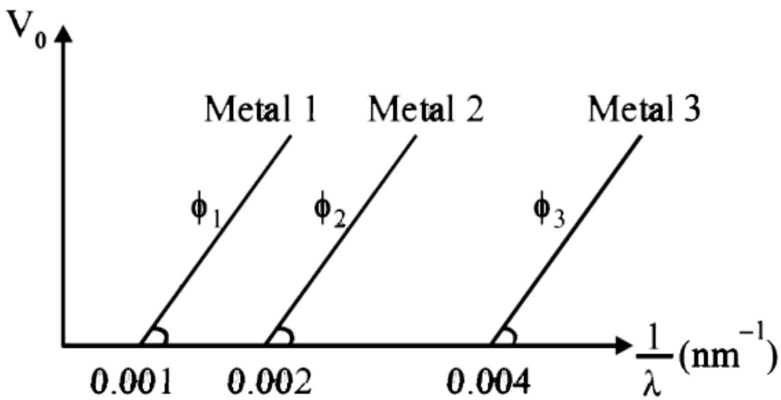
18. The graph between the stopping potential (V_0) and $\left(\frac{1}{\lambda}\right)$ is shown in the figure ϕ_1, ϕ_2 and ϕ_3 are work function , which of the following is /are correct



A. Ration of work functions $\phi_1 : \phi_2 : \phi_3 = 1 : 2 : 4$

B. Ration of work functions $\phi_1 : \phi_2 : \phi_3 = 4 : 2 : 1$

C. $\tan\theta$ directly proportional to hc/e, where h is Plack's constant and c is the speed of light

D. The violet colour light can eject photoelectrons from metals 2 and 3.

Answer: A::C

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19. When a monochromatic point source of light is at a distance of 0.2 m from a photoelectric cell, the cut off voltage and the saturation current are respectively $0.6V$

and $18.0 mA$ if the same source is placed $0.6 m$ away from the photoelectric cell , then

A. The stopping potential will be $0.2 V$

B. the stopping potential will be $0.6 V$

C. The saturation current will be $6.0 mA$

D. The saturation current will be $2.0 mA$

Answer: B::D

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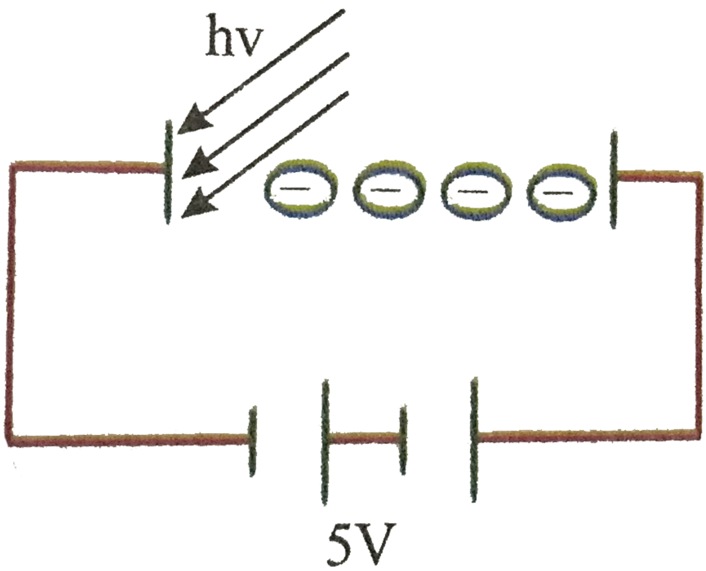
20. The collecter of the photocell (in photoelectric experiment) is made of tugsten while the emitter is Platinum having work function of $10 eV$.Monochromotic radiation of wavelength 124Å & power 100 watt is incident on emitter which emits photo electrons with a quantum efficiency of 1% .The accelerating voltage acros the photocell is of $10,000$ volts (Use: $hc = 12400 eV \text{Å}$)

What is the power supplied by the accelerating voltage source.



A. 100 watt

B. 10 watt

C. 0.1 watt

D. 1 watt

Answer: A

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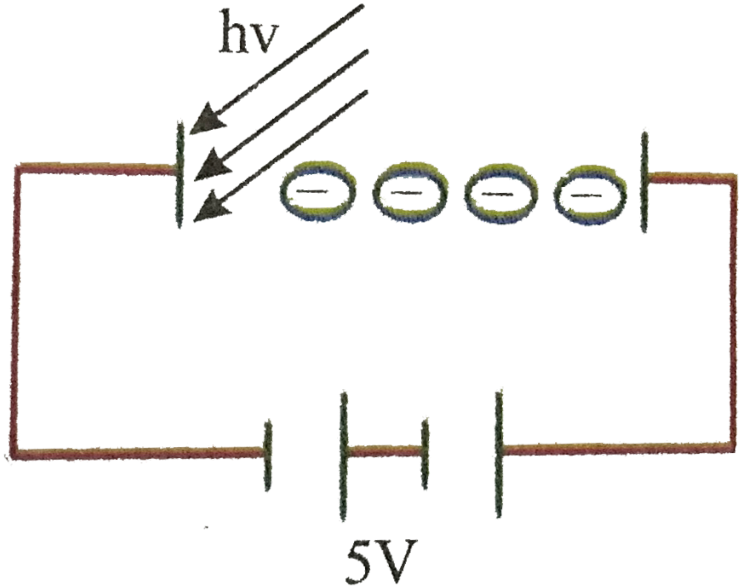
21. The collecter of the photocell (in photoelectric experiment) is made of tugsten while the emitter is Platinum having work function of $10eV$.Monochromotic radiation of wavelength 124Å & power 100 watt is incident on emitter which emits photo electrons with a quantum efficiency of 1%.The accelerating voltage acros the photocell is of $10,000$ volts (Use: $hc = 12400eV\text{Å}$)

The minimum wavelength of radiation coming from the tungsten target (collector) is



A. 124Å

B. 1.24Å

C. 1.23Å

D. 12.3Å

Answer: C

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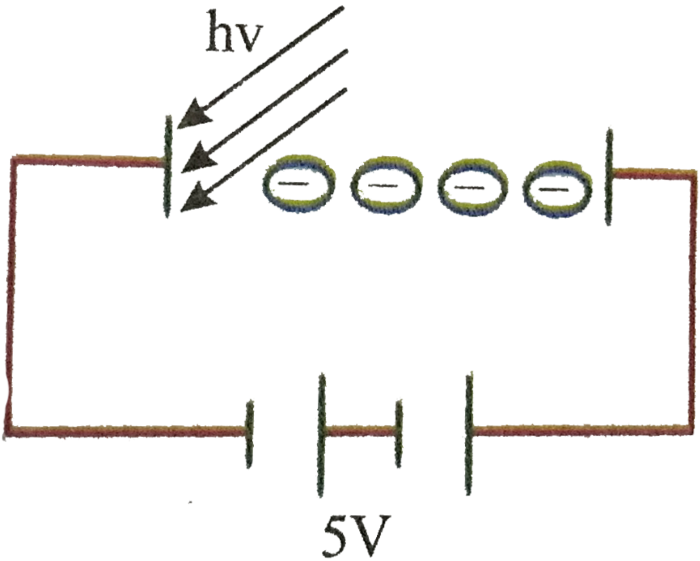
22. The collecter of the photocell (in photoelectric experiment) is made of tugsten while the emitter is Platinum having work function of $10eV$.Monochromotic radiation of wavelength 124Å & power 100 watt is incident on emitter which emits photo electrons with a quantum efficiency of 1%.The accelerating voltage acros the photocell is of $10,000$ volts (Use: $hc = 12400eV\text{Å}$)

If the source of monochromatic radiation of wavelength 124Å has an efficiency of 50%, and the power of X ray emitted by the tungsten target is $3W$, the overall efficiency of the apparatus for $X - ray$ production is



A. 1%

B. 0.1%

C. 1.5%

D. 0.67%

Answer: A

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23. In a photoelectric effect set up, a point source of light of power $3.2 \times 10^{-3} W$ emits monoenergetic photons of energy $5 eV$.The source is located at a distance of a stationary metallic sphere of work function $3 eV$ and radius $8 \times 10^{-3} m$.The efficiency of photoelectron emission is one for every 10^{6} incident photons.Assume that the sphere is isolated and initially neutral and the photoelectrons are initially swept away after emission.

Find the number of photons emitted per second

A. 10^{5}

B. 2×10^{15}

C. 4×10^{15}

D. 6×10^{15}

Answer: C

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24. In a photoelectric effect set up, a point source of light of power $3.2 \times 10^{-3} W$ emits monoenergetic photons of energy $5eV$.The source is located at a distance of a stationary metallic sphere of work function $3eV$ and radius $8 \times 10^{-3} m$.The efficiency of photoelectron emission is one for every 10^6 incident photons.Assume that the sphere is isolated and initially neutral and the photoelectrons are initially swept away after emission.

Find the maximum kinetic energy of photoelectrons:

A. $8 \times 10^{-20} J$

B. $16 \times 10^{-20} J$

C. $24 \times 10^{-20} J$

D. $32 \times 10^{-20} J$

Answer: D

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25. The radius of and α-particle moving in a circle in a constant magnetic field is half of the radius of and electron moving in circular path in the same field. The de Broglie wavelength of α-particle is n times that of the electron. Find n (an integer).

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26. The de Broglie wavelength of an electron moving with a velocity of $1.5 \times 10^8 ms^{-1}$ is equal to that of a photon find the ratio of the kinetic energy of the photon to that of the electron.

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27. $'S'$ is isotropic point source producing monochromatic radiation with power P. Force on hemisphere is $\frac{P}{nC}$. Find the value of 'n' (C is speed of ligth).

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28. A monochromatic source of light operation at 200 W emits 4×10^{20} photons per second. Find the wavelength of the light $(\text{in} 10^{-7} m)$.

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29. An electron of mass m with an initial velocity $\overrightarrow{v} = v_0 \hat{}(\text{i}) \ (v_0 > 0)$ enters an electric field $\overrightarrow{E} = -E_0 \hat{i} \ (E_0 = cons \tan t > 0)$ at $t = 0$. If λ_0 is its de - Broglie wavelength initially, then its de - Broglie wavelength at time t is

A. $\dfrac{\lambda_0}{\left(1 + \frac{eE_0 t}{m v_0}\right)}$

B. $\lambda_0 \left(1 + \dfrac{eE_0 t}{m v_0}\right)$

C. λ_0

D. $\lambda_0 t$

Answer: A

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

A. λ_0

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

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

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

Answer: C

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31. Light of wavelength 180 nm ejects photoelectrons from a plate of metal whose work - function is 2 eV. If a uniform magnetic field of 5×10^{-5} T be applied parallel to the plate, what would be the radius of the path followed by electrons ejected normally from the plate with maximum energy.

A. $0.148m$

B. $0.2m$

C. $0.25m$

D. $0.3m$

Answer: A

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Level Vi

1. Two photons having

A. equal wavelengths have equal linear momenta

B. equal energies have equal linear momenta

C. equal frequencies have equal linear momenta

D. equal linear momenta have equal wavelengths.

Answer: D

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2. The work function of a certain metal is $\frac{hC}{\lambda_0}$. When a monochromatic light of wavelength $\lambda < \lambda_0$ is incident such that the plate gains a total power P. If the efficiency of photoelectric emission is $\eta\%$ and all the emitted photoelectrons are captured by a hollow conducting sphere of radius R already charged to potential V, then neglecting any interaction of potential of the sphere at time t is:

A. $V + \frac{100\eta\lambda Pet}{4\pi\varepsilon_0 RhC}$

B. $V - \frac{\eta\lambda Pet}{400\pi\varepsilon_0 RhC}$

C. V

D. $\frac{\lambda Pet}{4\pi\varepsilon_0 RhC}$

Answer: B

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3. A metal plate is exposed to light with wavelength λ. It is observed that electrons are ejected from the surface of the metal plate. When a retarding uniform electric field E is imposed, no electron can move away from the plate farther than a certain distance d. Then the threshold wavelength λ_0 for the material of plate is (e is the electronic charge, h is Planck's constant and c is the speed of light)

A. $\lambda_0 = \left(\frac{1}{\lambda} - \frac{hc}{eEd}\right)^{-1}$

B. $\lambda_0 = \left(\frac{1}{\lambda} - \frac{eEd}{hc}\right)^{-1}$

C. $\lambda_0 = \lambda_0 - \frac{hc}{eEd}$

D. $\lambda_0 = \lambda_0 - \frac{eEd}{hc}$

Answer: B

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4. In a photoemissive cell, with exciting wavelength λ, the faster electron has speed v. If the exciting wavelength is changed to $3\lambda/4$, the speed of the fastest electron will be

A. $v\sqrt{\frac{3}{4}}$

B. $v\sqrt{\frac{4}{3}}$

C. less than $v\sqrt{\frac{3}{4}}$

D. greater than $v\sqrt{\frac{4}{3}}$

Answer: D

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5. The frequency and the intensity of a beam of light falling on the surface of a photoelectric material are increased by a factor of two. This will

A. increase both, the maximum kinetic energy of the photo-electrons, as well as photoelectric saturation current by a factor of two.

B. increase the maximum kinetic energy of the photo-electrons by a factor greater than two and would increase the photoelectric saturation current by a factor of two.

C. increase the maximum kinetic energy of the photo-electrons by a factor greater than two and will have no effect on the magnitude of the photoelectric saturation current produced.

D. increase the maximum kinetic energy of the photo-electrons by a factor of two but will have no effect on the saturation photoelectric current.

Answer: C

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6. Light of frequency 1.5 times the threshold frequency is incident on a photo-sensitive material. If the frequency is halved and the intensity is doubled, the photoelectric current becomes

A. zero

B. half of its initial value

C. one fourth the initial value

D. three fourth the initial value

Answer: A

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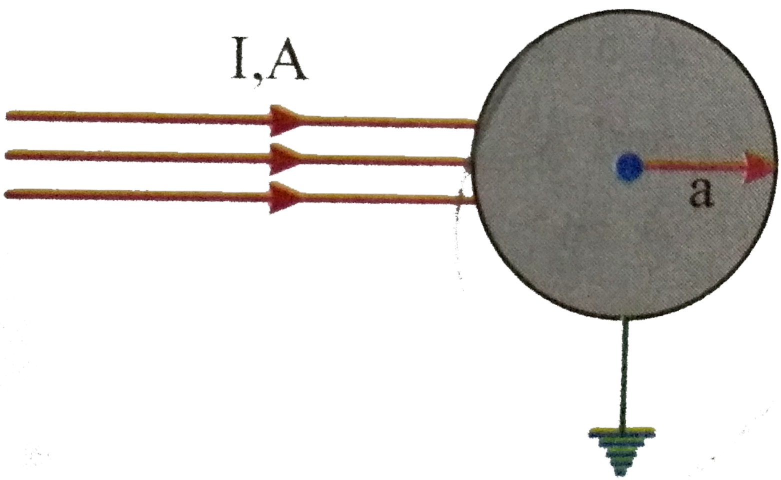
7. A parallel beam of monochromatic radiation of cross-section area $A(<\pi a^2)$, intensity I and frequency v is incident on a solid conducting sphere of work function $\phi_0[hv > \phi_0]$ and radius $'a'$. The sphere is grounded by a conducting wire. Assume that for each incident photon one photoelectron is ejected. Just after this radiation is incident on initially unchanged sphere, the current through the conducting wire is:



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

B. $\frac{Iae}{2hv}$

C. $\frac{2Iae}{hv}$

D. none of these

Answer: A

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8. A parallel beam of ligth of intensity I and cross section area S is incident on a plate at normal incidence. The photoelectric emission efficiency is 100%, the frequency of beam is v and the work function of the plate is $\phi(hv > \phi)$. Assuming all the electrons are ejected normal to the plane and with same maximum possible speed. The net force exerted on the plate only due to striking of photons and subsequent emission of electrons is

A. $\frac{IS}{hv}\left(\frac{2h}{\lambda}+\sqrt{2m(hv-\phi)}\right)$

B. $\frac{2IS}{hv}\left(\frac{h}{\lambda}+\sqrt{2m(hv-\phi)}\right)$

C. $\frac{IS}{hv}\left(\frac{h}{\lambda}+\sqrt{2m(hv-\phi)}\right)$

D. $\frac{2IS}{hv}\left(\frac{h}{\lambda}+\sqrt{m(hv-\phi)}\right)$

Answer: C

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9. A particle of mass m is projected form ground with velocity u making angle θ with the vertical. The de Broglie wavelength of the particle at the highest point is

A. ∞

B. $\frac{h}{\text{mu}\sin\theta}$

C. $\frac{h}{\text{mu}\cos\theta}$

D. $\frac{h}{\text{mu}}$

Answer: B

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10. A particle of charge q_0 and of mass m_0 is projected along the y-axis at $t = 0$ from origin with a velocity V_0. If a uniform electric field E_0 also exist along the x-axis, then the time at which debroglie wavelength of the particle becomes half of the initial value is:

A. $\frac{m_0 v_0}{q_0 E_0}$

B. $2\frac{m_0 v_0}{q_0 E_0}$

C. $\sqrt{3}\frac{m_0 v_0}{q_0 E_0}$

D. $3\frac{m_0 v_0}{q_0 E_0}$

Answer: C

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11. If we assume that perptraing power of any radiation/particle is inversely proportional to its de-Broglie wavelength of the particle then:

A. a proton and an α particle after getting accelerated through same potential difference will have equal penetration power.

B. penetrating power of α particle will be greater than that of proton which have been accelerated by same potential difference.

C. proton's penetrating power will be less than penetrating power of an electron which has been accelerated by the same potential difference.

D. penetrating powers can not be compared as all these are particles having no wavelength or wave nature.

Answer: B

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12. When a point light source, of power W, emiting monochromatic light of wavelength λ is kept at a distance a from a small photosensitive surface of work function ϕ and area S. Then

A. number of photons striking the surface per unit time as $WS\lambda / 4\pi hca^2$

B. the maximum energy of the emitted photoelectrons is $\frac{hc - \lambda\phi}{\lambda}$

C. the stopping potential needed to stop the most energetic emitted photoelectrons as $e\frac{(hc - \lambda\phi)}{\lambda}$

D. photoemission occurs only if λ lies in the range $0 \leq \lambda \leq hc / \phi$.

Answer: A::B::D

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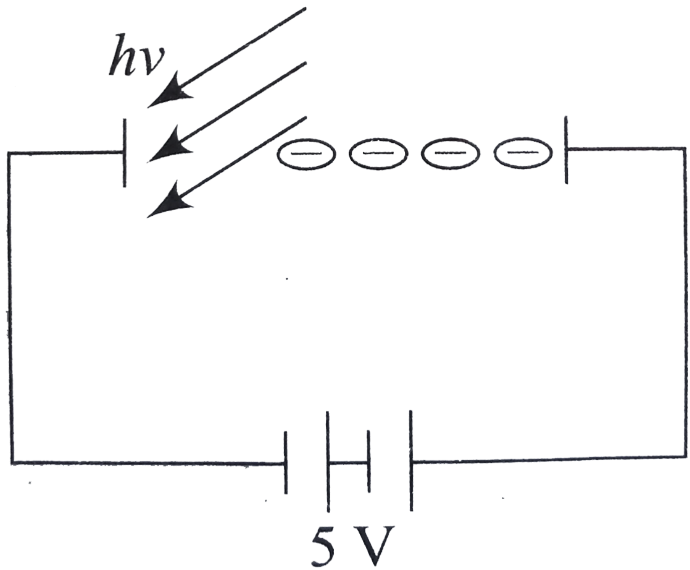

13.

Photons of energy 5eV are incident on the cathode. Electrons reaching the anode have kinetic energies varying from 6eV to 8eV. Find the work function of the metal and state whether the current in the circuit is less than or equal to saturation current.

A. Work function of the metal is $2eV$

B. Work function of the metal is $3eV$

C. Current in the circuit is equal to saturation value.

D. Current in the circuit is less than saturation value.

Answer: A::D

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14. The maximum K.E. of photoelectrons ejected from a photometer when it is irradiated with radiation of a wavelength 400nm is 1eV. If the threshold energy of the surface is 1.9 eV,

A. The maximum $K.E.$ Of photo electrons when it is irradiated with $500nm$ photons will be $0.42eV$

B. The maximum $K.E.$ In case (a) will be $1.725eV$

C. The longest wavelength which will eject the photo electrons from the surface is nearly $610nm$

D. The maximum $K.E.$ Will increase if the intesity of radiation is increased

Answer: A::C

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15. A beam of ligth having frequency v is incident on an initially neutral metal or work function $\phi(hv > \phi)$. Then

A. all emitted photoelectrons have kinetic energy equal to $(hv > \phi)$

B. all free electrons in the metal, that absorb photons of energy hv completely, may not be ejected out of the metal.

C. after being emitted out of the metal, the kinetic energy of photoelectrons decreases continuously as long as they are at a finite distance from metal .

D. the emitted photo electrons move with constant speed after escaping from the electric field of metal.

Answer: B::C

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16. Which of the following statements about the photoelectric effect, are true

A. greater the frequency of the incident light, greater is the stopping potential.

B. greater the energy of photons is, the smaller is the stopping potential.

C. greater the intensity of light is, greater is the cut off frequency.

D. greater thefrequency of incident light is, greater is max kinetic energy of ejected electrons.

Answer: A::D

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17. The work function of a metal is $2.5eV$. A monochromatic ligth of wavelength 300Å falls on it

A. The maximum kinetic energy of ejected electron is $1.64eV$ approximately

B. The minimum kinetic energy of ejected electron is zero

C. The stopping potential is $1.64V$ approximately

D. Electrons can not be ejected

Answer: A::B::C

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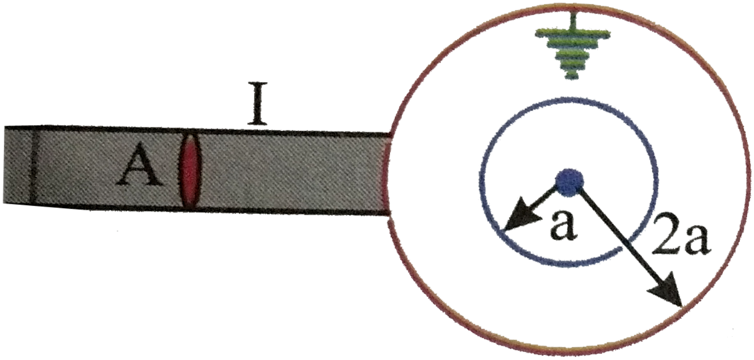
18. Two initially uncharged concentric than conducting spherical shells of radius a and $2a$ are as shown and the inner shell is grounded. The work function of outer shell is ϕ_0.At time $t = 0$, a continuous parallel beam of monochromatic radiation of cross-section area A and intensity I is incident on outer shell.The enerfy of each photon is hv such that $hv > \phi_0$ Assuming for each incident photon one photoelectron is ejected, answer the following questions.

The time after $t = 0$, at which charge on outer sphere becomes constant.



A. $\dfrac{8\pi \in_0 ahv(hv - \phi_0)}{IAe^2}$

B. $\dfrac{4\pi \in_0 ahv(hv - \phi_0)}{IAe^2}$

C. $\dfrac{2\pi \in_0 ahv(hv - \phi_0)}{IAe^2}$

D. None of these

Answer: A

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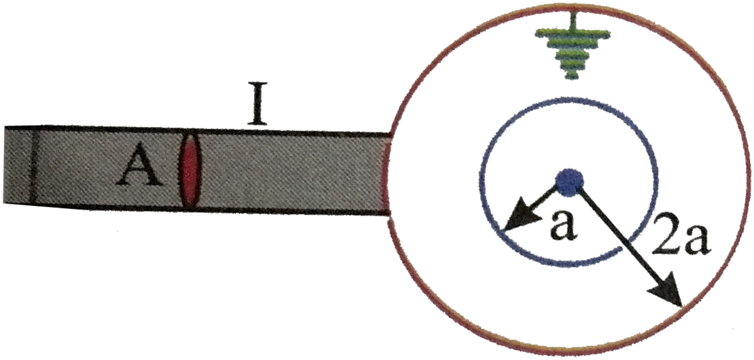
19. Two initially uncharged concentric than conducting spherical shells of radius a and $2a$ are as shown and the inner shell is grounded. The work function of outer shell is ϕ_0.At time $t = 0$, a continuous parallel beam of monochromatic radiation of cross-section area A and intensity I is incident on outer shell.The energy of each photon is hv such that $hv > \phi_0$ Assuming for each incident photon one photoelectron is ejected, answer the following questions.

The time after $t = 0$, at which charge on outer sphere becomes constant.



A. $\frac{16\pi \in_0 a(hv - \phi_0)}{e}$

B. $\frac{8\pi \in_0 a(hv - \phi_0)}{e}$

C. $\frac{4\pi \in_0 a(hv - \phi_0)}{e}$

D. None of these

Answer: C

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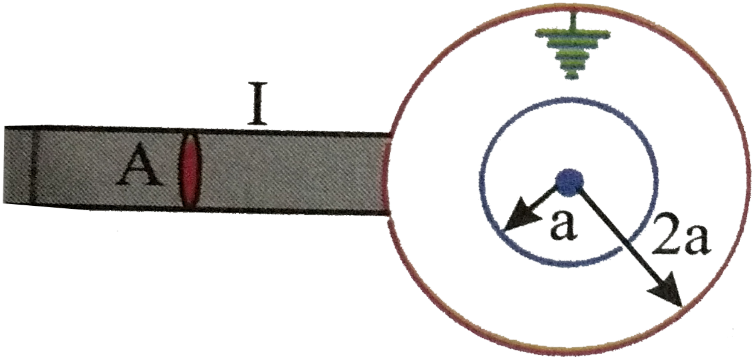
20. Two initially uncharged concentric than conducting spherical shells of radius a and $2a$ are as shown and the inner shell is grounded. The work function of outer shell is ϕ_0.At time $t=0$, a continuous parallel beam of monochromatic radiation of cross-section area A and intensity I is incident on outer shell.The energy of each photon is hv such that $hv > \phi_0$ Assuming for each incident photon one photoelectron is ejected, answer the following questions.

The time after $t=0$, at which charge on outer sphere becomes constant.



A. $\frac{hv-\phi_0}{e}$

B. $\frac{hv-\phi_0}{2e}$

C. $\frac{2}{3}\frac{hv-\phi_0}{e}$

D. None of these

Answer: A

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21. The ratio of de - Broglie wavelength of α- particle to that of a proton being subjected to the same magnetic field so that the radii of their path are equal to each other assuming the field induction vector $\vec{B}$ is perpendicular to the velocity vectors of the α - particle and the proton is

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Level I H W

1. The threshold wavelength for a surface having a threshold frequency of $0.6 \times 10^{15} Hz$ is (given $c = 3 \times 10^8 m/s$)

A. $4000 A^{\circ}$

B. $6000A^\circ$

C. $5000A^\circ$

D. $3500A^\circ$

Answer: C

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

A. $4125A^\circ$

B. $2062.5A^\circ$

C. $3006.06A^\circ$

D. $6000 A^{\circ}$

Answer: C

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3. A photoelectron is moving with a maximum velocity of $10^6 m/s$. Given $e = 1.6 \times 10^{-19} c$, and $m = 9.1 \times 10^{-31} kg$, the stopping potential is

A. $2.5V$

B. $2.8V$

C. $2.0V$

D. $1.4V$

Answer: B

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4. Threshold wavelength for a metal having work function w_0 is λ. Then the threshold wavelength for a metal having work function $2w_0$ is

A. 4λ

B. 2λ

C. $\lambda/2$

D. $\lambda/4$

Answer: C

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5. The threshold wavelength for photoelectric emission from a

material is 5200Å. Photoelectrons will be emitted when this material is

illuminated with monochromatic radiation from a

(a) 50 W infrared lamp

(b) 1 W infrared lamp

(c) 50 W ultraviolet lamp

(d) 1 W ultraviolet lamp

.

A. 50 watt infrared lamp

B. 1 watt infrared lamp

C. 1 watt ultraviolet lamp

D. 50 watt sodium vapour lamp

Answer: C

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6. The de - Broglie wavelength of an electron having $80ev$ of energy is nearly

$(1eV = 1.6 \times 10^{-19} J$, Mass of electron $= 9 \times 10^{-31} kg$ Plank's constant $= 6.6 \times 10^{-34} J - \text{sec})$

A. $140 A^{\circ}$

B. $0.14 A^{\circ}$

C. $14 A^{\circ}$

D. $1.4 A^{\circ}$

Answer: D

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7. If accelerating potential of an alpha particle is doubled than its new debrolgie wavelength becomes

A. $\frac{1}{\sqrt{2}}$times of initial

B. $\sqrt{2}$times of initial

C. $\frac{1}{2}$times of initial

D. 2times of initial

Answer: A

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Level I H W

1. Two photons of energies twice and thrice the work function of a metal are incident on the metal surface. Then the ratio of maximum velocity of the photoelectrons emitted in the two cases respectively, is

A. $\sqrt{2} : 1$

B. $\sqrt{3} : 1$

C. $\sqrt{3} : 2$

D. $\sqrt{1} : 2$

Answer: D

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2. The energy of emitted photoelectrons from a metal is $0.9ev$, The work function of the metal is $2.2eV$. Then the energy of the incident photon is

A. $0.9eV$

B. $2.2eV$

C. $4.4eV$

D. $3.1eV$

Answer: D

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3. A metal of work function $4eV$ is cexposed to a radiation of wavelegth $140 \times 10^{-9}m$. Find the stopping potential.

A. $6.42V$

B. $2.94V$

C. $4.86V$

D. $3.2V$

Answer: C

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4. The work functions of metals A and B are in the ratio $1:2$. If light of frequencies f and $2f$ are incident on the surfaces of A and B respectively , the ratio of the maximum kinetic energy of photoelectrons emitted is (f is greater than threshold frequency of $A, 2f$ is greater than threshold frequency of B)

A. $1:1$

B. $1:2$

C. $1:3$

D. $1:4$

Answer: B

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5. A particle having a de Broglie wavelength of $1.0A^0$ is associated with a momentum of (given $h = 6.6 \times 10^{-34} Js$)

A. $6.6 \times 10^{-26} kgm/s$

B. $6.6 \times 10^{-25} kgm/s$

C. $6.6 \times 10^{-24} kgm/s$

D. $6.6 \times 10^{-22} kgm/s$

Answer: C

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6. Electrons are accelerated through a $p. d.$ Of $150V$. Given $m = 9.1 \times 10^{-31} kg, e = 1.6 \times 10^{-19} c, h = 6.62 \times 10^{-34} Js$, the de Broglie wavelength associated with it is

A. $1.5A^{\circ}$

B. $1.0A^{\circ}$

C. $3.0A^{\circ}$

D. $0.5A^{\circ}$

Answer: B

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7. The ratio of the deBroglie wavelengths of proton, deuteron and alpha particle accelerated through the same potential difference $100V$ is

A. $2:2:1$

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

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

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

Answer: D

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Level Ii H W

1. When a metal surface is illuminated by a monochromatic light of wave-length λ, then the potential difference required to stop the ejection of electrons is $3V$. When the same surface is illuminated by the light of wavelength 2λ, then the potential difference required to stop the ejection of electrons is V. Then for photoelectric effect, the threshold wavelength for the metal surface will be

A. 6λ

B. $4\lambda/3$

C. 4λ

D. 8λ

Answer: C

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2. Ultraviolet light of wavelength $800A$ and $700A$ when allowed to fall on hydrogen atoms in their ground states is found to liberate electrons with kinetic energies $1.8eV$ and $4.0eV$, respectively. Find the value of Planck's constant.

A. $6.57 \times 10^{-34} Js$

B. $6.63 \times 10^{-34} Js$

C. $6.66 \times 10^{-34} Js$

D. $6.77 \times 10^{-34} Js$

Answer: A

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3. In a photoelectric effect experiment, photons of energy $5eV$ are incident on a metal surface They liberate photoelectron which are just stopped by an electrode at a potential of $-3.5V$ with respect to the metal. The work fuction of the metal is

A. $1.5eV$

B. $3.5eV$

C. $5.0eV$

D. $8.5eV$

Answer: A

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4. The number of photons emitted per second by a $62W$ source of monochromatic light of wavelength $4800A^{\circ}$ is

A. 1.5×10^{19}

B. 1.5×10^{20}

C. 2.5×10^{20}

D. 4×10^{20}

Answer: B

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5. Photons of frequencies $2.2 \times 10^{15} Hz$ and $4.6 \times 10^{15} Hz$ are incident on a metal surface. The corresponding stopping potentials were found to be $6.6V$ and $16.5V$

respectively. Given $e = 1.6 \times 10^{-19} c$, the value of universal planck's constant is

A. $6.6 \times 10^{-34} Js$

B. $6.7 \times 10^{-34} Js$

C. $6.5 \times 10^{-34} Js$

D. $6.8 \times 10^{-34} Js$

Answer: A

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6. If stopping potentials corresponding to wavelengths $4000 A$ and $4500 A$ are 1.3 V and 0.9 V, respectively, then the work function of the metal is

A. $0.3eV$

B. $1.3eV$

C. $1.8eV$

D. $5eV$

Answer: C

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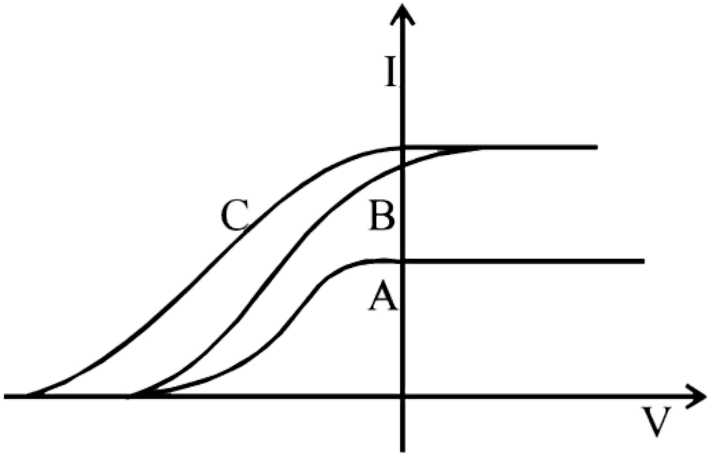
7. In a photoelectric experiment anode potential is ploted against plate current.



A. A and B will have same intensities while B and C will have different frequencies

B. B and C will have different intensities while A and B will have different frequencies.

C. A and B will have different intensities while B and C will have equal frequencies.

D. B and C will have equal intensities while A and B will have same frequencies.

Answer: D

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8. An electron moves with a speed of $\frac{\sqrt{3}}{2}c$. Then its mass becomes.... Times its rest mass.

A. 2

B. 3

C. $\frac{3}{2}$

D. 4

Answer: A

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9. Photons of energy $2.0 eV$ fall on a metal plate and release photoelectrons with a maximum velocity V. By decreasing λ and 25% the maximum velocity of photoelectrons is doubled. The work function of the metal of the material plate in eV is nearly

A. 2.22

B. 1.985

C. 2.35

D. 1.80

Answer: D

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10. A proton when accelerated through a $p.d$ of V volt has wavelength λ associated with it. An electron to have the same λ must be accelerated through a $p.d$ of

A. $\frac{V}{8}$ volt

B. $4V$ volt

C. $2V$ volt

D. $1838V$ volt

Answer: D

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11. The momentum of photon of electromagnetic radiation is $3.3 \times 10^{-29} kgms^{-1}$. What is the frequency and wavelength of the waves associated with it ?

$h = 6.6 \times 10^{-34} Js.$

A. $3.0 \times 10^3 Hz$

B. $6.0 \times 10^3 Hz$

C. $7.5 \times 10^3 Hz$

D. $1.5 \times 10^3 Hz$

Answer: D

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12. If the energy of a particle is reduced to one fourth, then the percentage increase in its de Broglie wavelength will be

A. $41\ \%$

B. $141\ \%$

C. $100\ \%$

D. $71\ \%$

Answer: C

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13. The de Broglie wavelength associated with an electron of velocity $0.3c$ and rest mass $9.1 \times 10^{-31} kg$ is

A. $7.68 \times 10^{-10} m$

B. $7.68 \times 10^{-12} m$

C. $5.7 \times 10^{-12} m$

D. $9.1 \times 10^{-12} m$

Answer: B

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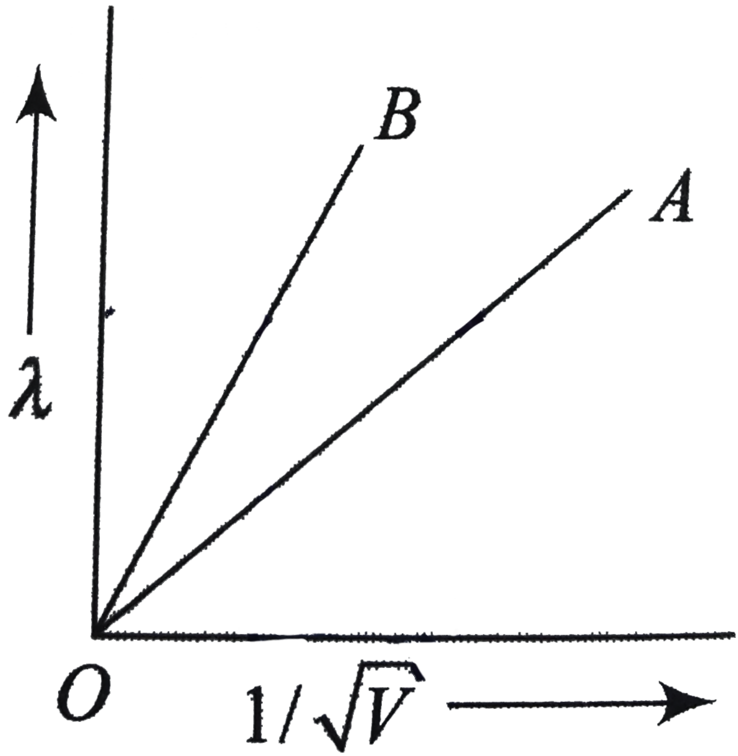

14.

The two lines A and B in fig. show the photo electron of de Broglie wavelength (λ) as a function of $\frac{1}{\sqrt{V}}$ (V is the accelerating potential) for two particles having the same charge. Which of the two represents the particle of heavier mass?

A. A

B. B

C. Both A and B

D. Data insufficient

Answer: A

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15. The uncertainity in the position of a particle is equal to the de-Broglie wavelength. The uncertainity in its momentum will be

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

B. $\frac{2h}{3\lambda}$

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

D. $\frac{3\lambda}{2h}$

Answer: A

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16. If the uncertainty in the position of proton is $6 \times 10^{-8}m$, then the minimum uncertainty in its speed is

A. $1cms^{-1}$

B. $1ms^{-1}$

C. $1mms^{-1}$

D. $100ms^{-1}$

Answer: B

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17. From Davisson-Germer experiment an α particle and a proton are accelerated through the same pdV. Find the ratio of the de Broglie wavelengths associated with them

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

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

C. $1:\sqrt{2}$

D. $\sqrt{2}:1$

Answer: A

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