PHYSICS

BOOKS - KUMAR PRAKASHAN KENDRA PHYSICS (GUJRATI ENGLISH)

DUAL NATURE OF RADIATION AND MATTER

Section A Question Answers

1. How it can be said that light posses wave nature?

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2. Write observation of various experiments which suggest that rays are stream (flow) of negatively charged particles.

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3. Write information about negative electric charge emitted from metals when UV light is incident in them or metal are heated.

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4. Explain emission of electron from metal.Define work function .Write its unit,work function of metal depend on which factors?

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5. What is the unit of energy in atomic and nuclear physics?Define it.

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6. Write and explain methods to obtain emission of electron from metal.

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7. What is photoelectric effect?

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8. Hert's observation-Explain in short.

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9. Describe Hallwach's and Lenard's observation regarding photoelectric effect in short.

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10. Value of threshold frequency depend on which factors?

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11. Give outline of experimental study of photoelectric effect.

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12. Explain effect of variation of intensity of incident radiation on photoelectric current.

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13. Explain effect of potential on photoelectric current in experiment of photoelectric effect.

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14. Explain effect of frequency of incident radiation in th experiment of photoelectric effect.

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15. Explain -"for photoelectric emission frequency of incident radiation should be greater than threshold frequency".

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16. Write characteristics of photoelectric effect.

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17. Show that wave theory cannot explain fundamental chatacteristics of phtoelectric effect.

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18. Write Einstein's proposed a new theory to explain photoelectric effect.

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19. Why phtoelectric current is proportional to intensity?

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20. In experiment aimed to disprove Einstein's equation how millikan proved Einstein's equation?

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21. Can quantum of light be associated with particle?

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22. Write characteristics of photon.

How photon of electromagnetic raidation can be represented?

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23. Explain particle-wave (dual) nature of matter.

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24. By suitable example show that particle or wave nature depend on type of experiment.

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25. Write de-Broglie hypothesis and derive equation of de-Broglie wavelength.

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26. Explain Heisenberg's uncertainty principle.

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27. What is wave packet?Explain by using necessary diagram.

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28. Explain arrangement of Davission and Germer experiment.

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29. Explain method of davisson and Germer experiment and its results.

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Section A Try Yourself

1. Who obtained electromagnetic wave first time in the laboratory ?

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2. Who invented X-rays?

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3. In 1897 ,J.J Thomson invented which particle?

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4. Which scientist invented cathode rays?

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5. What is specific charge?Write its standard value.

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6. Write speed of cathode rays.

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7. Write name of universal and fundamental particle of matter.

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8. What is charge on an electron?

Watch Video Solution

9. How mass of an electron can be obtained?

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10. Which particles are responsible for conductivity of metal?

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11. Define work function of metal and write its unit.

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12. Write dimensional formula of electron volt?

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13. Define an electron Volt and show it in Joule unit.

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14. 1 J is equal to how many electron volt?

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15. What is value (magnitude) of electric field required for field emission?

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16. What is photoelectron?

Watch Video Solution

17. What did Hertz observe in experiment to produce electomagnetic waves?

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18. In Lenard's experiment what is effect on current when ultraviolet radiation incident on cathode is stopped?

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19. Define threshold frequency.

Watch Video Solution

20. Value of threshold frequency depend on which factors?

Watch Video Solution

21. For most metals threshold frequencies lie in which region?

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22. For alkali metals threshold frequencies lie in which region?

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23. How frequency of incident radiation is changed in experiment of photoelectric effect?

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24. How intensity of incident radiation is changed in experiment of photoelectric effect?

Watch Video Solution

25. No. of photoelectrons emitted varies with which physical quantity?

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26. What is saturation current?

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27. What is stopping potential?

Watch Video Solution

28. What is cut-off potential ?

Watch Video Solution

29. Energy of photoelectron depends on which factors?

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30. What phenomena of light can be explained on the basis of wave theory of light

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31. Why wave theory can not explain change in energy of electron with change In frequency?

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32. "with increase in frequency of light incident number of electrons emitted increase"-True or false?

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33. What is called as quantum of energy ?What is its energy?

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34. Write value and unit of plank's constant.

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35. What is intensity of radiation (light)?

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36. How intensity of radiation is determined?

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37. How maximum kinetic energy of photoelectron depend on frequency ?it do not depend on which factors?

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38. Why maximum kinetic energy of photoelectron cannot be negative?

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39. What is slope of $V_0 \rightarrow v$ graph ?Write its equation .Also mention whether it depend on type material or not.

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40. Write slope of $eV_0 \rightarrow v$ graph.

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41. What is called as photon?

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42. What is energy of photon having frequency v?

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43. What is momentum of photon having frequency v?

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44. Write equation of mass of photon.

Watch Video Solution

45. What is relation between photon and intensity of radiation ?

Watch Video Solution

46. What is velocity of photon?

Watch Video Solution

47. Write charge on photon.

Watch Video Solution

48. Which optical phenomena can be explained by wave nature of light?

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49. Which phenomena can be explained by using particle nature of light?

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50. Write de-Broglie hypothesis and derive equation of de-Broglie wavelength.

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51. Write equation of de-Broglie wavelength of a particle having momentum (p).

Watch Video Solution

52. Write equation of energy of photon.

Watch Video Solution

53. Explain Heisenberg's uncertainty principle.

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54. Explain how according to Born's probability interpretation a wave having single (unique) wavelength is extended all over space.

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55. What is wave packet?Explain by using necessary diagram.

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56. Who made experimental verification of wave nature of electron?

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57. Filament of electron gun is made up of which material and it coated with which material ?Why?

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58. In davisson-Germer experiment deflection of galvanometer is proportional to which quantity?

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59. In Davisson-Germer experiment,for which value of accelerating voltage,intesity of electron beam was found to be maximum?

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60. What is theoretical value of de-Broglie wavelength?

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61. What is experimental value of de-Broglie wavelength?

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62. In electron microscope which nature of electron is used?

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Section A Example

1. For electron moving with speed of 20 m/s and accelerated by 120 V p.D. de-Broglie wavelength can be easily obtained.

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2. For a ball of mass 0.12 kg and moving with speed of 20 m/s .Calculate de-Broglie wave length.

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Section B Numericals

1. Monochromatic light of frequency 6.0×10^{14} Hz is produced by a laser.The power emitted is 2.0×10^{-3} W. (a)What is the energy of a photon in the light beam?(b)How many photons per second.on an average ,are emitted by the source?

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2. The work function of caesium is 2.14 eV.Find (a) the threshold frequency for caesium,and (b)The wavelength of the incident light if the photocurrent is brought to zero by stopping potential of 0.60 V.

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3. The wavelength of light in the visible region is about 390 nm for violet colour ,about 550 nm (average wavelength) for yellow-green colour and about 760 nm for red colour.

(a)What are the energies of photons in (eV) at the (i) violet end, (ii)average wavelength,yellow-green colour,and (iii) red end of the visible spectrum ? (Take $h = 6.63 \times 110^{-34}$) js and 1 eV= 1.6×10^{-19}J).

(b)From which of the photosensitive material with work functions listed n Table 11.1 and using the results of (i),(ii) and (iii) of (a), can you build a photoelectric device that operates with visible light?

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4. What is the de-Broglie wavelength associated with (a) an electrin moving with a speed of $5.4 \times 10^6 m/s$ and (b) a ball of mass 150 g travelling at 30.0 m/s?

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5. An electron ,an α-particle and a proton have the same kinetic energy .Which of these particles has the shortest de-Broglie wavelength?

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6. A particle is moving three times as Fast as an electron .The ratio of the de-Broglie wavelength of the particle to that of the electron is 1.813×10^{-4}. Calculate the particle's mass and indentify the particle.

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7. What is the de-Broglie wavelength associated with an electron,accelerated through a potential difference of 100 volts?

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Section B Numerical From Textual Exercise

1. Find the

(a)Maximm frequency,and

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

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2. The work function of caesium metal is 2.14 eV.When light of frequency 6×10^{14} Hz is incident on the metal surface ,photoemission of electrons occurs.What is the

(a)Maximum kinetic energy of the emitted electrons.

(b)Stopping potential ,and

(c)Maximum speed of the emitted photoelectrons?

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3. The photoelectric cutoff voltage in a certain expertiment is 1.5 V.What is the maximum kinetic energy of photoelectrons emitted?

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

(b)How many photons per second,on the average ,arrive at a target irradiated by this beam ? (Assume the beam to have uniform cross-section which is less than the target area),and

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

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

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6. In an experiment on photoelectric effect.the slope of the cutoff voltage versus frequency incident light is found to be 4.12×10^{-15} V sec calculate the value of Planck's constant.

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7. A 100 W sodium lamp radiates energy uniformly in all directions .The lamp located at the centre of a large sphere the absorbs all the sodium light which is incident on it.The wavelength of the sodium light 589 nm.(a) what is the energy per photo assosciated

with the sodium light? (b)At what rate are the photons delivered to the sphere.

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8. The threshold frequency for a certain metal is 3.3×10^{14} Hz.If light of frequency 8.2×10^{14}Hz is incident on the metal ,predict the cutoff voltage for the photoelectric emission.

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

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

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11. Light of wavelength 488 nm is produced by an argon laser which is used in the photoelectric effect.When light from this spectral (cutoff)potential of photoelectrons is 0.38 V.Find the work function of the material from which the emitter is made.

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12. Calculate the

(a)Momentum ,and

(b)de-Broglie wavelength of the electrons accelerated through a potential differene of 56 V.

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13. What is the

(a)Momentum

(b)speed ,and

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

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

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15. What is the de-Broglie wavelength of

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

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

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

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

(a) their momentum ,

(b) the energy of the photon and

(c) the kinetic energy of electron.

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

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

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

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Section B Numerical From Textual Exercise Additional Exercise

1. (a) Estimate the speed with which electrons emitted from a heated emitter of an evacuated tube impinge on the collector maintained at a potential difference of 500 V with respect to the emitter.Ignore the small initial speeds of the electrons.The specific charge of the electron ,i.e., its

$\frac{e}{m}$ is given to be $1.76 \times 10^{11} Ckg^{-1}$

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

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2. (a) A monoenergetic electron beam with electron speed of $5.20 \times 10^{6} ms^{-1}$ is subject to a magnetic field of $1.30 \times 10^{-4} T$ normal to the beam velocity. What is the radius of the circle traced

by the beam, given e/m for electron equals $1.76 \times 10^{11} Ckg^{-1}$.

(b) Is the formula you employ in (a) valid for calculating radius of the path of a 20 MeV electron beam? If not, in what way is it modified?

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3. An electron gun with its collector at a potential of 100 v fires out electrons in a spherical bulb containing hydrogen gas at low pressure $\left(\sim 10^{-2} \text{ mm of Hg}\right)$. A magnetic field of $2.83 \times 10^{-4} T$ curves the path of the electrons in a circular orbit of radius 12.0 cm. (The path can be viewed because the gas ions in the path focus the beam by attracting electrons, and emitting light by electron capture, this method is known as the 'fine beam tube' method.) Determine e/m from the data.

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4. (a) An X-ray tube produces a continuous spectrum of radiation with its short wavelength end at 0.45Å. What is the maximum energy of a photon in the radiation?

(b) From your answer to (a), guess what order of accelerating voltage (for electrons) is required in such a tube ?

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5. In an accelerator experiment on high-energy collisions of electrons with positrons, a certain event is interpreted as annihilation of an electron-positron pair of total energy 10.2 Bev into two $\gamma-$ rays of equal energy. What is the wavelength associated with each $\gamma-$ ray? $\left(1\text{Bev}=\ 10^9 eV\right)$

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6. Estimating the following two numbers should be interesting. The first number will tell you why radio engineers do not need to worry much about photons! The second number tells you why our eye can never 'count photons', even in barely detectable light.

(a) The number of photons emitted per second by a Medium wave transmitter of 10 kW power, emitting radiowaves of wavelength 500 m.

(b) The number of photons entering the pupil of our eye per second corresponding to the minimum intensity of white light that we humans can perceive $\left(\sim 10^{-10} W m^{-2}\right)$. Take the area of the pupil to be about 0.4 cm2 , and the average frequency of white light to be about $6 \times 10^{14} Hz$

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7. Ultraviolet light of wavelength $2271 Å$ from a 100 W mercury source irradiates a photo-cell made of molybdenum metal. If the

stopping potential is $-1.3V$, estimate the work function of the metal. How would the photo-cell respond to a high intensity $\left(\sim 10^5 Wm^2\right)$ red light of wavelength 6328Å produced by a He-Ne laser ?

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

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

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

The stopping voltages, respectively, were measured to be:

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

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

[Note: You will notice that to get h from the data, you will need to know e (which you can take to be $1.6 \times 10^{-19}C$). Experiments of this kind on Na, Li, K, etc. were performed by Millikan, who, using his own value of e (from the oil-drop experiment) confirmed Einstein's photoelectric equation and at the same time gave an independent estimate of the value of h.]

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10. The work function for the following metals is given: $Na: 2.75eV$, $K: 2.30eV$, $Mo: 4.17eV$, $Ni: 5.15ev$. Which of these metals will not give photoelectric emission for a radiation of wavelength 3300Å 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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11. Light of intensity $10^{-5}Wm^{-2}$ falls on a sodium photo-cell of surface area $2cm^2$. Assuming that the top 5 layers of sodium absorb the incident energy, estimate time required for photoelectric emission in the wave-picture of radiation. The work function for the metal is given to be about 2 eV. What is the implication of your answer?

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

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13. (a) Obtain the de Broglie wavelength of a neutron of kinetic energy 150 eV. As you have seen in Exercise 11.31, an electron beam of this energy is suitable for crystal diffraction experiments. Would a neutron beam of the same energy be equally suitable? Explain. $\left(m_n = 1.675 \times 10^{-27} kg\right)$

(b) Obtain the de Broglie wavelength associated with thermal neutrons at room temperature $(27^\circ C)$. Hence explain why a fast

neutron beam needs to be thermalised with the environment before it can be used for neutron diffraction experiments.

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14. 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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15. The wavelength of a probe is roughly a measure of the size of a structure that it can probe in some detail. The quark structure of protons and neutrons appears at the minute length-scale of

$10^{-15}m$ or less. This structure was first probed in early 1970's using high energy electron beams produced by a linear accelerator at Stanford, USA. Guess what might have been the order of energy of these electron beams. (Rest mass energy of electron = 0.511 MeV.)

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

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

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18. Answer the following questions:

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

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Section B Numerical From Textual Exercise Numerical From Darpan Based On Textbook

1. Let an electron requires 5×10^{-19} joule energy to just escape from the irradiated metal.If photoelectron us emited after 10^{-9} s of the incident light,calculate the rate of absorption of energy .If this process is considered clasically.The light energy is assumed to

be continously distributed over the wave front.Now,the electron can only absorb the light incident within a small area,say $10^{-19}m^2$ .What is the intensity of illumination in order to see the photoelectric effect?

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2. Work function of metal is 2 eV.Light of intensity $10^{-5}Wm^{-2}$ is incident on $2cm^2$ area of it.If 10^{17} electrons of these metals absorb the light,in how much time does the photo electric effect start? Consider the waveform of incident light.

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3. If the efficiency of an electric bulb of 1 watt is 10% what is the number of photons emitted by it in one second ?(The wavelength of light emitted by it is 500 nm.)(`h=6.625xx10^(-34)J.s).

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4. 11×10^{11} photons are incident on a surface in 100s.These photons correspond to a wavelength of 10Å .If the surface area of the given surface is $0.01m^2$,the intensity of given radiations is ..... (velocity of light is $3 \times 10^8 ms^{-1}, h = 6.625x10^{-34}JS$)

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5. A proton falls freely under gravity of Earth.Its de-Broglie wavelength after 10s of its motion is .....Neglect the forces other than gravitational force. ($g = 10m/s^2, m_p = 1.67 \times 10^{-27}Kg, h = 6.625 \times 10^{-34}Js$)

[similar as Oct. 2012,'15]

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6. An electron is at a distance of 10 m from a charge of 10c.Its total energy is 15.6×10^{-10} J.Its de-Broglie wavelength at this point is..... $.\left(h = 6.625 \times 10^{-34}\right)$J.s ,

$m_e = 9.1 \times 10^{-31} kg, K = 9 \times 10^9 SI$

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7. Wavelength of light incident on a photo-sensitive surface is reduced from 3500 Å to 290 nm.The change in stopping potential is .....$\left(h = 6.625 \times 10^{-34} Js\right)$

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8. An electric bulb of 100 W converts 3% of electrical energy into light energy.If the wavelength of light emitted is 6625 Å,the number of photons emitted in 1 s is.....

$\left(h = 6.625 \times 10^{-34}\right) JS$

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9. Work function of Zn is 3.74 eV.If the sphere of Zn is illuminated by the X-rays of wavelength 12Å,the maximum potential produced on the sphere is .....$(h = 6.625 \times 10^{-34} Js)$

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10. Monochromatic light of wavelength 3000 Å is incident normally on a surface of area $4cm^2$ If the intensity of light is $150 \frac{mW}{m^2}$, the number of photon being incident on this surface in one second is .....

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11. A star which can be seen with naked eye fro Earth has intensity $1.6 \times 10^{-9} Wm^{-2}$ on Earth.If the corresponding wavelength is 560 nm,and the radius of the lens of human eye is 2.5×10^{-3}m,the number of photons entering in our eye in 1s is.....

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Section B Questions

1. Monochromatic light frequency 5.0×10^{14} Hz is produced by a laser.The power emitted is 66 W. How many photons per second,on an average ,are emitted by the source?

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2. Work function of potassium is 2.30 eV.Find

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

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3. The work function for the following metals is given: $Na: 2.75eV$, $K: 2.30eV$, $Mo: 4.17eV$, $Ni: 5.15ev$. Which of these metals will not give photoelectric emission for a radiation of wavelength $3300Å$ 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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4. What is the de-Broglie wavelength associated with (a) Electron moving with velocity of $4.5 \times 10^{6} m / s$ and (b)30 g ball moving with speed of 15.0 m/s

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5. An electron ,an alpha -particle and a duteron have the same kinetic energy .which of these particles has the longest de-Broglie wavelength?

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6. A particle is moving 1.5 times as fast as an electron.The ratio of the de-Broglie wavelength of the particle to that of the electron is 1.813×10^{-4} Calculate the particle's mass and identify the particle

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7. What is the de-Broglie wavelength associated with an electron ,accelerated through a potential difference of 10K volts?

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Section C Ncert Exemplar Solution Multiple Choice Questions Mcqs

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

A. H

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

C. H^{0}

D. $H^{\frac{-1}{2}}$

Answer: D

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

A. 1.2 nm

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

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

D. $1.2 \times 10^{1} nm$

Answer: B

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

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

B. electron can be emitted but all with an energy,E_0.

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

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

Answer: D

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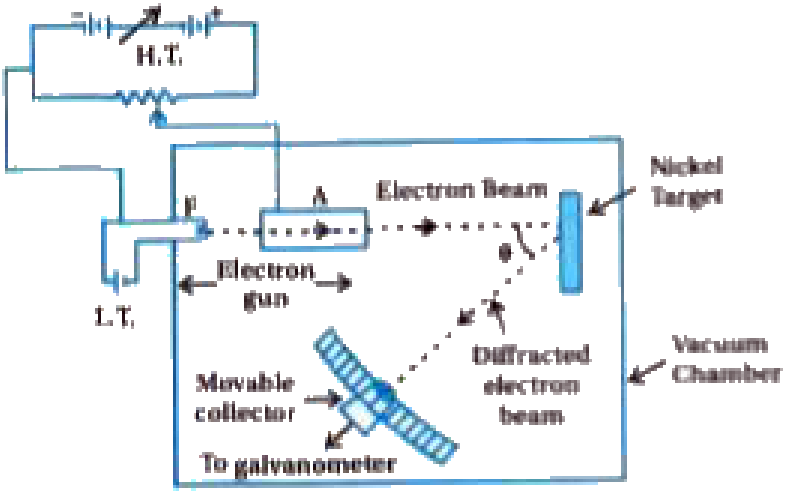

4.

Consider arrangement shown In figure for davisson-Germer experiment when voltage applied to A is increased in diffracted beam will have maximum number of electron for value diffraction angle (θ) such that.....

A. Will be larger than the earlier value.

B. Will be the same as the earlier value

C. Will be less than the earlier value

D. Will depend on the target

Answer: C

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

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

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

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

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

Answer: B

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6. An electron is moving with an initial velocity $\overrightarrow{v} = v_0\hat{i}$ and is in a magnetic field $\overrightarrow{B} = B_0\hat{j}$

Then it's de-Broglie wavelength

A. remains constant

B. Increases with time.

C. decreases with time

D. increases and decreases periodically

Answer: A

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7. An electron (mass m)with an initial velocity $\overrightarrow{v} = v_0\hat{i}$ is in an electric field $\overrightarrow{E} = E_0\hat{j}$.

If $l, ambda_0 = h. . mv_0$.it's de-Broglie wavelength at time t is given by

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

B. $\lambda_0\left(1+\frac{eE_0t}{mv_0}\right)$

C. λ_0

D. $\lambda_0 t$

Answer: A

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8. An electron (mass m)with an initial velocity $\overrightarrow{v}=v_0\hat{i}$ is in an electric field $\overrightarrow{E}=E_0\hat{j}$.

If $l, ambda_0 = h..mv_0$.it's de-Broglie wavelength at time t is given by

A. λ_0

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

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

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

Answer: C

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Section C Multiple Choice Questions More Than One Options

1. Relativistic corrections become necessary when the expression for the kinetic energy $\frac{1}{2}mv^2$,

becomes comparable with mc^2,where m is the mass of the particle.At what de-Broglie wavelength will realtivistic corrections become important for an electron?

A. λ=10 nm

B. $labda = 10^{-1}$nm

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

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

Answer: C::D

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2. Two particles A_1 and A_2 masses $m_1, m_2 (m_1 > m_2)$ have the same de-Broglie wavelegth .Then

A. their momenta are the same

B. their energies are the same

C. energy of A_1 is less the energy of A_2

D. energy of A_1 is more than the energy of A_2

Answer: A::C

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

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

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

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

D. $\frac{p_e}{m_e c} = 10^{-4}$

Answer: B::C

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

A. decreases with increasing n,with v fixed.

B. decreases with n fixed ,v increasing

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

D. Increases when the product nv increases.

Answer: A::B::C

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5. A particle moves in a closed orbit around the origin ,due to a force which is directed towards the origin.The de-Broglie wavelength of the particle varies cyclically between two value λ_1, λ_2 with $\lambda_1 > \lambda_2$.Which of the following statement are true?

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

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

C. When the de-Broglie wavelength is λ_1,the particle is nearer the origin than when its value is λ_2

D. When the de-Broglie wavelength is λ_2, the particle is nearer the origin than when its values is λ_1

Answer: B::D

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Section C Very Short Answer Type Questions

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

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2. (i) In the explanation of photoelectric effect we assume one photon of frequency with v collides with an electron and transfers its energy.This lead to the equation for the maximum energy $E_{\max}$ of the emitted electron as

$E_{\max} = hv - \phi_0$

Where ϕ_0 is the work function of the metal If an electron absorbs 2 photon (each of frequency v)What will be the maximum energy for the emitted electron?

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

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3. There are materials which absorb photons of shorter wavelength and emit photons of longer wavelength .Can there be stable substances which absorb photons of larger wavelength and emit light of shorter wavelength.

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

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5. There are two sources of light,each emitting with a power of 100W.One emits X-rays of wavelength 1 nm and the other visible light at 500 nm.Find the ratio of number of photons of X-rays to the photon of visible light of the given wavelength?

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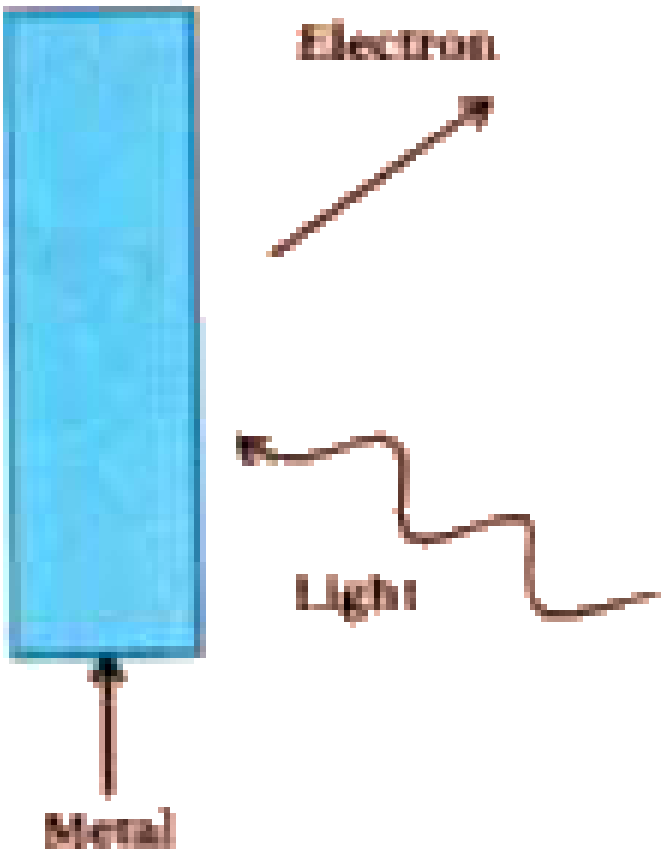
6. Consider figure for photoemission.



How would you reconcile with momentum-conservation ?Note light (photons)have momentum in a different direction than the emitted electrons.

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

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8. Assuming an electron is confined to a 1nm wide region,find the uncertainty in momentum using Heisenberg Uncertainty principle .You can assume the uncertainty in position Δx as 1 nm.Assuming $p \approx \Delta p$, find th energy of the electron in electron volts.

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9. Two monochromatic beam A and B of equal intensity I,hit a screen.The number of photons hitting the screen by beam A is

twice that by beam B.Then what inference can you make about their frequencies?

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

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

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Section C Long Answer Type Question

1. Consider a thin target (10^{-2} m square ,10^{-3} m thickness) of sodium ,which produces a photocurrent of 100 μA when a light of intensity $100W/m^2$ (λ=660nm) falls on it.Find the probability that a photoelectron is produced when a photon strikes a sodium atom. [Take density of Na=0.97 kg/m^3].

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2. Consider an electron in front of metallic surface at a distance d(treated as an infinite plane surface).Assume the force of attraction by the plate is given as $\frac{1}{4}\frac{q^2}{4\pi\varepsilon_0 d^2}$.

Calculate work in taking the charge to an infinite distance from the

plate.Taking d=0.1 nm,find the work done in electron volts.[Such a force law is not valid for d $<$ 0.1 nm].

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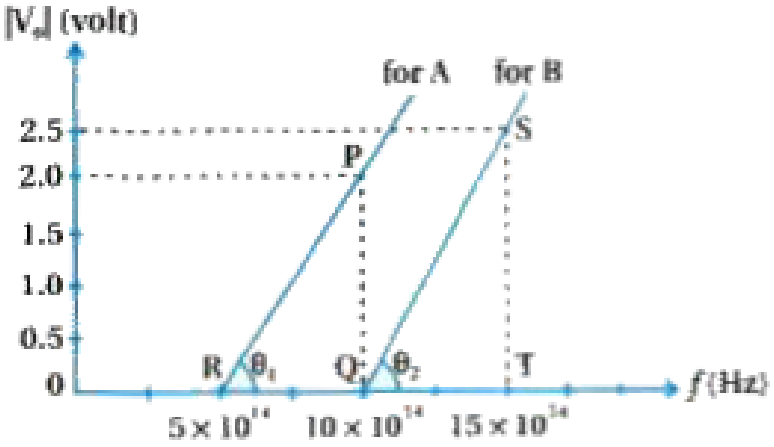
3.



A student performs an experiment on photoelectric effect,using two materials A and B.A plot $V_{\text{stop}} vs$ v is given in figure.

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

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

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

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

(i)Estimate no. of photons emitted by the bulb per second.[Assume no other losses]

(ii)Will much time would be required by the atomic disk to receive energy equal to work function (2eV)?

(iv)How many photons would atomic disk receive within time duration calculated in (iii)above?

(v) Can you explain how photoelectric effect was observed instantaneously?

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Section D Multiple Choice Questions Mcqs

1. Scientist .....invented electron.

A. Roentgen

B. J.J Thomson

C. Max-Planck

D. William crookes

Answer: B

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2. Which scientist invented cathode rays?

A. Maxwell

B. Hertz

C. Max-Planck

D. William crookes

Answer: D

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3. Scientist.....proved that electric charge is quantized.

A. R.A millikan

B. J.J Thomson

C. Max-Planck

D. Maxwell

Answer: A

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4. When a clean metal surface incident with radiation of sufficiently high frequency ,electron are emitted from it.This method of emission of electron is called.....

A. thermionic emission

B. Field emission

C. photo-electric effect

D. collision emission

Answer: C

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5. SI unit of work function is.....

A. N

B. J

C. eV

D. W

Answer: C

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6. Value of work function depend on.....

A. type of metal

B. type of metal surface

C. type of metal surface and surface area.

D. type of metal and type of metal surface.

Answer: D

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7. Which of the following is best metal for photoelectric emission?

A. Sodium

B. Potassium

C. Cesium

D. Lithium

Answer: C

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8. Frequency of radiation incident on metal surface is called threshold frequency.

A. Any

B. minimum

C. Maximum

D. 10 kHz

Answer: B

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9. For most of metals threshold frequency lies in which region of electro-magnetic radiation?

A. Infrared

B. Visible

C. Ultraviolet

D. X-rays

Answer: C

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10. For alkali metals threshold frequencies lie in which region?

A. Ultraviolet

B. Visible

C. X-rays

D. None of these

Answer: B

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11. For photosensitive surface threshold wavelength is 5200Å .When monochromatic radiation of .....is incident on this surface,photoelectron will be emitted.

A. Infrared bulb of power 1 W

B. infrared bulb of 50 W power

C. Ultraviolet bulb of 1 W power

D. ultraviolet bulb of 50 W power and 1 W power.

Answer: D

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12. Electrons are emitted from photo-cell with maximum speed of 4×10^8 cm/s .Its stopping potential will be.....

(Mass of electron $= 9 \times 10^{-31}$ kg.

A. 30V

B. 45V

C. 59V

D. Information is insufficient

Answer: B

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13. Radiation of $4f_0$ frequency is incident on metal surface with f_0 threshold frequency maximum kinetic energy of photo-electric emitted will be ....

A. $3hf_0$

B. $2hf_0$

C. $\frac{3hf_0}{2}$

D. $\frac{hf_0}{2}$

Answer: A

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14. Work function of metal is ϕ wavelength of incident light is λ .Which condition should be followed for not emitting the photo-electron?

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

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

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

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

Answer: A

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15. Four photon of $\lambda > \lambda_0$ are incident on metal surface .....photo - electron will be emitted.

A. Zero

B. One

C. Two

D. Four

Answer: A

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16. If ratio of threshold frequencies of two metals is 1:3 ,ratio of their work function is .....

A. $1:3$

B. $3:1$

C. $4:16$

D. $16:4$

Answer: A

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17. When a piece of sodium or potassium are exposed to sunlight .....

A. they will become negatively charged.

B. will be remain neutral.

C. they will become positively charged

D. will emit proton.

Answer: C

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18. If photo-electric effect is not seen with the ultraviolet radiation in a given metal ,photo-electrons may be emitted with the.....

A. infrared waves

B. radio waves

C. X-rays

D. visible light

Answer: C

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19. Threshold wavelength of metal is 30 Å If radiation of 2000Å Is incident metal surface then .....

A. positron will be emitted.

B. proton will be emitted.

C. electron will be emitted

D. electron will not be emitted.

Answer: D

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20. Work function of metal A,B and C are 4.5 eV 4.3 eV and 3.8eV respectively .If radiation of 3000 Å is incident on it then .....($h = 6.62 \times 10^{-34} js, c = 3 \times 10^{8} m/s, 1eV 1.6 \times 10^{-19} C$)

A. photo-electron will be emitted from metal surface A.

B. photo-electron will be emitted from metal B

C. Photo-electron will be emitted from metal C.

D. Photo-electron will be emitted from metal A.B and C

Answer: C

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21. What will be maximum value of wavelength by which photo-electric emission can be obtained on metal surface with work function of 3.2 eV? ($h = 6.625 \times 10^{-34}$ Js)

A. 1988Å

B. 2466 Å

C. 2953 Å

D. 3882 Å

Answer: D

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22. A metal surace objects electrons when hit by green light but none when hit by yellow light .The electrons will be ejected when the surface is hit by.....

A. blue light

B. heat rays

C. infrared rays

D. red light

Answer: A

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23. Photo-electric emission is observed from a metalli surface for frequenceis f_1 and f_2 of the incident light. $(f_1 > f_2)$ .If the maximum values of K.E. of photo-electrons emitted in two cases are in the ratio 1:n, then the threshold frequency of a metallic surface is .....

A. $\frac{f_1 - f_2}{n - 1}$

B. $\frac{nf_1 - f_2}{n - 1}$

C. $\frac{nf_2 - f_1}{n - 1}$

D. $\frac{f_1 - f_2}{n}$

Answer: B

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24. If photo-electric effect,when frequency of incident radiation is doubled ,maximum speed of electron emitted also becomes double .work function of metal will be.....

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

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

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

D. $\frac{2hv}{3}$

Answer: D

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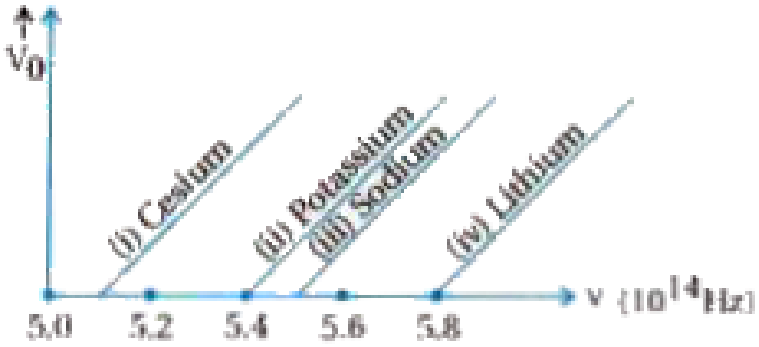
25. For metals cesium ,potassium ,sodium and lithium graph of stopping potential $(V_0) \rightarrow$ frequency (v) is shown in figure .These graph are parallel.Arrange work function from lerger to smaller

value.



A. $(i) > (ii) > (iii) > (iv)$

B. $(i) > (iii) > (ii) > (iv)$

C. $(iv) > (iii) > (ii) > (i)$

D. $(iv) = (iii) > (iii) = (iv)$

Answer: C

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26. Maximum kinetic energy of photoelectron emitted is independent of .....

A. frequency of incident radiation

B. intensity of incident radiation

C. type of cathode

D. all of the above

Answer: B

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27. In two different experiment X-rays are incident on sodium metal and then X-rays are incident on copper.In both case stoppin potential V_0 is measured ,stopping potential ...given $\left[(\phi_0)_{na} < (\phi_0)_{cu}\right]$

A. will be same in both case

B. will be more for sodium metal

C. more for copper

D. will be infinite for both metal

Answer: B

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28. Ultraviolet radiation in incident on sodium metal.Then visible light is incident.Potential difference is measured in both case.Stopping potential....

A. Will be same for both metals

B. more for ultraviolet radiation

C. more for visible light

D. can not be said.

Answer: B

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29. When monochromatic source is kept at distance of 0.2 m from photocell,cutoff voltage obtained is 0.6 V and saturation current is 18 mA.Noe if source is kept at distance of 0.6 m.....

A. Stopping potential will be 0.2 V

B. stopping potential will be 0.6 V

C. saturation current will be 6 mA

D. saturation current will be 18 mA

Answer: B

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30. Maximum speed of electron emitted from metal surface is $5 \times 10^6 ms^{-1}$ .If specifi charge of electron is $1.8 \times 10^{11} ckg^{-1}$,then value of stopping potential will be.....

A. 2V

B. 3V

C. 7V

D. 4V

Answer: C

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31. The work function of a metal surface is 4.2 eV. The maximum wavelength which can eject photo-electron from this surface is =.....Å

A. 2956

B. 3076

C. 4116

D. 5088

Answer: A

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32. Threshold frequency for metal surface is 4×10^{14} Hz.When radiation of 5×10^{14}Hz is incident on this surface ,photo-electric current obtained is 1.8 mA.If frequency of incident radiation is made half and intensity is made three times,value of photo-electric current will be.....

A. 0.9 mA

B. 5.4 mA

C. 3.6 mA

D. zero

Answer: D

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33. On metal surface radiation of 2000Å and 5000 Å is incident sequentially .Change in kinetic energy of photo-electric emitted during this will be.....h $= 6.6 \times 10^{-34}$Js .

A. 3.71 eV

B. 5.94 eV

C. 7.42 eV

D. 2.97 eV

Answer: A

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34. Slope of $V_0 \rightarrow V$ graph shows.....

A. h

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

C. eh

D. e^h

Answer: B

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35. Slope of $V_0 e \rightarrow V$ represent.....

A. h

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

C. eh

D. e^h

Answer: A

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36. .....potentail on collector w.r.t. emitter for which photo-electric current become zero is called stopping potential.

A. minimum negative

B. minimum positive

C. maximum negative

D. maximum positive

Answer: A

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37. In condition of stopping potential value of photo-electric current will be.....

A. Zero

B. Minimum

C. maximum

D. infinite

Answer: A

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38. Value of stopping potential depends on..... Of incident light.

A. frequency of incident radiation

B. intensity of incident radiation

C. number of incident photon

D. number of photo-electron emitted

Answer: A

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39. When metal surface with 2.1 eV work function is irridated with photon of 6.0 eV energy.Value of stopping potential will be....

A. $+8.1$

B. $-8.1V$

C. $+3.9V$

D. $-3.9V$

Answer: D

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40. When photon of v frequency os incident on photo sensitive surface with V_0 threshold frequency,maximum kinetic energy of photo-electron emitted will be....

A. $h(v - v_0)$

B. $h(v + v_0)$

C. hv

D. hv_0

Answer: A

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41. .....cannot be explained by wave theory of light.

A. Interference

B. Diffraction

C. Polarizaton

D. Photo-electric effect

Answer: D

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42. Photo-electric effect show .....nature of radiation.

A. wave

B. particle

C. wave and particle

D. wave or particle

Answer: B

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43. Which of the following has same dimension as that of planck's constant?

A. Force

B. Energy

C. Linear momentum

D. Angular momentum

Answer: D

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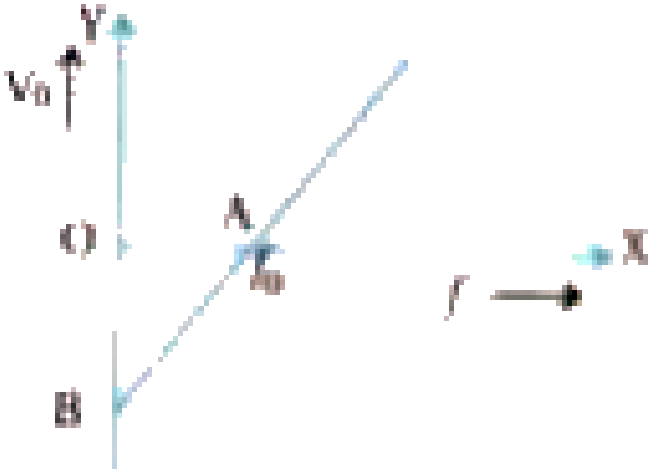
44. Figure shows graph of stopping potential v frequency in experiment of photo-electric effect work function of metal will be.....

e=change of electron.



A. $Ov \times e(\in eV)$

B. OB (In volt)

C. OA (in eV)

D. Slope of line AB

Answer: A

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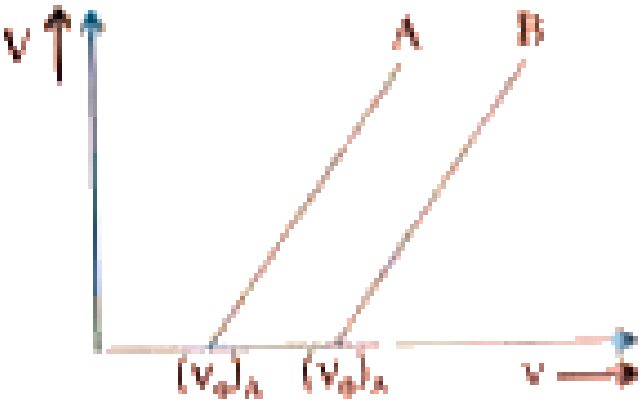
45. For photo senstive surface A and B graph of stopping potential versus frequency (v) is shown in figure .From graph work function of A surface .....



A. More than that of B.

B. Less than that of B.

C. equal to B.

D. Cannot be said about work function.

Answer: B

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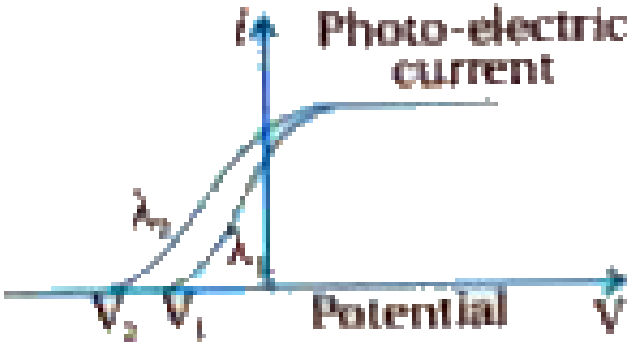
46. In given graph if $V_{02} > V_{01}$ then.....



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

B. $\lambda_1 < \lambda_2$

C. $\lambda_1 > \lambda_2$

D. $\lambda_1 > \lambda_2$

Answer: D

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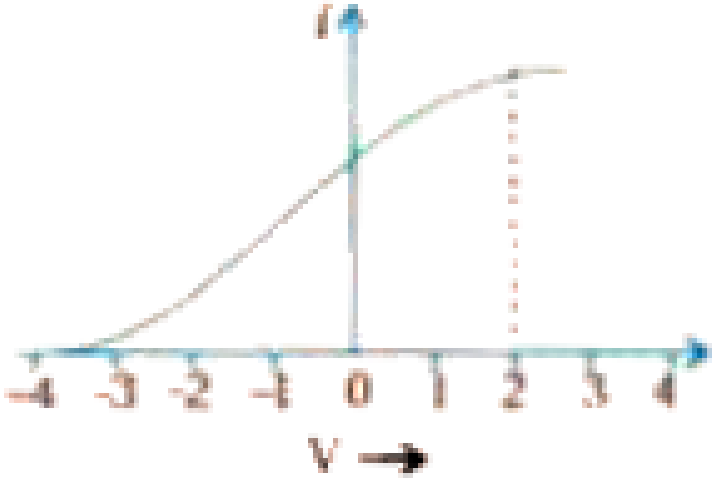
47. Graph shown in figure is the relation between photo current (i) versus incident voltage (V). Maximum energy of electron emitted will be ...



A. 2 eV

B. 4 eV

C. 0 eV

D. 4 J

Answer: B

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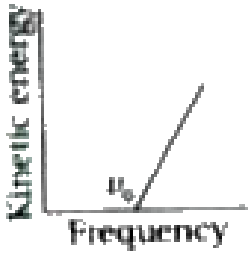
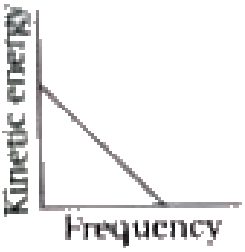
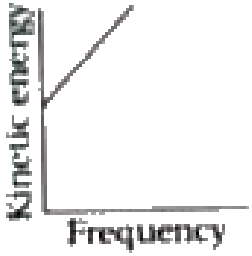
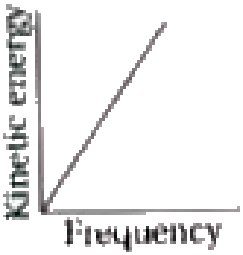
48. According to Einstein's equation of photo-electric effect which of the following graph shows realtion between kinetic energy of electron emitted and frequency of incident radiation?

A. 

B. 

C. 

D. 

Answer: A

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Section D Multiple Choice Questions Mcqs Photo Electric Effect

1. Scientist.....performed experiment related to photo-electric effect.

A. Only Hallwach

B. Only Lenard

C. Only J.J thomson

D. Both (A) and (B)

Answer: D

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Section D Multiple Choice Questions Mcqs Photon

1. Which of the following statement is not true for a photon a photon?

A. photon produces pressure

B. Photon has energy hf.

C. Photon has momentum $\frac{hf}{c}$

D. Rest mass of photon is zero

Answer: A

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2. Rest mass of photon is.....

A. zero

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

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

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

Answer: A

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3. Mass of photon moving with speed v is .....,m_0 is rest mass of photon.

A. zero

B. $\frac{m_0}{\sqrt{1-\frac{c^2}{v^2}}}$

C. $\frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}}$

D. infinite

Answer: C

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4. Possessing energy E of photon's wavelength in air is.....

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

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

C. $\frac{c}{hE}$

D. $h \times cE$

Answer: A

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5. Energy of n photon having frequency v is.....

A. nhv^2

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

C. nhv

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

Answer: C

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6. Light of which of the following energy is no possible?

A. $6.625 \times 10^{-34} J$

B. $13.25 \times 10^{-34} J$

C. $3.3125 \times 10^{-34} J$

D. $66.25 \times 10^{-34} J$

Answer: C

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7. If E and p are the energy and momentum of a photon respectively then on decreasing in the wavelength of photon.

A. p and E both will decrease.

B. p and E both will increase

C. p will increase and E will decrease

D. p will decrease and E will increase

Answer: A

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8. Wavelength of an electron having energy 10 keV .....Å

A. 0.12

B. 1.2

C. 12

D. 120

Answer: A

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9. If the momentum of an electron is required to be same as that of wave of 5200 Å wavelength, its velocity should be .....ms^{-1}

A. 10^3

B. 1.2×10^3

C. 1.4×10^3

D. 2.8×10^3

Answer: C

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10. Frequency of photon having 66 eV energy will be..... $\left(h = 6.6 \times 10^{-34} Js\right)$

A. $8 \times 10^{-15} Hz$

B. $12 \times 10^{-15} Hz$

C. $16 \times 10^{-15} Hz$

D. $24 \times 10^{-15} Hz$

Answer: C

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11. Energy of 1photon of γ rays having wavelength of 2.5×10^{-13}m will be how many times energy of radiation having wavelength of 5000 Å

A. 2×10^6

B. 4×10^6

C. 8×10^6

D. 0.5×10^6

Answer: A

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12. What is the velocity of particle whose mass is double that of rest mass?

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

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

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

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

Answer: C

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13. An electron with rest mass m_0 moves with a speed of 0.8c.Its mass when it moves with this speed is.....

A. m_0

B. $\frac{m_0}{6}$

C. $\frac{5m_0}{3}$

D. $\frac{3m_0}{5}$

Answer: C

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14. For proton and α-particle,de-Broglie wavelength is same .For them.....will be equal .

A. velocity

B. energy

C. frequency

D. momentum

Answer: D

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15. To reduce de-Broglie wavelength of an electron from 10^{-10} m to 0.5×10^{-10} m,its energy should be ...

A. increased to 4 times

B. doubled

C. halved

D. decreased to fourth part

Answer: A

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16. Electron starting from rest is acclerated between two point having p.d. of 20 V and 40 V. de-Broglie wavelength of electron.....

A. 0.75 Å

B. 7.5 Å

C. 2.75 Å

D. 0.75 nm

Answer: C

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17. A particle having rest mass m_0 travel with speed of light in vaccum.Its de-Broglie wavelength will be.....

A. $\frac{h}{m_0 c}$

B. 0

C. ∞

D. $\frac{m_0 C}{h}$

Answer: B

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18. Electron should be accelerated which voltage so that its de-Broglie wavelength will become 0.4 Å.

A. 9410 V

B. 94.10 V

C. 9.140 V

D. 941 V

Answer: D

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19. When de-Broglie wavelength of electron in increased by 1% its momentum...

A. increase by 1%

B. decrease by 1%

C. increase by 2%

D. decreased by 2%

Answer: B

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20. de-Borglie wavelength of particle moving at a $\frac{1^{th}}{4}$ od speed of light having rest mass m_0 is....

A. $\frac{3.87h}{m_0c}$

B. $\frac{4.92h}{m_0c}$

C. $\frac{7.57h}{m_0c}$

D. $\frac{9.46h}{m_0c}$

Answer: A

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21. An electrons enters perpendicularly into uniform magnetic field having magnitude $0.5 \times 10^{-4} T$.If it moves on a circular path of radius 2mm,its de-Broglie wavelength is.....A

A. 3410

B. 4140

C. 2070

D. 2785

Answer: B

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22. A proton moves with speed $\frac{c}{10}$.Its de-Broglie wavelength will be.....

$\left(h = 6.63 \times 10^{-34} Js, m_p = 1.673 \times 10^{-27} Kg\right)$

A. 0.1321 Å

B. 1.321 Å

C. $0.1321 \times 10^{-2} Å$

D. $1.321 \times 10^{-4} Å$

Answer: D

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23. If electron is accelerated under 50 KV in microscope ,find its de-Broglie wavelength.

A. $5.485 \times 10^{-12} m$

B. $8.545 \times 10^{-12} m$

C. $4.585 \times 10^{-12} m$

D. $5.845 \times 10^{-12} m$

Answer: A

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24. An electron is at a distance of 10 m from a charge of 10c.Its total energy is 15.6×10^{-10} J.Its de-Broglie wavelength at this point is..... $.\left(h = 6.625 \times 10^{-34}\right)$ J.s ,

$m_e = 9.1 \times 10^{-31} kg, K = 9 \times 10^9 SI$

A. 9.87 Å

B. 9.87 fermi

C. 8.97 Å

D. 8.97 fermi

Answer: D

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25. At $10^{\circ}C$ tempreture ,de-Broglie wave length of atom is 0.4 Å.If temperatire of atom is increased by $30^{\circ}C$,What will be change in de-Broglie of atom?

A. decreases 10^{2}Å

B. decreases $2 \times 10^{-1}\text{Å}$

C. increase 10^{-2} Å

D. increase $2 \times 10^{-2}\text{Å}$

Answer: B

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26. Velocity of particle having 1 mg mass is 72 km/hr.Its de-Broglie wavelength is ....

A. 3.3×10^{-29}

B. 3.3×10^{-10}

C. 3.3×10^{-32}

D. 3.3×10^{-6}

Answer: A

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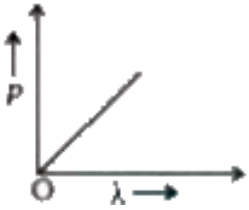
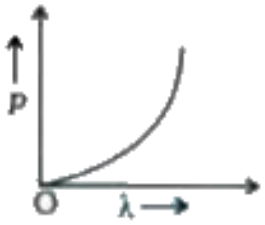
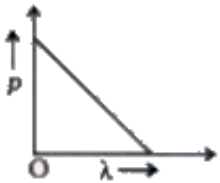
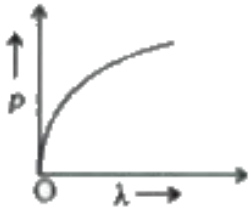
27. Which of the following represent relation between momentum and de-broglie wavelength ?

A. 

B. 

C. 

D. 

Answer: C

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28. Change on two particle is 3q and 2q respectivley.Their mass is 2m and 3m respectively.Both are accelerated under same potential difference .Ratio of their de-Broglie wavelength will be....

A. $2:3$

B. $3:2$

C. $1:$

D. $1:1$

Answer: D

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Section D Multiple Choice Questions Mcqs Dual Nature Of Light De Broglie Wavelength

1. If proton and electron have same de-Broglie wavelength then....

A. both will have same kinetic energy

B. kinetic energy of proton will be more than kinetic energy of electron

C. kinetic energy of electron will be more than kinetic energy of proton

D. Both will have same velocity

Answer: C

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Section D Multiple Choice Questions Mcqs Principle Of Uncertainty

1. On the basis of the uncertainty particle ,it can be proved that ....

A. electron exist inside the nucleus.

B. electron do not exist inside the nucleus.

C. neutron exist inside the nucleus

D. protons exist inside the nucleus.

Answer: B

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2. In practice principle of uncertainty is applied

A. only for micro particles

B. only on general particles

C. only on microscopic particles

D. none of the above

Answer: A

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3. If a proton and an electron are confined to the same region.then uncertainty in momentum .....

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

B. for electron is more as compared to the proton

C. same for the both particles

D. directly proportional to their masses.

Answer: C

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4. Principle of uncertainty show.....

A. a relation between momentum of particles and wave property

B. that to determine the exact value for both momentum and position of a particle is impossible

C. that it is another statement of de-Broglie hypothesis

D. relation between velocity of matter wave and frequency.

Answer: B

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5. Uncertainty in position of electron is of the order of de-Broglie wavelength .By using Heisenberg's principle uncertainty in velocity will be....

A. 1 v

B. 2 v

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

D. $2\pi v$

Answer: C

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6. Uncertainty in frequency of laser is 2000 Hz.Uncertainty in its periodic time will be.....

A. $5 \times 10^{-31} S$

B. $10^{-16} S$

C. $8 \times 10^{-5} S$

D. $10^{-24} S$

Answer: C

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7. The uncertainty in the position of a particle equal to the de-Broglie wavelength uncertainty in its momentum will be.....

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

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

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

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

Answer: A

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8. A proton and electron are lying in a box having unpenetrable walls,the ratio of uncertainty in their velociteis are .....[m_e=mass of electron and m_p=mass of proton.]

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

B. $m_e . m_p$

C. $\sqrt{m_e . m_p}$

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

Answer: A

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9. Uncertainty in position of a particle is 0.1587×10^{-10} m what will be uncertainty in its momentum in kg ms^{-1}?

A. 4×10^{-23}

B. 6.6×10^{-28}

C. 3.1×10^{-24}

D. 6.6×10^{-24}

Answer: D

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10. Accuracy in momentum of electron moving with velocity of 50 ms^{-1} is 0.005 %. Then accuracy in its position is.....

A. $2.32 \times 10^{-2} m$

B. $46 \times 10^{-4} m$

C. $46 \times 10^{-3} m$

D. $46 \times 10^{-6} m$

Answer: A

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11. Maximum uncertainty in position of a proton is $6 \times 10^{-8} m$ .Uncertainty in measurement of its velocity will be .....($h = 6.625 \times 10^{-34}$) Js,Mass of proton =$1.67 \times 10^{-27} kg$

A. $1 mms^{-1}$

B. $1 ms^{-1}$

C. $1 cms^{-1}$

D. $100ms^{-1}$

Answer: B

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12. Uncertainty of momentum of a particle is $10^{-30}kgms^{-1}$,minimum uncertainty in its position will be.....

A. $10^{-8}m$

B. $10^{-12}m$

C. $10^{-16}m$

D. $10^{-4}m$

Answer: D

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13. In quantum mechanics ,a particle ...

A. can be regarded as a group of harmonic waves

B. can be regarded as a single wave of definite wavelength only

C. can be regarded as only a pair of two harmonic waves

D. is a point-like object with mass.

Answer: A

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Section D Multiple Choice Questions Mcqs Davisson And Germer Experiment

1. in Davisson-Germer experiment filament of electron gun is coated with.....

A. carbon oxide

B. barium oxide

C. berillium oxide

D. rubber

Answer: B

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2. In davisson-Germer experiment,thermionically emitted electron are incident on.....crystal.

A. tungsetn

B. lead

C. nickel

D. berillium

Answer: C

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3. In davisson-Germer experiment ,intensity of electron beam scattered by.....

A. photometer

B. electroscope

C. detector

D. galvanometer

Answer: C

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4. In davisson -Germer experiment ,de-Broglie wavelength of electron is....of accelerating voltage.

A. proporational

B. inversly proportional

C. directly proportional to square root

D. inversly proportional to square root

Answer: D

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5. In Davisson-Germer experiment ,deflection of galvanometer is..... proportional to intensity of electron beam entering to collector.

A. directly

B. inversly

C. directly proportional to square

D. inversly proportional to square root

Answer: A

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6. Wavelength of electron obtained in Davisson-Germer experiment is..

A. 0.165 nm

B. 0.167 nm

C. 0.165 Å

D. 0.167 Å

Answer: B

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7. In electron microscope.....property of electron is used.

A. particle

B. wave

C. particle and wave both

D. none of the above

Answer: B

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8. Monochromatic light of frequency 6.0×10^{14} Hz is produced by a laser.The power emitted is 2.0×10^{-3} W. (a)What is the energy of a photon in the light beam?(b)How many photons per second.on an average ,are emitted by the source?

A. $3.98 \times 10^{-10} J$

B. $3.98 \times 10^{-19} J$

C. $3.98 \times 10^{-48} J$

D. $3.98 \times 10^{48} J$

Answer: B

Watch Video Solution

9. Monochromatic light of frequency 6.0×10^{14} Hz is produced by a laser.The power emitted is 2.0×10^{-3} W. (a)What is the energy of a photon in the light beam?(b)How many photons per second.on an average ,are emitted by the source?

A. 6×10^{14}

B. 5×10^{15}

C. 1.99×10^{16}

D. 5×10^{16}

Answer: B

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10. The work function of caesium is 2.14 eV.Find (a) the threshold frequency for caesium,and (b)The wavelength of the incident light if the photocurrent is brought to zero by stopping potential of 0.60 V.

A. $v_0 = 4.54 \times 10^{14} Hz, \lambda = 454nm$

B. $v_0 = 5.16 \times 10^{14} Hz, \lambda = 516nm$

C. $v_0 = 5.16 \times 10^{14} Hz, \lambda = 454nm$

D. $V_0 5.16 \times 10^{14} Hz, \lambda = 414nm$

Answer: C

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11. What is the de-Broglie wavelength associated with (a) an electrin moving with a speed of $5.4 \times 10^6 m/s$ and (b) a ball of mass 150 g travelling at 30.0 m/s?

A. 0.135Å

B. 1.35Å

C. 0.0135Å

D. 4.92Å

Answer: B

Watch Video Solution

12. What is the de-Broglie wavelength associated with (a) an electrin moving with a speed of $5.4 \times 10^6 m/s$ and (b) a ball of

mass 150 g travelling at 30.0 m/s?

A. 1.47 nm

B. 1.47 Å

C. $1.47 \times 10^{-34} m$

D. $1.47 \times 10^{-15} m$

Answer: C

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13. A particle is moving three times as Fast as an electron .The ratio of the de-Broglie wavelength of the particle to that of the electron is 1.813×10^{-4}. Calculate the particle's mass and indentify the particle.

A. $1.675 \times 10^{-27} kg$,electron

B. $1.675 \times 10^{-27} kg$ proton

C. $1.675 \times 10^{-27} kg$, deuteron

D. $1.675 \times 10^{27} kg$,position

Answer: B

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14. What is the de-Broglie wavelength associated with an electron,accelerated through a potential difference of 100 volts?

A. 0.01227 nm

B. 0.1227 nm

C. 1.227 nm

D. 12.27 nm

Answer: B

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15. Find the

(a)Maximm frequency,and

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

A. $V_{\max} = 7.24 \times 10^{18} Hz, \lambda_{\min} = 0.414nm$

B. $v_{\max} = 7.24 \times 10^{18} Hz, \lambda_{\min} = 0.414Å$

C. $v_{\max} = 4.14 \times 10^{18} Hz, \lambda_{\min} = 0.724nm$

D. $V_{\max} = 7.24 \times 10^{18} Hz, \lambda_{\min} = 0.0414nm$

Answer: D

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16. The photoelectric cutoff voltage in a certain expertiment is 1.5 V.What is the maximum kinetic energy of photoelectrons emitted?

A. 1.5 eV

B. 1.5 J

C. $2.4 \times 10^{-19} J$

D. 2.4 eV

Answer: C

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17. In an experiment on photoelectric effect.the slope of the cutoff voltage versus frequency incident light is found to be 4.12×10^{-15} V sec calculate the value of Planck's constant.

A. $6.625 \times 10^{-34} Js$

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

C. $6.592 \times 10^{-34} Js$

D. $6.692 \times 10^{-34} Js$

Answer: C

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

A. $2.47 \times 10^{14} Hz$

B. $9.68 \times 10^{14} Hz$

C. $2.27 \times 10^{14} Hz$

D. $4.74 \times 10^{14} Hz$

Answer: D

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19. What is the

(a)Momentum

(b)speed ,and

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

A. $1121 \times 10^{-13} m$

B. $1121 \times 10^{-12} m$

C. $0.1121 \times 10^{-11} m$

D. $0.1121 \times 10^{-10} m$

Answer: A

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

(a) their momentum ,

(b) the energy of the photon and

(c) the kinetic energy of electron.

A. 1.243 keV

B. $2.41 \times 10^{-19} eV$

C. 1.51 eV

D. 1.51 keV

Answer: C

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21. 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 300 K.

A. 0.146 nm

B. 0.461 nm

C. 0.416 nm

D. 0.164 nm

Answer: A

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22. (a) An X-ray tube produces a continuous spectrum of radiation with its short wavelength end at 0.45Å. What is the maximum energy of a photon in the radiation?

(b) From your answer to (a), guess what order of accelerating voltage (for electrons) is required in such a tube ?

A. 27.6 eV

B. 27.6 keV

C. 27.6 MeV

D. 27.6 meV

Answer: B

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23. Estimating the following two numbers should be interesting. The first number will tell you why radio engineers do not need to worry much about photons! The second number tells you why our eye can never 'count photons', even in barely detectable light.

(a) The number of photons emitted per second by a Medium wave

transmitter of 10 kW power, emitting radiowaves of wavelength 500 m.

(b) The number of photons entering the pupil of our eye per second corresponding to the minimum intensity of white light that we humans can perceive $\left(\sim 10^{-10} W m^{-2}\right)$. Take the area of the pupil to be about 0.4 cm2 , and the average frequency of white light to be about $6 \times 10^{14} Hz$

A. 2.51×10^{31}

B. 2.51×10^{32}

C. 2.51×10^{30}

D. 2.51×10^{24}

Answer: A

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Section D Mcq Based On Textual Illustrations And Exercise

1. An electric bulb of 100 W converts 3% of electrical energy into light energy.If the wavelength of light emitted is 6625 Å,the number of photons emitted in 1 s is.....

$\left(h = 6.625 \times 10^{-34}\right) JS$

A. 10^{17}

B. 10^{19}

C. 10^{21}

D. 10^{15}

Answer: B

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Section D Mcqs Asked In Competitve Exams

1. Work function of sodium and copper is 2.3 eV and 4.5 eV respectively.Ratio of their threshold wavelength will be.....

A. $1:2$

B. $2:1$

C. $4:1$

D. $1:4$

Answer: B

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2. When frequencies f_1 and f_2 are incident on two indentical photo sensitive surfaes ,maximum velocities of photo-electrons of mass m are v_1 and v_2 hence.....

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

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

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

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

Answer: A

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3. Radiation of energy E is incident on complete reflecting surface.Momentum imparted to surface will be.....

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

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

C. Ec

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

Answer: B

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4. According to Einstein's photoelectric equation graph of kinetic energy of emitted photo electrons from metal versus frequency of incident radiation is linear .Its slope.....

A. depends on type of metal used

B. depends on intensity of radiation

C. depends on both metal used and intensity of radiation

D. is same for all metals and free from intensity of radiation.

Answer: D

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5. A photocell is placed at 1 m distance from light source when distance is changed to $\frac{1}{2}$m no.of photoelectron emitted from cathode will come

A. become 2 times

B. decreases by factor of 2

C. becomes 4 times

D. decreases by factor of 4

Answer: C

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6. If speed of electron emitted becomes double change in wavelength will be .....

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

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

C. increased by 2λ

D. decreased by 2λ

Answer: B

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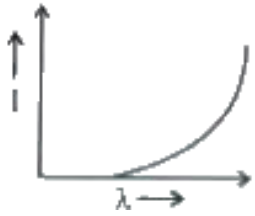
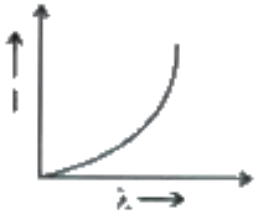
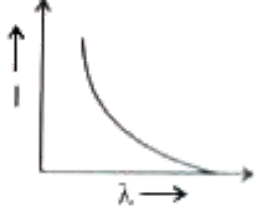
7. Keeping voltage on anode of photocell,wavelength of light is changed periodically.How does current of photocell I and λ change out of the following graphs ?

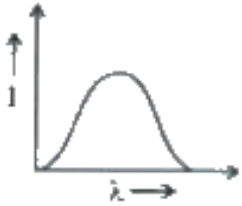
A.



B.



C. 

D. 

Answer: C

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8. Energy corresponding to threshold frequency of metal is 6.2 eV.For given radiation stopping potential is 5 V then incident radiation will be in ...region.

A. X-ray

B. ultraviolet

C. infrared

D. visible

Answer: B

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9. When metal surface is incident with photon after how much time photoelectron are emitted?

A. $10^{-1}S$

B. $10^{-4}S$

C. $10^{-10}S$

D. $10^{-16}S$

Answer: C

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10. Momentum of photon with frequency f will be .....(where c is velocity of light)

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

B. hfc

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

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

Answer: D

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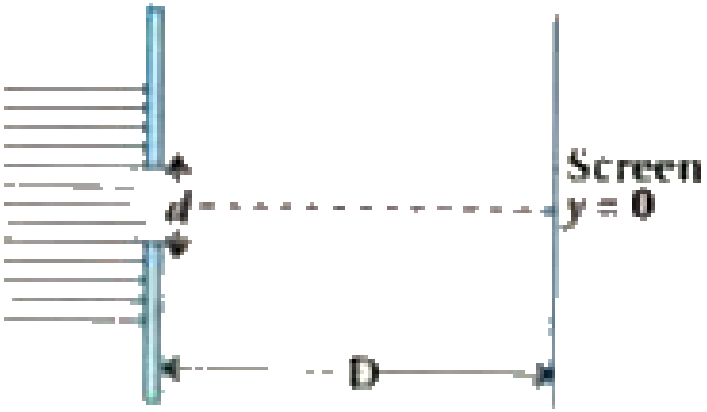
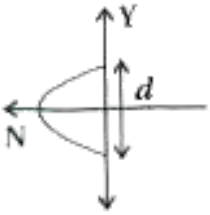
11. In experiment of photoelectric effect width of slit is equal to de-Broglie wavelength.Beam of light is incident normal to plane and by using detector D it is detected.Which of the following best

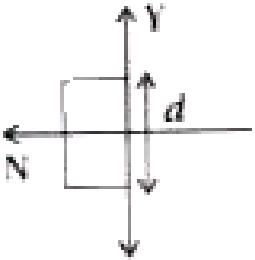
represent number of electron (N) and position of detector (y)?



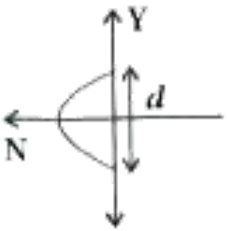
A.

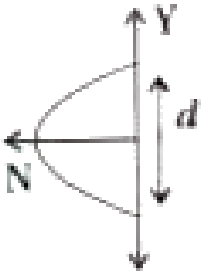


B.



C.



D. 

Answer: D

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12. When radiation of 400 nm wavelength Is incident on photocell ,emitter produces photoelectron with maximum kinetic energy of 1.68 eV work function of emitter will be..... [hc=1240 eVnm]

A. 3.09 eV

B. 1.42 eV

C. 1.51 eV

D. 1.68 V

Answer: B

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13. From source of power 4 kW,radiation emitted are such that photon are emitted at rate of 10^{20} photon/sec.This radiation will be in .....region of electromagnetic waves...

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

A. gamma rays

B. X-rays

C. ultraviolet rays

D. microwaves

Answer: B

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14. A nucleus of mass M is initially at rest.It absorb neutron having m_N rest mass compound nucleus divided in two nucleus of m_1 and 5 m_1.If wavelength of nucleus with mass m_1 is λ,then wavelength of other nucleus will be.....

A. 25λ

B. 5λ

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

D. λ

Answer: D

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15. The radiation corresponding to $3 \rightarrow 2$ transition of hydrogen atom falls on a metal surface to produce photoelectrons.These

electrons are made to enter a magnetic field of 3×10^{-4}T.If the radius of the largest circular path followed by these electrons is 10.0 mm the work function of the metal is close to:

A. 0.8 eV

B. 1.6 eV

C. 1.8 eV

D. 1.1 eV

Answer: D

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16. Radiation of wavelength λ is incident on a photocell.The fastest emitted electron has

speed v.If wavelength is changed to $\frac{3\lambda}{4}$

the speed of the fastest emitted electron will be

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

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

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

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

Answer: A

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17. A metal plate of area $1 \times 10^{-4} m^2$ is illuminated by a radiation 16 mW/m^2.The work function of the metal is 5eV.The energy of the incident photons is 10 eV and only 10% of it produces photo-electrons .The number of emitted photoelectrons per second and their maximum energy respectively will be

A. 10^{10} and 5 eV

B. 10^{12} and 4 eV

C. 10^{11} and 5 eV

D. 10^{14} and 10 eV

Answer: C

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18. A beam of electromagnetic radiation intensity $6.4 \times 10^{-5} W/cm^2$ is comprised of wavelength ,λ=310 nm.It falls normally on metal (work function 2 eV) of surface are $1cm^2$.If one in 10^3 photons ejects an electron ,total number of electrons ejected in 1 s is 10^x [hc=1240 eV-nm ,1 eV=$1.6 \times 10^{-19} J$],the value of x is....

A. 14

B. 12

C. 11

D. 10

Answer: C

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19. An electron (of mass m) and a photon have the same energy E in the range of few eV.The ratio of the de-Broglie wavelength associated with the electron and the wavelength of the photon is (c=speed of light in vaccum)

A. $\frac{1}{c}\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

B. $c\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

C. $\frac{\sqrt{2mE}}{c}$

D. $\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

Answer: A

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20. Two photons of energy 4 eV and 4.5 eV are incident on two metals A and B respectively.The maximum kinetic energy for an ejected electron is T_A for A and $T_B = T_A - 1.5eV$ for the metal B.The relation between the de-Broglie wavelengths of the ejected electron of A and B are $\lambda_B = 2\lambda_B$ .The work function of the metal B is

A. 1.5 eV

B. 3 eV

C. 4eV

D. 4.5 eV

Answer: C

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21. When electron with mass m is accelerated with volt V associated de-Broglie wavelength is λ .When proton with mass M is accelerated with same voltage associated de-Broglie wavelength will be.....

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

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

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

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

Answer: C

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22. For wave concerned with proton ,de-Broglie wavelength changes by 0.25 %.If its momentum changes by p_0, initial

momentum

A. $100p_0$

B. $\frac{p_0}{400}$

C. $401p_0$

D. $\frac{p_0}{100}$

Answer: C

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23. Photocell is kept at distance of 1 m from the source and incident radiation .Now distance from source is changed to 2m,then....

A. no. of photoelectron emitted are $\frac{1}{4}$ times intital value.

B. energy of electron emitted is $\frac{1}{4}$ times intitial energy

C. no. of electron emitted is half of intital electron emitted.

D. Energy of electron emitted is half of initial energy

Answer: A

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24. Work function of photo sensitive is hf_0 If surface is incident with photon of $2hf_0$ energy,then maximum speed of electron emitted is 4×10^6 m/s .If energy of photon incident is changed to $5hf_0$ then maximum speed of photoelectron will be.....

A. $2 \times 10^7 m/s$

B. $2 \times 10^6 m/s$

C. $8 \times 10^6 m/s$

D. $8 \times 10^5 m/s$

Answer: C

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25. Work function of metal a,b and c are 1.92 eV 2.0 eV and 5 eV respectively .According to Einstein's equation radiation 4100 Å will produce electron emission which metal or metals?

A. None of these

B. Only A

C. Only (A) and (B)

D. All (A),(B),(C)

Answer: C

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26. Work function of aluminium plate is ϕ when radiation of hf energy is incident on metal surface photoelectron of kinetic energy

K is emitted .Now if frequency of radiation is made double,kinetic energy of photoelectron will become.....

A. 2K

B. K

C. K=hf

D. $K + E_0$

Answer: C

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27. Ionization in discharge tube us due to collision of .....gas filled in tube.

A. electron and neutral atom/molecules

B. photon and neutral atom/molecules

C. neutral atom/molecules of gas

D. positive and neutral atom/molecules

Answer: A

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28. Photoelectric effect in photocell convert....

A. charge in intensity of light into change in photo current

B. change in intensity of light into change in work function of cathode of tube

C. change in frequency of light into change in current

D. change in frequency of light into change in voltage

Answer: A

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29. Momentum of photon having 1 MeV energy is

A. 7×10^{-24}

B. 10^{-22}

C. 5×10^{-22}

D. 0.33×10^{6}

Answer: C

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30. A laser emit monochromatic light of $6.0 \times 10^{14} Hz$ frequency and produce power of 2×10^{-3} W.No of photon produced per second will be.....

A. 5×10^{16}

B. 5×10^{17}

C. 5×10^{14}

D. 5×10^{15}

Answer: D

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31. A light source emit monochromatic light of 5000 Å wavelength and produce 5 W power .When it is displaced by 0.5 m from photo sensitive surface photoelectron are emitted,when distance increased by 0.5, no.of photoelectron liberated will become .....

A. 8

B. 16

C. 2

D. 4

Answer: D

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32. Energy corresponding to threshold frequency of metal is 6.2 eV.For given radiation stopping potential is 5 V then incident radiation will be in ...region.

A. ultraviolet

B. visible region

C. infrared region

D. X-rays region

Answer: A

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33. Colour in discharge tube filled with gas at low pressure is due to ...

A. electron in excited state in atom

B. collision between atoms of gas

C. collision between charged particles emitted from cathode and gas atom.

D. collision between electrons of atoms.

Answer: A

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34. Find velocity of particle with 1 mg mass and having same wavelength that of electron moving with speed of 3×10^6 m/s.

Mass of electron 9.1×10^{-31} kg

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

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

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

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

Answer: D

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35. No . Of photoelectron emited by light with frequency f is proportional to ....[Here frequency f $>$ threshold frequency f_0]

A. thereshold frequency

B. intensity of light

C. frequency of light

D. $f - f_0$

Answer: B

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36. helium-Neon laser emit monochromatic light of 667 nm abd produce power of 9 kW.number of photon reaching to target every second will be.....

A. 3×10^{16}

B. 9×10^{15}

C. 3×10^{22}

D. 3×10^{17}

Answer: A

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37. In given region electric and magnetic field are prpendicular to each other.Electron moving in this region do not get deflected,charge on cathode will be.....

[V=potential between anode and cathode]

A. $\frac{B^2}{2VE^2}$

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

C. $\frac{2VE^2}{B^2}$

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

Answer: D

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38. A source S_1 produces 10^{15} photon every second having wavelength of 5000Å .Another source S_2 produce 1.02×10^{15}

photon every second with wavelength 5100 Å product [Power of S_1] $\times$ [Power of S_2]=....

A. 1.00

B. 1.02

C. 1.04

D. 0.98

Answer: A

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39. Ultraviolet light of 200 nm wavelength is incident on nickel surface having work function of 5.01 eV.Potential difference of ..... Volt should be applied to stop electron emitted with maximum speed.

A. 2.4 V

B. $-1.2V$

C. $-2.4V$

D. 1.2V

Answer: D

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40. In Davisson-Germer experiment in order to increase velocity of electron emitted from electron gun.....

A. potential ddifference between anode and filament should be increased

B. filament current should be increased

C. filament current should be decreased

D. potential difference between filament and anode should be decreased

Answer: A

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41. In electron microscope 25 kV voltage is used to accelerate electron .By changing voltage to 100 kV de-Broglie wavelength becomes..

A. increases by two times

B. decrease by two times

C. decreases by four times

D. increase by 4 times

Answer: B

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42. The threshold frequency for a certain metal is 3.3×10^{14} Hz.If light of frequency 8.2×10^{14}Hz is incident on the metal ,predict the cutoff voltage for the photoelectric emission.

A. 2 V

B. 3 V

C. 5 V

D. 1 V

Answer: A

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43. For photoelectric emission from certain metal the cutoff fequency is v.If radiation of frequency 2 v impinges on the metal plate,the maximum possible velocity of the emitted electron will be (m is the electron's mass),

A. $\sqrt{\frac{hv}{(2m)}}$

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

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

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

Answer: C

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44. The wavelength λ_e of an electron and λ_P of a photon of same energy E are related by:

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

B. $\lambda_p \propto \lambda_e$

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

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

Answer: A

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45. When the energy of the incident radiation is increased by 20% ,the kinetic a metal surface increased from 0.5 eV to 0.8 eV.The work function of the metal is .....

A. 0.65 eV

B. 1.0 eV

C. 1.3 eV

D. 1.5 eV

Answer: B

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46. A certain metallic surface is illuminated with monochromatic light of wavelength λ.The stopping potentail for photelectric current for this light is $3V_0$.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 effect is

A. 4λ

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

C. $\frac{\lambda}{6}$

D. 6λ

Answer: A

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47. Light of wavelength 500 nm is incident on a metal with work functin 2.28 eV.The de-Broglie wavelength of the emitted electron is :[$h = 6.6 \times 10^{-34Js}$ and $c = 3 \times 10^{8} m/s$]

A. $\leq 2.8 \times 10^{-12} m$

B. $< 2.8 \times 10^{-10} m$

C. $< 2.8 \times 10^{-9} m$

D. $\geq 2.8 \times 10^{-9} m$

Answer: D

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48. A photoelectric surface is illuminated successively by monochromatic light of wavelength λ and $\frac{\lambda}{2}$.If the maximum kinetic energy of the emitted photoelectrons in the second case is 3 times in the first case,the work function of the surface of the material is: (h=Plank's constant ,c=speed of light)

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

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

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

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

Answer: B

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49. When a metallic surface is illuminated with radiation of wavelength λ,the stopping potential is V.If the same surface is

illuminated with radiation of wavelength 2λ,the metallic surface is

A. $5\ \lambda$

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

C. 3λ

D. 4λ

Answer: C

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50. An electron of mass m and a photon have same energy E.The ratio of de-Broglie wavelengths associated with them is (C being velocity of light0)

Here C is speed of light

A. $\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

B. $C(2mE)^{\frac{1}{2}}$

C. $\frac{1}{C}\left(\frac{2m}{E}\right)^{\frac{1}{2}}$

D. $\frac{1}{C}\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

Answer: D

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51. When cathode C of photocell is incident with photon of 5 eV energy ,maximum KE of electron emitted is 2 eV.For which value of stopping potential on anode (A) photo incident with energy of 6 eV,number of electron reaching to anode will become zero?

A. $-1V$

B. $-3V$

C. $+3V$

D. $+4V$

Answer: B

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52. If the mass of neutron is 1.7×10^{-27} kg , then the de-Broglie wavelength of neutron of energy 3 eV Is.....$\left(h = 6.6 \times 10^{-34} JS\right)$

A. $1.4 \times 10^{-11} m$

B. $1.6 \times 10^{-10} m$

C. $1.65 \times 10^{-11} m$

D. $1.4 \times 10^{-10} m$

Answer: C

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53. In an experiment on photoelectric effect the stopping potentail was measured to be V_1 and V_2 with incident light of wavelength λ and $\frac{\lambda}{2}$ respectively.The relation between V_1 and V_2 is....

A. $V_2 > 2V_1$

B. $V_2 < V_1$

C. $V_2 < V_2 < 2V_1$

D. $V_2 = 2V_1$

Answer: A

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54. For given metal plate threshold frequency is V_0. When radiation of $2V_0$ is incident on metal surface ,maximum velocity of photoelectron emitted is V_1 when frequency of incident radiation is

charged to $5V_0$,maximum velocity of photoelectron emitted is v_2 .Ration of v_1 and v_2 is .....

A. $2:1$

B. $1:2$

C. $4:1$

D. $1:4$

Answer: B

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55. Electron of mass m and intial velocity $\vec{V} = v_0\hat{i}$ $(V_0 > 0)$ enter electric field $\vec{E} = -E_0\hat{i}(E_0)$ constant at t=0 initial de-Broglie wavelength of electron is λ_0 then at time t=t its de-Broglie wavelength will be.....

A. λ_0

B. $\frac{\lambda_0}{\left(1+\frac{eE_0}{mV_0}t\right)}$

C. $\lambda_0 t$

D. $\left(1+\frac{eE_0}{mV_0}t\right)$

Answer: B

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56. An electron is accelerated through a potential difference of 10,000 V.Its de-Broglie wavelength is ,(nearly) $\left(m_e = 9 \times 10^{-31} kg\right)$

A. 12.2 m

B. $12.2 \times 10^{-13} m$

C. $12.2 \times 10^{-12} m$

D. $12.2 \times 10^{-14} m$

Answer: C

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Section D Mcqs Asked In Cbse Pmt Aipmt Neet

1. Work function of metal in photoelectric effect is 3.5 eV for -1.2 V potential photoelectric current become zero,Hence.....

A. energy of incident photon is 4.7 eV

B. energy of incident photon is 2.3 eV

C. when photon of high frequency are used then photoelectric current will be produced .

D. when energy of photon is 2.3 eV then photoelectric current is maximum

Answer: A

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Section D Mcqs Asked In Aiims

1. Which phenomena shows both particle and wave nature of electromagnetic waves and electron?

A. Electron reflected from metal surface

B. Diffraction and reflection from metal plate

C. Scattering and diffraction of light.

D. Photoelectric and electromicroscope

Answer: D

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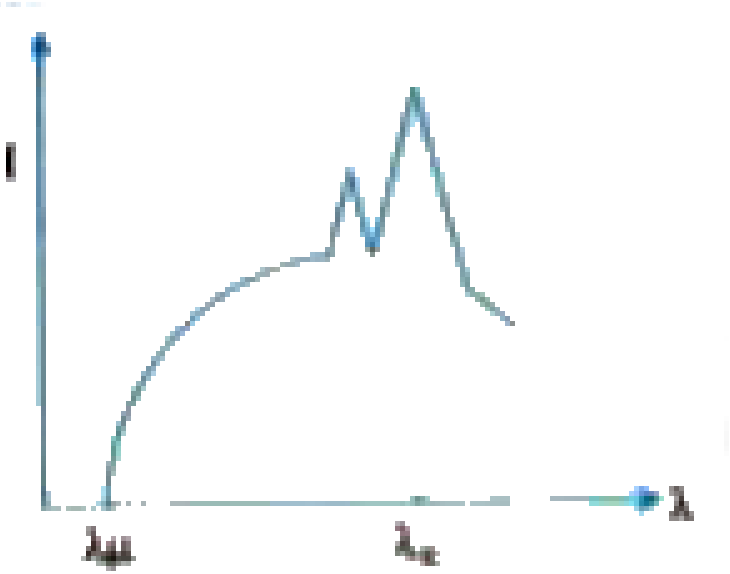
2. Graph shows relation between intensity (I),wavelength for X-rays emitted from collidge tube if minimum wavelength is λ_μ and wavelength of $K_\propto$ line is λ_K.By increasing accelerating voltage



A. $\lambda_K - \lambda_\mu$ increase

B. $\lambda_K - \lambda_\mu$ decrease

C. λ_K increase

D. λ_K decrease

Answer: A

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3. Acceleration of electron charge e and mass m moving electric field E will be.....

A. $\frac{e^2}{m}$

B. $\frac{Ee^2}{m}$

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

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

Answer: C

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4. Speed of electron with wavelength 10^{-10} m will be.....

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

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

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

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

Answer: A

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5. Wavelength of particle moving with momentum $2 \times 10^{-28} kgms^{-1}$ will be .....

A. $3.3 \times 10^{-6} m$

B. $3.3 \times 10^{5} m$

C. $3.3 \times 10^{-4} m$

D. 1.30 m

Answer: A

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6. If we want to observe inside atom.Assume diameter of atom 100 pm That means we can determine region of about 10 pm.For this electron microscope is used. Minimum required energy of electron should be .....

A. 1.5 keV

B. 15 keV

C. 150 keV

D. 1.5 MeV

Answer: B

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7. In photoelectric effect,for emission of electron metal surface ,incident light should have.....

A. minimum wavelength

B. minimum frequency

C. minimum amplitude

D. minimum angle of incidence.

Answer: B

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8. In photoelectric effect for emission of electron incident light should have minimum .....

A. wavelength

B. frequency

C. amplitude

D. angle of incidence

Answer: B

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9. If momentum of alpha,beta and gamma waves is equal then which out of these will have maximum wavelength?

A. Alpha rays

B. Beta rays

C. Gamma rays

D. None of three ,all have same wavelength

Answer: D

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10. Calculate energy of photon having 6840 Å wavelength (hc=12400 eVÅ)

A. 1.81 eV

B. 3.6 eV

C. $-13.6eV$

D. 12.1 eV

Answer: A

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11. Relation between de-Broglie wavelength and absolute temp.is given by .....

A. $\lambda \propto T$

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

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

D. $\lambda \propto T_2$

Answer: C

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12. If kinetic energy of particle is made 16 times,percentage change in its de-Broglie wavelength will be.....

A. 25

B. 50

C. 60

D. 75

Answer: D

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13. If K_1 and K_2 are maximum K.E. photoelectron emitted when lights wavelength λ_1 and λ_2 respectively incident a metallic surface .If $\lambda_1 = 3\lambda_2$,then.....

A. $K_2 > \frac{K_2}{3}$

B. $K_2 < \frac{K_2}{3}$

C. $K_1 = 2K_2$

D. $K_2 = 2K_1$

Answer: B

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14. When kinetic energy of proton is equal to energy of photon then ratio of de-Broglie wavelength of proton and photon is proportional to .....

A. E

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

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

D. $K_2 = 2K_1$

Answer: C

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15. A:Relation between energy of photon (E) and momentum (P) is $P = \frac{E}{c}$

R:Photon behaves as particle.

A. Both assertion and reason are true and the reason is correct explanation of the assertion.

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

C. Assertion is true but the reason is false

D. Both assertion and reason are false.

Answer: A

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16. A:When monochromatic beam of light is incident on metal surface ,it is dispersed in form of kinetic energy.

R:Work function of metal depend on depth of metal.

A. Both assertion and reason are true and the reason is correct explanation of the assertion.

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

C. Assertion is true but the reason is false

D. Both assertion and reason are false.

Answer: C

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17. A:Value of stopping potential depend on frequency of incident light and independent of intensity of light.

R:Maximum kinetic energy of photoelectron is proportional to stopping potential .

A. Both assertion and reason are true and the reason is correct explanation of the assertion.

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

C. Assertion is true but the reason is false

D. Both assertion and reason are false.

Answer: B

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18. A:Photon do not have mass then also it possess momentum.

R:Momentum of photon is due to energy and energy is equivalent to mass.

A. Both assertion and reason are true and the reason is correct explanation of the assertion.

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

C. Assertion is true but the reason is false

D. Both assertion and reason are false.

Answer: A

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19. A:For microscope particles or sub microscopic particles wavelength of de-Broglie is important.

R:If velocity is constant then de-Broglie wavelength is inversely proportional to mass of particle.

A. Both assertion and reason are true and the reason is correct explanation of the assertion.

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

C. Assertion is true but the reason is false

D. Both assertion and reason are false.

Answer: A

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20. Work function of material is 4.0 eV. Maximum wavelength by which photoelectric emission can be obtained is .....

A. 540 nm

B. 400 nm

C. 310 nm

D. 220 nm

Answer: C

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21. A proton accelerated by potential difference 100 V have de-Broglie wavelength of λ_0

α-particle is accelerated by same potential different.Its de-Broglie wavelength will be .....

A. $2\sqrt{2}\lambda_0$

B. $\frac{\lambda_0}{2\sqrt{2}}$

C. $\frac{\lambda_0}{\sqrt{2}}$

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

Answer: B

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22. When monochromatic light of frequency f_1 incident on photosensitive surface ,stopping potential obtained is V_1.When same surface is incident with monochromatic light of frequency f_2 is incident on same surface ,stopping potential will become.....

A. $V_1 + \frac{h}{e}(f_2 - f_1)$

B. $V_1 - \frac{h}{e}(f_2 - f_1)$

C. $V_1 + \frac{h}{e}(f_1 + f_2)$

D. $V_1 - \frac{h}{e}(f_1 + f_2)$

Answer: A

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23. For given metal work function is W_0 and threshold wavelength is λ_0.If metal has work function $\frac{W_0}{2}$ then what will be threshold wavelength ?

A. $\frac{\lambda_0}{4}$

B. $\frac{\lambda_0}{2}$

C. $2\lambda_0$

D. $4\lambda_0$

Answer: C

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24. When point source is kept at 20 cm distance from photcell ,stopping voltage obtained is V_0 When source distance is changed to 1m, stopping potential will be .....

A. $\frac{V_0}{u}$

B. $\frac{V_0}{2}$

C. V_0

D. $2V_0$

Answer: C

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25. Wavelength of matter particle is independent of which of the quantities?

A. Mass

B. Velocity

C. Momentum

D. Electric charge

Answer: D

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26. No .of photon emitted eery second from 60 W bulb will be .....

A. 3×10^{20}

B. 1.5×10^{20}

C. 2×10^{-20}

D. 2×10^{20}

Answer: D

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27. A photon having 8 eV energy is incident on metal suraface with threshold frequency of 1.6×10^{15} Hz .Maximum kinetic energy of

photoelectron emitted will be.....

$h = 6.6 \times 10^{-34} JS, c = 3 \times 10^{8} m/s$

$eV = 1.6 \times 10^{-19} JS$

A. 1.4 eV

B. 0.4 eV

C. 4.2 eV

D. 2.8 eV

Answer: A

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28. Ultraviolet light of 200 nm wavelength is incident on polished surface of iron .Its work function is 4.71 eV what will be value of stopping potential?

$\left[h = 6.626 \times 10^{-34}\right] JSc = 3 \times 10^{8} m/s 1eV = 1.6 \times 10^{-19} J\right]$

A. 0.5V

B. 1.5 V

C. 2.5 V

D. None of these

Answer: B

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29. α-particle and deuteron moves with speed v and 2v respectively .What will be ratio of de-Broglie wavelength ?

A. $1:1$

B. $\sqrt{2}:1$

C. $1:\sqrt{2}$

D. $2:1$

Answer: A

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30. If linear momentum of a particle is $2.2 \times 10^4 kgms^{-1}$ then what will be its de-Broglie wavelength ? $\left[h = 6.6 \times 10^{-34} Js\right]$

A. $3 \times 10^{-29} nm$

B. $6 \times 10^{-29} nm$

C. $3 \times 10^{29} nm$

D. $6 \times 10^{29} nm$

Answer: A

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31. In photoelectric effect threshold wavelength of sodium is 5000Å .Find its work function.

$[h = 6.6 \times 10^{-34} Js, c = 3 \times 10^{8} m/s, 1eV = 1.6 \times 10^{-19} Js]$

A. 2.5 eV

B. 5.0 eV

C. 7.5 eV

D. 10 eV

Answer: A

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32. Photoelectric effect represent that .....

A. electron has a wave nature

B. light has a particle nature

C. (A) and (B) both

D. none of the above

Answer: B

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33. Frequency of photon having 100 eV energy is .....Hz [$h = 6.62 \times 10^{-34} Js, 1eV = 1.6 \times 10^{-19} Js$]

A. 2.417×10^{-16}

B. 2.417×10^{16}

C. 2.417×10^{17}

D. 1.054×10^{17}

Answer: B

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34. An electron and proton move in same direction with equal kinetic energy.Ratio of de-Broglie wavelength will be....

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

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

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

D. $m_p . m_e$

Answer: C

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35. Work function of photosensitive surface is ϕ .When photon of 3ϕ energy is incident on surface electron with maximum speed of

$6 \times 10^6 m/s$ is emitted from the surface .If energy of photon is changed to 9ϕ,maximum speed of photoelectron will be.....

A. $12 \times 10^6 m/s$

B. $6 \times 10^6 m/s$

C. $3 \times 10^6 m/s$

D. $24 \times 10^6 m/s$

Answer: A

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36. If particle mentioned below moves with same velocity which will have highest de-Broglie wavelength ?

A. Neutron

B. Proton

C. β-particle

D. α-particle

Answer: C

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37. Work function of metal is 1.6 eV for which maximum wavelength photoelectric emission can be obtained ?

$\left[h = 6.6 \times 10^{-34} JS, c = 3 \times 10^{8} m/s\right] eV = 1.6 \times 10^{-19} J\Big]$

A. 5800 Å

B. 3867Å

C. 29000Å

D. 7734Å

Answer: D

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38. The K.E. of photoelecttron emitted from a metal are K_1 and K_2 ,when it is irradiated with lights of wavelength λ_1 and λ_2 respectively .The work function of metal is .....

A. $\frac{K_1\lambda_1 - K_2\lambda_2}{\lambda_2 - \lambda_1}$

B. $\frac{K_1\lambda_2 - K_2\lambda_1}{\lambda_2 - \lambda_1}$

C. $\frac{K_1\lambda_1 + K_2\lambda_2}{\lambda_2 + \lambda_1}$

D. $\frac{K_1\lambda_2 + K_2 + \lambda_1}{\lambda_2 + \lambda_1}$

Answer: A

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39. A particle of mass m kg and charge q coulomb is accelerated through V volt then the de-Broglie wavelength associated with it,in meter is λ=.....m.

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

B. $\lambda = \frac{h}{\sqrt{2mqV}}$

C. $\lambda = \frac{h}{\sqrt{mqV}}$

D. $\lambda = \frac{hq}{\sqrt{2mV}}$

Answer: B

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40. When a strong electric field of approximately .....is applied on the metal the electron is pulled ut from the metal.

A. $10^1 \frac{V}{m}$

B. $10^5 \frac{V}{m}$

C. $10^3 \frac{V}{m}$

D. $10^8 \frac{V}{m}$

Answer: D

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41. If kinetic energy of emitted electron is made double then its de-Broglie wavelength will become.....times initial de-Broglie wavelength.

A. $\sqrt{2}$

B. 2

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

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

Answer: C

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42. Threshold wavelength for lithium metal is 6250 Å wavelength of incident radiation required for photoelectric emission will be.....

A. more than 6250 Å

B. equal to or greater than 6250Å

C. 6250 Å

D. equal to or less than 6250 Å

Answer: D

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43. Object of 100 g mass moves with velocity of 36 km/hr .de-Broglie wavelength associated with it will be of .....order $\left(h = 6.626 \times 10^{-34} Js\right)$

A. 10^{-14}

B. 10^{-34}

C. 10^{-24}

D. 10^{-44}

Answer: B

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44. The wavelength of de-Broglie wave associated with a neutron of mass m at absolute temperature T is given by ..... (here K is the Boltzman constant)

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

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

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

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

Answer: C

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45. Photons of energy 1 eV and 2.5 eV sucesseively illuminate a metal,whose work function is 0.5 eV,the ratio of maximum speed of emitted electron is.....

A. $1:2$

B. $3:1$

C. $2:1$

D. $1:3$

Answer: A

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46. To change de-Broglie wavelength from $0.5 \times 10^{10} m$ to $1 \times 10^{-10} m$ its energy should be.....

A. half of initial kinetic energy

B. double of initial kineric energy

C. four times initial kinetic energy

D. $\frac{1}{4}$ times initial kinetics energy

Answer: D

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47. The threshold wavelength of Na element is 6800 Å.Its work function is ..... $\times 10^{-19} J.\left(h=6.625 \times 10^{-34} Js, C=3 \times 10^{8} ms^{-1}\right)$

A. 2.9

B. 2.7

C. 2.8

D. 3

Answer: A

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48. In discharge tube with increase in number density of gas intensity of spectral lines...

A. decreases

B. increases

C. remain constant

D. none of these

Answer: B

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49. In davision -Germer experiment electron emitted from filament is accelerated by V volt.Its de-Broglie wavelength will be.....

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

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

C. $\frac{\sqrt{2Vem}}{h}$

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

Answer: B

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50. Wavelength of photon having 35 keV energy will be..... $\left(h = 6.625 \times 10^{-34}\right) J - s, c = 3 \times 10^{8} m s^{-1}, 1eV = 1.6 \times 10^{-19} J\right)$

.

A. $35 \times 10^{-12} m$

B. 35Å

C. 3.5nm

D. 3.5Å

Answer: A

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51. Uncertainty in position of electron is 10^{-10} m. uncertainty in its momentum will be.....$kgms^{-1}$. $\left(h = 6.62 \times 10^{-34} J - s\right)$

A. 1.05×10^{-24}

B. 1.03×10^{-24}

C. 1.06×10^{-24}

D. 1.08×10^{-24}

Answer: B

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52. If energy of photon of 6000 Å is 3.2×10^{-19} J then energy of photon with 4000 Å will be.....

A. $4.44 \times 10^{-19} J$

B. $2.22 \times 10^{-19} J$

C. $1.11 \times 10^{-19} J$

D. $4.80 \times 10^{-19} J$

Answer: D

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53. Work function of .....is the lowest.

A. caesium

B. platinum

C. nickel

D. copper

Answer: A

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54. By applying electric field of the order of.....Vm^{-1} to a metal, electrons can be pulled out of the metal.

A. 10^5

B. 10^6

C. 10^8

D. 10^2

Answer: C

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55. Monochromatic light of frequency $6 \times 10^{14} Hz$ is produced by laser. Each photon has an energy=.....

A. 4×10^{-19}

B. 6×10^{14}

C. 4×10^{-20}

D. 6×10^{-14}

Answer: A

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Section D Mcqs Asked In Gujcet Board Exam

1. Mass of photon in motion is .....

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

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

C. hf

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

Answer: D

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