PHYSICS

BOOKS - CENGAGE PHYSICS (ENGLISH)

PHOTOELECTRIC EFFECT

Illustration

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

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2. The sun delivers about $1.4 kW m^{-2}$ of electromagnetic flux to the earth's surface. Calculate

A. the total power incident on a roof of dimensions $8 m \times 20$m.

B. the solar energy in joules incident on the roof in 1h.

C.the radiation pressure and force assuming the roof to be a perfect absorber.

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3. A bulb lamp emits light of mean wavelength of $4500A$. The lamp is rated at $150W$ and 8% of the energy appears as emitted light. How many photons are emitted by the lamp per second?

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4. The sun gives light at the rate of $1400Wm^{-2}$ of area perpendicular to the direction of light. Assume $\lambda(sunlight) = 6000A$. Calculate

A.the number of photons per second arriving at $1m^2$ area at earth.

B. the number of photons emitted from the sun per second assuming the average radius of the Earth's orbit is 1.49×10^{11} m.

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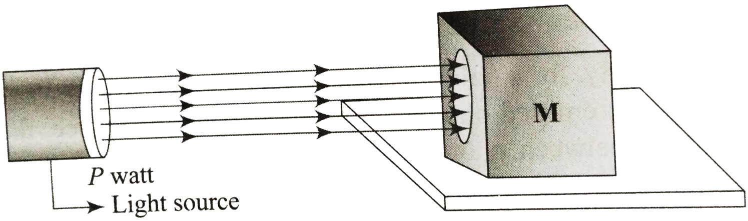
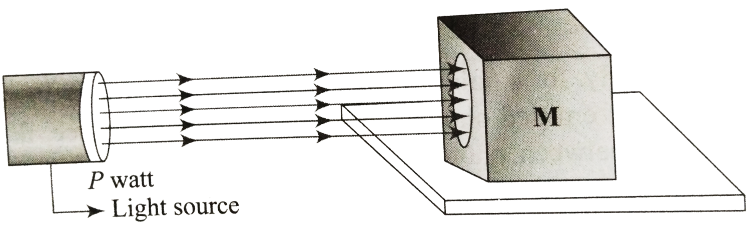


5.

A source of light of power P is shown in Fig. 3.6. Find the force on the block placed in the path of the light rays. The surface of body on which the light beam is incident is having a reflection coefficient $a_r = 0.7$ and absorption coefficient $a_a = 0.3$.



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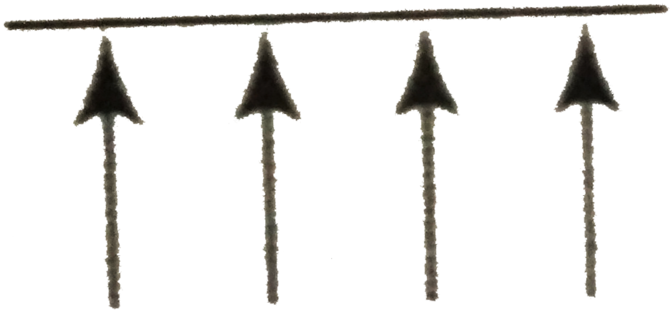
6. A plate of mass 10g is in equilibrium in air due to the force exerted by a light beam on the plate. Calculate power of the beam. Assume that the plate is perfectly absorbing.



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7. A radiation of wavelength 200nm is propagating in the form of a parallel surface. The power 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.

A. 3.33×10^{-5}

B. 4.33×10^{-5}

C. 5×10^{-2}

D. None of the above

Answer: A

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8. A. How many photons of a tradiation of wavelength $\lambda = 5 \times 10^{-7}$ m must fall per second on a blackened plate in order to produce a force of 6.62×10^{-5}N?

B. At what rate will the temperature of plate rise if its mass is 19.86kg and specific heat is equal to $2500J\left(kgK^{-1}\right)$?

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9. A monochromatic beam of light $(\lambda = 4900A)$ incident normally upon a surface produces a pressure of $5 \times 10^{-7}Nm^{-2}$ on it. Assume that 25% of the light incident in reflected and the rest absorbed. Find the number of photons falling per second on a unit area of thin surface

A. 1×10^{23}

B. 2×10^{24}

C. 3×10^{20}

D. None of the above

Answer: C

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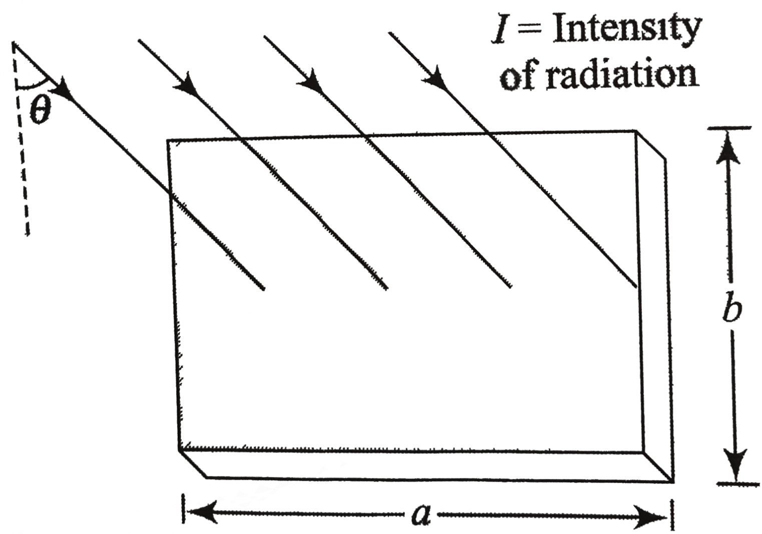
10. 

A plank of mass m is lying on a rough suface having coeffient of frinction as μ is situation as shown in fig Find the acceleration of the plank assuming that it slips and the surface of body exposed to radiaton is black body.

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11. 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.

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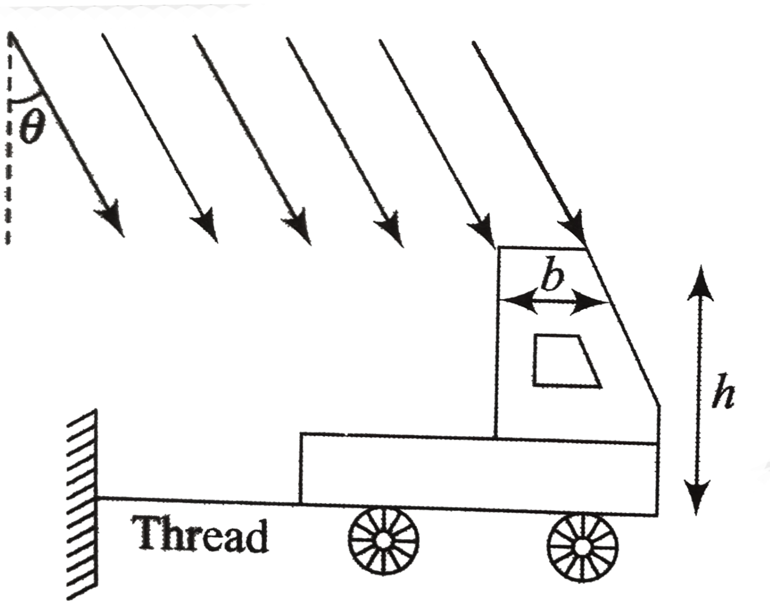
12. 

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.

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13. What is the de Broglie wavelength of the wave associated with an electron that has been accelerated through a potential difference of

50.0 V?

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14. What voltage must be applied to an elect-non microscope to produce electrons of wavelength $0.4A$?

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15. An electron and a photon have the same de Broglie wavelength. Which one of these has higher kinetic energy?

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16. A photon and an electron have the same de Broglie wavelength. Which has greater total energy? Explain

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17. The wavelength of light from the spectral emission line of sodium is 589 nm. Find the kinetic energy at which (a) an electron, and (b) a neutron, would have the same de Broglie wavelength.

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18. A. For what kinetic energy of neutron will the associated de Broglie wavelength be $1.40 \times 10^{-10} m$?

B. Also, find the de Broglie wavelength of a neutron, in thermal equilibrium with matter, having an average kinetic energy of $\left(\frac{3}{2}\right)$ kT at $300K$. Given the mass of neutron $= 1 : 66 \times 10^{-27} kg$ and $k = 1.38 \times 10^{-23} Jkg^{-1}$`.

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

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20. Determine the de Broglie wavelength of a proton, whose kinetice energy is equal to the rest of the mass energy of an electron. Given that the mass of an electron is 9×10^{-31} kg and the mass of a proton is 1837 times as that of the electron.

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21. The extent of localization of a particle is determined roughly by its de Broglie wave. If an electron is localized within the nucleus (of size about 10^{-14}m) of an atom, what is its energy? Compare this energy with the typical binding energies (of the order of a few MeV) in a nucleus and hence argue why electrons cannot reside in a nucleus.

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22. 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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23. What is the energy (in eV) of a photon of walelength $12400 A$?

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24. Will photoelectrons be emitted from a copper surface, of work function $4.4eV$, when illuminated by a visible light?

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

$\lambda_1 = 3650A^\circ, \lambda_2 = 4047A^\circ, \lambda_3 = 4358A^\circ, \lambda_4 = 5461A^\circ, \lambda_5 = 6907A^\circ$

The stopping voltages, respectively were measured to be:

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

(a) Determine the value of Planck's constant h.

(b) Estimate the threshold frequency and work function for the material.

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26. 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 $= 9.11 \times 10^{-31}$).

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27. The stopping potential for photoelectrons emitted from a surface illuminated by light wavelength of $5893A$ is $0.36V$. Calculate the maximum kinetic energy of photoelectrons, the work function of the surface, and the threshold frequency.

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28. When a surface is irradiated with light of wavelength $4950A$, a photoncurrent appears which vanishes if a retarding potential greater than 0.6 V is applied across the photo tube. When a different source of light is used, it is found that the critical retarding potential is changed to 1.1 V. Find the work function of the emitting surface and the wavelength of the second source. If the photoelectrons (after emission from the surface) are subjected to a magnetic field of 10 T, what chages will be observed in the above two retarding potentials?

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29. Calculate the valocity of a photoelectron 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 potentia is necessary to stop the emission of the electrons?

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30. 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 $1.0 cm^2$ 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.

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31. A photocell is operating in saturation mode with a photocurrent $4.8 mA$ when a monochromatic radiation of wavelength $3000\text{Å}$and power of $1 mW$ is incident. When another monochromatic radiation of wavelength 1650Å and power $5 mW$ 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.

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Examples

1. 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 $6 \times 10^{14} Hz$. (Given $h = 6.63 \times 10^{-34} Js$).

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2. Light of wavelength 2000Å falls on an aluminium surface . In aluminium $4.2eV$ of energy is required to remove an electron from its surface. What is the kinetic energy , in electron volt of (a) the fastest and (b) the slowest emitted photo-electron . (c) What is the stopping potential ? (d) What is the cut - off wavelength for aluminum? (Plank's constant $h = 6.6 \times 10^{-34} J - s$ and speed of light `c = 3 xx 10^(8) m s^(-1).

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3. 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 photons eject photoelectrons. Find the number of photoelectrons emitted per second

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4. a. A stopping potential of $0.82V$ is required to stop the emission of photoelectrons from the surface of a metal by light of eavelength $4000A$. For light of wavelength $3000A$, the stopping potential is $1.85V$. Find the value of Planck's constant. [1 electrons volt (eV) $= 1.6 \times 10^{-19} J$]

b. At stopping potential, if the wavelength of the incident light is kept fixed at $4000A$, but the intensity of light increases two times, will photoelectric current be botained ? Give reasons for your answer.

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5. 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.

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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.

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7. 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.)

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8. 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. $\left[Take, h = 4.14 \times 10^{-15} eV - s\right]$

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Exercise 3.1

1. Find the de Broglie wavelength of 2 MeV proton. Mass of proton $= 1.64 \times 10^{-27} kg, h = 6.625 \times 10^{-34} Js$

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2. Find the de Broglie wavlength of a neutron at 127° C Given that Boltzmann's constant $k = 1.38 \times 10^{-23} J \text{ molecule}^{-1} \ K^{-1}$. Planck's constant $= 6.625 \times 10^{-34} Js$, mass of neutron $= 1.66 \times 10^{-27} kg$.

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3. The intensity of direct sunlight before it passes through the earth's atmosphere is $1.4 kW / m^2$. If it is completely absorbed, find the corresponding radiation pressure.

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4. An electron is accelerated by a potential difference of 25 V. Find the de Broglie wavelength associated with it.

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5. Why are de Broglie waves associated with a moving football is not apparent to us?

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6. The de Broglie wavelength of a particel of kinetic energy K is λ. What will be the wavelength of the particle, if its kinetic energy is $\frac{K}{4}$?

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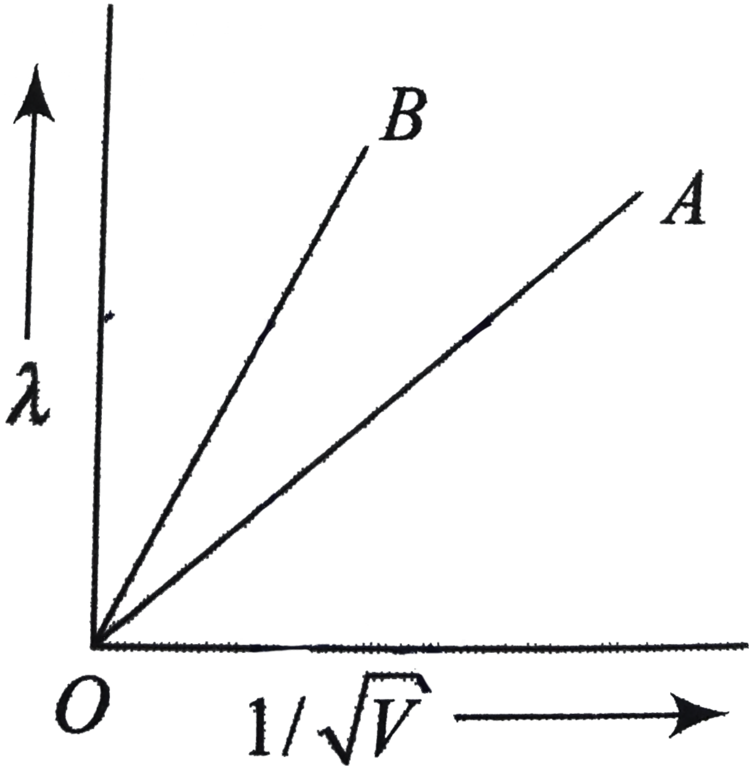

7.

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

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8. A helium-neon laser emits light of wavelength 632.8nm. Calculate the energy of each photon in electron volt.

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9. The energy flux of sunlight reaching the surface of the earth is $1.388 \times 10^3 Wm^{-2}$. The photons in the sunlight have an average wavelength of 550 nm.

How many photons per square metre are incident on the earth per second ?

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10. An electron and a photon each have a wavelength of 1.00 nm. Find (a) their momenta, (b) the energy of the photon, and (c) the kinetic energy of electron.

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11. For a given kinetic energy, which of the following has the smallest de Broglie wavelength : electron, proton and $\alpha - partic \leq$?

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12. A plate is kept in front of a beam of photons. The plate reflects 40% of the incident photons and absorbs the remainder. If the plate absorbs energy at a rate $1200 J^{-1} s$, find the net force acting on it.

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13. A sensor is exposed for 0.1 s to a 200 W lamp 10m away The sensor has an opening that is 20 mm in diameter. How many photons enter the sensor if the wavelength of light is 600nm? Assume that all the energy of the lamp is given off as light.

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14. Photons of wavelength $\lambda = 662$ nm are incident normally on a perfectly reflecting screen. Calculate their number of photons per second falling on the screen such that the exerted force is 1 N.

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15. A voltage applied to an X-ray tube being increased $\eta = 1.5$ times, the short wave limit of an x-ray continuous spectrum shifts by $\Delta\lambda = 26\text{pm}.$ Find the initial voltage applied to the tube.

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Exercise 3.2

1. Explain Briefly how classical theory could not explain the phenomenon of photoelectric effect

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

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

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4. 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.

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5. The maximum KE of photoelectrons emitted from a cetain metallic surface is 30 eV when monochromatic radiation of wavelength λ falls on it. When the same surface is illuminated with light of wavelength 2λ, the minimum KE of photoelectrons is found to be 10 eV. (a) Calculate the wavelength λ and (b) determine the maximum wavelength of incident radiation for which photoelectric emission is possible.

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6. A horizontal cesium plate$(\phi = 1.9eV)$ is moved vertically downward at a constant speed v in a room full of radiation of wavelength 250nm and above. What should be the minimum value of v so that the vertically upward component of velocity is nonpositive for each photoelectron?

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7. 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.

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8. A uniform monochromatic beam of light of wavelength 365×10^{-9}m and intensity $10^{-8} Wm^{-2}$ falls on a surface having absorption coefficient 0.8 and work function 1.6 eV. Determine the number of electrons emitted per square metre per second, power absorbed per m^2, and the maximum kinetic energy of emitted photo electrons.

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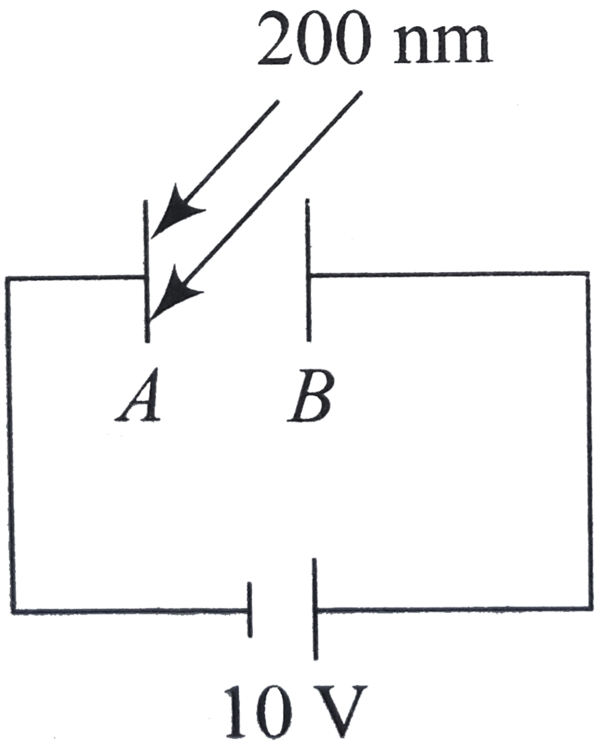
Subjective



1.

In Fig. electromagnetic radiations of wavelength 200nm are incident on a metallic plate A. the photoelectrons are accelerated by a potential difference of 10 V. These electrons strike another metal plate B from which electromagnetic radiations are emitted. The minimum wavelength of emitted photons is 100nm. If the work function of metal

A is found to be $\left(\times x10^{-1}\right)ev$, then find the value of x. (Given $hc = 1240eV$ nm)

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2. The path of photoelectrons emitted due to electromagnetic radiation incident on a sample of material A, is found to have a maximum bending radius of 0.1 m in a magnetic field of $\left(\frac{\sqrt{2}}{3}\right) \times 10^{-4}$T. When the radiation is incident normally on a double slit having a slit separation of 0.1mm, it is observed that there are 10 fringes in a width of 3.1 cm on a screen placed at a distance of 1 m from the double slit. Find the work function of the material. and the corresponding threshold wavelength. What sould be the wavelength of the incident light so that the bending radius is one-half of what it was before? Given that mass of the electron $= 0.5Me\frac{V}{c^2}$, $hc = 12400eV - A$

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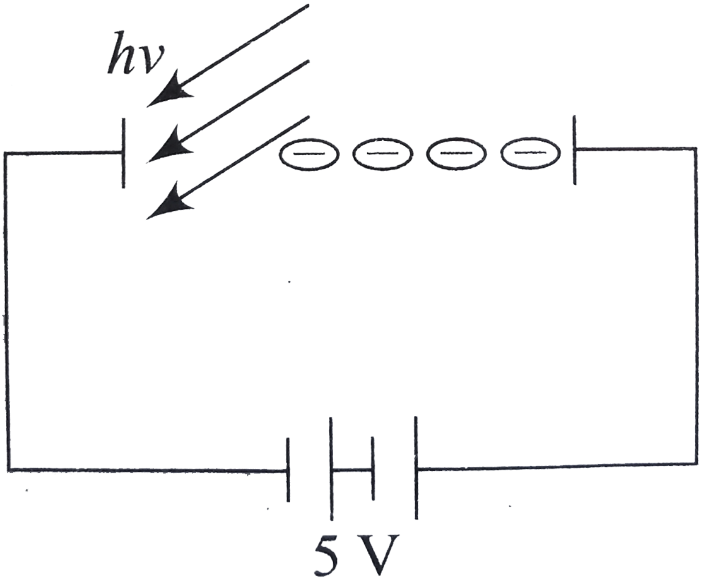

3.

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.

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4. A plane light wave of intenstiy $I = 0.20cm^{-2}$ falls on a plane mirror surface with reflection coefficient $\rho = 0.8$. The angle of incidence is

45°. In terms of corpuscular theory, find the magnitude of the normal pressure exerted on that surface.

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5. 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.

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6. When a surface is irradiated with light of wavelength $4950A$, a photocurrent appears which vanishes if a retarding potential greater than $0.6V$ is applied across the photo tube. When a different source of light is used, it is found that the critical retarding potential is changed to $1.1V$. Find the work function of the emitting surface and the wavelength of the second source.

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7. 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.

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8. A vacuum photocell consists of a central cathode and an anode. The internal surface is silver of work function 4.5 eV. The contact potential difference between the electrodes equals to 0.6 V. The photocell is illuminated by light of wavelength 2.3×10^{-7}m.

a. What retrading potential difference should be applied between electrodes of the photocell for the photocurrent to drop to zero?

b. If a retarding potential of 1V is applied between electrodes at what limiting wavelength λ of light incident on the cathode will on the cathode will the photoelectric effect begin?

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9. 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.

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10. A parellel beam of monochromatic light of wavelength 500 nm is incident normally on a perfectly absorbing surface. The power through any cross section of the beam is 10 W. Find

(a) the number of photons absorbed per second by the surface and

(b) the force exerted by the light beam on the surface.

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11. A uniform monochromatic beam of light of wavelength 365×10^{-9} m and intensity $10^{-8} W m^{-2}$ falls on a surface having absorption coefficient 0.8 and work function 1.6 eV. Determine the number of electrons emitted per square metre per second, power absorbed per m^2, and the maximum kinetic energy of emitted photo electrons.

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12. Calculate de Broglie wavelength for an average helium atom in a furnace at 400 K. Given mass of helium $= 4.002$amu.

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13. What amount of energy sould be added to an electron to reduce its de Broglie wavelength $\lambda_1 = 550nm$ incident on it, causing the ejection of photoelectrons for which the stopping potential is $V_{s1} = 0.19V$. If the radiation of wavelength $\lambda_2 = 190nm$ is now incident on the surface, (a) calculate the stopping potential V_{S2}, (b) the work function of the surface, and (c) the threshold frequency for the surface.

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14. What amount of energy should be added to an electron to reduce its de Broglie wavelength $\lambda_1 = 550nm$ incident on it, causing the ejection of photo-electrons for which the stopping potential is $V_{s1} = 0.19V$. If the radiation of wavelength $\lambda_2 = 190nm$ is now incident on the surface, (a) calculate the stopping potential V_{S2}, (b) the work function of the surface, and (c) the threshold frequency for the surface.

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15. 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.

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16. 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?

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Single Correct

1. The minimum orbital angular momentum of the electron in a hydrogen atom is

A. h

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

C. $\frac{h}{2\pi}$

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

Answer: C

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2. An electron beam accelerated from rest through a potential difference of 5000 V in vacuum is allowed to impinge on a surface normally. The incident current is $50\mu A$ and if the electrons come to rest on striking the surface the force on it is

A. $1.1924 \times 10^{-8} N$

B. $2.1 \times 10^{-8} N$

C. $1.6 \times 10^{-8} N$

D. $1.6 \times 10^{-6} N$

Answer: A

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3. 10^{-3} W of $5000A$ light is directed on a photoelectric cell. If the current in the cell is $0.16\mu A$, the percentage of incident photons which produce photoelectrons, is

A. 40%

B. 0.04%

C. 20%

D. 10%

Answer: B

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4. A certain metallic surface is illuminated with monochromatic light of wavelength λ. The stopping potential for photoelectric current for this light is $3V_{\circ}$. If the same surface is illuminated with light of wavelength 2λ, the stopping potential is V_0. The threshold wavelength for this surface for photoelectric effiect is

A. 6λ

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

C. 4λ

D. 8λ

Answer: C

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5. A particle of mass 10^{31}kg is moving with a velocity equal to $10^{5}ms^{-1}$. The wavelength of the particle is equal to

A. 0

B. $6.6 \times 10^{-8}m$

C. 0.66m

D. $1.5 \times 10^{7}m$

Answer: B

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6. 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. $\frac{4}{5} \times 10^8$

B. 2×10^8

C. 8×10^8

D. 20×10^8

Answer: C

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7. Light of wavelength 0.6 μm from a sodium lamp falls on a photocell and causes, the emission of photoelectrons for which the stopping potential is 0.5 V. With light of wavelength 0.4 μm from a sodium lamp,

stopping potential is 1.5V. With this data, the value of h/e is $(n \times 10^{-15})$ Vs. Find value of n.

A. $0.75eV$

B. $1.5eV$

C. $3eV$

D. $2.5eV$

Answer: B

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8. Ultraviolet light of wavelength 300nm 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. $9.61 \times 10^{14}s^{-1}$

B. $4.12 \times 10^{13} s^{-1}$

C. $1.51 \times 10^{12} s^{-1}$

D. $2.13 \times 10^{11} s^{-1}$

Answer: C

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9. Radiation of wavelength λ, is incident on a photocell. The fastest emitted electron has speed v. If the wavelength is changed to $\frac{3\lambda}{4}$, the speed of the fastest emitted electron will be :

A. $v\left(\frac{3}{4}\right)^{\frac{1}{2}}$

B. $v\left(\frac{4}{3}\right)^{\frac{1}{2}}$

C. less than $v\left(\frac{4}{3}\right)^{\frac{1}{2}}$

D. greater than $v\left(\frac{4}{3}\right)^{\frac{1}{2}}$

Answer: D

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10. Two identical photo-cathodes receive light of frequencies v_1 and v_2. If the velocities of the photoelectrons (of mass m) coming out are v_1 and v_2 respectively, then

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

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

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

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

Answer: B

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11. If the intensity of radiation incident on a photocell be increased four times, then the number of photoelectrons and the energy of photoelectrons emitted respectively become.

A. four times, doubled

B. doubled, remains unchanged

C. remains unchanged, double

D. four times, remains unchanged

Answer: D

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12. The work function of metal is W and λ is the wavelength of the incident radiation. There is no emission of photoelecrons when

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

B. $\lambda = \frac{hc}{W}$

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

D. $\lambda \leq \frac{hc}{W}$

Answer: A

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13. If a suface has work function of 3.00eV, the longest wavelength of light which will cause the emission of electrons is

A. 4.8×10^{-7}m

B. 5.99×10^{-7}m

C. 4.13×10^{-7}m

D. 6.84×10^{-7}m

Answer: C

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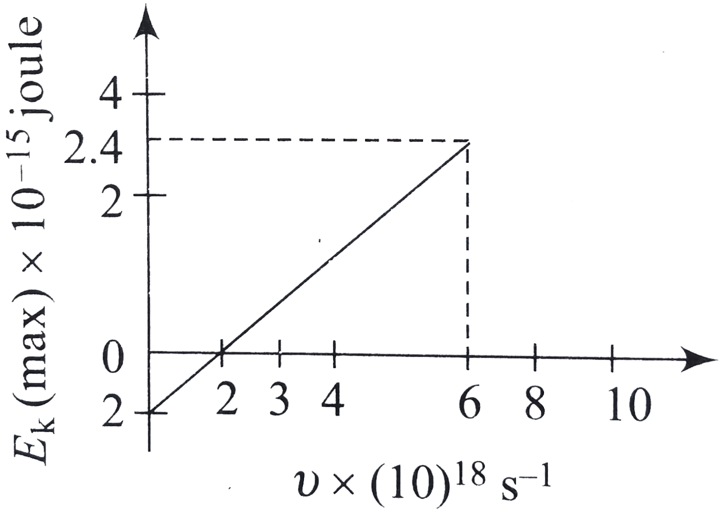
14.



In the experiment on photoelectric effect, the graph between $E_K(\text{ max })$ and v is found to be a straight line as sshoen in fig. The threshold frequency and Planck's constant according to this graph are

A. $3.33 \times 10^{18} s^{-1}$,$6 \times 10^{-34} J - s$

B. $6. .10^{18} s^{-1}$,$6 \times 10^{-34} J - s$

C. $2.66 \times 10^{18} s^{-1}$,$4 \times 10^{-34} J - s$

D. $4 \times 10^{18} s^{-1}$,$3 \times 10^{-34} J - s$

Answer: A

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15. Monochromatic light incident on a metal surface emits electrons with kinetic energies from zero to 2.6 eV. What is the least energy of the incident photon if the tightly bound electron needs 4.2eV to remove?

A. $1.6eV$

B. From $1.6eV \rightarrow 6.8eV$

C. $6.8eV$

D. More than $6.8eV$

Answer: C

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16. 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. the threshold frequency for sodium will be less than that for aluminium

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

C. both sodium and aluminium will have the same threshold frequency

D. none of the above

Answer: A

Watch Video Solution

17. 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. $\left(\frac{1}{16}\right)$th of original value

B. unchanged

C. twice the original value

D. four times the original value

Answer: B

Watch Video Solution

18. Representing the stopping potential V along y-axis and $\left(\frac{1}{\lambda}\right)$ along x-axis for a given photocathode, the curve is a straight line, the slope of which is equal to

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

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

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

D. $\frac{e}{W}$

Answer: B

Watch Video Solution

19. In the intercept on the y-axis is equal to

A. $+\frac{W}{e}$

B. $-\frac{W}{e}$

C. $-We$

D. $\frac{e}{W}$

Answer: B

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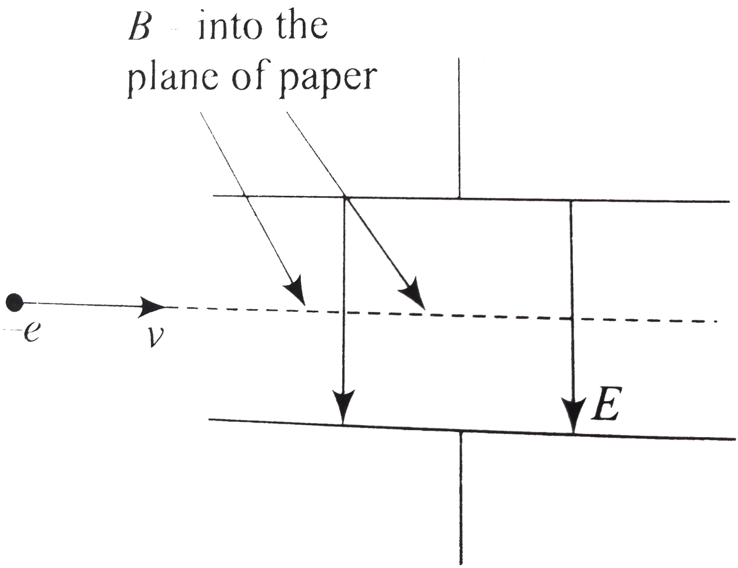

20.

Electrons taveling at a velocity of $2.4 \times 10^6 ms^{-1}$ enter a region of crossed electric and magnetic fields as shoen in Fig. If the electric field is 3.0×10^6 Vm and the flux density of the magnetic field is 1.5 T, the electrons upon entering the region of the crossed fields will

A. continue to travel undeflected in their original derection.

B. be deflected upward in the plane of the diagram

C. be deflected upward on the plane of the diagram

D. none of the above

Answer: C

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21. A surface irradiated with light of wavelength 480 nm gives out electrons with maximum velocity vms^{-1}, the cut off wavelength being 600 nm. The same surface would release electrons with maximum velocity $2vms^{-1}$ if it is irradiated by light of wavelength

A. 325 nm

B. 360nm

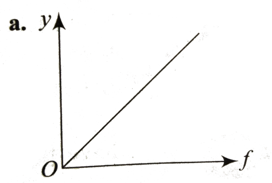
C. 384 nm

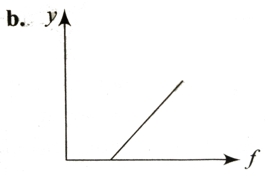
D. 300 nm

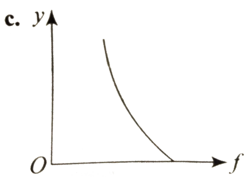
Answer: D

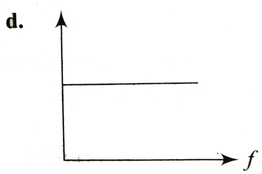
Watch Video Solution

22. In an experiment on the photoelectric effect, an evecuated photocell with a pure metal cothode is used. Which graph best represents the variation of B, the minimum potential defference needed to prevent current from flowing, when x, the frequency of the incident light, is varied?

A. 

B. 

C. 

D. 

Answer: B

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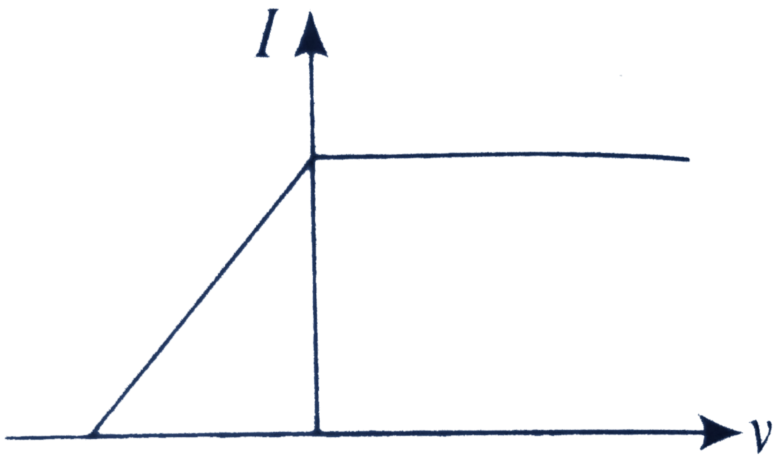
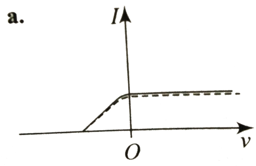
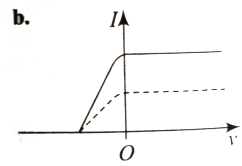
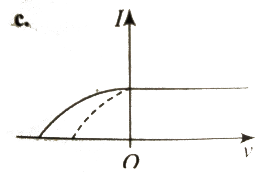


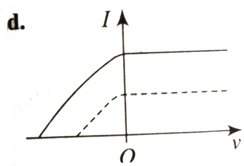
23.

A metal surface in an evacuated tube is illuminated with monochromatic light causing the emission of photoelectrons. For a given intensity of light, a graph between saturation current and potential of the electrode is given in Fig. If the experiment were repeated with light of twice the intensity but the same wavelength, which of the graphs below would best represent the new relation between I and V?(Dotted represents initial condition)

A. 

B. 

C. 

D. 

Answer: B

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

A. 0.3 eV

B. 1.3 eV

C. 2.3 eV

D. 5 eV

Answer: C

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25. The photoelectric threshold of a certain metal is $3000A$. If the radiation of $2000A$ is incident on the metal

A. electrons will be emitted

B. positrons will be emitted

C. protons will be emitted

D. electrons will no be emitted

Answer: A

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26. 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, the photoelectrons, as well as photoelectric current by a factor of 2

B. increase the maximum kinetic energy of the photoelectrons and would increase the photoelectric current by a factor of 2

C. increase the maximum kinetic energy of the photoelectrons by a factor of 2 and will gave no effect on the magnitude of the photoelectric current produced

D. not produce any effect on the kinetic energy of the emitted electrins but will increase the photoelectric current by a factor of 2

Answer: B

Watch Video Solution

27. The frequency of incident light falling on a photosensitive metal plate is doubled, the KE of the emitted photoelectrons is

A. double the earlier value

B. unchanged

C. more than doubled

D. less than doubled

Answer: C

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28. Two radiations of photons energies 1 eV and 2.5 eV, successively illuminate a photosensitive metallic surface of work function 0.5 eV. The ratio of the maximum speeds of the emitted electrons is -

A. $1:5$

B. $1:4$

C. $1:2$

D. $1:1$

Answer: C

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29. 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 volt

B. 4V vold

C. 2 V volt

D. $\left(\frac{V}{8}\right)$ volt

Answer: D

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30. Given that a photon of light of wavelength $10, 000A$ has an energy equal to 1.23 eV. When light of wavelength $5000A$ and intenstiy I_0 falls on a photoelectric cell, the saturation current is $0.40 \times 10^{-6}A$ and the stopping potential is 1.36V, then the work function is

A. 0.43eV

B. 1.10 eV

C. 1.36 eV

D. 2.47 eV

Answer: B

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31. In the previous question, if the intensity of light is made $4I_0$, then the stopping potential will become

A. $1.36 \times 1V$

B. $1.36 \times 2V$

C. $1.36 \times 3V$

D. $1.36 \times 4V$

Answer: A

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32. if the intensity of light is made $4I_0$, then the saturation current will become

A. $0.40 \times 1\mu A$

B. $0.40 \times 2\mu A$

C. $0.40 \times 4\mu A$

D. $0.40 \times 8\mu A$

Answer: C

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33. if the cathode and the anode are kept at the same potential, the emitted electrons have

A. the same KE equal to 1.36 eV

B. the average KE equal to $\left(\frac{1.36}{2}\right)$ eV

C. the maximum KE equal to 1.36 eV

D. the minimum KE equal to 1.36 eV

Answer: C

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34. if the wavelength is chaged from$4000A. \rightarrow 3000A$, then stopping potential will become

A. 1.36 V

B. 3.40 V

C. 1.60 V

D. 1.97 V

Answer: D

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35. A light source is at a distance d from a photoelectric cell, then the number of photoelectrons emitted from the cell is n. If the distance of light source and cell is reduced to half, then the number of photoelectrons emitted will become

A. each carry one-quarter of their previous momentum

B. each carry one-quarter of their previous energy

C. are one-quarter as numerous

D. are half as numerous

Answer: C

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36. 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. 1.4×10^{19}

B. 3×10^{3}

C. 1.4×10^{-19}

D. 3×10^{4}

Answer: A

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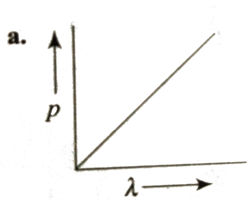
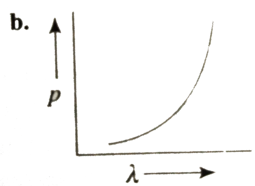
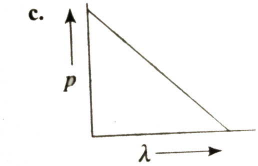
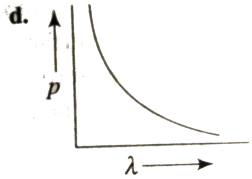
37. Which of following graphs correctly represents the variation of particle momentum with de-Broglie wavelength?

A. 

B. 

C. 

D. 

Answer: D

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38. Five volt of stopping potential is needed for the photoelectrons emitted out of a surface of work function 2.2 eV by the radiation of wavelength

A. $1719A$

B. $3444A$

C. $861A$

D. $3000A$

Answer: A

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39. The work function for tungsten and sodium are $4.5eV$ and $2.3eV$ respectively . If the threshold wavelength λ for sodium is 5460Å, the value of λ for tungsten is

A. $5893A$

B. $10683A$

C. $2791A$

D. $528A$

Answer: C

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40. In a series of photoelectric emission experiments on a certain metal surface, possible relationships between the following quantities were investigated: threshold frequency f_0, frequency of incident light f, light intensity P, photocurrent I, maximum kinetic energy of photoelectrons $T_{\max}$. Two of these quantities, when plotted as a graph of y against x, give a straight line through the origin. Which of the following correctly identifies x and y with the photoelectric quantities ?

A. x I y f_0

B. x f y f_0

C. x P y I

D. x P y $T_{\max}$

Answer: C

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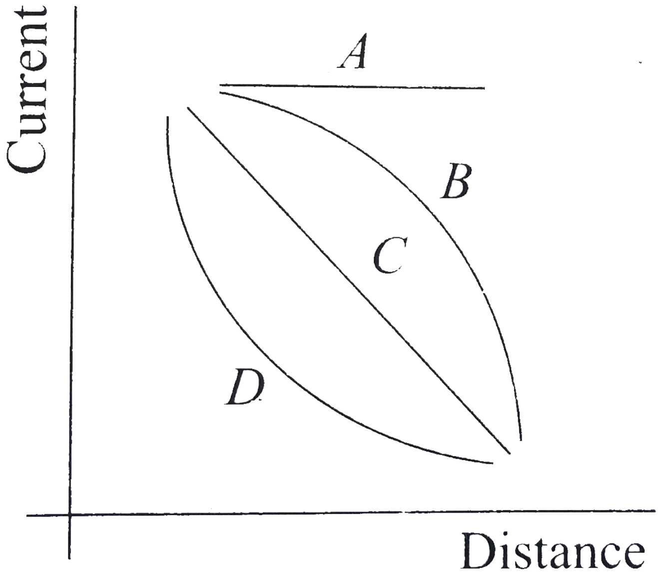

41.

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

A. bot p and E increase

B. p increases E decreases

C. p dereases and E increases

D. both p and E decreases

Answer: A

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43. Light from a hydrogen tube is incident on the cathode of a photoelectric cell the work function of the cathode surface is $4.2eV$. In order to reduce the photo - current to zero the voltage of the anode relative to the cathode must be made

A. $-4.2V$

B. $-9.4V$

C. $-17.8V$

D. $+9.4V$

Answer: B

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44. The photoelectric threshold for some material is 200 nm. The material is irradiated with radiations of wavelength 40 nm. The maximum kinetic energy of the emitted photoelectrons is

A. 2 eV

B. 1 eV

C. 0.5 eV

D. none of these

Answer: D

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45. The human eye can barely detect a yellow lings $(\lambda = 6000A)$ that delivers 1.7×10^{-18}W to the retina. The number of photons per second falling on the eye is nearest to

A. 5×10^{9}

B. 5000

C. 50

D. 5

Answer: D

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46. X-rays are used to irradiate sodium and copper surfaces in two separate experiments and stopping potential are determined. The stopping potential is

A. equal in both cases

B. greater for sodium

C. greater for copper

D. infinite in both cases

Answer: B

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47. An electron is accelerated through a potential difference of 200 volts. If e/m for the electron be 1.6×10^{11} coulomb/kg, the velocity acquired by the electron will be

A. $8 \times 10^{6} ms^{-1}$

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

C. $5.9 \times 10^{6} ms^{-1}$

D. $5.9 \times 10^{5} ms^{-1}$

Answer: A

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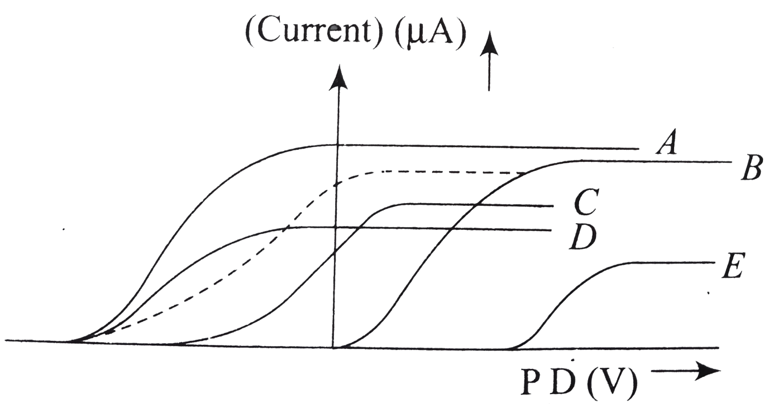
48.



A photoelectric cell is connected to a source of variable potential difference, connected across it and the photoelectric current resulting (μA) is plotted against the applied potential difference (V). The graph in the broken line represents one for a given frequency and intensity of the incident radiation . If the frequency is increased and the intensity is reduced, which of the following graphs of unbroken line represents the new situation?

A. A

B. B

C. C

D. D

Answer: D

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49. Photoelectric work function of a metal is $1eV$, light of wavelength $\lambda = 3000\text{Å}$ falls on it. The photoelectrons come out with velocity.

A. $10ms^{-1}$

B. $10^3 ms^{-1}$

C. $10^4 ms^{-1}$

D. $10^6 ms^{-1}$

Answer: D

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50. If a surface has a work function 4.0 eV, what is the maximum velocity of electrons liberated from the surface when it is irradiated with ultraviolet radiation of wavelength 0.2μm?

A. $4.4 \times 10^5 ms^{-1}$

B. $8.8 \times 10^7 ms^{-1}$

C. $8.8 \times 10^5 ms^{-1}$

D. $4.4 \times 10^7 ms^{-1}$

Answer: C

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51. An image of the sun is formed by a lens, of the focal length of 30 cm, on the metal surface of a photoelectric cell and a photoelectric current I is produced. The lens forming the image is then replaced by another of the same diameter but of focal length 15 cm. The photoelectric current in this case is

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

B. I

C. 2I

D. 4I

Answer: B

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52. A 200 W sodium street lamp emits yellow light of wavelength $0.6 \mu m$. Assuming it to be 25% efficient in coverting electrical energy to light, the number of photons of yellow light it emits per second is

A. 62×10^{20}

B. 3×10^{19}

C. 1.5×10^{20}

D. 6×10^{18}

Answer: C

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53. The work function of a metallic surface is 5.01 eV. The photoelectrons are emitted when light of wavelength $2000 A$ falls on it. The potential difference applied to stop the fastest photoelectrons is

A. 1.2 V

B. 2.24 V

C. 3.6 V

D. 4.8 V

Answer: A

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54. An electron of mass m_e and a proton of mass m_p are accelerated through the same potential difference. The ratio of the de Broglie wavelength associated with an electron to that associated with proton is

A. 1

B. $\frac{m_p}{m_e}$

C. $\frac{m_e}{m_p}$

D. $\sqrt{\frac{m_p}{m_e}}$

Answer: D

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55. A material particle with a rest mass m_o is moving with a velocity of light c. Then, the wavelength of the de Broglie wave associated with it is

A. $\left(\frac{h}{m_o c}\right)$

B. zero

C. ∞

D. $\left(\frac{m_o c}{h}\right)$

Answer: B

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56. If a photocell is illuminated with a radiation of $1240A$, then stopping potential is found to be 8 V. The work function of the emitter and the threshold wavelength are

A. a. 1 eV,$5200A$

B. b. 2 eV,$6200A$

C. c. 3 eV,$7200A$

D. d. 4 eV,$4200A$

Answer: B

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57. Silver has a work function of 4.7 eV. When ultraviolet light of wavelength 100 mm is incident upon it, a potential of 7.7 V is required to stop the photoelectrons from reaching the collector plate. How much potential will be required to stop the photoelectrons when light of wavelength 200mm is incident upon silver?

A. 1.5 V

B. 3.85 V

C. 2.35 V

D. 15.4 V

Answer: A

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58. The equation E=pc is valid

A. both

B. neither

C. photon only

D. electron only

Answer: C

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59. 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. 6λ

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

Answer: B

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60. Light of wavelength λ strikes a photoelectric surface and electrons are ejected with kinetic energy K. If K is to be increased to exactly twice its original value, the wavelength must be changed to λ' such that

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

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

C. $\lambda > \lambda' > \frac{\lambda}{2}$

D. $\lambda' = \frac{\lambda}{2}$

Answer: C

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61. The ratio of momenta of an electron and an α-particle which are accelerated from rest by a potential difference of 100 V is

A. 1

B. $\sqrt{\frac{2m_e}{m_\alpha}}$

C. $\sqrt{\frac{m_e}{m_\alpha}}$

D. $\sqrt{\frac{m_e}{2m_\alpha}}$

Answer: D

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62. The maximum kinetic energy of an electron is E when the incident wavelength is λ To increase the maximum kinetic energy of the electron to 2E the incident wavelength must be :

A. 2λ

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

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

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

Answer: C

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63. The KE of the photoelectrons is E when the incident wavelength is $\frac{\lambda}{2}$. The KE becomes 2E when the incident wavelength is $\frac{\lambda}{3}$. The work function of the metal is

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

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

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

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

Answer: A

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64. If λ_0 stands for mid-wavelength in the visible region, the de Broglie wavelength for 100 V electrons is nearest to

A. $\frac{\lambda_0}{5}$

B. $\frac{\lambda_0}{50}$

C. $\frac{\lambda_0}{500}$

D. $\frac{\lambda_0}{5000}$

Answer: D

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65. The threshold frequency for certain metal is v_0. When light of frequency $2v_0$ is incident on it, the maximum velocity of photoelectrons is $4 \times 10^6 ms^{-1}$. If the frequency of incident radiation is increaed to $5v_0$, then the maximum velocity of photoelectrons will be

A. $\frac{4}{5} \times 10^6 ms^{-1}$

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

C. $8 \times 10^6 ms^{-1}$

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

Answer: C

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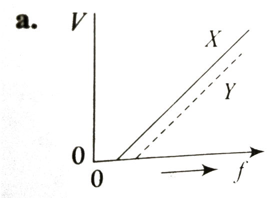
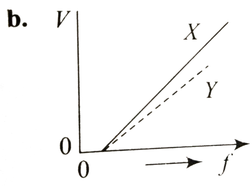
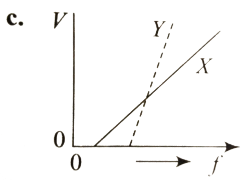
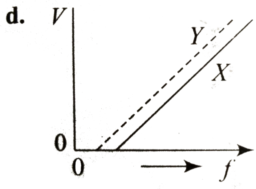
66. In a photoelectric emission, electrons are ejected from metals X and Y by light of frequency f. The potential difference V required to stop the electrons is measured for various frequencies.. If Y has a greater work function than X, which graph illustrates the expected results?

A. 

B. 

C. 

D. 

Answer: A

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67. In a photoelectric cell, the wavelength of incident light is chaged from $4000A$ to $3600A$. The change in stopping potential will be

A. 0.14 V

B. 0.24 V

C. 0.35 V

D. 0.44 V

Answer: C

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68. When a metallic surface is illuminated by a light of frequency 8×10^{14}Hz, photoelectron of maximum energy 0.5 eV is emitted. When the same surface is illuminated by light of frequency 12×10^{14} Hz, photoelectron of maximum energy 2 eV is emitted. The work function is

A. 0.5 eV

B. 2.85 eV

C. 2.5 eV

D. 3.5 eV

Answer: C

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69. The de Broglie wavelength of neutrons in thermal equilibrium is (given $m_n = 1.6 \times 10^{-27}$kg)`

A. $\frac{30.8}{\sqrt{T}}A$

B. $\frac{3.08}{\sqrt{T}}A$

C. $\frac{0.308}{\sqrt{T}}A$

D. $\frac{0.0308}{\sqrt{T}}A$

Answer: A

Watch Video Solution

70. A partical of mass M at rest decays into two Particles of masses m_1 and m_2 having non-zero velocities. The ratio of the de - Broglie wavelengths

of the particles $\lambda_1 \mid \lambda_2$ is

(a) m_1 / m_2 (b)m_2 / m_1 (c) 1 (d)$\sqrt{2} / \sqrt{1}$

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

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

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

D. $1:1$

Answer: D

Watch Video Solution

71. What is the energy of a proton possessing wavelength $0.4A$?

A. 0.51 eV

B. 1.51 eV

C. 10.51 eV

D. 100.51 eV

Answer: A

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72. An electron and a photon possess the same de Broglie wavelength. If E_e and E_ph are, respectively, the energies of electron and photon while v and c are their respective velocities, then $\frac{E_e}{E_{ph}}$ is equal to

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

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

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

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

Answer: B

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73. In Q.72,An electron and a photon possess the same de Broglie wavelength. If E e and E p h are, respectively, if the velocity of electron is 25% of the velocity of photon, then $\frac{E_e}{E_{ph}}$ equals

A. 0.04356

B. 0.044

C. 0.0472

D. 0.125

Answer: D

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74. An electron and a photon, each has a wavelength of $1.2A$. What is the ratio of their energies?

A. 0.0486111111111111

B. $1:10^2$

C. $1:10^3$

D. $1:10^4$

Answer: B

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75. What is the wavelength of a photon of energy 1 eV?

A. $12.4 \times 10^3 A$

B. $2.4 \times 10^3 A$

C. $0.4 \times 10^2 A$

D. $1000 A$

Answer: A

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76. If λ_1 and λ_2 denote the wavelength of de Broglie waves for electrons in the first and second Bohr orbits in a hydrogen atom, the $\frac{\lambda_1}{\lambda_2}$ is equal to

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

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

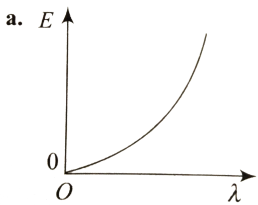
C. $\frac{1}{4}$

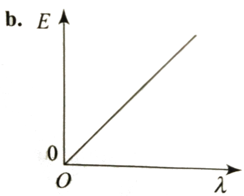
D. $\frac{4}{1}$

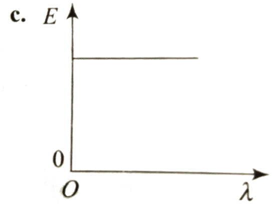
Answer: B

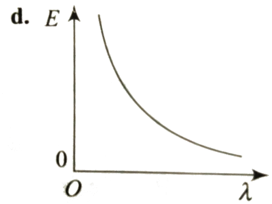
Watch Video Solution

77. Which curve shows the relation ship between the energy R and the wavelength λ of a photon of electromagnetic radiation?

A. 

B. 

C. 

D. 

Answer: D

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78. Work function of nickel is 5.01 eV. When ultraviolet radiation of wavelength $200A$ is incident of it, electrons are emitted. What will be the maximum velocity of emitted electrons?

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

B. $6.46 \times 10^5 ms^{-1}$

C. $10.36 \times 10^5 ms^{-1}$

D. $8.54 \times 10^6 ms^{-1}$

Answer: B

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79. An electron is accelerated through a potential difference of V volt. It has a wavelength λ associated must be accelerated so that its de Broglie wavelength is the same as the of a proton? Take mass of proton to be 1837 times larger than the mass of electron.

A. V volt

B. 1837V volt

C. $\frac{V}{1837}$ volt

D. $\sqrt{1837V}$ volt

Answer: C

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80. The kinetic energy of most energetic electrons emitted from a metallic surface is doubled when the wavelength λ of the incident radiation is changed from 400 nm to 310 nm. The work function of the metal is

A. 0.9 eV

B. 1.7 eV

C. 2.2 eV

D. 3.1 eV

Answer: C

Watch Video Solution

81. How many photons are emitted per second by a 5 m W laser source operating at 632.8nm?

A. 1.6×10^{16}

B. 1.6×10^{13}

C. 1.6×10^{10}

D. 1.6×10^{3}

Answer: A

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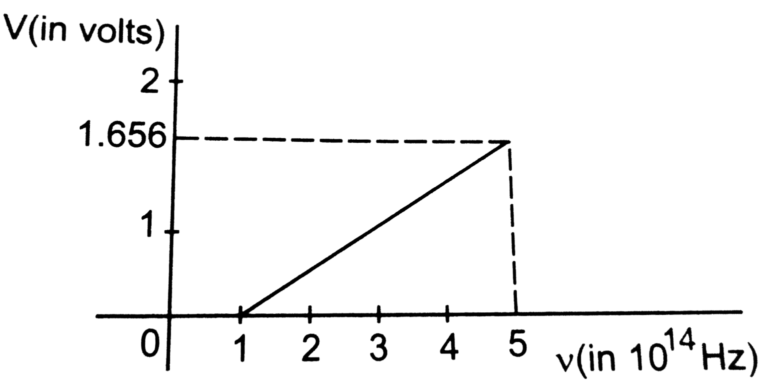
82. Figure is the plot of the stopping potential versus the frequency of the light used in an experiment on photoelectric effect. Find (a) the ratio h/e and (b) the work function.



A. $10^{-15} Vs^{-15} Vs$

B. $2 \times 10^{-15} Vs$

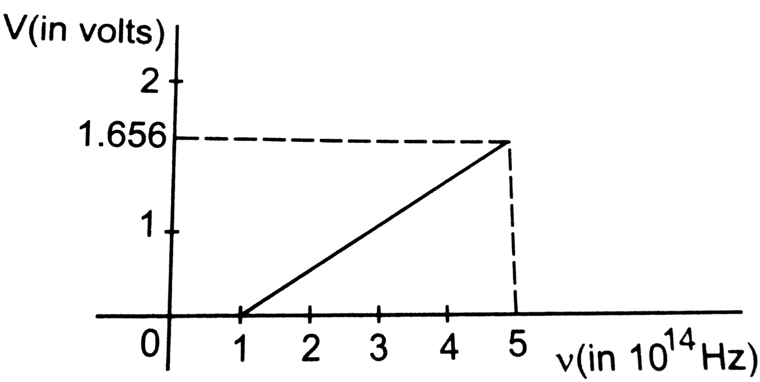
C. $3 \times 10^{-15} Vs$

D. $4.14 \times 10^{-15} Vs$

Answer: D

Watch Video Solution

83. Figure is the plot of the stopping potential versus the frequency of the light used in an experiment on photoelectric effect. Find (a) the ratio h/e and (b) the work function.



A. 0.212 eV

B. 0.313 eV

C. 0.414 eV

D. 0.515 eV

Answer: C

Watch Video Solution

84. Two identical metal plates show photoelectric effect. Light of wavelength λ_A falls on plate A and λ_B fall on plate B $lama_A = 2\lambda_B$, The maximum KE of the photoelectrons are K_A and K_B, respectively, Which one of the following is true?

A. $2K_A = K_B$

B. $K_A = 2K_B$

C. $\left(K_A < \frac{K_B}{2}\right)$

D. $K_A > 2K_B$

Answer: C

Watch Video Solution

85. The potential difference applied to an X-ray tube is V The ratio of the de Broglie wavelength of electron to the minimum wavlength of X-ray is directrly proportional to

A. V volt

B. $\sqrt{V}$

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

D. $V\left(\frac{7}{2}\right)$

Answer: B

Watch Video Solution

86. The maximum velocity of the photoelectrons emitted from the surface is v when light of frequency n falls on a metal surface. If the incident frequency is increased to 3n, the maximum velocity of the ejected photoelectrons will be

A. 2v

B. $> 2v$

C. $< 2v$

D. between2v and 4v

Answer: B

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87. A homogeneous ball (mass=m) of ideal black material at rest is illuminated with a radiation having a set of photons (wavelength $= \lambda$), each with the same momentum and the same energy. The rate at whoch photons fall on the ball is n. the linear acceleration of the ball is

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

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

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

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

Answer: B

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88. The eye can detect 5×10^4 photons $(m^2 s)^{-1}$ 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. Eye is more sensitive and by a factor of 5.00

B. Ear is more sensitive by a factor of 5.00

C. Both are equally sensitive

D. Eye is more sensitive by a factor of 10^{-1}

Answer: A

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89. A photon of wavelength $0.1A$ is emitted by a helium atom as a consequence of the emission of photon. The KE gained by helium atom is

A. 0.05eV

B. 1.05 eV

C. 2.05 eV

D. 3.05 eV

Answer: C

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90. A monochromatic source of lightis placed at a large distance d From a metal surface. Photoelectrons are ejected at rate n, the kinetic energy being E. If the source is brought nearer to distance $\frac{d}{2}$, the rate and kinetic energy per photoelectron become nearly

A. 2n and 2E

B. 4n and 4E

C. 4n and E

D. n and 4E

Answer: C

Watch Video Solution

91. A. How many photons of a tradiation of wavelength $\lambda = 5 \times 10^{-7}$ m must fall per second on a blackened plate in order to produce a force of 6.62×10^{-5}N?

A. 3×10^{19}

B. 5×10^{22}

C. 2×10^{22}

D. 1.67×10^{18}

Answer: B

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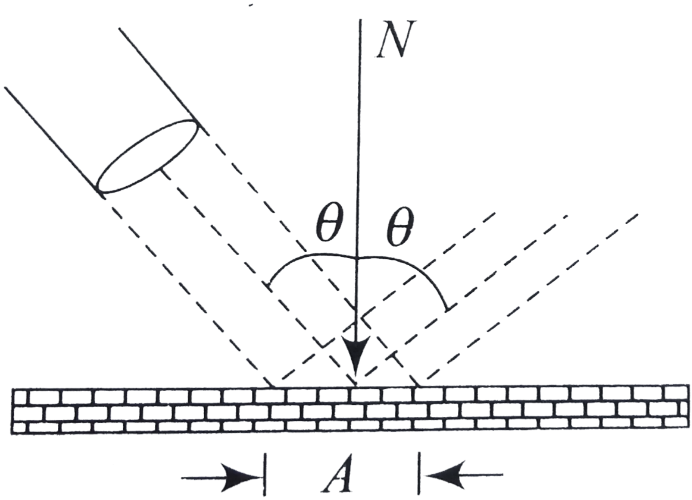
92.



A nozzle throws a stream of gas against a wall with a velocity v much larger than the thermal agitation of the molecules. The wall deflects the molecules without changing the magnitude of their velocity. Also, assume that the force exerted on the wall by the molecules is perpendicular to the wall. (This is not strictly true of a rough wall). Find the force exerted on the wall

A. $Anmv^2 \cos^2 \theta$

B. $2Anmv^2 \cos^2 \theta$

C. $2nmv^2 \sin^2 \theta$

D. $Anmv^2 \cos \theta$

Answer: B

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93. A plane light wave of intensity $I = 0.20 W cm^{-2}$ falls on a plane mirror surface with reflection coefficient $\rho = 0.8$. The angle of incidence is 45°. In terms of corpuscular theory, find the magnitude of the normal pressure exerted on that surface.

A. $1.2 N cm^{-2}$

B. $0.2 N cm^{-2}$

C. $2.6 N cm^{-2}$

D. $0.5 N cm^{-2}$

Answer: D

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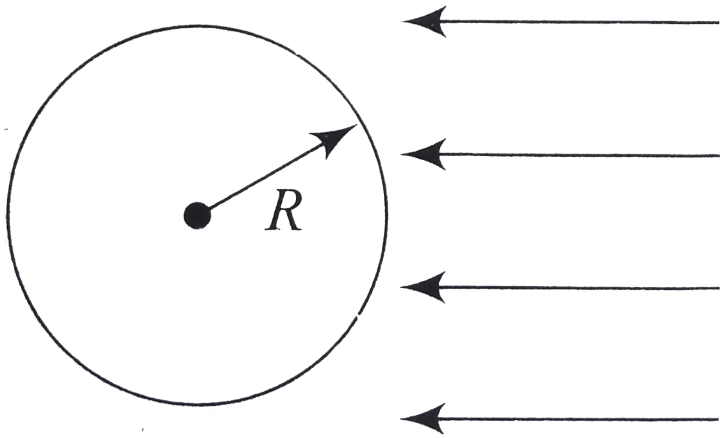

94.

A plane wave of intensity $I = 0.70 W cm^{-2}$ illuminates a sphere with ideal mirror surface. The radius of sphere is $R = 5.0 cm$. From the standpoint of photon theory, find the force that light exerts on the sphere.

A. $0.8 \mu N$

B. $0.2 \mu N$

C. $0.5 \mu N$

D. $1.2 \mu N$

Answer: A

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95. Light of wavelength λ from a small 0.5 mW He-Ne laser source, used in the school laboratory, shines from a spacecraft of mass 1000 kg. Estimate the time needed for the spacecraft to reach a velocity of $1.0km^{-1}$ from rest. The momentum p of a photon of wavelength λ is given by $p = \frac{h}{\lambda}$, where h is Planck's constant.

A. $6. .10^{18}$

B. 3×10^{17}

C. 6×10^{17}

D. 2×10^{15}

Answer: C

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96. An electron is accelerated by a potential difference of 50 V. Find the de Broglie wavelength associated with it.

A. 2.7×10^{-10}

B. $1.74 \times 10 =^{-10}$

C. 3.6×10^{-9}

D. 4.9×10^{-11}

Answer: B

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97. 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.

A. $2:0$

B. $3:4$

C. $5:7$

D. $1:2$

Answer: D

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

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

B. $3:2$

C. $3\sqrt{2}:1$

D. $2:1$

Answer: A

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99. 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. 2 eV

D. 2.2 eV

Answer: D

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100. 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. $0.3A$

B. $3A$

C. $30A$

D. $10A$

Answer: A

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101. In a photoelectric effect, electrons are emitted

A. with a maximum velocity proportional to the frequency of the incident radiation

B. at a rate that is independent of the intensity of the incident radiation

C. only if the frequency of the incident radiation is above a certain threshold value

D. only if the temperature of the emitter is high

Answer: C

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102. 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. $\frac{h}{mu\sin\theta}$

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

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

Answer: B

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103. A 60 W bulb is placed at a distance of 4 m from you. The bulb is emtting light of wavelength 600 nm uniformly in all directions. In 0.1 s, how many photons enter your eye if the pupil of the eye is having a diameter of 2mm? [take $hc = 1240eV - nm$]

A. 2.84×10^{12}

B. 2.84×10^{11}

C. 9.37×10^{11}

D. 6.48×10^{11}

Answer: B

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104. Two electrons are moving with non-relativistic speeds perpendicular to each other. If corresponding de Broglie wavelengths are λ_1 and λ_2 their the Brogile wavelength in the frame of reference attached to their centre of mass is :

A. $\lambda_1 + \lambda_2$

B. $\frac{2\lambda_1\lambda_2}{\left(\sqrt{\lambda_1^2 + \lambda_2^2}\right)}$

C. $\frac{\lambda_1\lambda_2}{\left(\sqrt{|\lambda_1^2 + \lambda_2^2|}\right)}$

D. $\frac{(\lambda_1 + \lambda_2)}{2}$

Answer: B

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105. A photosensitive material is at 9m to the left of the origin and the source of light is at 7 m to the right of the origin along x-axis.The photosensitive material and the source of light start from rest and move, respectively, with $8\hat{i} ms^{-1}$ and $4\hat{i} ms^{-1}$. The ratio of intensities at $t = 0$ to $t - 3s$ as received by the photosensitive material

A. $16 : 1$

B. $1 : 16$

C. $2 : 7$

D. $7 : 2$

Answer: B

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106. A sodium metal piece is illuminated with light of wavelength 0.3 μm. The work function of sodium is 2.46 eV. For this situation ,mark out the correct statement (s).

A. The maximum kinetic energy of the ejected photoelectrons is 1.68 eV

B. The cut-off wavelength for sodium is 505 nm

C. The minimum photon energy of incident light for photoelectric effect to take place is 2.46 eV

D. All of the above

Answer: D

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107. The kinetic energy of a particle is equal to the energy of a photon. The particle maves at 5% of the speed of light . The ratio of the photon wavelength to the de Broglie wavelength of the particle is [No nee to use reletivistic formula for particle.]

A. 40

B. 4

C. 2

D. 80

Answer: A

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108. The resolving power of an electron microscope operated at 16kV is R. The resolving power of the electron microscope when operated at 4kV is

A. $\frac{R}{4}$

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

C. $4R$

D. $2R$

Answer: B

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109. With respect to electromegnetic theory of light, the photoelectric effect is best explained by statement

A. Light waves carry energy and when light is incident on the metallic surface, the energy absorbed by the metal may somehow concentrate on individual electrons and reappear as their kinetic energy when ejected

B. Particles of light (photons) collide with the metal and the electrons take this energy and may eject

C. When light waves fall on a metallic surface, the stability of atoms is disturbed and the electrons come out to make the system stable

D. none of the above

Answer: A

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110. Two protons are having same kinetic energy. One proton enters a uniform magnetic field at right angles ot it. Second proton enters a uniform electric field in the direction of field. After some time their de Broglie wavelengths are λ_1 and λ_2 then (a) $\lambda_1 = \lambda_2$ (b) $\lambda_1 < \lambda_2$ (c) $\lambda_1 > \lambda_2$ (d) some more information is required

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111. The energy of a photon is equal to the kinetic energy of a

proton. The energy of the photon is E. Let $\lambda_1$be the de-Broglie wavelength of the

proton and λ_2 be the wavelength of the photon. The ratio $\dfrac{\lambda_1}{\lambda_2}$ is proportional to

(a)E^0 (b) $E^{1/2}$ (c) E^{-1} (d)E^{-2}

A. E^0

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

C. E^{-1}

D. E^{-2}

Answer: B

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112. Up to what potential V can a zinc ball (work function 3.74 eV) removed from other bodies be charged by irradiating it with light of $\lambda = 200nm$?

A. 2.5 V

B. 1.8 V

C. 2.2 V

D. 3 V

Answer: A

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

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

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

Answer: A

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114. A photon has same wavelength as the de Broglie wavelength of electrons. Given $C = speedoflight$, $v =$ speed of electron. Which of the followitg relation is correct? [Here $E_e =$ kinetic energy of electron, $E_{ph} =$ energy of photon, $P_e =$ momentum of electron and $P_{ph} =$ momentum of photon]

A. $\frac{E_e}{E_{ph}} = \frac{2C}{v}$

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

C. $\frac{P_e}{P_{ph}} = \frac{2C}{v}$

D. $\frac{P_e}{P_{ph}} = \frac{C}{v}$

Answer: B

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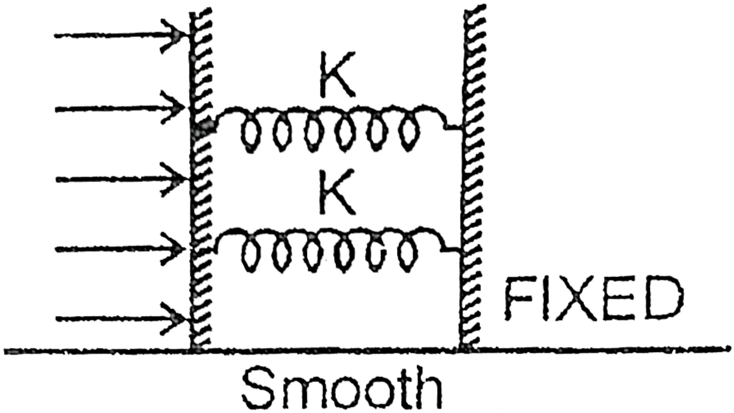
115. Light of intensity I is incident perpendicularly on a perfectly reflecting plate of area A kept in a gravity free space. If the photons strike the plate symmetrically and initially the springs were at natural lengths, what is the maximum compression



A. $\frac{IA}{Kc}$

B. $\frac{2IA}{3Kc}$

C. $\frac{3IA}{Kc}$

D. $\frac{4IA}{3Kc}$

Answer: D

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116. The de Broglie wavelength of a thermal neutron at $927^\circ C$ is λ. Its wavelength at $27^\circ C$ will be

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

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

C. $\lambda\sqrt{2}$

D. 2λ

Answer: C

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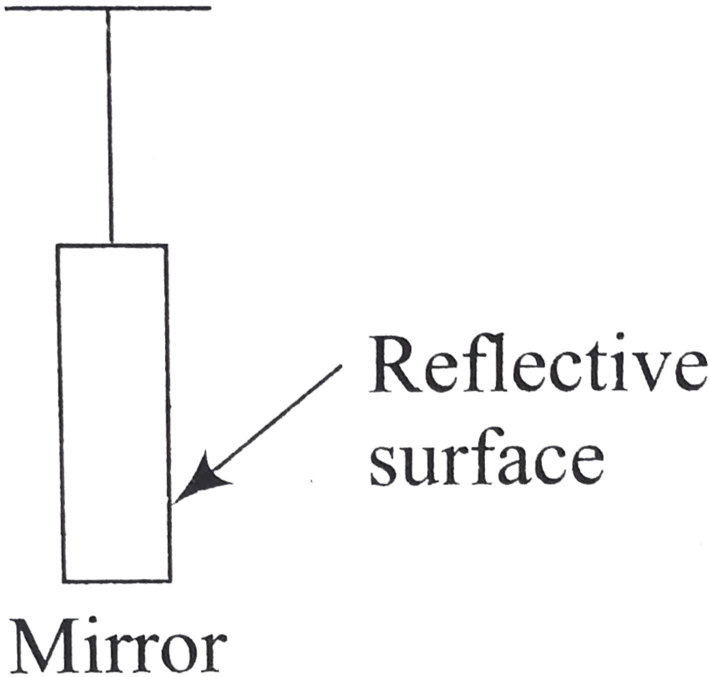

117.

A small mirror of mass m is suspended by a light thread of length l. A short polse of laser falls on the mirror with energy E. Then, whoch of the following statement is correct?

A. If the pulse falls normally on the mirror, it deflects by

$$\theta = \frac{2E}{\left(mc\sqrt{2gl}\right)}$$

B. If the pulse falls normally on the mirror, it deflects by

$$\theta = \frac{2E}{\left(mc\sqrt{2g}\right)}$$

C. Impulse in thread depends on angle at which the pulse falls on the mirror

D. None of the above

Answer: C

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118. A particle of mass 3m at rest decays into two particles of masses m and 2m having non-zero volocities. The ratio of the de-Broglie wavelength of the particles $\left(\frac{\lambda_1}{\lambda_2}\right)$ is

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

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

C. 2

D. none of these

Answer: D

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119. The radius of seocnd orbit of an electron in hydrogen atom is $2.116 eV Å$ The de-Broglie wavlength associated with this electron in this orbit would at t=25 s is

A. $6.64 A$

B. $1.058 A$

C. $2.116 A$

D. $13.28 A$

Answer: A

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120. Radiation of wavelength 546 nm falls on a photo cathode and electrons with maximum kinetic energy of 0.18 eV are emitted. When radiation of wavelength 185 nm falls on the same surface, a (negative) stopping potential of 4.6 V has to be applied to the collector cathode to reduce the photoelectric current to zero. Then, the ratio $\frac{h}{e}$ is

A. $6.6 \times 10^{-15} JsC^{-1}$

B. $4.14 \times 10^{-15} JsC^{-1}$

C. $6.6 \times 10^{-34} JsC^{-1}$

D. $4.12 \times 10^{-34} JsC^{-1}$

Answer: B

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121. The human eye is most sensitive to green light of wavelength 505 nm. Experiments have found tthat when people are kept in a dark room until their eye adapt to the darkness, a single photon of green light will trigger receptor cells in the rods of the retina. The velocity of typical bacterium of mass 9.5×10^{-12}g, if it had absorbed all energy of photon ,is nearly

A. $10^{-6} ms^{-1}$

B. $10^{-8} ms^{-1}$

C. $10^{-10} ms^{-1}$

D. $10^{-13} ms^{-1}$

Answer: D

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122. The light sensitive compound on most photographic films is silver bromide AgBr. A film is exposed when the light energy of dissociation of AgBr is $10^5 Jmol^{-1}$. For a photon that is just able to dissociate a molecule of AgBr, the photon energy is

A. 1.04 eV

B. 2.08 eV

C. 3.12 eV

D. 4.16 eV

Answer: A

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123. Photoelectric effect supports quantum nature of light because

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

B. the maximum KE of photoelectrons depends only on the frequency of light and not on its intensity

C. even when the metal surface is faintly illuminated by light of wavelength less than the threshold wavelength, the photoelectrons leave the surface immediately

D. electric charge of photoelectrons is quantized

Answer: A::B::C

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124. A point source of light is taken away from the experimental setup of photoelectric effect. For this situation, mark out the correct statement (s).

A. Saturation photocurrent decreases

B. Saturation photocurrent increases

C. Stopping potential remains the same

D. Stopping potential increases

Answer: A::C

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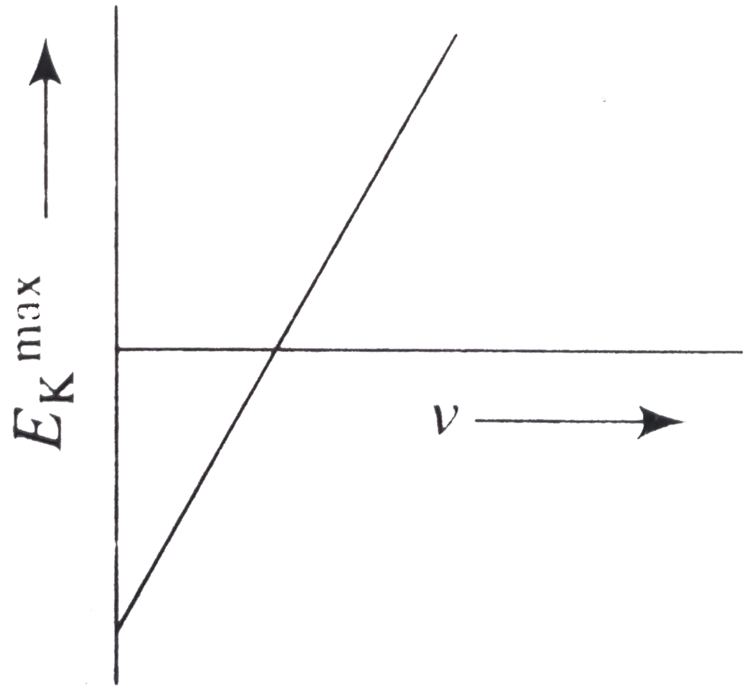

125.

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. work function of the cathode-metal

B. threshold frequency

C. Planck's constant

D. charge on an electron

Answer: A::B::C

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126. 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 decrease

B. the cut off potential will increase

C. the photoelectric current will increase

D. the kinetic energy of the emitted electrons will increase

Answer: B::D

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127. When a point light source of power W emitting monochromatic light of wavelength λ is kept at a distance α from a photo-sensitive surface of work function ϕ and area S, we will have

A. number of photons striking the surface per unit time as $\frac{W\lambda S}{4}\pi hca^2$

B. the maximum energy of the emitted photoelectrons as $\left(\frac{1}{\lambda}\right)(hc-\lambda_{\phi})$

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

D. photo emission only if λ lies in the range $0 \leq \lambda \leq \left(\frac{hc}{\phi}\right)$

Answer: A::B::D

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128. 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 transferred to the screen during a 1000 s interval, then

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

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

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

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

Answer: B::D

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129. When photons of energy $\frac{hc}{\lambda}$ fall on a metal surface, photoelectrons are ejected from it. If the work function of the surfacei s hv_0, then

A. maximum kinetic energy of the electron is $\left[\left(\frac{hc}{\lambda}\right) - hv_0\right]$

B. maximum kinetic energy of the photoelectron is equal to $\left(\frac{hc}{\lambda}\right)$

C. minimum KE of the photoelectron is zero

D. minimum kinetic energy of the photoelectron is equal to $\frac{hc}{\lambda}$

Answer: A::C

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130. Threshold wavelength of certain metal is λ_0 A radiation of wavelength $\lambda < \lambda_0$ is incident on the plate. Then, choose the correct statement from the following.

A. Initially electrons will come out from the plate

B. The ejected electrons experience retarding force due to development of positive charges on the plate

C. After some time, ejection of electrons stops

D. None of the above

Answer: A::B

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Multiple Correct

1. When barium is irradiated by a light of $\lambda = 4000 A$ all the photoelectrons emitted are bent in a circle of radius 50 cm by a magnetic field of flux density 5.26×10^{-6} T acting perpendicular to plane of emission of photoelectron. Then,

A. the kinetic energy of fastest photoelectrin is 0.6 eV

B. work function of the metal is 2.5 eV

C. the maximum velocity of photoelectron is $0.46 \times 10^{6} ms^{-1}$

D. the stopping potential for photoelectric effect is 0.6 V

Answer: A::B::C::D

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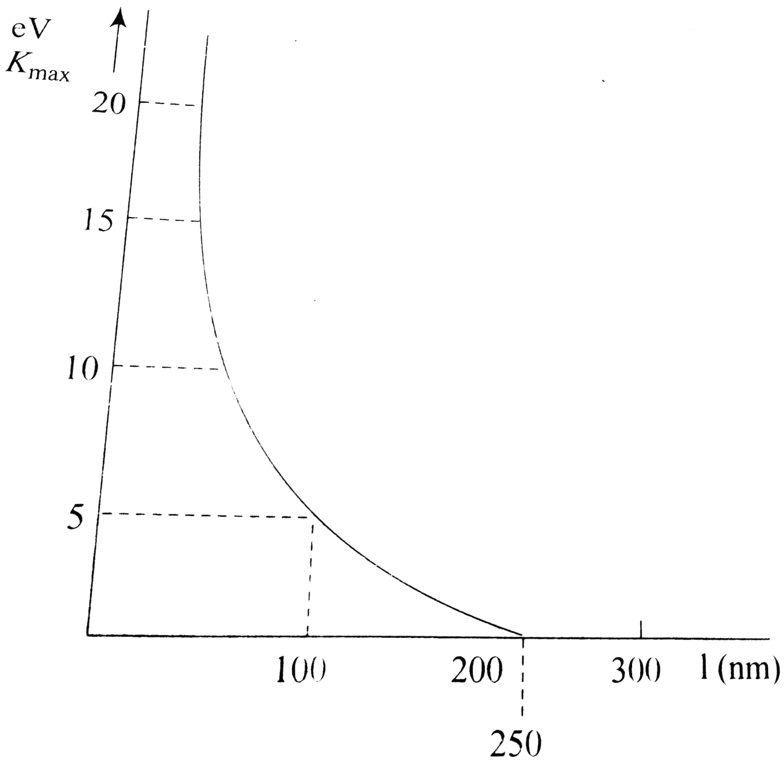

2.

In a photoelectric effect experiment , the maximum kinetic energy of the ejected photoelectrons is measured for various wavelength of the incident light. Figure shows a graph of this maximum kinetic energy $K_{\max}$ as a function of the wavelength λ of the light falling on the surface of the metal. Which of the following statement/i is/ are correct?

A. Threshold frequency for the metal is $1.2 \times 10^{15} m$

B. Work function of the metal is 4.968 eV

C. Maximum kinetic energy of photoelectrons corresponding to light of wavelength 100 nm is nearly 7.4 eV

D. Photoelectric effect takes place with red light

Answer: A::B::C

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3. 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. the energy of each photon is $3.048 \times 10^{-19} J$

B. the energy content in each pulse is 12mJ

C. the number of photons in each pulse is nearly 4×10^{15}

D. the energy of each photon is nearly 1.9 eV

Answer: A::B::C::D

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4. A proton and an electron both have energy 50 eV.

Statement I: Both have different wavelength.

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

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 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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5. 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.

Statement:I Though light of a single frequency (monochromatic light) is incident on a 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.

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6. 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, 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 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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7. Photoelectric threshold of silver is $\lambda = 3800A$. Ultraviolet light of $\lambda = 2600A$ is incident of a silver surface.(Mass of the electron $9.11 \times 10^{-31} kg)$`

1. Calculate the value of work function is eV.

A. 1.77

B. 3.27

C. 5.69

D. 2.32

Answer: B

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8. Photoelectric threshold of silver is $\lambda = 3800A$. Ultraviolet light of $\lambda = 2600A$ is incident of a silver surface.(Mass of the electron $9.11 \times 10^{-31}kg$)`

3. Calculate the maximum velocity of the photoelectrons.

A. 1.51

B. 2.36

C. 3.85

D. 4.27

Answer: A

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9. 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. 71.89×10^{8}

B. 57.89×10^{8}

C. 42.93×10^{8}

D. 68.26×10^{8}

Answer: A

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

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

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Linked Comprehension

1. 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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2. 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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3. A metallic surface is illuminated alternatively with light of wavelenghts 3000Å and 6000Å. It is observed that the maximum speeds of the photoelectrons under these illuminations are in the ratio 3 : 1 . Calculate the work function of the metal and the maximum speed of the photoelectrons in two cases.

A. 1.45 eV

B. 2.26 eV

C. 1.23 eV

D. 3.4 eV

Answer: C

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4. A metallic surface is illuminated alternatively with light of wavelenghts 3000Å and 6000Å. It is observed that the maximum speeds of the photoelectrons under these illuminations are in the ratio 3 : 1 . Calculate the work function of the metal and the maximum speed of the photoelectrons in two cases.

A. $9 \times 10^5 ms^{-1}$

B. $9 \times 10^7 ms^{-1}$

C. $3.6 \times 10^5 ms^{-1}$

D. $4.5 \times 10^7 ms^{-1}$

Answer: A

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5. A helium-neon laser emits light of wavelength 632.8nm. Calculate the energy of each photon in electron volt.

A. 2.5

B. 1.96

C. 0.53

D. 3.3

Answer: B

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6. A helium-neon laser has a power output of 1mW of light of wavelength 632.8 nm.

Q. Determine the number of photons emitted by the laser each second.

A. 3.18×10^{15}

B. 4.5×10^{16}

C. 1.2×10^{15}

D. 2.9×10^{17}

Answer: A

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7. Photoelectrons ar ejected from a surface when light of wavelenght $\lambda_1 = 550nm$ is incident on it. The stopping potential for such electrons is $\lambda_{S1} = 0.19V$. Suppose that radiation of wavelength $\lambda_2 = 190nm$ is incident of the surface.

Q. Calculate the stopping potential V_{S2}.

A. 4.47

B. 3.16

C. 2.76

D. 5.28

Answer: A

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8. Photoelectrons ar ejected from a surface when light of wavelenght $\lambda_1 = 550nm$ is incident on it. The stopping potential for such electrons is $\lambda_{S1} = 0.19V$. Suppose that radiation of wavelength $\lambda_2 = 190nm$ is incident of the surface.

Q. Calulate the work function of the surface.

A. 3.75

B. 2.07

C. 4.2

D. 3.6

Answer: B

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9. Photoelectrons ar ejected from a surface when light of wavelenght $\lambda_1 = 550nm$ is incident on it. The stopping potential for such electrons is $\lambda_{S1} = 0.19V$. Suppose that radiation of wavelength $\lambda_2 = 190nm$ is incident of the surface.

Q. Calculate the stopping potential V_{S2}.

A. 500×10^{12} Hz

B. 480×10^{13} Hz

C. 520×10^{11} Hz

D. 460×10^{13} Hz

Answer: A

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10. In a photoelectric effect experimetent, a metallic surface of work function 2.2 eV is illuminated with a light of wavelenght 400 nm. Assume that an electron makes two collisions before being emitted and in each collision 10% additional energy is lost.

Q. Find the kinetic energy of this electron as it comes out of the metal.

A. 0.46 eV

B. 0.31 eV

C. 0.23 eV

D. none of these

Answer: D

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11. A light beam of wavelength $400nm$ is incident on a metal of work-function $2.2eV$. A particular electron absorbs a photon and makes 2 collisions before coming out of the metal

(a) Assuming that 10% of existing energy is lost to the metal in each collision find the final kinetic energy of this electron as it comes out of the metal.

(b) Under the same assumptions find the maximum number of collisions, the electron should suffer before it becomes unable to come out of the metal.

A. 2

B. 6

C. 4

D. 8

Answer: C

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12. in an experimental set up to study the photoelectric effect a point source of light of power 3.2×10^{-3} W was taken. The source can emit mono energetic photons of energy 5eV and is located at a distance of 0.8 m from the center of a stationary metallic sphere of work-function 3.0 eV. The radius of the sphere is $r = 8 \times 10^{-3}$ m. The efficiency of photoelectric emission is one for every 10^6 incident photons. Based on the information given above answer the questions given below. (Assume that the sphere is isolated and photoelectrons are instantly swept away after the emission).

Time after which photoelectric emission stops is

A. 10^3

B. 10^4

C. 5×10^4

D. 10^5

Answer: D

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13. in an experimental set up to study the photoelectric effect a point source of light of power 3.2×10^{-3} W was taken. The source can emit mono energetic photons of energy 5eV and is located at a distance of 0.8 m from the center of a stationary metallic sphere of work-function 3.0 eV. The radius of the sphere is $r = 8 \times 10^{-3}$ m. The efficiency of photoelectric emission is one for every 10^6 incident photons. Based on the information given above answer the questions given below. (Assume that the sphere is isolated and photoelectrons are instantly swept away after the emission).

Time after which photoelectric emission stops is

A. $2\left(\frac{KE_{\max}}{e}\right)$

B. $\left(\frac{KE_{\max}}{e}\right)$

C. $\left(\frac{KE_{\max}}{3e}\right)$

D. $\left(\frac{KE_{\max}}{2e}\right)$

Answer: B

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14. in an experimental set up to study the photoelectric effect a point source of light of power 3.2×10^{-3} W was taken. The source can emit mono energetic photons of energy 5eV and is located at a distance of 0.8 m from the center of a stationary metallic sphere of work-function

3.0 eV. The radius of the sphere is $r = 8 \times 10^{-3}$ m. The efficiency of photoelectric emission is one for every 10^6 incident photons. Based on the information given above answer the questions given below. (Assume that the sphere is isolated and photoelectrons are instantly swept away after the emission).

Time after which photoelectric emission stops is

A. 1.85

B. 2.36

C. 2.75

D. 0.78

Answer: A

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15. The incident intensity on a horizontal surface at sea level from the sun is about $1 kW m^{-2}$.

Assuming that 50 per cent of this intensity is reflected and 50 per cent is absorbed, determine the radiation pressure on this horizontal surface (in pascals).

A. 8.2×10^{-2}

B. 5×10^{-6}

C. 6×10^{-12}

D. 8×10^{-11}

Answer: B

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16. The incident intensity on a horizontal surface at sea level from the sun is about $1kWm^{-2}$.

Q. Find the ratio of this pressure to atmospheric pressure p_0 (about 1×10^5 Pa) at sea level

A. 5×10^{-11}

B. 4×10^{-8}

C. 6×10^{-12}

D. 8×10^{-11}

Answer: A

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17. Light of intensity I falls along the axis on a perfectly reflecting right circular cone having semi-vertical angle θ and base radius R. If E is the energy of one photon and c is the speed oh light, then find the number of photons hitting the cone per second

A. $\frac{\pi R^2 I}{2E}$

B. $\frac{2\pi R^2 I}{E}$

C. $\frac{\pi R^2 I}{4E}$

D. $\frac{\pi R^2 I}{E}$

Answer: D

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18. Light of intensity I falls along the axis on a perfectly refleccting right circular cone having semi-vertical angle θ and base radius R. If E is the energy of one photon and c is the speed oh light, then find

Q. The net force of the cone.

A. $\dfrac{(\pi R^2 I)(1-\cos 2\theta)}{c}$

B. $\dfrac{(\pi R^2 I)}{2c(1-\cos 2\theta)}$

C. $\dfrac{2(\pi R^2 I)}{c(1-\cos 2\theta)}$

D. $\dfrac{(\pi R^2 I)}{2}c(1+\cos 2\theta)$

Answer: A

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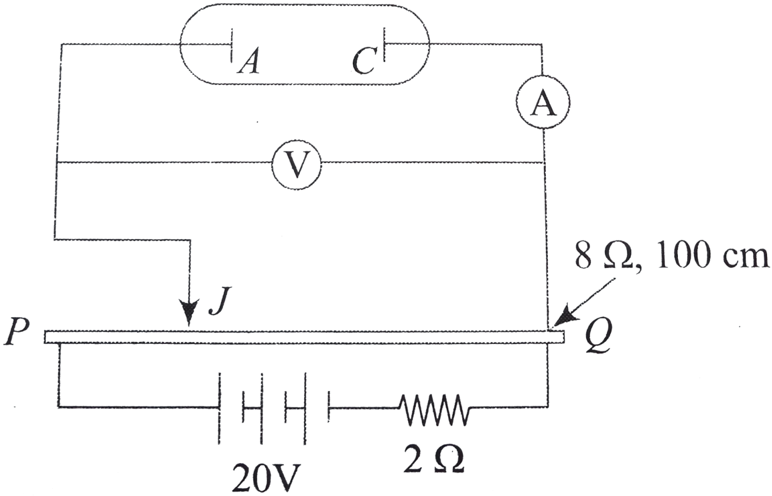
19.



An experimental setup of verification of photoelectric effect is shown if Fig. The voltage across the electrodes is measured with the help of an ideal voltmeter, and which can be varied by moving jockey J on the potentiometer with wire. The battery used in potentiometer circuit is of 20 V and its internal resistance is 2Ω. The resistance of 100 cm long potentiometer wire is 8Ω.

The photocurrent is measured with the help of an ideal ammeter. Two plates of potassium oxide of area $50cm^2$ at separation 0.5mm are used in the vacuum tube. Photocurrent in the circuit is very small, so we can treat the potentiometer circuit as an independent circuit. The wavelength of various colors is as follows:

Q. Calculate the number of electrons that appear on the surface of the cathode plate, when the jockey is connected at the end P of the potentiometer wire. Assume that no radiation is falling on the plates.

A. 8.85×10^6

B. 11.0625×10^9

C. 8.85×10^9

D. 0

Answer: C

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20.

An experimental setup of verification of photoelectric effect is shown if Fig. The voltage across the electrodes is measured with the help of an ideal voltmeter, and which can be varied by moving jockey J on the potentiometer with wire. The battery used in potentiometer circuit is of 20 V and its internal resistance is 2Ω. The resistance of 100 cm long potentiometer wire is 8Ω.

The photocurrent is measured with the help of an ideal ammeter. Two plates of potassium oxide of area $50cm^2$ at separation 0.5mm are used in the vacuum tube. Photocurrent in the circuit is very small, so we can treat the potentiometer circuit as an independent circuit. The wavelength of various colors is as follows:

Q. When radiation falls on the cathode plate, a current of $2\mu A$ is recorded in the ammeter. Assuming that the vacuum tube setup sollows Ohm's law, the equivalent resistance of vacuum tube operating in this case when jockey is at end P is

A. $8 \times 10^8\Omega$

B. $16 \times 10^6\Omega$

C. $8 \times 10^6\Omega$

D. $10 \times 10^6\Omega$

Answer: C

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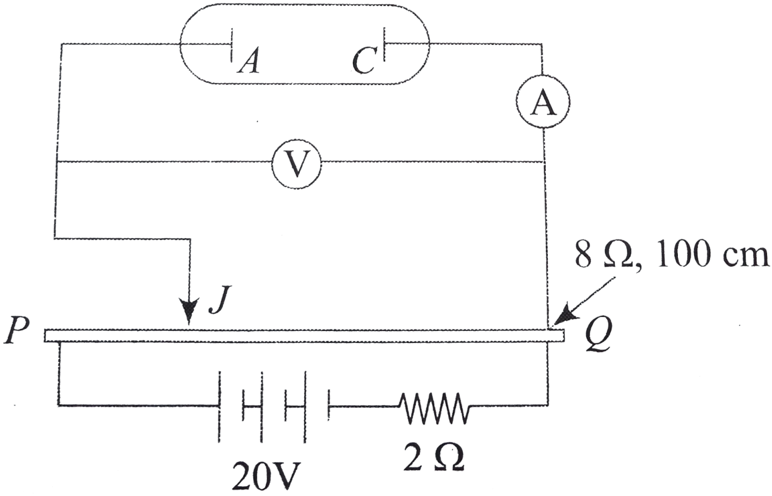
21.



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The photocurrent is measured with the help of an ideal ammeter. Two plates of potassium oxide of area $50cm^2$ at separation 0.5mm are used in the vacuum tube. Photocurrent in the circuit is very small, so we can treat the potentiometer circuit as an independent circuit. The wavelength of various colors is as follows:

Q. It is found that ammeter current remains unchanged $(2\mu A)$ even when the jockey is moved from the end P to the middle point of the potentiometer wire. Assuming that all the incident photons eject electrons and the power of the light incident is 4×10^{-6} W. Then, the color of the incident light is

A. Green

B. Violet

C. Red

D. Orange

Answer: D

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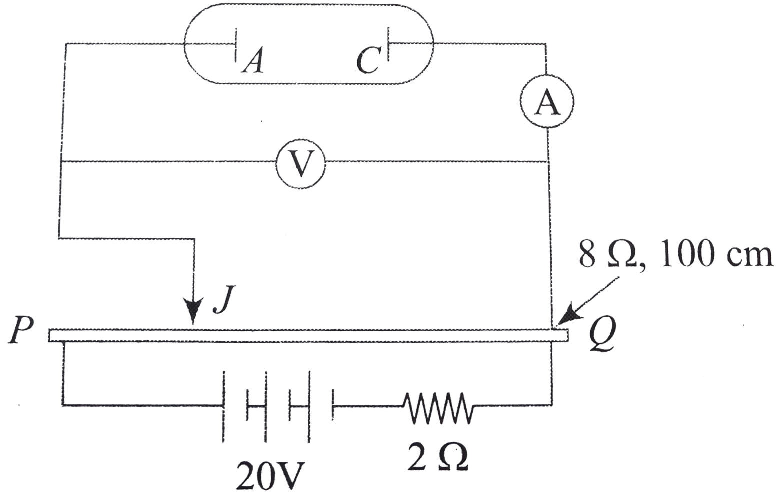
22.



An experimental setup of verification of photoelectric effect is shown if Fig. The voltage across the electrodes is measured with the help of an ideal voltmeter, and which can be varied by moving jockey J on the potentiometer with wire. The battery used in potentiometer circuit is of 20 V and its internal resistance is 2Ω. The resistance of 100 cm long potentiometer wire is 8Ω.

The photocurrent is measured with the help of an ideal ammeter. Two plates of potassium oxide of area $50cm^2$ at separation 0.5mm are used in the vacuum tube. Photocurrent in the circuit is very small, so we can treat the potentiometer circuit as an independent circuit. The wavelength of various colors is as follows:

Q. Which of the following colors may not give photoelectric effect for this cathode? if power of incident light is 4*10^-6 and currenr 2micro ampere.

A. Green

B. Violet

C. Red

D. Orange

Answer: C

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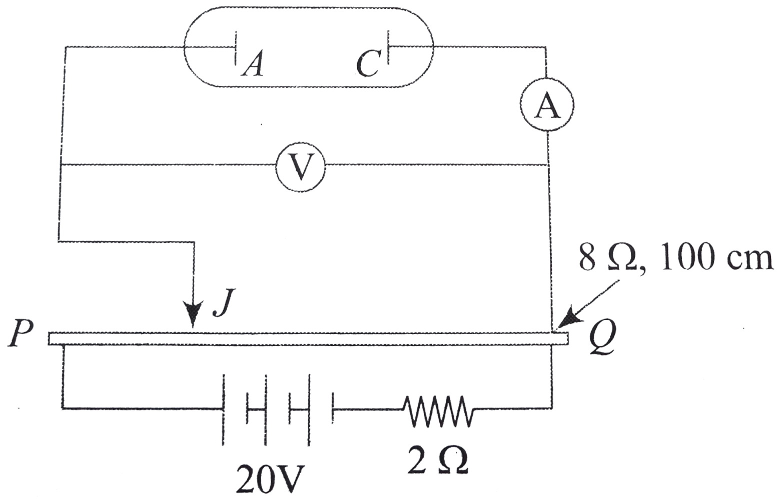
23.



An experimental setup of verification of photoelectric effect is shown if Fig. The voltage across the electrodes is measured with the help of an ideal voltmeter, and which can be varied by moving jockey J on the potentiometer with wire. The battery used in potentiometer circuit is of 20 V and its internal resistance is 2Ω. The resistance of 100 cm long potentiometer wire is 8Ω.

The photocurrent is measured with the help of an ideal ammeter. Two plates of potassium oxide of area $50cm^2$ at separation 0.5mm are used in the vacuum tube. Photocurrent in the circuit is very small, so we can treat the potentiometer circuit as an independent circuit. The wavelength of various colors is as follows:

Q. When other light falls on the anode plate, the ammeter reading remains zero till jockey is moved from the end P to the middle point of the wire PQ. Thereafter, the deflection is recorded in the ammeter. The maximum kinetic energy of the emitted electron is

A. 16 eV

B. 8 eV

C. 4 eV

D. 10 eV

Answer: B

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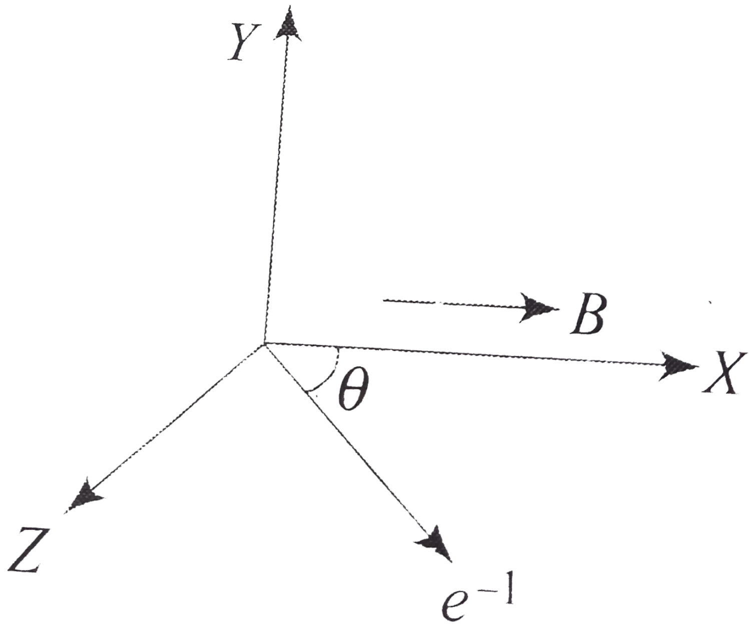

24.

Light having photon energy hv is incident on a metallic plate having work function ϕ to eject the electrons. The most energetic enectrons are then allowed to enter in a region of uniform magnetic field B as shown in Fig. The electrons are projected In X-Z plane making an angle θ with X-axis and magnetic field is $\vec{B} = B_0\hat{i}$ along X-axis maximum pitch of the helix described by an electron is found to be p. Take mass of electron as m and charge as q. Based on the above information, answer the following questions:

Q. The correct relation between p and B_0 is

A. $qpB_0 = 2\pi \cos\theta \sqrt{2(hv - \phi)m}$

B. $qpB_0 = 2\pi \cos\theta \sqrt{\frac{2(hv - \phi)}{m}}$

C. $pqB_0 = 2\pi \sqrt{2(hv - \phi)m}$

D. $p = \frac{2\pi m}{qB_0} \times \sqrt{hv - \phi}$

Answer: A

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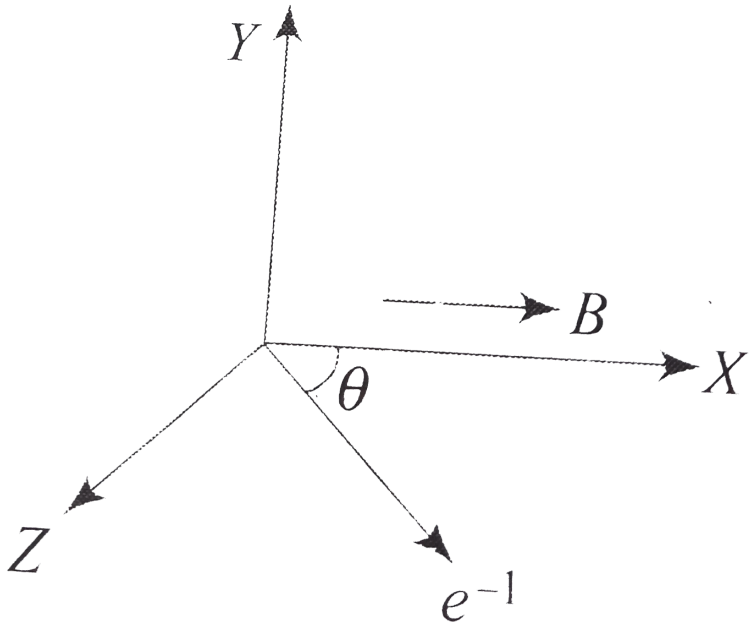
25.



Light having photon energy hv is incident on a metallic plate having work function ϕ to eject the electrons. The most energetic enectrons are then allowed to enter in a region of uniform magnetic field B as shown in Fig. The electrons are projected In X-Z plane making an angle θ with X-axis and magnetic field is $\overrightarrow{B} = B_0\hat{i}$ along X-axis maximum pitch of the helix described by an electron is found to be p. Take mass of electron as m and charge as q. Based on the above information, answer the following questions:

Q. Considering the instant of crossing origin at $t = 0$,the Z-coordinate of the location of electron as a function of time is

A. $-\frac{\sqrt{2m(hv-\phi)}}{pB-0} \times \sin\theta\left[1-\cos\theta\left(\frac{qB_0t}{m}\right)\right]$

B. $\frac{\sqrt{2m(hv-\phi)}}{qB_0} \times \sin\theta \times \sin\left[\frac{qB_0t}{m}\right]$

C. $\frac{-\sqrt{2m(hv-\phi)}}{qB_0} \times \sin\theta \times \sin\left[\frac{qB_0t}{m}\right]$

D. $\frac{\sqrt{2m(hv-\phi)}}{qB_0} \times \sin\left(\frac{qB_0t}{m}\right)$

Answer: B

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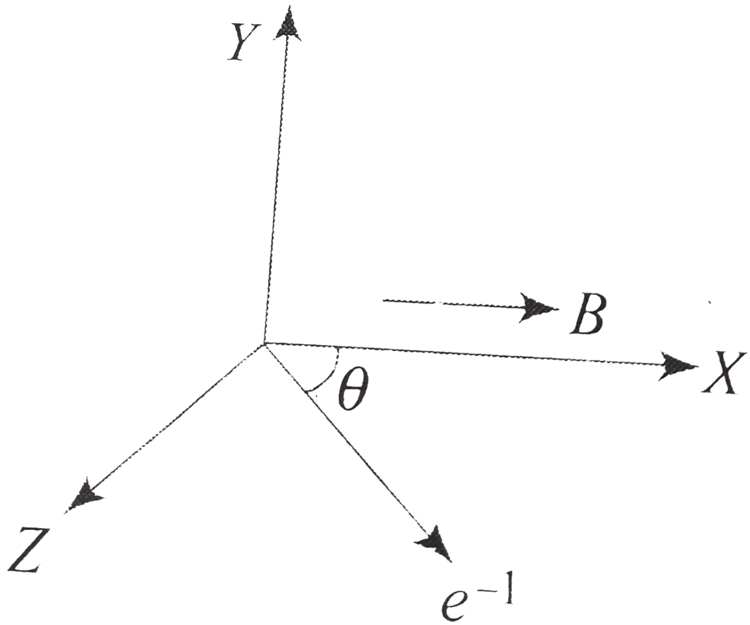
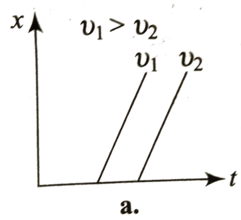
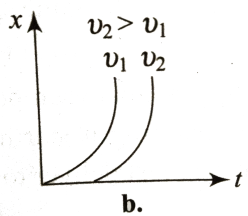
26.

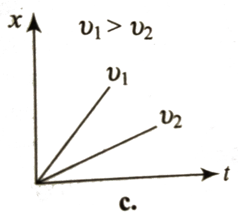


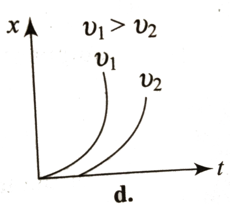
Light having photon energy hv is incident on a metallic plate having work function ϕ to eject the electrons. The most energetic enectrons are then allowed to enter in a region of uniform magnetic field B as shown in Fig. The electrons are projected In X-Z plane making an angle θ with X-axis and magnetic field is $\overrightarrow{B} = B_0\hat{i}$ along X-axis maximum pitch of the helix described by an electron is found to be p. Take mass of electron as m and charge as q. Based on the above information, answer the following questions:

Q. The plot between X-coordinate of the location of electron as a function of time for different frequencies υ of the incident light is

A. 

B. 

C. 

D. 

Answer: C

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27. When light of sufficiently high frequency is incident on a metallic surface, electrons are emitted from the metallic surface. This phenomenon is called photoelectric emission. Kinetic energy of the emitted photoelectrons depends on the wavelength of incident light and is independent of the intensity of light. Number of emitted photoelectrons depends on intensity. $(hv - \phi)$ is the maximum kinetic energy of emitted photoelectron (where ϕ is the work function of metallic surface). Reverse effect of photo emission produces X-ray. X-ray is not deflected by electric and magnetic fields. Wavelength of a continuous X-ray depends on potential difference across the tuve. Wavelength of charasteristic X-ray depends on the atomic number.

Q. If frequency $(v > v_0)$ of incident light becomes n times the initial frequency (v), then KE of the emitted photoelectrons becomes (v_0 threshold frequency).

A. n times of the initial kinetic energy

B. more than n times of the intial kinetic energy

C. less than n times of the initial kinetic energy

D. kinetic energy of the emitted photoelectrons remains unchanged

Answer: B

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28. When light of sufficiently high frequency is incident on a metallic surface, electrons are emitted from the metallic surface. This phenomenon is called photoelectric emission. Kinetic energy of the emitted photoelectrons depends on the wavelength of incident light and is independent of the intensity of light. Number of emitted photoelectrons depends on intensity. $(hv - \phi)$ is the maximum kinetic energy of emitted photoelectron (where ϕ is the work function of metallic surface). Reverse effect of photo emission produces X-ray. X-ray is not deflected by electric and magnetic fields. Wavelength of a continuous X-ray depends on potential difference across the tuve. Wavelength of charasteristic X-ray depends on the atomic number.

Q. A monochromatic light is used in a photoelectric experiment on photoelectric effect. The stopping potential

A. is related to the mean wavelength

B. is related to the shortest wavelength

C. is related to the maximum kinetic energy of emitted photoelectrons

D. intensity of incident light

Answer: B::C

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29. When light of sufficiently high frequency is incident on a metallic surface, electrons are emitted from the metallic surface. This phenomenon is called photoelectric emission. Kinetic energy of the emitted photoelectrons depends on the wavelength of incident light and is independent of the intensity of light. Number of emitted photoelectrons depends on intensity. $(hv-\phi)$ is the maximum kinetic energy of emitted photoelectron (where ϕ is the work function of metallic surface). Reverse effect of photo emission produces X-ray. X-ray is not deflected by electric and magnetic fields. Wavelength of a continuous X-ray depends on potential difference across the tuve. Wavelength of charasteristic X-ray depends on the atomic number.

Q. If potential difference across the tube is increased then

A. $\lambda_{\min}$ will decrease

B. characteristic wavelength will increase

C. $\lambda_{\min}$ will increase

D. none of these

Answer: A

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30. The energy reveived from the sun by the earth and surrounding atmosphere is 2 cal cm^{-2} "min" ^ (-1) on a surface normal to the rays of sun.

Q. What is the total energy received, in joule, by the earth and its atmosphere?

A. $10.645 \times 10^{18} J \text{min}^{-1}$

B. $10.645 \times 10^{15} J \text{min}^{-1}$

C. $8.645 \times 10^{17} J \text{min}^{-1}$

D. $9.645 \times 10^{14} J \text{min}^{-1}$

Answer: A

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31. The energy reveived from the sun by the earth and surrounding atmosphere is 2 calcm^{-2} $\overset{-1}{\text{min}}$ on a surface normal to the rays of sun.

Q. What is the total energy radiated, in J $\min^{-1}$, by the sun to the universe? Distance of the sun from the earth is 1.49×10^{11}m.

A. $2.3444 \times 10^{28} J\min^{-1}$

B. $2.33 \times 10^{24} J\min^{-1}$

C. $2.34 \times 10^{20} J\min^{-1}$

D. none of these

Answer: A

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32. The energy reveived from the sun by the earth and surrounding atmosphere is 2 cal cm^{-2} "min" ^ (-1) on a surface normal to the rays of sun.

Q. What is the total energy received, in joule, by the earth and its atmosphere?

A. 3.66×10^{14} mega gram $\overset{-1}{\text{min}}$

B. 3.66×10^{16} mega gram $\overset{-1}{\text{min}}$

C. 3.66×10^{-15} mega gram $\overset{-1}{\text{min}}$

D. 3.66×10^{10} mega gram $\overset{-1}{\text{min}}$

Answer: B

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33. When a high frequency electromagnetic radiation is incident on a metallic surface, electrons are emitted from the surface. Energy of emitted photoelectrons depends only on the frequency of incident electromagnetic radiation and the number of emitted electrons depends only on the intensity of incident light.

Einstein's protoelectron equation $[K_{\max} = hv - \phi\}$ correctly explains the PE, where $v =$ frequency of incident light and $\phi =$ work function.

Q. The slope of the graph between stopping potential and frequency is [here h is the Planck's constant and e is the charge of an electron] is

A. A will emit photoelectrons but B will not

B. B will emit photoelectrons but A will not

C. both A and B will not emit photoelectrons

D. neither A nor B will emit photoelectrons

Answer: B

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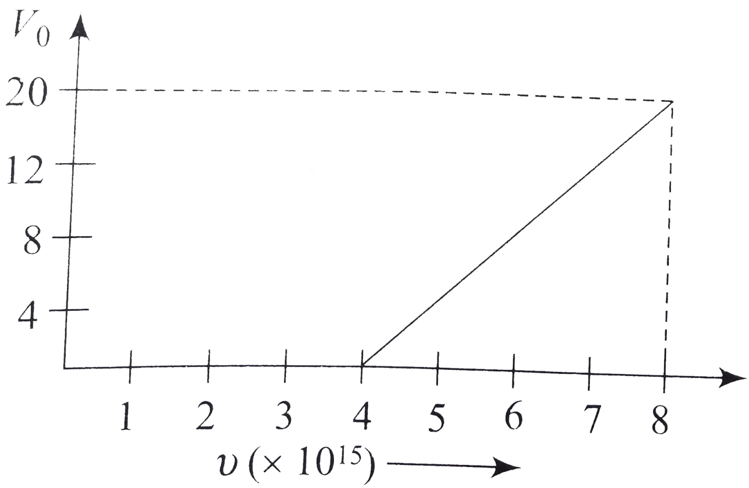

34.

When a high frequency electromagnetic radiation is incident on a metallic surface, electrons are emitted from the surface. Energy of emitted photoelectrons depends only on the frequency of incident electromagnetic radiation and the number of emitted electrons depends only on the intensity of incident light.

Einstein's protoelectron equation $[K_{\max} = hv - \phi]$ correctly ecplains the PE, where $v =$ frequency of incident light and $\phi =$ work function.

Q. For photoelectric effect in a metal, the graph of the stopping potential V_0 (in volt) versus frequency v (in hertz) of the incident radiation is shown in Fig. The work function of the metal (in eV) is.

A. 12.5

B. 14.5

C. 16.5

D. 18.5

Answer: C

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35. When a high frequency electromagnetic radiation is incident on a metallic surface, electrons are emitted from the surface. Energy of emitted photoelectrons depends only on the frequency of incident electromagnetic radiation and the number of emitted electrons depends only on the intensity of incident light.

Einstein's protoelectron equation $[K_{\max} = hv - \phi\}$ correctly explains the PE, where $v =$ frequency of incident light and $\phi =$ work function.

Q. The slope of the graph between stopping potential and frequency is [here h is the Planck's constant and e is the charge of an electron] is

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

B. eh

C. h

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

Answer: A

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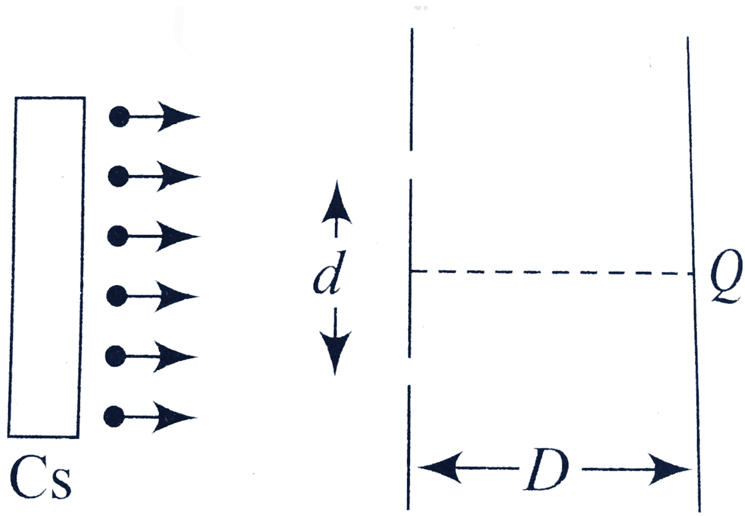

36.

A Cs plate is irradiated with a light of wavelength $\lambda = \frac{hc}{\phi}$,$\phi$ being the work function of the plate, h Plank's constant, and c the velocity of light in vacuum. Assume all the photoelectron are moving perpendicular to the plate toward a YDSE setup when accelerated through a potential difference V. Take charge on a proton $= e$ and moss of an electron $= m$. Read the paragraph carefully and answer the following question:The fringe width due to the electron beam is

A. $\frac{\lambda D}{d}$

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

C. $\frac{hD}{\left(d\sqrt{2emV}\right)}$

D. none of these

Answer: C

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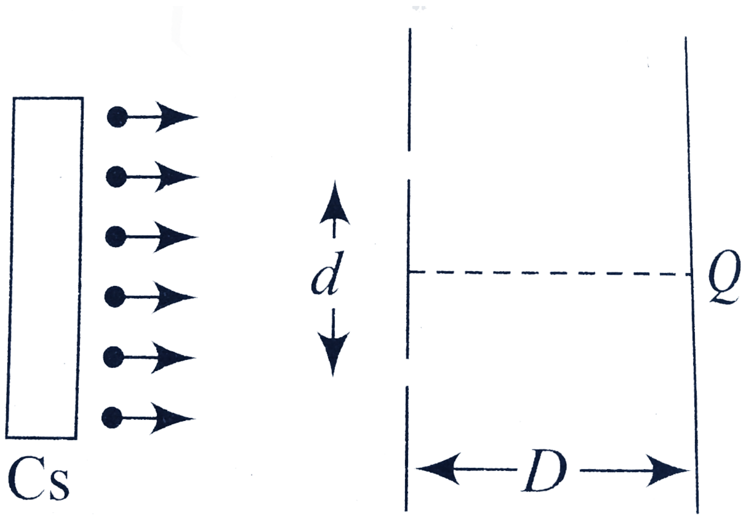

37.

A Cs plate is irradiated with a light of wavelength $\lambda = \frac{hc}{\phi}$,$\phi$ being the work function of the plate, h Plank's constant, and c the velocity of light in vacuum. Assume all the photoelectron are moving perpendicular to the plate toward a YDSE setup when accelerated through a potential difference V. Take charge on a proton $= e$ and moss of an electron $= m$. Read the paragraph carefully and answer the following question:

Q. If the wavelength of light used in photoemission is less that λ, then the fringe width will

A. increase

B. decrease

C. remain same

D. cannot be dicided

Answer: B

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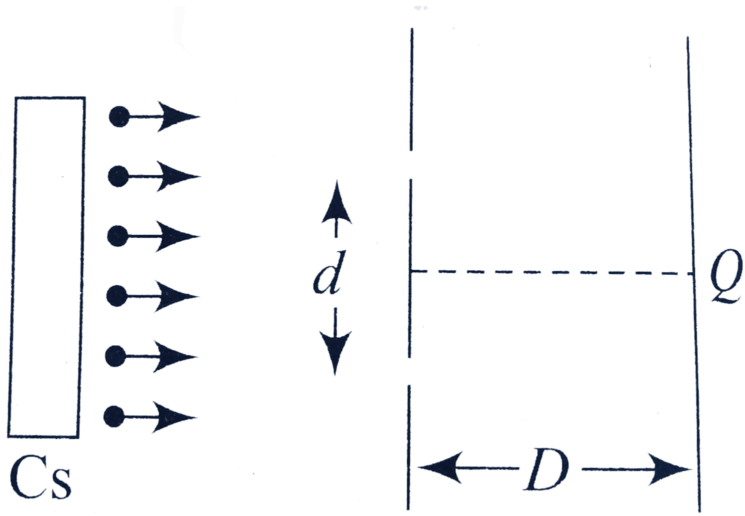

38.

A Cs plate is irradiated with a light of wavelength $\lambda=\frac{hc}{\phi}$,ϕ being the work function of the plate, h Plank's constant, and c the velocity of light in vacuum. Assume all the photoelectron are moving perpendicular to the plate toward a YDSE setup when accelerated through a potential difference V. Take charge on a proton $=e$ and moss of an electron $=m.$ Read the paragraph carefully and answer the following question:The fringe width due to the electron beam is

A. upward

B. downward

C. no shift

D. no fringes will be formed

Answer: C

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39. A pushed dye laser emits light of wavelength 585 nm. Because this wavelength is strongly absorbed by the haemoglobin in the blood, the method is especially effective for removing various types of blemishes due to blood. To get a reasonable estimate of the power required for such laser surgery, we can model the blood as having the same specific heat and heat of vaporization as water. $[S = 4.2 \times 10^3 J(kgK)^{-1}$, $L = 2.25 \times 10^6 Jkg]$

Q. Suppose that each pulse must remove $2\mu g$ of blood by evaporating it starting at 30°C. The energy that each pulse must deliver to the blemish is nearly

A. $5.1J$

B. $5.1mJ$

C. $5.1\mu J$

D. $5.1kJ$

Answer: B

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40. A pushed dye laser emits light of wavelength 585 nm. Because this wavelength is strongly absorbed by the haemoglobin in the blood, the method is especially effective for removing various types of blemishes due to blood. To get a reasonable estimate of the power required for such laser surgery, we can model the blood as having the same specific heat and geat of vaporization as water. $[S = 4.2 \times 10^3 J(kgK)^{-1}$, $L = 2.25 \times 10^6 Jkg]$

Q. Suppose that each pulse must remove 2μg of blood by evaporating it starting at 30∘C.The power output of laser in time 450μs must be

A. 5.5 W

B. 11 W

C. 16.5 W

D. 22 W

Answer: B

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41. A pushed dye laser emits light of wavelength 585 nm. Because this wavelength is strongly absorbed by the haemoglobin in the blood, the method is especially effective for removing various types of blemishes due to blood. To get a reasonable estimate of the power required for such laser surgery, we can model the blood as having the same specific heat and geat of vaporization as water. $[S = 4.2 \times 10^3 J(kgK)^{-1}$, $L = 2.25 \times 10^6 Jkg]$

Q. Suppose that each pulse must remove 2μg of blood by evaporating it starting at 30∘C.The number of photons that each pulse delivers to the blemish is

A. 1.5×10^{16}

B. 1.5×10^{8}

C. 3×10^{16}

D. 3×10^{8}

Answer: A

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

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44. An element of atomic number 9 emits K_α X-ray of wavelength λ. Find the atomic number of the element which emits K_α X-ray of wavelength 4λ.

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Integer

1. A monochromatic source of light operating at 200W emits 4×10^{20} photons per second. Find the wavelength of the light.

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2. 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 1.0×10^{19}. Calculate the force exerted by the light beam on the mirror.

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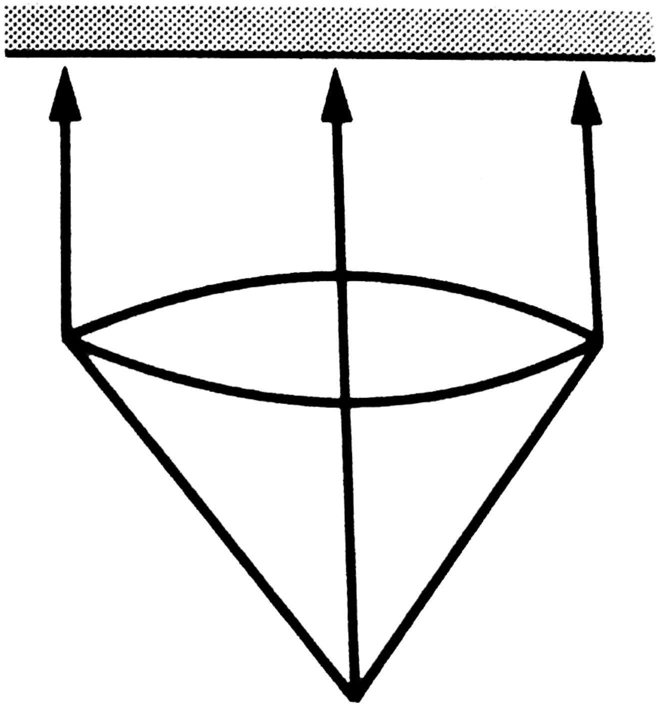
3. A totally reflecting, small plane mirror placed horizontally faces a parallel beam of lighy as shown in figure. The mass of the mirror is 20g. Assume that there is no absorption in the lens and that 30% of the light emitted by the source goes through the lens. Find the power of the source needed to support the weight of the mirror. Take

$g = 10ms^{-2}$.



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4. A silver ball of radius 4.8 cm is suspended by a thread in a vacuum chamber, Ultraviolet light of wavelength 200nm is incident on the ball for some time during which a total light energy of 1.0×10^{-7} J falls on the surface. Assuming that on the average one photon out of every ten thousand is able to eject a photoelectron, find the electric potential at the surface of the ball assuming zero potential at infinity. What is the potential at the centre of the ball?

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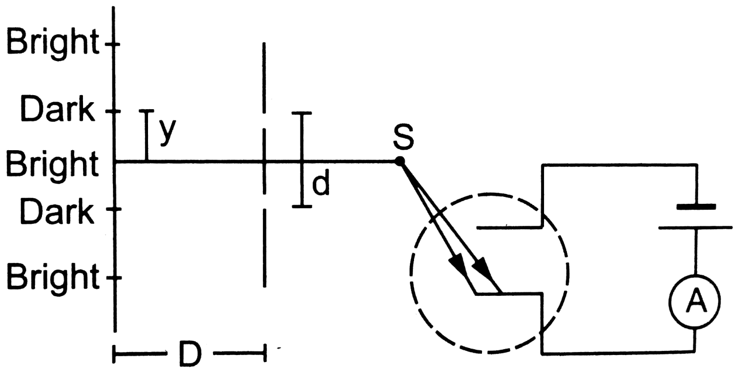
5. In the arrangement shown in figure, $y = 1.0mm$, $d = 0.24mm$ and $D = 1.2m$. The work function of the material of the emitter is $2.2eV$. Find the stopping potential V needed to stop the photocurrent.



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6. The maximum kinetic energy of electrons emitted in the photoelectric effect is linearly dependent on the .... Of the incident radiation .

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7. The kinetic energy of photoelectrons emitted by a photosensitive surface depends on the internsity of the incident radiation

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8. In a photoelectric emission process the maximum energy of the photo - electrons increase with increasing intensity of the incident light .

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9. The maximum kinetic energy of photoelectrons emitted from a surface when photons of energy $6eV$ fall on it is $4eV$. The stopping potential , in volt is

A. 2

B. 4

C. 6

D. 10

Answer: B

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Single Correct Answer Type

1. The work function of a substance is $4.0eV$. The longest wavelength of light that can cause photo electron emission from this substance is approximately. (a) $540nm$ (b) $400nm$ (c) $310nm$ (d) $220nm$

A. 540 nm

B. 400 nm

C. 310 nm

D. 220 nm

Answer: C

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2. A praticle of mass M at rest decays into two particle of masses m_1 and m_2, having non-zero velocities. The ratio of the de Broglie wavelength of the particles $\frac{\lambda_1}{\lambda_2}$ is

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

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

C. 1

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

Answer: C

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3. A proton has kinetic energy E = 100 ke V which is equal to that of a photon. The wavelength of photon is λ_2 and that of proton is λ_1. The ratio λ_2 / λ_1 is proportional to

A. E^2

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

C. E^{-1}

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

Answer: B

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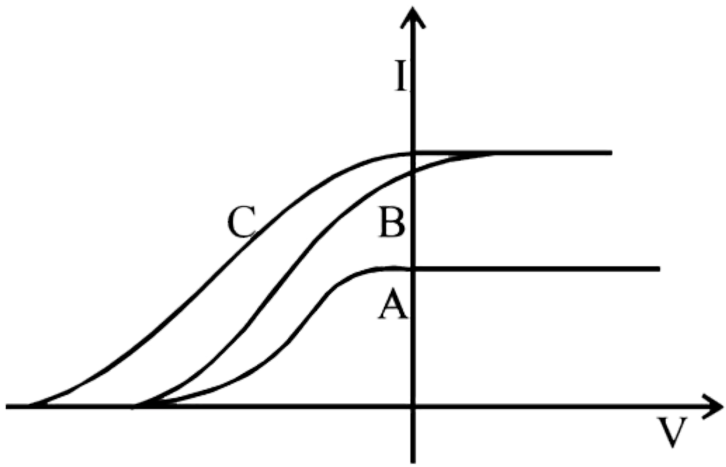
4. In a photoelectric experiment anode potential is ploted against plate current.



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

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

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

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

Answer: D

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5. A beam of electron is used $YDSE$ experiment . The slit width is d when the velocity of electron is increased ,then

A. no interference is observed

B. fringe width increases

C. fringe width decreases

D. fringe width remains same

Answer: C

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6. If a star converts all helium in its core to oxygen then energy released per oxygen nuclei is

[Mass of He = 4.0026 amu, Mass of O = 15.9994 amu]

A. 7.6 MeV

B. 56.12 MeV

C. 10.24 MeV

D. 23.9 MeV

Answer: C

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7. A pulse of light of duration $100ns$ is absorbed completely by a small object initially at rest power of the pulse is $30mW$ and the speed of light is $3 \times 10^8 ms^{-1}$ The final momentum of the object is

A. $0.3 \times 10^{-17} kgms^{-1}$

B. $1.0 \times 10^{-17} kgms^{-1}$

C. $0.3 \times 10^{-17} kgms^{-1}$

D. $9.0 \times 10^{-17} kgms^{-1}$

Answer: B

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Multiple Correct Answers Type

1. The threshold wavelength for photoelectric emission from a material is 5200 Å. Photoelectrons will be monochromatic radiation from a

A. 50 W infrared lamp

B. 1 W infrared lam

C. 50 W ultraviolet lamp

D. 1 W ultraviolet lamp

Answer: C::D

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2. Photoelectric effect supports quantum nature of light because

A. there is a 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 metal surface is faintly illuminated, the photoelectrons leave the surface immediately

D. electric charge of the photoelectrons is quantized

Answer: A::B::C

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3. 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 0.2 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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4. 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 2.25 eV

B. the work funtion of B is 4.20 eV

C. $T_A = 2.00eV$

D. $T_B = 2.75eV$

Answer: A::B::C

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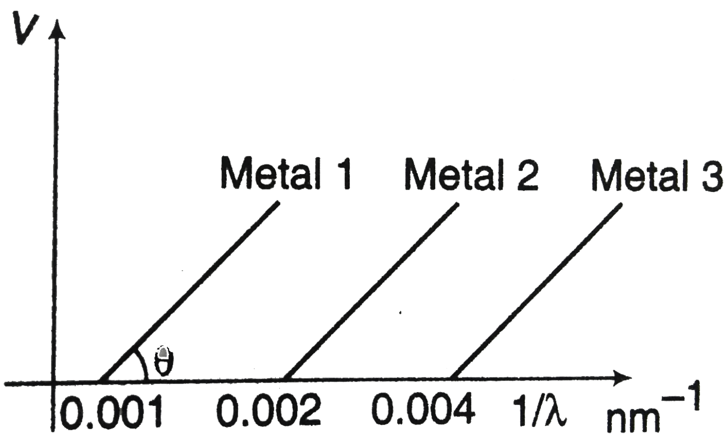
5. The graph between $1/\lambda$ and stopping potential (V) of three metals having work- functions Φ_1, Φ_2 and Φ_3 in an experiment of photoelectric effect is plotted as shown in the figure. Which of the following statement(s) is/are correct? (Here, λ is the wavelength of the incident ray).



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

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

C. $\tan\theta \propto \frac{(hc)}{e}$

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

Answer: A::C

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6. In a Young's double slit experiment, the separaton between the two slits is d and the wavelength of the light is λ. The intensity of light fallin on slit 1 is four times the intensity of light falling on slit 2. Choose the correct choice (s).

A. If $d = \lambda$, the screen will contain only one maximum

B. If $\lambda < d < 2\lambda$, at least one more maximum (besides the central maximum) will be observed on the screen

C. If the intensity of light falling on slit 1 is reduced so that it becomes equal to that of slit 2, the intensities of the observed dark and bright fringes will increase

D. If the intensity of light falling on slit 2 is increased so that it bacomes equal to that of slit 1, the intensities of the obserbed dark and bright fringes will increase

Answer: A::B

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7. The radius of the orbit of an electron in a Hydrogen - like atom is $4.5s_0$ where a_0 is the bohr radius its orbital angular momentum is $\frac{3h}{2\pi}$ it is given that is is plank constant and R is rydberg constant .The possible wavelength (s) , when the atom de- excite , is (are)

A. $\frac{9}{32R}$

B. $\frac{9}{16R}$

C. $\frac{9}{5R}$

D. $\frac{4}{3R}$

Answer: A::C

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Linked Comprehension Type

1. When a particle is restricted to move along x-axis between $x = 0$ and $x = a$, where α if of nenometer dimension, its energy can take only certain specific values. The allowed energies of the particle moving in such a restricted region, correspond to the formation of standing waves with nodes at its ends $x = 0$ and $x = a$. The wavelength of this standing wave is related to the linear momentum p of the particle according to the de Broglie relation. The energy of the particle of mass m is related to its linear momentum as $E = \frac{p^2}{2m}$. Thus the energy of the particle can be denoted by a quantum number n taking values 1,2,3, ...($n = 1$, called the ground state) corresponding to the number of loops in the standing wave.

Use the model described above to answer the following three questions for a particle moving along the line from $x = 0$ to $x = \alpha$. Take $h = 6.6 \times 10^{-34} Js$ and $e = 1.6 \times 10^{-19}$ C.

Q. The allowed energy for the particle for a particular value of n is proportional to

A. α^{-2}

B. $\alpha^{\frac{-3}{2}}$

C. α^{-1}

D. α^{2}

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2. When a particle is restricted to move along x-axis between $x=0$ and $x=a$, where α if of nenometer dimension, its energy can take only certain specific values. The allowed energies of the particle moving in such a restricted region, correspond to the formation of standing waves with nodes at its ends $x=0$ and $x=a$. The wavelength of this standing wave is related to the linear momentum p of the particle according to the de Broglie relation. The energy of the particle of mass

m is related to its linear momentum as $E = \frac{p^2}{2m}$. Thus the energy of the particle can be denoted by a quantum number n taking values 1,2,3, ...($n = 1$, called the ground state) corresponding to the number of loops in the standing wave.

Use the model described above to answer the following three questions for a particle moving along the line from $x = 0$ to $x = \alpha$. Take $h = 6.6 \times 10^{-34} Js$ and $e = 1.6 \times 10^{-19}$ C.

Q. If the mass of the particle is $m = 1.0 \times 10^{-30}$kg and $\alpha = 6.6 nm$, the energy of the particle in its ground state is closest to

A. 0.8 meV

B. 8 meV

C. 80 meV

D. 800 meV

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3. When a particle is restricted to move along x-axis between $x = 0$ and $x = a$, where α if of nenometer dimension, its energy can take only certain specific values. The allowed energies of the particle moving in such a restricted region, correspond to the formation of standing waves with nodes at its ends $x = 0$ and $x = a$. The wavelength of this standing wave is related to the linear momentum p of the particle according to the de Broglie relation. The energy of the particle of mass m is related to its linear momentum as $E = \frac{p^2}{2m}$. Thus the energy of the particle can be denoted by a quantum number n taking values 1,2,3, ...($n = 1$, called the ground state) corresponding to the number of loops in the standing wave.

Use the model described above to answer the following three questions for a particle moving along the line from $x = 0$ to $x = \alpha$. Take $h = 6.6 \times 10^{-34} Js$ and $e = 1.6 \times 10^{-19}$C

Q. The speed of the particle that can take discrete values is proportional to

A. $n^{\frac{-3}{2}}$

B. n^{-1}

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

D. n

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Integer Type

1. An α particle and a proton are accelerated from rest by a potential difference of 100V. After this, their de-Broglie wavelengths are λ_a and λ_p respectively. The ratio $\frac{\lambda_p}{\lambda_a}$, to the nearest integer, is.

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2. A silver sphere of radius 1 cm and work function 4.7 eV is suspended from an insulating thread in free-space. It is under continuos illumination of 200 jnm jwavelength light. As photoelectrons are emitted, the sphere gets charged and acquires a potential. The maximum number of photoelectrons emitted from the sphere is $A \times 10^{z}(\text{where} 1 < A < 10)$. the value of Z is

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3. A proton is fired from very far away towards a nucleus with charge Q = 120 e, where e is the electronic charge. It makes a closest approach of $10 fm$ to the nucleus. The de - Broglie wavelength (in units of fm) of the proton at its start is take the proton mass, $m_p = 5/3 \times 10^{-27} kg, h/e = 4.2 \times 10^{-15} J - s/C,$ $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^{9} m/F, 1 fm = 10^{-15}.$

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4. The work function of Silver and sodium are $4.6 \text{ and } 2.3 eV$, respectively . The ratio of the slope of the stopping potential versus frequency plot for silver to that of sodium is

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