PHYSICS

BOOKS - GK PUBLICATIONS PHYSICS (HINGLISH)

PHOTOELECTRIC EFFECT AND MATTER WAVES

Illustration

1. The photoelectric threshold of the photo electric effect of a certain metal is $2750A^{\circ}$. Find

(i) The work function of emission of an electron from this metal,

(ii) Maximum kinetic energy of these electrons.

(iii) The maximum velocity of the electrons ejected from the metal by light with a wavelength $1800A^{\circ}$.

2. Light quanta with energy 4.9 eV eject photoelectrons from metal with work function 4.5 eV. Find the maximum impulse transmitted to the surface of the metal when each electron flies out.

Watch Video Solution

3. In an experiment tungsten cathode which has a threshold 2300Å is irradiated by ultraviolet light of wavelength 1800Å. Calculate

(i) Maximum energy of emitted photoelectron and

(ii) Work function for tungsten.

(Mention both the results in electron-volts)

Given Planck's constant $h = 6.6 \times 10^{-34} jo\underline{e} - \text{sec},$ $\leq V = 1.6 \times 10^{-19}$ joule and velocity of light $c = 3 \times 10^{8} m/\text{sec}$

Watch Video Solution

4. 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.

Watch Video Solution

5. The rediation emitted when an electron jumps from $n = 3 \rightarrow n = 2$ orbit in a hydrogen atom falls on a metal to produce photoelectron. The electron from the metal surface with maximum kinetic energy are made to move perpendicular to a magnetic field of $(1/320)T$ in a radius of $10^{-3}m$. Find (a) the kinetic energy of the electrons, (b) Work function of the metal , and (c) wavelength of radiation.

Watch Video Solution

6. Photoelectrons are emitted when $400nm$ radiation is incident on a surface of work - function 1.9 eV. These photoelectrons pass through a region containing α-particles. A maximum energy electron combines with an α -particle to from a He^{+} ion, emitting a single photon in this process. He^{+} ions thus formed are in their fourth excited state. Find the energies in eV of the photons lying in the 2 to 4 eV range, that are likely to be emitted during and after the combination. $\left[Take, h = 4.14 \times 10^{-15} eV - s\right]$

Watch Video Solution

7. Find the frequency of light which ejects electrons from a metal surface. Fully stopped by a retarding potential of $3V$, the photoelectric effect begins in this metal at a frequency of $6 \times 10^{14} Hz$. Find the work function for this metal. (Given $h = 6.63 \times 10^{-34} Js$).

Watch Video Solution

8. Electrons with maximum kinetic energy 3eV are ejected from a metla surface by ultraviolet radiation of wavelength 1500Å. Determine the work function of the metal, the threshold wavelength of metal and the stopping potential difference required to stoop the emission of electrons.

Watch Video Solution

9. Calculate the velocity of a photo-electron if the work function of the target material is $1.24eV$ and the wavelength of incident light is 4.36×10^{-7}m. What retarding potential is necessary to stop the emission of the electrons?

Watch Video Solution

10. Determine the Planck's constant h if photoelectrons emitted from a surface of a certain metal by light of frequency 2.2×10^{15}Hz are fully retarted by a reverse potential of 6.6 V and those ejected by light of frequency 4.6×10^{15} Hz by a reverse potential of $16.5eV$.

Watch Video Solution

11. When a surface is irradiated with light of wavelength 4950Å, a photocurrent appears which vanishes if a retarding potential appears which vanishes if a retarding potential greater than 1.2 volt is applied across the phototube. When a different source of light is used, it is found that the critical retarding potential is changed to 2.1 volt. Find the work function of the emitting surface and the wavelength of second source. If the photoelectrons (after emission from the surface) are subjected to a magnetic field of 10 tesla, what changes will be observed in the above two retarding potentials. Use $h = 6.6 \times 10^{-34} Js, e = 1.6 \times 10^{-19} C$.

Watch Video Solution

12. (a) If the wavelength of the light incident on a photoelectric cell be reduced from λ_1 to λ_2Å, then what will be the change in the cut-off potential?

(b) Light is incident on the cathode of a photocell and the stopping voltages are measured for light of two different wavelengths. From the data given below, determine the work function of the metal of the cathode in eV and the value of the universal constant hc/e.

Wavelength Å	Stopping voltage (volt)
4000	1.3
4500	0.9

Watch Video Solution

13. Ultraviolet light of wavelength 2271Å from a 100W mercury source irradiates a photocell made of molybdenum metal. If the stopping potential is 1.3V, estimate the work function of the metal. How would the photocell respond to a high intensity $(\sim 10^5 Wm^{-2})$ red light of wave length 6328Å produced by a He-Ne laser?

Watch Video Solution

14. The peak emission from a black body at a certain temprature occurs at a wavelength of 9000Å. On increase its temperature , the total radiation emmited is increased its 81 times. At the intial temperature when the peak radiation from the black body is incident on a metal surface , it does not cause any photoemission from the surface . After the increase of temperature, the peak from the black body caused photoemission. To bring these photoelectrons to rest , a potential equivalent to the excitation energy between $n = 2$ and $n = 3$ bohr levels of hydrogen atoms is required. Find the work function of the metal.

Watch Video Solution

15. Find the number of photons emitted per second by a 25 watt source of monochromatic light of wavelength 6000Å.

Watch Video Solution

16. Calculate the number of photons emitted in 10 h by a 60 W sodium lamp $(\lambda = 5893A)$.

Watch Video Solution

17. A cylindrical rod of some laser material 5×10^{-2}m long and $10^{-2}m$ in diameter contains 2×10^{25} ions per m^3. If on excitation all the ions are in the upper energy level and de-excite simultaneously emitting photons in the same direction , calculate the maximum energy contained in a polse of radiation of wavlength 6.6×10^{-7}m. If the pulse lasts for $10^{-7}s$, calculate the average power of the laser during the pulse.

Watch Video Solution

Watch Video Solution

18. A 100 W sodium lamp is radiating light of wavelength $5890A$, uniformly in all directions,

a. At what rate, photons are emitted from the lamp?

b. At what distance from the lamp, the average flux is 1 photon($cm^2 - s)^{-1}$?

c. What are the photon flux and photon density at 2m from the lamp?

Watch Video Solution

19. One milliwatt of light of wavelength 4560 A is incident on a cesium surface. Calculate the photoelectric current liberated assuming a quantum efficiency of 0.5 %. Given Planck's constant $h = 6.62 \times 10^{-34} J - s$ and velocity of light $c = 3 \times 10^8 ms^{-1}$.

Watch Video Solution

20. A uniform monochromatic beam of light of wavelength 365×10^{-9}m and intensity $10^{-8} Wm^{-2}$ falls on a surface having avsorption coefficient 0.8 and work functoin1.6 eV. Determine the rate of number of electrons emitted per m^2, power absorbed per m^2 and the maximum kinetic energy of emitted photoelectrons.

Watch Video Solution

21. When a beam of $10.6 eV$ photons of intensity $2.0 W/m^2$ falls on a platinum surface of area $1.0 \times 10^4 m^2$ and work function $5.6 eV$, 0.53% of the incident photons eject photoelectrons. find the number of photoelectrons emitted per second and their minimum and maximum energies (in eV)Take $1 eV = 1.6 \times 10^{-19} J$

Watch Video Solution

22. A beam of light has three wavelengths 4144Å, 4972Å and 6216Å with a total instensity of $3.6 \times 10^{-3} Wm^{-2}$ equally distributed amongst the three wavelengths. The beam falls normally on an area $1.0cm^2$ of a clean metallic surface of work function 2.3 eV. Assume that there is no loss of light by reflection and that each energetically capable photon ejects on electron. Calculate the number of photo electrons liberated in two seconds.

Watch Video Solution

23. A small plate of a metal (work function $= 1.7eV$) is placed at a distance of 2m from a monochromatic light source of wavelength $4.8 \times 10^{-7} m$ and power 1.0watt. The light falls normally on the plate. Find the number of photons striking the metal plate per square meter per second. If a constant magnetic field of strength $10^{-4} T$ is applied parallel to the metal surface, find the radius of the largest circular path followed by the emitted photoelectrons. (use

$h = 6.63 \times 10^{-34} Js$, mass of electron=$9.1 \times 10^{-31} kg$, charge of electron=$1.6 \times 10^{-19} C$

Watch Video Solution

24. A 40 W ultraviolet light source of wavelength $2480 A$. Illuminates a magnesium (mg) surface placed 2 m away. Determine the number of photons emitted from the surface per second and the number incident on unit area of Mg surface per second . The photoelectric work function for Mg is $3.68 eV$. Calculate the kinetic energy of the fastest electrons ejected from the surface. Determine the maximum wavelength for which the photoelectric effects can be observed with Mg surface.

Watch Video Solution

25. A mercury arc lamp provides 0.10 W of UV radiation at a wavelength of $\lambda = 2537 Å$(all other wavelenghts having been absorbed by filters). The cathode of photoelectric device (a photo-tube) consists of potassium and has an effective area of $4cm^2$. The anode is located at a distance of 1 m from radiation source. The work function for potassium is $\phi_0 = 2.22eV$.

(a) According to classical theory, the radiation from the arc spreads out uniformly in space as spherical wave. What time of exposure to the radiation should be required for a potassium atoms(radius 2 Å) in the anode to accumulate sufficient energy to eject a photo-electron?

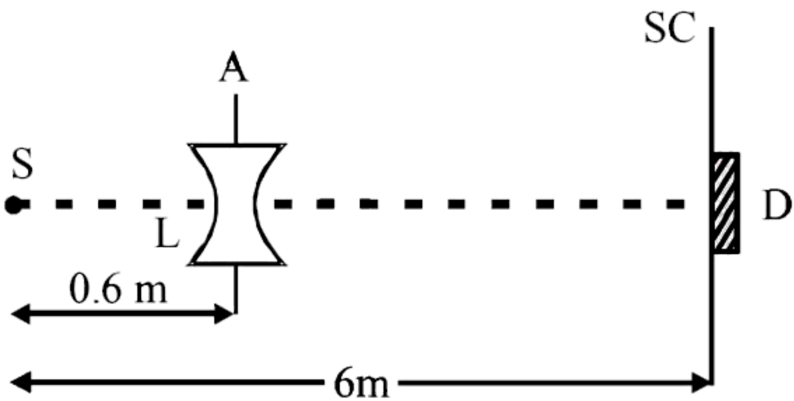
(b) What is the energy of a single photon from the source?

(C) What is the flux of photons(number per second) at the cathode? To what saturation current does this flux correspond if the photo-conversion efficiency is 5% (i.e. if each photon has a probability of 0.05 of ejecting an electron).

(d) what is the cutt off potential V_0?

Watch Video Solution

26. A monochromatic point source radiating wavelength 6000Å with power 2 watt, an aperture A of diameter $0.1m$ and a large screen SC are placed as shown in fig, A photoemissive detector D of surface area $0.5cm^2$ is placed at the centre of the screen . The efficiency of the detector for the photoelectron generation per incident photon is 0.9



(a) Calculate the photon flux at the centre of the screen and the photo current in the detector.

(b) If the concave lens L of focal length 0.6 m is inserted in the aperture as shown . find the new values of photon flux and photocurrent Assume a uniform average transmission of $80\,\%$ from the lens .

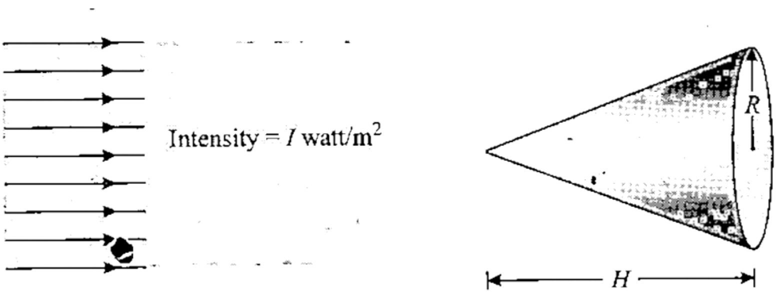
(c) If the work function of the photoemissive surface is $1eV$. calculate the values of the stopping potential in the two cases (within and with the lens in the aperture).

Watch Video Solution

27. In the path of a uniform light beam of large cross-sectional area and intensity I. a solid sphere of redius R which is perfectly reflecting is placed . Find the force exerted on this sphere due to the light beam.

Watch Video Solution

28. Figure2.25 shows a cone of radius R and height H with perfectly reflecting lateral surface, is placed in the path of a light beam of intensity I. Find the force exerted on this cone.



Watch Video Solution

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

Watch Video Solution

30. Hydrogen gas in the atomic state is excited to an energy level such that the electrostatic potential energy of H-atom becomes $-1.7eV$. Now, a photoelectric plate having work function w=2.3 eV is exposed to the emission spectra of this gas. Assuming all the transitions to be possible, find the minimum de-Broglie wavelength of the ejected photoelectrons.

Watch Video Solution

31. An α-particle and a proton are fired through the same magnetic field which is perpendicular to their velocity vectors. The α-partcles and the proton move such that radius of curvature of their paths is same. Find the ratio of their de Broglie wavelengths.

Watch Video Solution

32. Find the ratio of de Broglie wavelength of a proton and as α-particle which have been accelerated through same potential difference.

Watch Video Solution

33. Assume that the de Broglie wave associated with an electron can from a standing wave between the atom arrange in a one dimensional array with nodes at each of the atomic sites. It is found that one such standing wave if the distance d between the atoms of the array is $2A^0$ A similar standing wave is again formed if d is increased to 2.5Å . Find the energy of the electrons in electron volts and the least value of d for which the standing wave type described above can from .

Watch Video Solution

34. In a photoelectric effect set up, a point source of light of power $3.2 \times 10^{-3} W$ emits monochromatic 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 number of photons emitted per second

Watch Video Solution

Discussion Question

1. Wjhen the speed of a particle doubles, its momentum doubles, and its kinetic becomes four times greater. When the momentum of a photon doubles, does its energy becomes four times greater? Provide a reason for your answer.

Watch Video Solution

2. It is found that yellow light does not eject photoelectrons from a metal. Is it advisable to try with orange light? With green light?

Watch Video Solution

3. It is found that photosynthesis starts in certain plants when exposed to the sunlight but it does not start if the plant is exposed only to infrared light. Explain.

Watch Video Solution

4. Photon A has twice the energy of photon B.

(a) If the momentum of A less than, or equal to , or greater than that of B?

(b) is the wavelength of A less than, equal to, or greater than that of B?

Watch Video Solution

5. If electromagnetic radiation is made up of quanta, why don't we detect the discrete packets of energy, for example, when we listen to a radio?

Watch Video Solution

6. The threshold wavelength of a metal is (λ_0). Light of wavelength slightly less than $\lambda_0$is incident on an insulated plate made of this metal. It is found that photoelectrons are emitted for sometimes and after that the emission stops. Explain.

Watch Video Solution

7. Consider the de Broglie wavelength of an electron and a proton. Which wavelength is smaller if the two particles have (a) the same speed (b) the same momentum (c) the same energy?

Watch Video Solution

8. If an electron has a wavelength, does it also have a colour?

Watch Video Solution

9. Human skin is relatively insensitive to visible light, but ultraviolet radiation can cause severe burns. Does this have anything to do with photon energies? Explain

Watch Video Solution

10. Do all electrons emitted in the photoelectric effect have the same kinetic energy?

Watch Video Solution

11. If you shine ultraviolet light on an isolated metal plate, the plate emtis electrons for a while. Why does it eventually stop?

Watch Video Solution

12. Is it always true that for two sources of equal intensity, the number of photons emitted in a given time are equal?

Watch Video Solution

13. The wave theory of radiation cannot explain.......... Existence of threshold frequency, dependent of photocurrent on intensity, dependence of stopping potential on frequency, that stopping potentila is independent of intensity?

Watch Video Solution

14. The photoelectros emitted by an illuminted surface have a maximum kinetic energy of 3.0 eV. If the intensity of the light is tripled, What is the maximum kinetic energy of photoelectrons now?

Watch Video Solution

15. The threshold frequencies for photoemission for three metals numbered 1,2,3 are respectively v_1, v_2, v_3 and $v_1 > v_2 > v_3$. An incident radiation of frequency $v_0 > v_2$.....................cause the photoemission from 3 but................cause photoemission from 1.

Watch Video Solution

16. Is $p = \frac{E}{c}$ valid for electrons?

Watch Video Solution

17. Photon A is from an ultraviolet tanning lamp and photon B is from a television transmitter. Which has the greater

A. Wavelength

B. energy

C. frequency and

D. momentum

Answer:

Watch Video Solution

18. Of the following statement about the photoelectric effect, which are true and which are false?

(a) The greater the frequency of the incident light is, the greater is the stopping potential.

(b) The greater the intensity of the incident light is, the greater is the cutoff frequency.

(c) The greater the work function of the target material is, the greater is the stopping potential.

(d) The greater the work function of the target material is, the greater is the cutoff frequency.

(e) The greater the frequency of the incident light is, the greater is the maximum kinetic energy of the ejected electrons.

(f) The greater the energy of the photons is, the smaller is the stopping potential.

Watch Video Solution

19. In an experiment on photoelectric effect, a photon is incident on an electron from one direction and the photoelectron is emitted almost in the opposite direction. Does this violate conservation of momentum ?

Watch Video Solution

20. Can we find the mass of a photon by the definition p =mv?

Watch Video Solution

21. If the intensity of the light producing a photocurrent is doubled, how is that current affected?

Watch Video Solution

22. Should the energy of a photon be called its kinetic energy or its internal energy?

Watch Video Solution

23. In an experiment on photoelectric effect, a photon is incident on an electron from one direction and the photoelectron is emitted almost in the opposite direction. Does this violate conservation of momentum ?

Watch Video Solution

24. The de-Broglie hypothesis predicts that a wave associated with any object has momentum. Why do we not observe the wave nature of a moving car?

Watch Video Solution

25. In the photoelectric effect, if the frequency of the radiation is below a certain cutoff value, no photoelectrons will be observed no matter how intense the radiation is. Why does this fact favour a particle theory of light over a wave theory?

Watch Video Solution

26. The photons emitted by a source of light do not all have the same energy. Is the source monochromatic? Give your reasoning.

Watch Video Solution

27. Radiation of a given wavelength causes electrons to be emitted from the surface of one metal but not from the surface of another metal. Explain why this could be

Watch Video Solution

28. Can a photon be deflected by an electric field ? By a magnetic field ?

Watch Video Solution

29. In the photoelectric effect, suppose that the intensity of the light is increased, while the frequency is kept constant. The frequency is greater than the minimum frequency f_0. State whether each of the following will increases, decrease, or remain constant, and explain your choice. (a) the current in the phototube, (b) the number of electrons per second from the metal surface, c) the maximum kinetic energy that an electron could have, d) the maximum momentum that an electron could have, and e) the maximum de-Broglie wavelength that an electron could have.

Watch Video Solution

30. A hot body is placed in a closed room maintained at a lower temperature. Is the number of photons in the room increasing?

Watch Video Solution

31. What is the speed of a photon with respect to another photon if (a) the two photons are going in the same direction and (b) they are going in opposite directions?

Watch Video Solution

32. which coloured light bulb, red, orange, yellow, green, or blue, emits photons with (a) the least energy and (b) the greatest energy? Account for your answers.

Watch Video Solution

33. A stone is dropped from the top of a building. As the stone falls, does its de-Broglie wavelength increase, decrease, or remains the same? Provide a reason for your answer.

Watch Video Solution

34. "If the frequency of light incident on a metallic plate be doubled."

Explain if this statements is TRUE or FALSE

Watch Video Solution

35. 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 the maximum kinetic energy of the photoelectrons, as well as photoelectric current by a factor of two

B. Increase the maximum kinetic energy of the photoelectrons and would increase the photo electric current by a factor of two

C. Increase the maximum kinetic energy of the photoelectrons by a factor of two and will have no effect on the magnitude of the photo electrons by a factor of two and will have no effect on the magnitude of the photoelectric current produced

D. No produce any effect on the kinetic energy of the emitted electrons but will increase the photoelectric current by a factor of two.

Answer:

Watch Video Solution

36. Let be the maximum kinetic energy of photoelectrons emitted by light of wavelength λ_1 and λ_2 correspondingto wavelength λ_2. If $\lambda_1 = 2\lambda_2$ then:

A. $2K_1 = K_2$

B. $K_1 = 2K_2$

C. $K_1 < K_2 / 2$

D. $K_1 > 2K_2$

Answer:

Watch Video Solution

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

A. The emission of photo electrons 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:

Watch Video Solution

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

A. Be doubled

B. Behalved

C. Become more than double

D. Become less that double

Answer:

Watch Video Solution

39. A cesium photocell, with a steady potential difference of 60 V across it ,is illuminated by a small bright light placed 1m away. When the same light is placed 2m away, the electrons crossing the photocell

A. Each carry one quarter of their previous energy

B. Each carry one quarter of their previous momentum

C. Are half as numerous

D. Are one quarter as numerous

Answer:

Watch Video Solution

40. 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:

Watch Video Solution

41. A metal surface is illuminated by a light of given intensity and frequency to cause photoemission. If the intensity of illumination is reduced to one-fourth of its original value, then the maximum KE of emitted photoelectrons will become.

A. Unchanged

B. $\frac{l}{16}th$ of original value

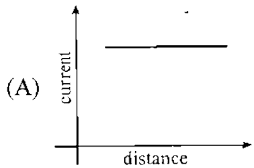
C. Twice the original value

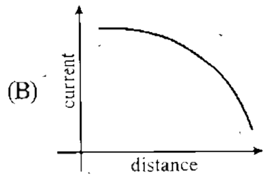
D. Four times the original value

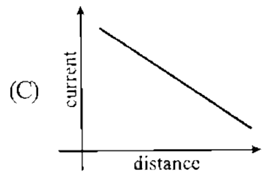
Answer:

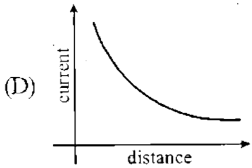
Watch Video Solution

42. 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:

Watch Video Solution

43. The stopping potential for acertain photosensitive metal is Vq when the frequency of incident radiation is V_0 When the frequency of the incident radiations is doubled, what will be the stopping potential ?

A. V_0

B. $2V_0$

C. $4V_0$

D. None of the above

Answer:

Watch Video Solution

44. The collector plate in an experiment of photoelectric effect is kept vertical above the emitter plate. Light source is put on, and a saturation photocurrent is recorded. An electric field is switched on which has a vertically downward direction-

A. The photo current will increase

B. The kinetic energy of the electron wil lincrease

C. The stopping potential will decrease

D. The threshold wave length will increase

Answer:

Watch Video Solution

45. Which electrons are emitted in the photoelectric effect

A. Electrons in the inner orbits of theatom

B. Electrons in the outermost orbit of the atom

C. Electrons from within the nucleus

D. Electrons freely roaming about in the interatomic space

Answer:

Watch Video Solution

46. Light of two different frequencies whose photons have energies 1eV and 2.5 eV respectively illuminate a metallic surface whose work function is 0.5 eV successively. Ratio of maximum kinetic energy of emitted electrons will be:

A. $4:1$

B. $1:4$

C. $1:5$

D. $1:2$

Answer:

Watch Video Solution

47. The image of the sun is formed on the photosensitive metal with a convex lens and the photoelectric saturation current obtained is I. If,the lens is replaced by another similar lens of half the diameter and double the focal-length, then photoelectric -current will be (Assume all lightpassing through lens felling on the photosensitive metal):

A. I

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

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

D. $\frac{I}{6}$

Answer:

Watch Video Solution

48. When monochromatic light of wavelength λ illuminates a metal surfrce, then stopping potential for photo electric current is $3V_0$. If wavelength changes to 2λ then stopping potential becomes V_0 Threshold wavelength for photo electric emission is:

A. 4λ

B. 8λ

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

D. 6λ

Answer:

Watch Video Solution

49. Accprding to Einste in theory of photoelectric effect, light is not behaving like a wave because :

A. Kinetic energy of ejected electrons does not depend on the intensity of light

B. Energy absorbed b an electron from a spreading wavefront is negligible

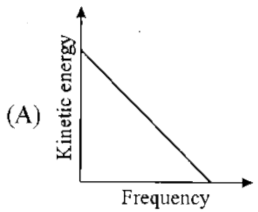
C. No electron is ejected if the frequency is not more than threshold frequency whatever may be the intensity of light

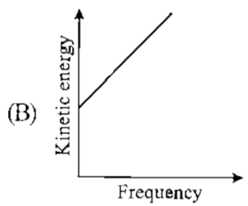
D. all the above

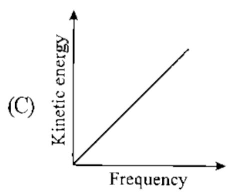
Answer:

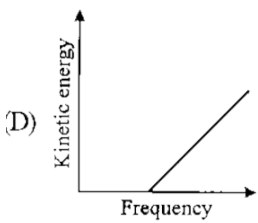
Watch Video Solution

50. 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:

Watch Video Solution

Conceptual Mcq

1. The photoelectric current in a photoelectric cell depends upon:

A. The nature of the metal used as the emitter

B. The wavelength of the incident light

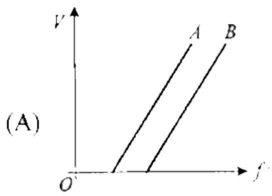
C. The intensity of the incident light

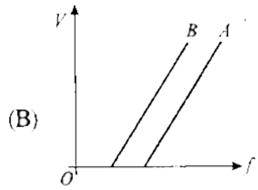
D. All the above parameters.

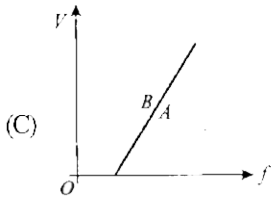
Answer:

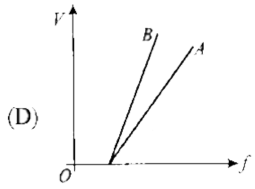
Watch Video Solution

2. In a photoelectric experiment, two metal pairs plates A and B are used for a given light intensity I and frequency f. work function of metal B is more than that of A. The correct variation of stopping potential difference versus frequency is given by:

A. 

B. 

C. 

D. 

Answer:

Watch Video Solution

3. The threshold wavelength for photoelectric emission for a material is $5200A^{\circ}$. Will the photoelectrons be emitted when this material is illuminated with monochromatic radiation from 1 watt ultra violet lamp?

A. 50-wattinfrared lamp

B. 100-wattredneon lamp

C. 40-watt sodium lamp

D. 5-wattultraviolet lamp

Answer:

Watch Video Solution

4. A photon of light enters a block of glass after travelling through vaccum. The energy of the photon on entering the glass block

A. A photon of lightenters a block of glass after travelling througha vacuum. The energy of the photon on entering the glass block

B. Decreases because the speed of the radiation decreases

C. Stays the same because the speed of the radiation and the associated wavelength do not change

D. Stays the same because the frequency of the radiation does not change

Answer:

Watch Video Solution

5. Which one of the following statements is NOT true for de Broglie waves?

A. All atomic particles in motion havewaves of a definite wavelength associated with them

B. Thehigherthemomentum, thelongeristhewavelength

C. Thefasterthe particle,theshorteris thewavelength

D. For the same velocity, a heavier particle has a shorter wavelength

Answer:

Watch Video Solution

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

A. p-particle

B. a-particle

C. Proton

D. Neutron

Answer:

Watch Video Solution

7. Two photons having

A. Equalwavelengths haveequallinearmomenta

B. Equal energies have equallinear momenta

C. Equal frequencies have equallinear momenta

D. Equal linear momenta have equal wavelengths

Answer:

Watch Video Solution

8. A proton and an electron move with the same velocity. The associated wavelength for proton is :

A. Shorter than that ofthe electron

B. Longer than that ofthe electron

C. The same as that ofthe electron

D.) Zero

Answer:

Watch Video Solution

9. In photoelectric effect when photons of energy hv fall on a photosensitive surface (work function hv^) electrons are emitted from the metallic surface with a kinetic energy. It is possible to say that:

A. All ejected electrons have same kinetic energy equal to $hv - hv_0$

B. The ejected electrons have a distribution of kinetic energy from zero to $(hv - hv_0)$

C. The most energetic electrons have kinetic energy equal to hv_0

D. All ejected electrons have kinetic energy hv_0

Answer:

Watch Video Solution

10. Photoelectric emission occurs only when the incident light has more than a certain minimum

A. Minimum frequency

B. Minimum wavelength

C. Minimum intensity

D. Minimum speed

Answer:

Watch Video Solution

11. 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:

Watch Video Solution

12. At frequencies of the incident radiation above the threshold frequency, the photoelectric current in a photoelectric

A. Intensity of incident radiation

B. Wavelength of incident radiation

C. Frequency of inciden tradiation

D. Speed of incident radiation

Answer:

Watch Video Solution

13. A metallic surface has a threshold wavelength 5200 A. This surfece is irradiated by monochromatic light of wavelength 4500 A. Which ofthe following statements is true ?

A. The electrons are emitted from the surface having energy between 0 and infinity

B. The electrons are emitted from the surface having energy between 0 and certain finite maximum value

C. The electrons are emitted from the surfrce, al lhaving certain finite energy

D. No electrons is emitted from the surface

Answer:

Watch Video Solution

14. 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 decreases

Answer:

Watch Video Solution

15. The equation E=pc is valid

A. For an electron as well as for a photon

B. For an electron but not for a photon

C. For a photon but not for an electron

D. Neither for an electron nor for a photon

Answer:

Watch Video Solution

16. Let `(n_r) and (n_b) be respectively the number of photons emitted by a red bulb and a blue blub of equal power in a given time.

A. $n_r = n_b$

B. $n_r < n_b$

C. $n_r > n_b$

D. The information is insufficient to get a relation between n_r and n_b

Answer:

Watch Video Solution

17. The photoelectrons emitted from a metal surface:

A. Are all at rest

B. Have the same kinetic energy

C. Have the same momentum

D. Have speeds varying from zero upto a certain maximum

Answer: D

Watch Video Solution

18. The graph between, which of the following two factors for photoelectric effect, is a straightline?

A. Intesity of radiation and photoelectric current

B. Potential of anode and photoelectric current

C. Threshold frequency and velocity of photoelectrons

D. Intensity of radiations and stopping potential

Answer:

Watch Video Solution

19. 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 X-rays are incident on the same cell, then:

A. V_0 and $K_{\max}$ both increase

B. V_0 and $K_{\max}$ both decrease

C. V_0 increase but $K_{\max}$ remains the same

D. $K_{\max}$ increases but V_0 remains the same

Answer:

Watch Video Solution

20. The slope of the stopping potential versus frequency graph for photoelectric effect is equal to:

A. h

B. he

C. h/e

D. e

Answer: C

Watch Video Solution

21. A phot of energy hv is absorbed by a free electron of a metal having work function $\phi < hv$

A. The electron is sure to come out

B. The electron is sure to come out with a kinetic energy $hv - \Psi$

C. Either the electron does not come out or it comes out with a kinetic energy $hv - \Psi$

D. It may come out with a kinetic energy less than $hv - \Psi$

Answer:

Watch Video Solution

22. Which one of the following statements is NOT true about photoelectric emission ?

A. For a given emitter illuminated by light of a given frequency, the number of photo-electrons emitted per second is proportional to the intensity of incident light.

B. For every emitter there is a definite threshold frequency below which no photoelectrons are emitted, no matter what the intensity of light is

C. Above the threshold frequency, the maximum kinetic energy of photo electrons is proportional to the frequency of incident light

D. The saturation value of the photoelectric current is independent of the intensity of incident light

Answer:

Watch Video Solution

23. Blue light can cause photo electric emission from a metal, but yellow light cannot. If red light Is incident on the metal,

A. Photoelectric current will increase

B. Rate of emission of photo electrons will-decrease

C. No photoelectric emission will occur

D. Energy of the photoelectrons will increase

Answer:

Watch Video Solution

24. 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. The relation between λ_e and λ_p depends on the accelerating potential difference.

Answer:

Watch Video Solution

25. Photoelectrons are being obtained by irradiating zinc by a radiation of BlOO A. In order to increase the kinetic energy of ejected photoelectrons:

A. The intensity of radiation should be increased

B. The wavelength of radiation should be increased

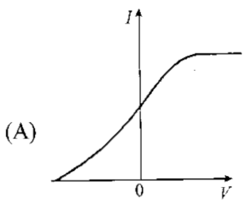
C. The wavelength of radiation should be decreased

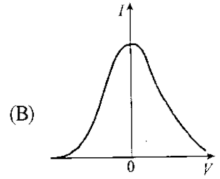
D. Both wavelength and intensity of radiation should be increased.

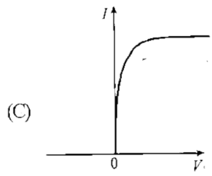
Answer:

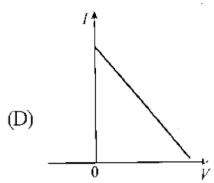
Watch Video Solution

26. Which one of the following graphs in figure shows the variation of photoelectric current (I) with voltage (V) between the electrodes in a photoelectric cell?

A. 

B. 

C. 

D. 

Answer:

Watch Video Solution

27. When monochromatic light falls on a photosensitive material, the number of photoelectrons emitted per second is n and their maximum kinetic energy is $K_{\max}$. If the intensity of the incident light is doubled keeping the frequency same, then:

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:

Watch Video Solution

Numerical Mcqs

1. Light of wavelength 400nm is incident continuously on a Cesium ball. (work function 1.9eV). The maximum potential to which the ball will be charged is

A. 3.1 V

B. $1.2V$

C. Zero

D. infinite

Answer:

Watch Video Solution

2. Electrons are accelerated in television tubes through potential differences ofabout 10 kV. The highest frequency of the electromagnetic waves emitted when these electrons strike the screen ofthe tube is :

A. 2.4×10^{18} Hz

B. 3.6×10^{18}Hz

C. 2.2×10^{17}Hz

D. 3.2×10^{16}Hz

Answer:

Watch Video Solution

3. 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. $0.36\mu A$

B. $0.48\mu A$

C. $0.42mA$

D. $0.32mA$

Answer:

Watch Video Solution

4. No.of identical photons incident on a perfectly black body of mass m kept at rest on smooth horizontal surface. Then the acceleration of the body if n no. of photons incident per sec. is (Assume wavelength of photon to be λ):

A. $\frac{nh}{2\pi\lambda m}$

B. $\frac{nh}{\lambda m}$

C. $\frac{2\pi nh}{\lambda m}$

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

Answer:

Watch Video Solution

5. No photoelectrons are emitted from a metal if the wavelength of light exceeds 6000 Å.The work function of the metal is approximately equal to:

A. 3.315×10^{-6} J

B. 3.315×10^{-19}J

C. 2.07×10^{19}J

D. 2.07×10^{-22}J

Answer:

Watch Video Solution

6. If 5% of the energy supplied to a bulb is irradiated as visible light, how many quanta are emitted per second by a 100 W lamp? Assume wavelength of visible light as 5.6×10^{-5} cm.

A. 0.75×10^{19}

B. 1.39×10^{19}

C. 2.16×10^{19}

D. 2.83×10^{19}

Answer:

Watch Video Solution

Watch Video Solution

7. All electrons ejected from a surface by incident light of wavelength 200nm can be stopped before traveling 1m in the direction of a uniform electric field of $4NC^{-1}$. The work function of the surface is

A. 4ev

B. 6.2 eV

C. 2eV

D. 2.2eV

Answer:

Watch Video Solution

8. Radiation pressure on any surface is :

A. dependent on wavelength of the light used

B. dependent on nature of surface and intensity of light used

C. dependent on frequency and nature of surface

D. depends on the nature of source from which light is coming and on nature of surface on which it is falling

Answer:

Watch Video Solution

9. The maximum energy of the photoelectrons emitted in a photocell Is 5eV. For no photoelectron to reach the anode, the potential difference of the anode with respect to the photo sensitive plate should be :

A. Zero

B. $+2V$

C. $+5V$

D. None of the above

Answer:

Watch Video Solution

10. 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 photoelectrons 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 emitted photo electrons by a factor of two but will have no effect. on the saturation photoelectric current.

Answer:

Watch Video Solution

11. Minimum light intensity that can be perceived by normal human eye is about $10^{-10} Wm^{-2}$. What is the minimum number of photons of wavelength 660 nm that must enter the pupil in one second, for one to see the object?Area of cross-section of the pupil is $10^{-4} m^2$?

A. 3.318×10^3

B. 1.453×10^3

C. 3.38×10^4

D. 1.453×10^5

Answer:

Watch Video Solution

12. 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. $\frac{h}{3mkT}$

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

Answer:

Watch Video Solution

13. What percentage increase in wavelength leads to 75% loss of photon energy in a photon-electron collision?

A. 2

B. 1

C. 0.677

D. 3

Answer:

Watch Video Solution

14. A parallel beam of light 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. $\frac{IS}{hV}\left(\frac{h}{\lambda}\right) + \sqrt{m(hv - \phi)}$

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

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

D. None of these

Answer:

Watch Video Solution

15. A desk lamp illuminates a desktop with light of wavelength X. The amplitude of this electromagnetic wave is E_0. Assuming illumination to be normally on the surface, the number of photons striking the desk per second per unit area N

A. $N = \frac{\lambda\varepsilon_0 E_0^2}{h}$

B. $N = \frac{2\lambda\varepsilon_0 E_0^2}{h}$

C. $N = (\lambda\varepsilon_0 E_0^2$

D. Data insufficient.

Answer:

Watch Video Solution

16. If a hydrogen atom at rest, emits a photon of wavelength λ, the recoil speed of the atom of mass m is given by :

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

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

C. $mh\lambda$

D. None of these

Answer: A

Watch Video Solution

17. A point source of radiation of power P is placed on the axis of completely absorbing disc. The distance between the source and the disc is 2times the radius of the disc. The force that light exerts on the disc is $\frac{Px}{40c}$. Then the value of x

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

B. $\frac{P}{5c}$

C. $\frac{P}{10c}$

D. $\frac{P}{20}C$

Answer:

Watch Video Solution

18. A beam of light has an power of 144 W equally distributed among three wavelengths of 4100Å, 4960Å and 6200Å. The beam is incident at an angle of incidence of 60° on an area of $1cm^2$ of a clean sodium surface, having a work function of 2.3 eV.Assuming that there is no loss of light by reflection and that each energetically capable photon ejects a photoelectron, find the saturation photocurrent. (Take $hc/e = 12400eV\text{Å}$)

Watch Video Solution

19. The work function of a substance is $4.0eV$. The longest wavelength of light that can cause photo-electron emission form this substance is approximately :

A. 540 nm

B. 400 nm

C. 310 nm

D. 220 nm

Answer:

Watch Video Solution

20. When a metallic surface is illuminated with monochromatic light of wavelength X, the stopping potential is 5Vq. When the same surface is illuminated with light of wavelength 3X, the stopping potential is Then the work function of the metallic surface is

A. $\frac{hc}{6\lambda}$

B. $\frac{hc}{5\lambda}$

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

D. $\frac{2hc}{4\lambda}$

Answer:

Watch Video Solution

21. In a photoelectric experiment, with light of wavelength λ, the fastest election has speed v. If the exciting wavelength is changed to $\frac{3\lambda}{4}$, the speed of the fastest emitted electron will become

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:

Watch Video Solution

Watch Video Solution

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

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

C. V

D. $\frac{\lambda Pet}{4}\pi\varepsilon RhC\Big)$

Answer:

Watch Video Solution

23. Radiation of frequency 1.5 times the threshold frequency is incident on a photosensitive material. If the frequency of incident radiation is halved and the intensity is doubled, the number of photoelectron ejected per second becomes:

A. Zero

B. half of its initial value

C. one fourth the initial value

D. three fourth the initial value

Answer: A

Watch Video Solution

24. The maximum kinetic energy of photoelectrons emitted from a surface when photons of energy 6eV fall on it is 4eV. The stopping potential is:

A. 2V

B. 4V

C. 6V

D. 10V

Answer:

Watch Video Solution

25. When a certain metallic surface is illuminated with mono chromatic light of wavelength λ, the stopping potential for photoelectric current is $3V_0$. When the same surface is illuminated with light of wavelength 2λ the stopping potential is V_0. The threshold wavelength for this surface for photoelectric effect is.

A. 6λ

B. 4λ

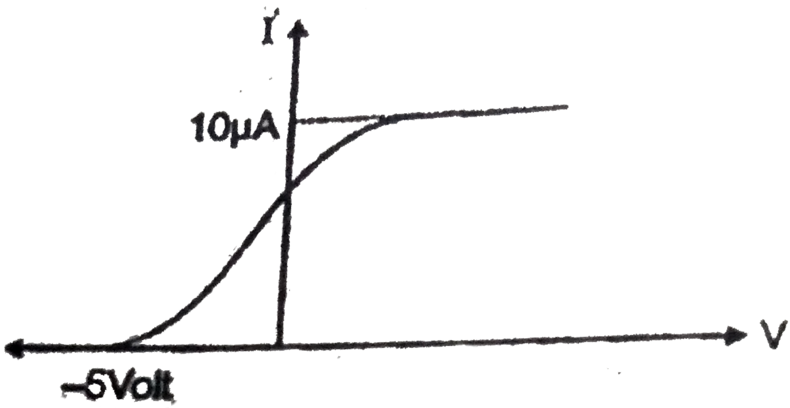
C. $\lambda/4$

D. 8λ

Answer:

Watch Video Solution

26. In the photoelectric experiment, if we use a monochromatic light, the I-V curve is as shown. If work function of the metal is 2eV, estimate the power of light used. (Assume efficiency of photo emission $=10^{-3}\%$, i.e. number of photoelectrones emitted are $10^{-3}\%$ of number of photons incident on metal.)



A. 2W

B. 5W

C. 7W

D. 10W

Answer:

Watch Video Solution

27. The eye can detect 5×10^4 photons $\left(m^2 s\right)^{-1}$ of green light ($\lambda = 5000A$), whole ear can detect $10^{-13} Wm^2$. As a power detector, which is more sensitive and by what factor?

A. Sensitivity of eye Is onoe fifth of the ear.

B. Sensitivity of eye is five times that of ear

C. Both are equally sensitive

D. Eye cannot be used as power detector

Answer:

Watch Video Solution

28. A metal whose work function is $3.3eV$ is illuminated by light of wavelength $3 \times 10^{-7}m$. What is the threshold frequency for photoelectric emission? Plank's constant $= 6.6 \times 10^{-34}$ Js?

A. $0.4 \times 10^{15} Hz$

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

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

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

Answer:

Watch Video Solution

29. In Q 28, the maximum energy of photoelectrons is:

A. $0.84eV$

B. $1.05eV$

C. $1.25eV$

D. $1.54eV$

Answer:

Watch Video Solution

30. In Q.28, what is the stopping potential?

A. 0.84 V

B. 1.05 V

C. 1.25 V

D. 1.i54 V

Answer:

Watch Video Solution

31. A point source of radiation power P is placed on the x-axis of an ideal plane mirror. The distance between the source and the mirror is n times the radius of the mirror. Find the force that light exerts on the mirror.

A. $\dfrac{2P}{C(n^2+1)}$

B. $\dfrac{P\left(n^2+1\right)}{2C}$

C. $\dfrac{P}{2C(n^2+1)}$

D. $\dfrac{P}{4C(n^2+1)}$

Answer:

Watch Video Solution

32. A sensor is exposed for time t to a lamp of power P placed at a distance l. The sensor has an opening that is 4d in diameter. Assuming all energy of the lamp is given off as light, the number of photons entering the sensor if the wavelength of light is λ is:

A. $N = \frac{P\lambda d^2 t}{hcl^2}$

B. $N = \frac{4P\lambda d^2 t}{hcl^2}$

C. $N = \frac{p\lambda d^2 t}{4hcl^2}$

D. $N = \frac{P\lambda d^2 t}{16hcl^2}$

Answer:

Watch Video Solution

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

A. 2

B. 4

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

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

Answer:

Watch Video Solution

34. Monochromatic light of frequency v_1 irradiates a photocell and the stopping potential is found to be V_1. What is the new stopping potential of the cell if it irradiated by monochromatic light of frequency v_2?

A. $V_1 + \left(\frac{h}{e}\right)(v_2 - v_1)$

B. $V_1 - \frac{h}{e}(v_2 - v_1)$

C. $V_1 + \left(\frac{h}{e}\right)(v_1 + v_2)$

D. $V_1 - \frac{h}{e}(v_1 + v_2)$

Answer:

Watch Video Solution

35. An electromagnetic radiation of frequency 3×10^{15} cycles per second falls on a photo electric whose work function is 4.0eV. Find out the maximum velocity of the photo electrons emitted by the surface.

A. $13.4 \times 10^{-19} m / s$

B. $19.8 \times 10^{-19} m / s$

C. $1.72 \times 10^{6} m / s$

D. None of these

Answer:

Watch Video Solution

36. Two identical photocathode receive light of frequencies f_1 and f_2. If the maximum velocities of the photoelectrons (of mass m) coming out are respectively v_1 and v_2 then:

A. $v_1^2 - v_2^2 = \frac{2h}{m}(f_1 - f_2)$

B. $v_1 + v_2 = \left[\frac{2h}{m}(f_1 + f_2\right]^{\frac{1}{2}}$

C. $v_1^2 + v_2^2 = \frac{2h}{m}(f_1 + f_2)$

D. $v_1 - v_2 = \left[\frac{2h}{m}(f_1 - f_2\right]^{\frac{1}{2}}$

Answer:

Watch Video Solution

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

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

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

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

Answer:

Watch Video Solution

38. The energy of an α-particle, whose de-Broglie wavelength is 0.004Å, will be:

A. $1297 eV$

B. 1245 KeV

C. 1205 MeV

D. 1288 GeV

Answer:

Watch Video Solution

39. A small potassium foil is placed (perpendicular to the direction of incidence of light) a distance $r(=0.5m)$ from a point light source whose output power P_0 is $1.0W$. Assuming wave nature of light how long would it take for the foil to soak up enough energy $(=1.8eV)$ from the beam to eject an electron? Assume that the ejected photoelectron collected its energy from a circular area of the foil whose radius eqals the radius of a potassium atom $(1.3 \times 10^{-10} m)$

A. 11s

B. 14s

C. 17s

D. 22s

Answer:

Watch Video Solution

40. A photon and an electron posses same de-Broglie wavelength. Given that c= speed of light and v=speed of electron, which of the following relations is correct? Here $E_e = KE$ of elecron, $E_{ph} = KE$ of photon, $p_e = momentumofe \leq ctron$, p_(ph)` = momentum of photon:

A. $E_e \frac{)}{E_{ph} = \frac{3c}{v}}$

B. $\frac{E_e}{E_{ph}} = \frac{v}{2c}$

C. $\left(\frac{p_e}{P_{ph}} = (2c)v\right)$

D. $\left(\frac{p_e}{p_{ph}} = \frac{c}{2v}\right.$

Answer:

Watch Video Solution

41. The maximum velocity of photoelectronos emitted hy a photoemitter is $1.8 \times 10^{6} m / \sec$. Taking $e / m = 1.8 \times 10^{11} \frac{C}{k} g$ for electrons, the stopping potential of the emitter is:

A. $1.82V$

B. $9.21V$

C. $11.82V$

D. $23.64V$

Answer:

Watch Video Solution

42. A proton with KE equal to that a photono (E = 100 keV). λ_1 is the wavelength of proton and λ_2 is the wavelength of photon. Then

$\left.\frac{\lambda_1}{\lambda}\right)_2$ is proportional to:

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

B. $E^{-\frac{1}{2}}$

C. E

D. E^{-1}

Answer:

Watch Video Solution

43. How much potential is to be applied to accelerate an electron, so that its de-broglie wavelength should 0.4Å?

A. 9434 V

B. 94.34V

C. 9.434 V

D. 943.4 V

Answer:

Watch Video Solution

44. A metallic surface is irradiated with monochromatic light of variable wavelength. Above a wavelength of 5000Å no photoelectrons are emitted from the surface. With an unknown wavelength, stopping potential fo 3V is necessary ot eliminate the photo current. Find the unknown wavelength.

A. 2268 A

B. 1116 A

C. 3426 A

D. 4801 A

Answer:

Watch Video Solution

45. Illuminating the surface of a certain metal alternately with light of wavelengths $\lambda_1 = 0.35\mu$ m and $\lambda - (2) = 0.54 \pm$, it was found that the corresponding maximum velocities of photo electrons have a ratio η = 2. Find the work function of that metal:

A. 3.22 eV

B. 1.88 eV

C. 5.64 eV

D. 6.28 eV

Answer:

Watch Video Solution

46. The de-Broglie wavelength associated with a material particlewhen it is accelerated through a potential difference of 150volt is 1A. The de-Broglie wavelength associated with the same particle when it is accelerated through a potential difference of 1350 V will be:

A. $\frac{1}{4}\text{Å}$

B. $\frac{1}{3}\text{Å}$1Å`

C. 1Å

D. 0

Answer:

Watch Video Solution

47. An electrono of mass m, when accelerated through a potential difference V, has de-Broglie wavelength λ. The de-Broglie wavelength associated with a proton of mass M accelerated through the same potential difference, will be:

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

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

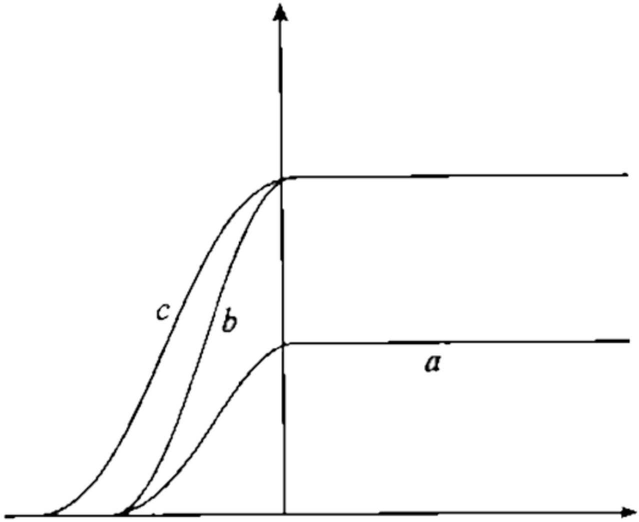
C. $\lambda \sqrt{\frac{M}{m}}$

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

Answer:

Watch Video Solution

48. In photoelectric experiment the plot between anode potential and photoelectric current is shown in figure 2.3.1. Which of the following is correct:



A. Frequency of light corresponding to "a" is same as that of "b" and is different that corresponding to "c".

B. Frequency of light corresponding to "a" is different from "b" & intensities are the same.

C. Frequency corresponding to "b" is same as that of "c", but intensities are differeent.

D. Frequency corresponding to "b" is different from that of "c", and intensities are different.

Answer: A

Watch Video Solution

49. If the momentum of electron is changed by P_m then the de-Broglie wavelength associated with it changes by 0.50%. The initial momentum of electron will be:

A. $\frac{P_m}{200}$

B. $\frac{P_m}{100}$

C. $200P_m$

D. $400P - (m)$

Answer:

Watch Video Solution

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

A. 3.27 eV

B. 4.54 eV

C. 5.86 eV

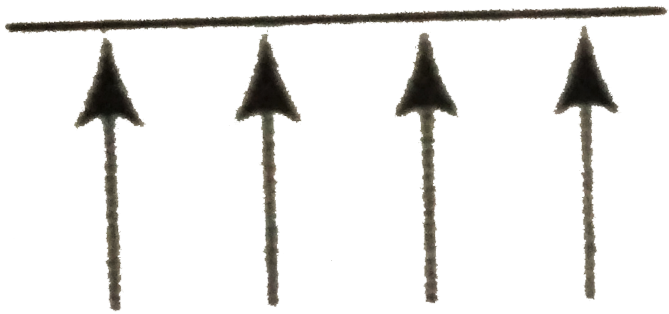
D. 6.54 eV

Answer:

Watch Video Solution

51. A plate of mass 10g is in equilibrium in air due to the force exerted by a light beam on the plate. Calculate power of the beam. Assume

that the plate is perfectly absorbing.



A. $1.5 \times 10^7 W$

B. $3 \times 10^7 W$

C. $4.5 \times 10^7 W$

D. $6 \times 10^7 W$

Answer:

Watch Video Solution

52. The energy that should be added to an electron, to reduce its de-Broglie wavelength from $2 \times 10^{-9} m$ to $0.5 \times 10^{-9} m$ will be:

A. $1.1 MeK$

B. $0.56 MeV$

C. $0.56 KeV$

D. $5.67 eV$

Answer:

Watch Video Solution

53. An electron of mass 'm', when accelerated through a potential V has de-Broglie wavelength λ. The de-Broglie wavelength associated with a proton of mass M accelerated through the same potential difference will be:

A. 1.1 MeV

B. 0.56 MeV

C. 0.56 KeV

D. 5.67 eV

Answer:

Watch Video Solution

54. An electron of mass 'm', when accelerated through a potential V has de-Broglie wavelength λ. The de-Broglie wavelength associated with a proton of mass M accelerated through the same potential difference will be:

A. $\lambda\left(\sqrt{\frac{M}{m}}\right.$

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

C. $\lambda\left(\frac{M}{m}\right)$

D. $\lambda\left(\frac{m}{M}\right)$

Answer:

Watch Video Solution

Watch Video Solution

55. Find the numerical value fo De Broglie wavelength of an electron in the 1^{st} orbit of hydrogen atom assuming Bohr's atomic model. You can use statndard values of the constants. Leave your answer in terms of π.

A. 1.058π

B. 2.223π

C. 2.116π

D. none of these

Answer:

Watch Video Solution

56. An electron filled with helium is heated to a temperature of 400k. A beam of helium atom emerges out of the enclosure. The mean debroglie wavelength of this beam is:

A. 0.44Å

B. 2.23π

C. 2.116π

D. none of these

Answer:

Watch Video Solution

57. If the short wavelength limit of the continous spectrum coming out of a Coolidge tube is $10A$, then the de Broglie wavelength of the electrons reaching the target netal in the Coolidge tube is approximately

A. 0.3Å

B. 3Å

C. 30Å

D. 10Å

Answer:

Watch Video Solution

58. 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. $3\frac{m_0 v_0}{q_0 E_0}\Big)$

Answer:

Watch Video Solution

59. Electrons in a sample of gas containing hydrogen-like atom $(Z = 3)$ are in fourth excited state. When photons emitted only due to transition from third excited state to second excited state are incident on a metal plate photoelectorns are ejected. The stopping potential for these photoelectorns is $3.95eV$. now, if only photons emitted due to transition from fourth excited state to third excited state are incident on the same metal plate, the stopping potential for the emitted photoelectrons will be appoximetely equal to

A. 0.85 eV

B. 0.75 eV

C. 0.65 eV

D. None of these

Answer:

Watch Video Solution

60. Threshold frequency for a certain metal is v_0. When light of frequency $2v_0$ is incident on it, the maximum velocity of photoelectrons is $4 \times 10^8 cms^{-1}$. If frequency of incident radiation is increased to $5v_0$, then the maximum velocity of photoelectrons, in cm s^{-1}, will be

A. $4/5 \times 10^6$

B. 2×10^6

C. 8×10^6

D. 2×10^7

Answer:

Watch Video Solution

Advance Mcq

1. A collimated beam of light of flux density $30kWm^{-2}$ is incident normally on $100mm^2$ completely absorbing screen. If P is the pressure exerted on the screen and $\triangle p$ is the momentum tranferred to the screen during a 1000 s interval, then

A. $P = 10^{-3} Nm^{-2}$

B. $P = 10^{-4} Nm^{-2}$

C. $\Delta p = 10^{-4} kgms^{-1}$

D. $\Delta p = 10^{-5} kgms^{-1}$

Answer:

Watch Video Solution

2. In a photoelectric experiment, the collector plate is at 2.0V with respect to the emitter plate made of copper $(\phi) = 4.5eV)$. The emitter is illuminated by a source of monochromatic light of wavelength 2000 Ånm.

A. the maximum kinetic energy of the photo electrons at collector is 1.7eV

B. the maximum kinetic energy of the photo electrons on the collector is 1.7eV.

C. if the polarity of the battery is reversed then the minimum kinetic energy of the photo electrons on the collector is 0.

D. if the polarity of the reversed then the maximum kinetic energy of the photo electrons on the collector is 3.7 eV

Answer:

Watch Video Solution

3. The work function for aluminium surface is 4.2 eV and that for sodium surface is 2.0 eV. The two metals were illuminated with appropriate radiations so as to cause photo emission. Then :

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

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

C. the threshold frequency of aluminium will be less than that of sodium

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

Answer:

Watch Video Solution

4. The stopping potential for the photoelectrons emitted from a metal surface of work function 1.7 eV is 10.4 V. Find the wavelength of the radiation used. Also, identify the energy levels in hydrogen atom, which will emit this wavelength.

A. The wavelength of light used is 1022Å.

B. The wavelength of light used is 970.6Å.

C. The light used is emitted by hydrogen gas sample which de-excites from n=3 to n=1

D. The light used is emitted by hydrogen gas sample which de-excites from n=4 to n=1

Answer:

Watch Video Solution

5. H^{+}, He^{+} and O^{++} all having the same kinetic energy pass through a region in which there is a uniform magnetic field perpendicular to their velocity . The masses of H^{+}, He^{+} and O^{2+} are $1a\mu$, $4a\mu$ and $16a\mu$ respectively . Then

A. H^{+} will be deflected the most

B. O^{++} will be deflected the most

C. He^{+} and O^{++} will be deflected equally

D. All will be deflected equally

Answer:

Watch Video Solution

6. When an electron of hydrogen like atom jumps from a higher energy level to a lower energy level.

A. Angular momentum of the electron remains constant

B. Kinetic energy increases

C. Wavelength of de-Broglie wave, associated with motion of the electron, decreases

D. none of these

Answer:

Watch Video Solution

7. Light rays are incident on an opaque sheet. Then they:

A. Exert a force energy to the sheet

B. transfer an energy to the sheet

C. transfer momentum to the sheet

D. transfer impulse to the sheet

Answer:

Watch Video Solution

8. The angular momentum of an electron in an orbit is quantized because:

A. Bohr's theory is basedon this postulate

B. It is a necessary condition for compatibility with the wave behavior of the electron

C. it is a necessary condition for compatibility with the particle behavior of the electron

D. it is a necessary condition for compatability with Pauli's exclusive principle

Answer:

Watch Video Solution

Watch Video Solution

9. The intensity of light falling on a phototube is increased while keeping the no of photons falling per seconds constant then for a given experiment.

A. Stopping potential will increase

B. Saturation current will increase

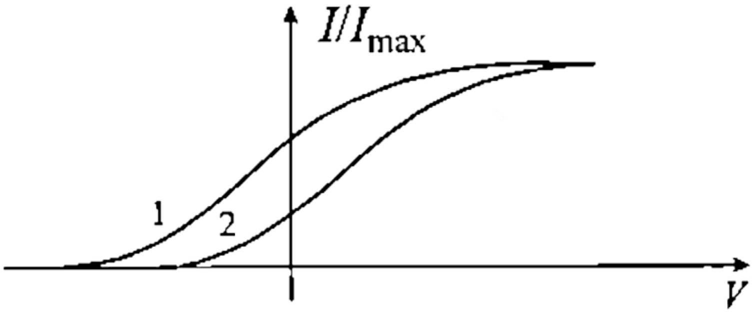
C. saturation current will decrease

D. saturation current will remain unaffected.

Answer:

Watch Video Solution

10. Two photocathodes are illuminated by the light emitted by a single source. The dependence of photocurrent versus voltages between cathode and anode is shown by curves 1 and 2 as shown in the figure. (I/I_(max) represents ratio of photocurrent to saturation current):



A. Photocathode 1 has higher work function than 2

B. Photocathode 2 has higher work function than 1

C. Saturation current may be different for 1 and 2

D. saturation current must be same for 1 and 2

Answer:

Watch Video Solution

11. 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 depends only on the frequency of light and not on its intensity

C. Even when the meal surface is fainlty illuminated the photoelectrons $(\text{ if } v > -v(th))$ leave the surface immediately

D. electric charge of the photoelectrons is quantized

Answer:

Watch Video Solution

12. The momentum of a single photon of red light of fequency 400×10^{12}Hz moving through free surface is given as:

A. Zero

B. $8.8 \times 10^{-28} kgms^{-2}$

C. $1.65 \times 10^{-6} Me\frac{V}{c}$

D. Data insufficient.

Answer:

Watch Video Solution

13. 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 saturation current will be 6.0 mA

D. the saturation current will be 2.0mA

Answer:

Watch Video Solution

14. In a photoelectric experiment, the collector plate is at 2.0 V with respect to the emitter plate made of copper. The emitter is illuminated by a source of monochromatic light of wavelength 200nm. Find the minimum and maximum kinetic energy of the photoelectrons reaching the collector.

A. The minimum kinetic energy of the photoelectrons reaching the collector is 0.

B. The maximum kinetic energy of the photoelectrons reaching the collector is 3.7 eV

C. If the polarity of the battery is reversed then answer to part A will be 0.

D. If the polarity of the battery is reversed then answer to part B will be 1.7 eV

Answer:

Watch Video Solution

15. A small mirror of area A and mass m is suspended in a vertical plane by a weightless string. A beam of light of intensity I falls normally on the mirror and the string is deflected from the vertical by a very small angle θ Assuming the mirror to be perfectly reflecting, obtain an expression for θ

A. Radiation pressure equal to $2I\frac{)}{c}$

B. Radiationi pressure equal to (I)/(2c)`

C. $\tan\theta = \frac{2IA}{mgc}$

D. $\tan\theta = \frac{IA}{2mgc}$

Answer:

Watch Video Solution

16. When photons of energy $4.25 eV$ 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 2.25 eV

B. the work function of B is 4.20 eV

C. $T_A = 2.00 eV$

D. $T_B = 2.75 eV$

Answer:

Watch Video Solution

17. In photoelectric effect, stopping potential depends on

A. frequency of the incident light

B. intensity of the incident light by varies source distance

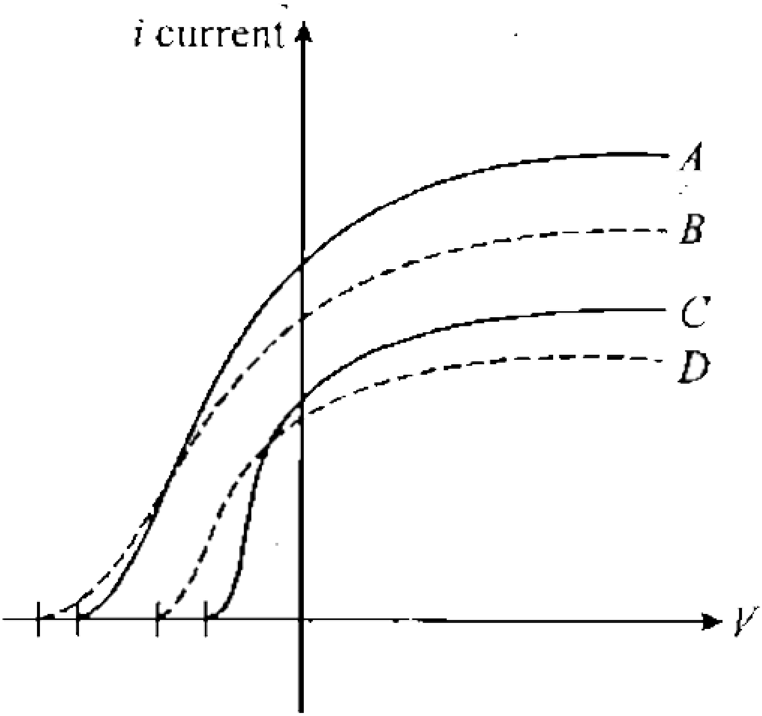
C. emitter's properties

D. frequency and intensity of the incident light

Answer:

Watch Video Solution

18. Thefigure shows the results of an experiment involving photoelectric effect. The graphs A, B,C and D relate to a light beam having different wavelengths. Select the correct alternative.



A. Beam B has highest frequency

B. Beam C has longet wavelengh

C. Beam A has highest rate of photoelectric emission

D. Photoelectrons emitted by B have highest momentum.

Answer:

Watch Video Solution

19. the photoelectric effect can not be explained by the wave theory of light because:

A. the energy carried by the light waves is not given to a particular present on the surface of metal.

B. waves do not have energy

C. energy of the waves becomes zero as it strikes the metal surface.

D. waves do not have sufficient energy which is required for electron emission.

Answer:

Watch Video Solution

20. 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 wavelengh

C. is related to the shortest wavelength

D. is not related to the wavelength

Answer:

Watch Video Solution

21. In a phtoelectron effect energy of photon is directly proportional to the frequency and photons are totally absorbed by the electrons of metals then frequency and photons are totally absorbed by the electrons of metals then photoelectric current is:

A. increased when the frequency of photon is increased.

B. decreased when the frequency of photon is increased

C. independent of the frequency of photon but it only depends on the intensity of incident photons

D. independent of the intensity of incident photons.

Answer:

Watch Video Solution

22. Suppose frequency of emitted photon is f_0 when the electron of a stationary hydrogen atom jumps from a higher state m to a lower state n. If the atom is moving with a velocity $v(< < c)$ and emits a photon of frequency f during the same transition,then which of the following statement are possible?

A. f may be equal to f_0

B. f may be greater than f_0

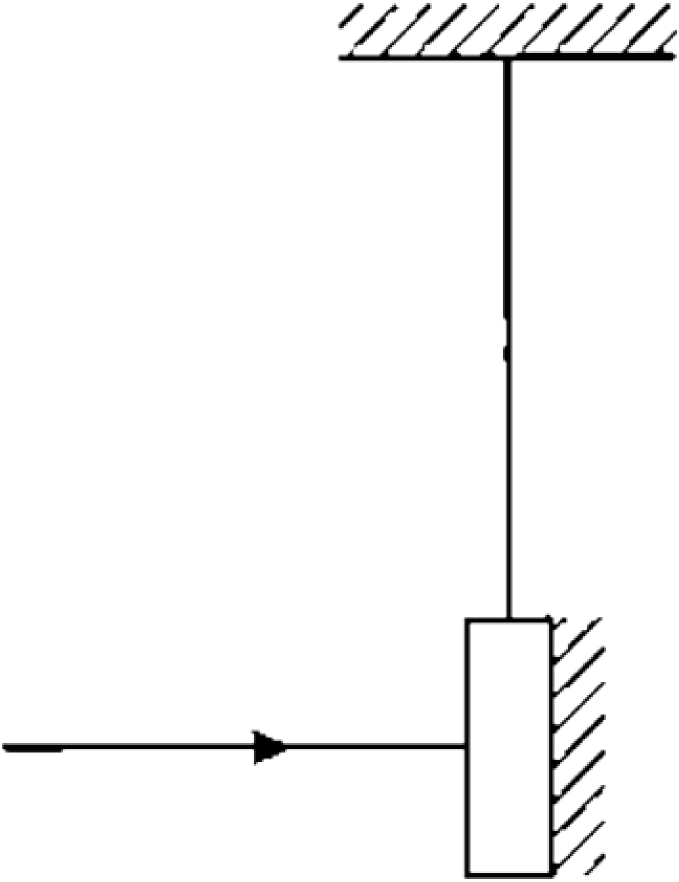
C. f may be less than f_0

D. f cannot be equal to f_0

Answer:

Watch Video Solution

23. A small miror is suspended by a thread as shownin figure 2.35. A short pulse of mono-chromatic light rays is incident normally on the mirror and gets reflected. Which of the following statements is/are correct?



A. mirror will start to oscilate

B. wavelengths of reflected rays will be greater than that of incident rays

C. wavelength of reflected rays may be less than that of incident rays.

D. none of these

Answer:

Watch Video Solution

24. When monochromatic light falls on a photosensitive material, the number of photoelectrons emitted per second is n and their maximum kinetic energy is $K_{\max}$. If the intensity of the incident light is doubled keeping the frequency same, then:

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:

Watch Video Solution

25. Mark the correct statement(s) related to the stopping potential difference.

A. At the stopping potential, emitter plate is positive with respect to the collector

B. At the stopping potential, emitter plate is negative with respect to the collector.

C. At the stopping potential, electrons does not come out of the plates.

D. At the stopping potential, electrons are able to reach the collector but retun before being absorbed.

Answer:

Watch Video Solution

26. If the wavelength of light in an experiment on photo electric effect is doubled,

A. The photoelectrons emission will not take place.

B. the photoemission may or may not take place

C. The stopping potential will increases

D. the stopping potential will decrease under the condition that energy of photon of doubled. Wavelength is more than work function of metal.

Answer:

Watch Video Solution

27. Photoelectric effect supports quantum nature of light because

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

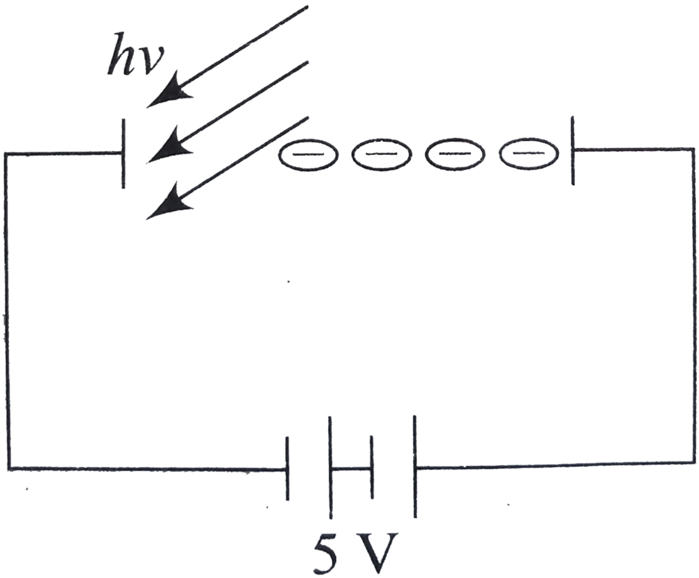
B. The maximum kinetic energy of photoelectrons depends only on the frequency of light and not on its intensity

C. Even when the meal surface is fainlty illuminated the photoelectrons $(\text{ if } v > -v(th))$ leave the surface immediately

D. electric charge of the photoelectrons is quantized

Answer:

Watch Video Solution



28.

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 metla 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:

Watch Video Solution

Unsolved Numerical Problems

1. Light from balmer series of hydrogen is able to eject photoelectron from a metal. What can be the maximum work function of the metal?

Watch Video Solution

2. A photocell is operating in saturation mode with a photocurrent $4.8mA$ when a monochromatic radiation of wavelength $3000\text{Å}$and power of $1mW$ is incident. When another monochromatic radiation of wavelength 1650Å and power $5mW$ is incident, it is observed that maximum velocity of photoelectron increases to two times. Assuming efficiency of photoelectron generation per incident photon to be same for both the cases, calculate.

(a) the threshold wavelength for the cell

(b) the saturation current in second case

(c) the efficiency of photoelectron generation per incident photon.

Watch Video Solution

3. Photo electrons are liberated by ultraviolet light of wavelength 3000Å from a metalic surface for which the photoelectric threshold wavelength is 4000Å. Calculate the de Broglie wavelength of electrons emitted with maximum kinetic energy.

Watch Video Solution

4. Lithium has a work function of $2.3eV$. It is exposed to light of wavelength 4800Å. Find the maximum kinetic energy with which electron leaves the surface. What is the longest wavelength which can produce the photoelectrons?

Watch Video Solution

5. A parallel beam of monochromatic light of wavelength 663 nm is incident on a totally reflecting plane mirror. The angle of incidence is 60° and the number of photons striking the mirror per second is $\left(1.0\times\left(10^{19}\right)\right)$. Calculate the force exerted by the light beam on the mirror.

Watch Video Solution

6. 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.

Watch Video Solution

7. The work functin of aluminium is 4.2 eV. Calcualte the Kinetic energy of the fastest & the slowest photoelectrons, the stopping potential & the cut off wavelength when light of wavelength 2000Å falls on a clean Aluminium surface.

Watch Video Solution

8. What potential difference must be applied to stop the fastest photoelectrons emitted by a nickel surface under the action of ultraviolet light of wavelength 2000Å? The work function of nickel is 5.01 eV.

Watch Video Solution

9. A sphere of radius 1.00 cm is placed in the path of a parallel beam of light of large aperture. The intensity of the light is 0.50 W cm^{-2}. If the sphere completely absorbs the radiation falling on it, find the force exerted by the light beam on the sphere.

Watch Video Solution

10. Find the frequency of light which ejects electrons from a metal surface. Fully stopped by a retarding potential of $3V$, the photoelectric effect begins in this metal at a frequency of $6 \times 10^{14} Hz$. Find the work function for this metal. (Given $h = 6.63 \times 10^{-34} Js$).

Watch Video Solution

11. state whether the following statements are TRUE or FALSE, giving reasons in brief to support your answer. In a photo electric emission process the maximum energy of the photo-electron increases with increasing intensity of the incident light.

Watch Video Solution

12. A point istropic light source of power $P = 12$ watt is located on the axis of a circular mirror plate of radius R = 3cm. If distance of source from the plate is α = 39 cm and reflection coefficient of mirror plate is α = 0.70, calcualte force exerted by light rays on the plate.

Watch Video Solution

13. A uniform monochromatic beam of light of wavelength 365×10^{-9}m and intensity $10^{-8} Wm^{-2}$ falls on a surface having avsorption coefficient 0.8 and work functoin1.6 eV. Determine the rate of number of electrons emitted per m^2, power absorbed per m^2 and the maximum kinetic energy of emitted photoelectrons.

Watch Video Solution

14. 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.

Watch Video Solution

15. Suppose the wavelength of the incident light is increased from 3000Å to 3040Å. Find the corresponding change in the stopping potential. [Take the product $hc = 12.4 \times 10^{-7} eVm)$]

Watch Video Solution

16. When a metal plate is exposed to a monochromatic beam of light of wavelength 400nm, a negative potential of 1.1 V is needed to stop the photocurrent . Find the threshold wavelength for the metal.

Watch Video Solution

17. The energy needed to detach the electron of a hydrogen like ion in ground state is a system(a) what is the wavelength of the radiation emitted when the electron jumps from the first excited state to the ground state? (b) What is the radius of the orbit for this atom?

Watch Video Solution

18. A stationary hydrogen atom emits a photon corresponding to first line of the Lyman series. What velocity does the atom acquire?

Watch Video Solution

19. In an experiment tungsten cathode which has a threshold wavelength 2300 Å is irradiated by ultraviolet light of wavelength 1800Å. Calculate

(a) maximum energy of emitted photoelectronos &

(b) work function of the tungsten

Watch Video Solution

20. Electrons with maximum kinetic energy 3eV are ejected from a metla surface by ultraviolet radiation of wavelength 1500Å. Determine the work function of the metal, the threshold wavelength of metal and the stopping potential difference required to stoop the emission of electrons.

Watch Video Solution

21. A small plate of a metal (work function $= 1.7eV$) is placed at a distance of 2m from a monochromatic light source of wavelength $4.8 \times 10^{-7}m$ and power 1.0watt. The light falls normally on the plate. Find the number of photons striking the metal plate per square meter per second. If a constant magnetic field of strength $10^{-4}T$ is applied parallel to the metal surface, find the radius of the largest circular path followed by the emitted photoelectrons. (use

$h = 6.63 \times 10^{-34} Js$, mass of electron=$9.1 \times 10^{-31} kg$, charge of electron=$1.6 \times 10^{-19} C$

Watch Video Solution

22. The electric field associated with a monochromatic beam becomes zero 1*2x10^15 times per seond. Find the maximum kineetic energy of the photoelectron when this light falls on a metal surface whose work function is 2*0 eV.

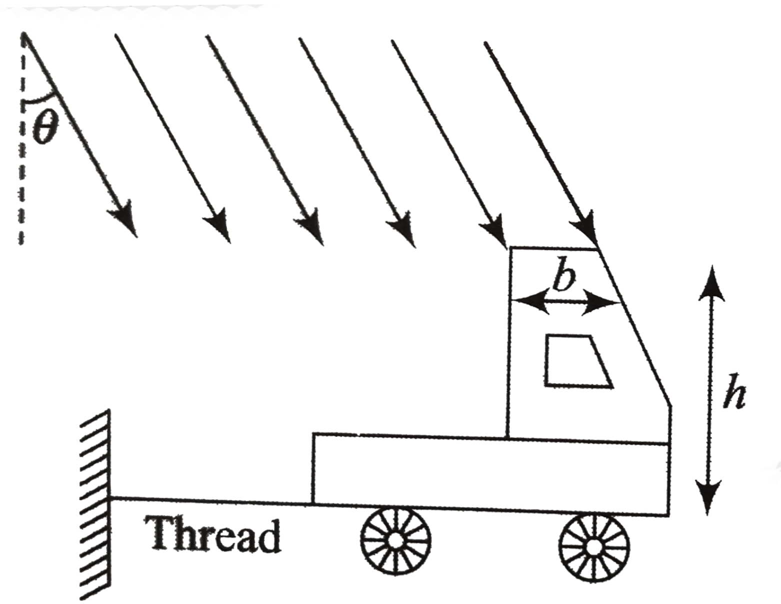
Watch Video Solution

23. Find the frequency of light which ejects electrons from a metal surface. Fully stopped by a retarding potential of $3V$, the photoelectric effect begins in this metal at a frequency of $6 \times 10^{14} Hz$. Find the work function for this metal. (Given $h = 6.63 \times 10^{-34} Js$).

Watch Video Solution

Watch Video Solution

24.



A toy truck has dimensions as shown in fig. and its width, normal to the plane of this paper, is d. The sun rays are incident on it as shiwn in the figure. If intensity of rays is I and all surfaces of truck are perfectly black, calculate tension in the thread used to keep the truck stationary. Neglect friction.

Watch Video Solution

25. 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.

Watch Video Solution

26. Electron in a hydrogen-like atom $(Z = 3)$ make transition from the forth excited state to the third excited state and from the third excited state to the second excited state. The resulting radiations are incident potential for photoelectrons ejested by shorter wavelength is $3.95 eV$.

Calculate the work function of the metal and stopping potiential for the photoelectrons ejected by the longer wavelength.

Watch Video Solution

27. An electron in a hydrogen like atom is in an excited state. I thas a total energyof-3.4eV.Calculate:

(i) The kinetic energy,

(ii) The de-Broglie wavelength of the electron.

Watch Video Solution

28. In an experiment on photo electric emission, following observations were made,

(i) Wavelength of the incident light $= 1.98 \times 10^{-7} m$,

(ii) Stopping potential $= 2.5 \text{volt}$.

Find: (a) Kinetic energy of photoelectrons with maximum speed.

(b) Work function and

(c)Threshold frequency,

Watch Video Solution

29. Light form a dicharge tube containing hydrogen atoms falls on the surface of a piece of sodium. The kinetic energy of the fastest photoelectrons emitted from sodium is 0.73 eV. The work function for sodium is 1.82 eV. Find (a) the energy of the photons causing the photoelectrons emission.

(b) the quantum numbers of the two levels involved in the emission of these photons.

(c) the change in the angular momentum of the electron in the hydrogen atom, in the above transition, and

(d) the recoil speed of the emitting atom assuming it to be at rest before the transition. (Ionization potential of hydrogen is 13.6 eV.)

Watch Video Solution

30. In a photo electric effects set-up, a point source of light of poewer 3.2×10^{-3} W emits mono energetic photons of energy 5.0 Ev. The source is located at a distance of 0.8m from the centre of a stationary metallic sphere of work function 3.0 Ev & of radius 8.0×10^6m. The efficiency of photo electric emission is one of every 10^6 incident photons. Assume that the sphere is isolated and initially neutral, and that photo electrons are instantly swept awy after emission.

(a) Calculate the number of photo electrons emitted.per second.

(b) Find the ratio of the wavelength of incident light to the de-Broglie wave length of the fastest photo electrons emitted. ltbr. (c) It is observed that the photo electron emission stops ata certain time tafter the light source is switched on. Why ?

(d) Evaluate the time t.

Watch Video Solution

31. State whether the following statements are true or false. Give brief reasons in support ofyour answers.

(1) The dimension of (h/e) is the same as that of magnetic flux ϕ. Here h & e represents Planck's constant and electronic charge respectively.

(ii) Two metal plates of same surface area and work function are irradiated by abeam of light, incident normally. Itis found that the photo electric current from the two metals are different.

Watch Video Solution

32. A 40 W ultraviolet light source of wavelength $2480A$. Illuminates a magnesium (mg) surface placed 2 m away. Determine the number of photons emitted from the surface per second and the number incident on unit area of Mg surface per second . The photoelectric work function for Mg is $3.68eV$. Calculate the kinetic energy of the fastest electrons ejected from the surface. Determine the maximum wavelength for which the photoelectric effects can be observed with Mg surface.

Watch Video Solution

33. Photoelectrons are emitted when $400nm$ radiation is incident on a surface of work - function 1.9 eV. These photoelectrons pass through a region containing α-particles. A maximum energy electron combines with an α -particle to from a He^{+} ion, emitting a single photon in this process. He^{+} ions thus formed are in their fourth excited state. Find the energies in eV of the photons lying in the 2 to 4 eV range, that are likely to be emitted during and after the combination. $\left[Take, h = 4.14 \times 10^{-15} eV - s\right]$

Watch Video Solution

34. At a given instant there are 25% undecayed radioactive nuclei in a sample. After $10s$ the number of undecayed nuclei reduces to 12.5%. Calculate

(a) mean life of the nuclei,

(b) the time in which the number of undecayed nuclei will further reduce to6.25% of the reduced number.

Watch Video Solution

35. When a beam of $10.6eV$ photons of intensity $2.0W/m^2$ falls on a platinum surface of area $1.0 \times 10^4 m^2$ and work function $5.6eV$, 0.53% of the incident photons eject photoelectrons. find the number of photoelectrons emitted per second and their minimum and maximum energies (in eV)Take $1eV = 1.6 \times 10^{-19} J$

Watch Video Solution

36. In a photoelectric experiment set up, photons of energy $5eV$ falls on the cathode having work function $3eV$ (a) if the saturation current is $i = 4\mu A$ for intensity $10^{-5} W/m^2$, then plot a graph between anode potential and current (b) Also draw a graph for intensity of incident radiation $2 \times 10^{-5} W/m^2$

Watch Video Solution

37. The photons from the Balmer series in Hydrogen spectrum having wavelength between $450nm$ to $700nm$ are incident on a metal surface of work function $2eV$ Find the maximum kinetic energy of ejected electron (Given hc = 1242 eV nm)`

Watch Video Solution

38. Monochromatic radiation of wave length 640.2 nm $(1nm = 10^{-9}m)$ from a neon lamp irradiates a photosensitive material made of calcium or tungsten. The stopping voltage is measured to be 0.54V. The source is replaced by an iron source and its 427.2 nm line irradiates the same photocell. Predict the new stopping voltage.

Watch Video Solution

39. Irradiating the metal surface successive by radiations of wavelength 3000Å and 5400Å, it is found that the maximum velocites of electrons are in the ratio $2:1$. Find the work function of the metal surface, meV.

Watch Video Solution

40. A filter transmits only the radiation of wavelength greater than $440 nm$. Radiation from a hydrogen discharge tube goes through such a filter and is incident on a metal of work function $2.0 eV$. Find the stopping potential which can stop the photoelectrons.

Watch Video Solution

41. The peak emission from a black body at a certain temprature occurs at a wavelength of 9000Å. On increase its temperature , the total radiation emmited is increased its 81 times. At the intial temperature when the peak radiation from the black body is incident on a metal surface , it does not cause any photoemission from the surface . After the increase of temperature, the peak from the black body caused photoemission. To bring these photoelectrons to rest , a potential equivalent to the excitation energy between

$n = 2$ and $n = 3$ bohr levels of hydrogen atoms is required. Find the work function of the metal.

Watch Video Solution

42. The rediation emitted when an electron jumps from $n = 3 \rightarrow n = 2$ orbit in a hydrogen atom falls on a metal to produce photoelectron. The electron from the metal surface with maximum kinetic energy are made to move perpendicular to a magnetic field of $(1/320)T$ in a radius of $10^{-3}m$. Find (a) the kinetic energy of the electrons, (b) Work function of the metal , and (c) wavelength of radiation.

Watch Video Solution