PHYSICS

BOOKS - MTG PHYSICS (ENGLISH)

DUAL NATURE OF RADIATION AND MATTER

Introduction

1. Who established that electric charge is quantised ?

A. J.J. Thomson

B. William Crookes

C. R.A Millikan

D. Wilhelm Rontgen

Answer: C

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2. Cathode rays were discovered by

A. Maxwell Clerk James

B. Heinrich Hertz

C. William Crookes

D. J.J. Thomson

Answer: C

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3. The specific charge of a proton is $9.6 \times 10^7 \mathrm{C\,kg}^{-1}$.

The specific charge of an alpha particle will be

A. $9.6 \times 10^7 \mathrm{C\,kg}^{-1}$

B. $19.2 \times 10^7 \mathrm{C\,kg}^{-1}$

C. $4.8 \times 10^7 \mathrm{C\,kg}^{-1}$

D. $2.4 \times 10^7 \mathrm{C\,kg}^{-1}$

Answer: C

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Electron Emission

1. Thermionic emissions are related to

A. conduction

B. convection

C. radiation

D. none of these

Answer: B

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2. The minimum energy required for the electron emission from the metal surface can be supplied to the free electrons by which of the following physical processes ?

A. Thermionic emission

B. Field emission

C. photoelectric emission

D. All of these

Answer: D

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Photoelectric Effect

1. The phenomenon of photoelectric emission was discovered in 1887 by

A. Albert Einstein

B. Heinrich Hertz

C. Wilhelm Hallwachs

D. Philipp Lenard

Answer: B

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2. A metal surface ejects 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 light

D. red light

Answer: A

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Experimental Study Of Photoelectric Effect

1. Which of the following statements is correct regarding the photoelectric experiment ?

A. The photocurrent increases with intensity of light.

B. Stopping potential increases with increase in intensity of incident light.

C. The photocurrent increases with increase in frequency.

D. All of these

Answer: A

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2. In photoelectic effect, the photocurrent

A. depends both on intensity and frequency of the incident light.

B. does not depand on frequency of incident light but depends on intensity of the incident light.

C. decreases with increase in frequency of incident light.

D. increases with increase in frequency of incident light.

Answer: B

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3. The maximum value of photoelectric current is called

A. base current

B. saturation current

C. collector current

D. emitter current

Answer: B

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4. In photoelectric effect, the photoelectric current is independent of

A. intensity of incident light

B. potential difference applied between the two electrodes

C. the nature of emitter material

D. frequency of incident light

Answer: D

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5. In photoelectric effect, stopping potential depends on

A. frequency of incident light

B. nature of the emitter material

C. intensity of incident light

D. both (a) and (b)

Answer: D

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6. The time taken by a photoelectron to come out after the photon strikes is approximately

A. $10^{-1}s$

B. $10^{-4}s$

C. $10^{-10}s$

D. $10^{-16}s$

Answer: C

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7. In a photoelectric experiment, if both the intensity and frequency of the incident light are doubled, then the saturation photoelectric current

A. remains constant

B. is halved

C. is doubled

D. becomes four times

Answer: C

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8. A photoelectric cell is illuminated by a point soures of light 1 m away. When the soures is shifted to 2 m then

A. each emitted electron carries one quarter of the initial energy

B. number of electrons emitted is half the initial number

C. each emitted electrons carries half the initial energy

D. number of electrons emitted is quarter of the initial number

Answer: D

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9. Light of wavelength λ falls on metal having work functions hc/λ_0 .

Photoelectric effect will take place only if :

A. $\lambda \geq \lambda_0$

B. $\lambda \leq \lambda_0$

C. $\lambda \geq 2\lambda_0$

D. $\lambda = 4\lambda_0$

Answer: B

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10. The photoelectric cut off voltage in a certain experiment is 1.5V. What is the maximum kinetic energy of photoelectrons emitted? $e = 1.6 \times 10^{-19} C.$

A. 2.4 eV

B. 1.5 eV

C. 3.1 eV

D. 4.5 eV

Answer: B

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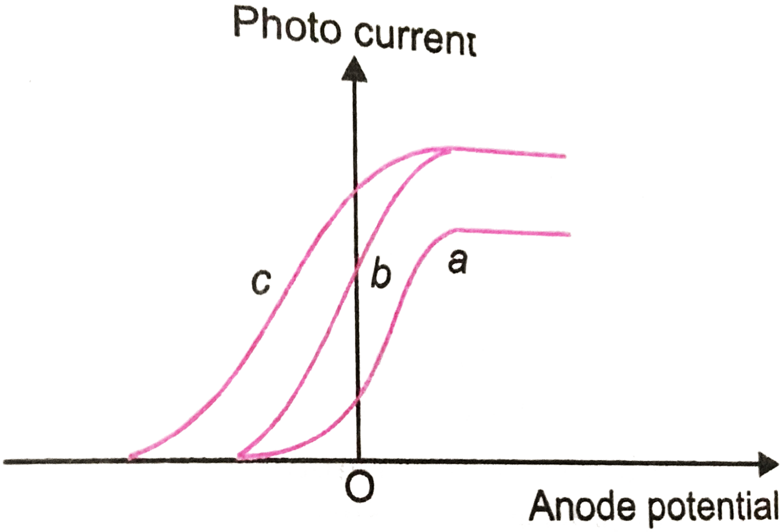
11. The fig. shows the variation of photon current with anode potential for a photo-sensitive surface for three different radiation. Let I_a, I_b and I_c be the intensities and f_a, f_b and f_c be the frequency for the curves a,b and c respectively.



A. $v_a = v_b$ and $I_a \neq I_b$

B. $v_a = v_c$ and $I_a = I_c$

C. $v_a = v_b$ and $I_a = I_b$

D. $v_b = v_c$ and $I_b = I_c$

Answer: A

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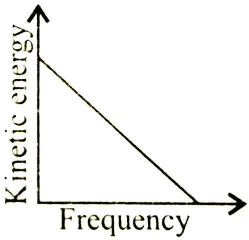
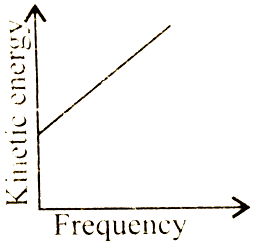
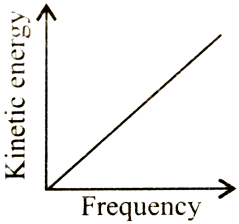
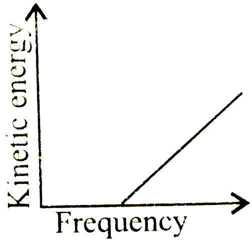
1. According to Einstein's photoelectric equation , the graph between the kinetic energy of photoelectrons ejected and the frequency of incident radiation is

A. 

B. 

C. 

D. 

Answer: D

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2. According to Einstein's photoelectric equation, the plot of the maximum kinetic energy of the emitted photoelectrons from a metal versus frequency of the incident radiation gives a straight line whose slope

A. depends on the intensity of incident radiation.

B. depends on the nature of the metal and also on the intensity of incident radiation.

C. is same for all metals and independent of the intensity of the incident radiation.

D. depends on the nature of the metal.

Answer: C

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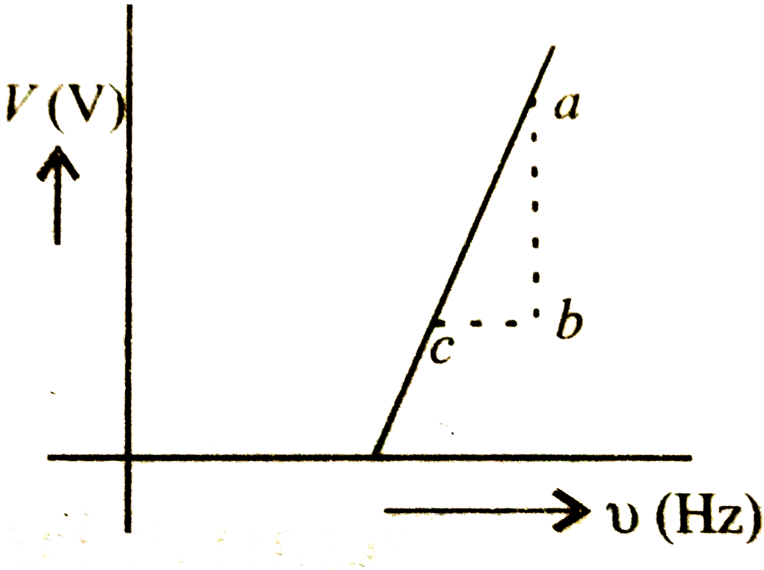
3. In a photoelectric experiment, the graph of frequency v of incident light (in Hz) and stopping potential V (in V) is as shown in the figure.

Planck's constant is (e is the elementary charge)



A. $e\dfrac{ab}{bc}$

B. $e\dfrac{cb}{ac}$

C. $e\dfrac{ac}{bc}$

D. $e\dfrac{ac}{ab}$

Answer: A

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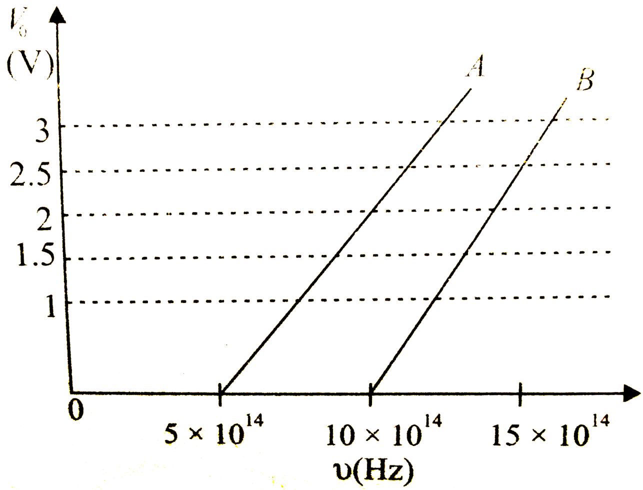
4. A student performs an experiment on photoelectric effect using two materials A and B. A plot of stopping potential (V_0) vs freqency (v) is as shown in the figure.



The value of h obtained from the experiment for both A and B respectively is

(Given electric charge of an electron $= 1.6 \times 10^{-19} C$)

A. $3.2 \times 10^{-34} Js, 4 \times 10^{-34} Js$

B. $6.4 \times 10^{-34} Js, 8 \times 10^{-34} Js$

C. $1.2 \times 10^{-34} Js, 3.2 \times 10^{-34} Js$

D. $4.2 \times 10^{-34} Js, 5 \times 10^{-34} Js$

Answer: B

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5. Light of wavelength $0.6\mu m$from a sodium lamp falls on a photocell and causes the emission of photoelectrons for which the stopping potential is 0.5 V. With wavelength $0.4\mu m$ from a sodium lamp, the stopping potential is 1.5 V. With this data , the value of h/e is

A. $4 \times 10^{-59} Vs$

B. $0.25 \times 10^{-15} Vs$

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

D. $4 \times 10^{-8} Vs.$

Answer: C

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6. When the photons of energy hv fall on a photosensitive metallic surface of work function hv_0, electrons are emitted are from the surface. The most energetic electron coming out of the surfece have kinetic energy equal to

A. hv

B. hv_0

C. $hv + hv_0$

D. $hv - hv_0$

Answer: D

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7. The photoeletric threshold 4v is incident on the metal is v. When light of freqency 4v is incident on the metal, the maximum kinetic energy of the emitted photoelectron is

A. 4hv

B. 3hv

C. 5hv

D. $\frac{5hv}{2}$

Answer: B

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

A. power

B. wavelength

C. intensity

D. frequency

Answer: D

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9. The work function for Al, K and Pt is 4.28 eV, 2.30 eV and 5.65 eV respectively. Their respective threshold frequencies would be

A. $Pt > Al > K$

B. $Al > Pt > K$

C. $K > Al > Pt$

D. $Al > K > Pt$

Answer: A

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10. The photoelectric threshold wavelength for silver is λ_0. The energy of the electron ejected from the surface of silver by an incident wavelength $\lambda(\lambda < \lambda_0)$ will be

A. $hc(\lambda_0 - \lambda)$

B. $\dfrac{hc}{\lambda_0 - \lambda}$

C. $\dfrac{h}{c} / \left(\dfrac{\lambda_0 - \lambda}{\lambda\lambda_0}\right)$

D. $hc\left(\dfrac{\lambda_0 - \lambda}{\lambda\lambda_0}\right)$

Answer: D

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11. A photon of energy E ejects a photoelectron from a metel surface whose work function is ϕ_0. If this electron enters into a unifrom magnetic field of induction B in a direction perpendicular to the field and describes a circular path of radius r, then the radius r, is given by, (in the usual notation)

A. $\sqrt{\dfrac{2m(E-\phi_0)}{eB}}$

B. $\sqrt{(2m(E-\phi_0))eB}$

C. $\sqrt{\dfrac{2m(E-\phi_0)}{mB}}$

D. $\dfrac{\sqrt{2m(E-\phi_0)}}{eB}$

Answer: D

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12. Two identical photocathodes receive light of frequencies v_1 and v_2. If the velocities of the photoelectrons (of mass m) coming out are respectively v_1 and v_2. then

A. $v_1^2+v_2^2=\dfrac{2h}{m}(v_1-v_2)$

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

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

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

Answer: A

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13. A metallic surface is irradiated by a monochromatic light of frequency v_1 and stopping potential is found to be V_1. If the light of frequency v_2 irradiates the surface, the stopping potential will be

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

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

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

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

Answer: B

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14. If K_1 and K_2 are maximum kinetic energies of photoelectrons emitted when light of wavelength λ_1 and λ_2 respectively are incident on a metallic surface. If $\lambda_1 = 3\lambda_2$ then

A. $K_1 > (K_2/3)$

B. $K_1 < (K_2/3)$

C. $K_1 = 3K_2$

D. $K_2 = 3K_1$

Answer: B

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15. The work function of cesium is 2.14 eV. The threshold freqency of caesium is

A. $5.16 \times 10^{19} Hz$

B. $5.16 \times 10^{16} Hz$

C. $5.16 \times 10^{18} Hz$

D. $5.16 \times 10^{14} Hz$

Answer: D

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16. The work function of Cs is 2.14 ev find the wavelength of the incident light if the stopping potential is 0.6 V.

A. 326 nm

B. 454 nm

C. 524 nm

D. 232 nm

Answer: B

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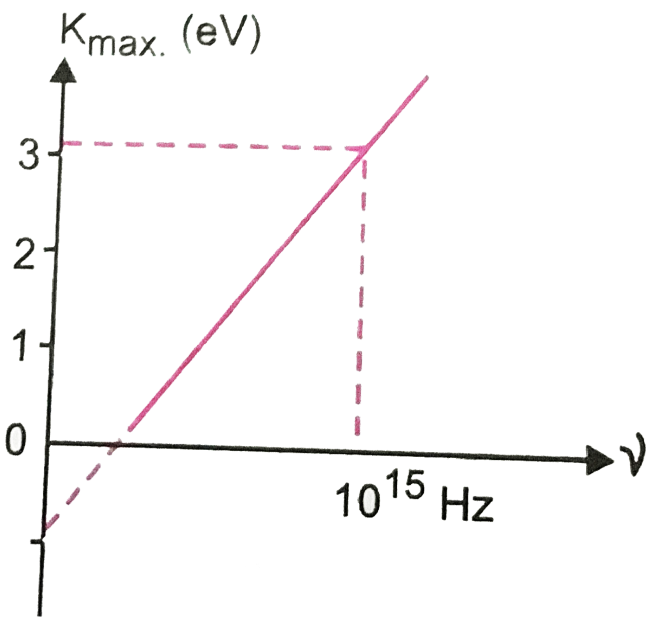
17. represents a graph of most energetic photoelectrons $K_{\max}$ (in eV) and frequency v for a metal used as cathode in photoelectrons experiment. The threshold frequency of light for the photoelectric emission from the metal is



A. $1 \times 10^{14} Hz$

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

C. $2 \times 10^{14} Hz$

D. $2.7 \times 10^{14} Hz$

Answer: D

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18. Light of frequency $7.21 \times 10^{14} Hz$ is incident on a metal surface. Electrons with a maximum speed of $6.0 \times 10^{5} ms^{-1}$ are ejected from the surface. What is the threshold frequency for photoemission of electrons? $h = 6.63 \times 10^{-34} Js, m_e = 9.1 \times 10^{-31} kg$.

A. $2.32 \times 10^{14} Hz$

B. $2.32 \times 10^{12} Hz$

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

D. $4.74 \times 10^{12} Hz$

Answer: C

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19. For a certain metal v is the five times of v_0 and the maximum velocity of coming out photons is $8 \times 10^6 m/s$. If $v = 2v_0$, then maximum velocity of photoelectrons will be

A. $4 \times 10^6 m \quad s^{-1}$

B. $6 \times 10^6 m \quad s^{-1}$

C. $8 \times 10^6 m \quad s^{-1}$

D. $1 \times 10^6 m \quad s^{-1}$

Answer: A

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20. A light of wavelength 600 nm is incident on a metal surface. When light of wavelength 400 nm is incident, the maximum kinetic energy of the emitted photoelectrons is doubled. The work function of the metals is

A. 1.03 eV

B. 2.11 eV

C. 4.14 eV

D. 2.43 eV

Answer: A

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21. The threshold frequency of a certain metal is $3.3 \times 10^{14} Hz$. If light of frequency $8.2 \times 10^{14} Hz$ is incident on the metal, predict the cut off voltage for photoelectric emission. Given Planck's constant, $h = 6.62 \times 10^{-34} Js.$

A. 2 V

B. 4 V

C. 6 V

D. 8 V

Answer: A

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22. A and B are two metals with threshold frequencies $1.8 \times 10^{14} Hz$ and $2.2 \times 10^{14} Hz$. Two identical photons of energy of 0.825 eV each are incident on them. Then photoelectrons are emitted in take $h = 6.6 \times 10^{-34} J / s$

A. B alone

B. A alone

C. neither A nor B

D. Both A and B

Answer: B

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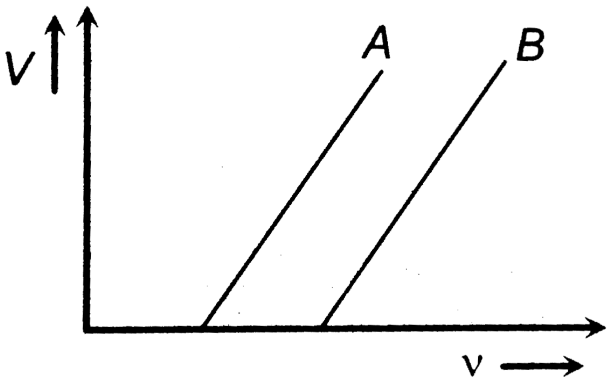
23. The stopping potential as a function of the frequency of the incident radiation is plotted for two different photoelectric surfaces A and B. The graphs show that work function of A is



A. less

B. more

C. equal

D. nothing can be said

Answer: A

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Particle Nature Of Light The Photon

1. Which of the following phenomena exhibits particle nature of light ?

A. Photoelectric effect

B. Interference

C. Refraction

D. Polarization

Answer: A

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2. Which of the follwing statements about photon is incorrect ?

A. Photons exert no pressure.

B. Momentum of photon is $\frac{hv}{c}$.

C. Rest mass of photon is zero.

D. Energy of photon is hv.

Answer: A

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3. In a photon-particle collision (sauch as photon-electron collision), which of the following may not be conserved ?

A. Total energy

B. Number of photons

C. Total momentum

D. both (a) and (b)

Answer: B

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4. The rest mass of the photon is

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

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

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

D. zero

Answer: D

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5. n' photons of wavelength $'\lambda'$ are absorbed by a black body of mass 'm'. The momentum gained by the body is

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

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

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

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

Answer: D

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6. The linear momentum of a 3 MeV photon is

A. $0.01 eV sm^{-1}$

B. $0.02 eV sm^{-1}$

C. $0.03 eV sm^{-1}$

D. $0.04 eV sm^{-1}$

Answer: A

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7. The wavelength of light in the visible region is about 390 nm for violet colour and about 760 nm for red colour. The energy of photon in eV at violet end is

A. 2.32

B. 3.19

C. 1.42

D. 4.13

Answer: B

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8. In the question number 48, the energy of photon in eV at the red of the visible spectrum is

A. 6.63

B. 3.62

C. 7.61

D. 1.64

Answer: D

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9. Monochromatic light of frequency $6 \times 10^{14} Hz$ is produced by a laser. The power emitted is 2×10^{-3} W.

The number of photons emitted per second is

$\left(\text{Given h} = 6.63 \times 10^{-34} Js\right)$

A. 2×10^{15}

B. 3×10^{15}

C. 4×10^{15}

D. 5×10^{15}

Answer: A

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

A. 3×10^{15}

B. 3×10^{10}

C. 3×10^{20}

D. 3×10^{19}

Answer: C

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

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

A. 4×10^{21}

B. 4×10^{34}

C. 4×10^{31}

D. 4×10^{28}

Answer: A

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12. If h is Plank's constant. Find the momentum of a photon of wavelength 0.01Å.

A. 10^{-2}

B. h

C. $10^{2}h$

D. $10^{12}h$

Answer: D

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

A. 3×10^{19}

B. 3×10^{24}

C. 3×10^{20}

D. 3×10^{18}

Answer: A

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

A. $1:500$

B. $1:400$

C. $1:300$

D. $1:200$

Answer: A

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15. A monochromatic light of frequency $3 \times 10^{14} Hz$ is produced by a LASER, emits the power of 3×10^{-3} W. Find how many number of photons are emitted per second.

A. 1.5×10^{16}

B. 2.5×10^{16}

C. 4.5×10^{16}

D. 8.5×10^{16}

Answer: A

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16. A source S_1 is producing 10^{15} photons per second of wavelength $5000\tilde{A}$. . .. Another source S_2 is producing 1.02×10^{15} wavelength 5100 A Then, $(\text{Power of}S_2) / (\text{Power of}S_1)$ is equal to

A. 1.00

B. 1.02

C. 1.04

D. 0.98

Answer: A

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

A. decreases with increasing n, with v fixed.

B. decreases with n fixed, v increasing.

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

D. All of these.

Answer: D

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18. An X-ray tube produces a continuous spectrum of radiation with its short wavelength end at $0.45\tilde{A}....$

The maximum energy of a photon in the radiation is

A. 30.4 ke V

B. 27.6 ke V

C. 15.2 ke V

D. 12.8 ke V

Answer: B

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19. If m is the mass of an electron and c the speed of light, the ratio of the wavelength of a photon of energy E to that of the electron of the same energy is

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

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

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

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

Answer: A

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Wave Nature Of Matter

1. Who won the Nobel prize in physics in the year 1929 for the discovery of the nature of electrons ?

A. Erwin Schrodinger

B. R.A Millikan

C. Louris Victor de Broglie

D. Albert Einstein

Answer: C

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2. The wavelength of the matter wave is independent of

A. mass

B. velocity

C. momentum

D. charge

Answer: D

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

A. Electron momentum

B. Electron diffraction

C. Photon momentum

D. Photon diffraction

Answer: B

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4. The matter-wave picture of electromagnetic wave/radiation elegantly incorporated the

A. Heinsenberg's uncertainty principle

B. correspondence principle

C. cosmic theory

D. Hertz's observations

Answer: A

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5. Wave theory cannot explain the phenomena of

A. Polarization , B.Diffraction

C. Compton effect , D. Photoelectric effect

Which of the following is correct ?

A. A and B

B. B and D

C. C and D

D. D and A

Answer: C

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6. Why is a photoelectric cell also called an electric eye?

A. LED

B. Photocell

C. Integrated chip (IC)

D. Solar cell

Answer: B

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7. In which of the following photocell is not used ?

A. Burglar alarm

B. Television camera

C. Automatic street lights

D. Vacuum cleaner

Answer: D

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8. The de Broglie wavelength is given by

A. $p = \frac{2\pi h}{\lambda}$

B. $p = \frac{h}{2\lambda}$

C. $p = \frac{2\pi}{h\lambda}$

D. $p = \frac{2\pi}{\lambda}$

Answer: A

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9. Which of these particles having the same kinetic energy has the largest de Broglie wavelength ?

A. Electron

B. Alpha particle

C. Proton

D. Neutron

Answer: A

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10. Consider the four gases hydrogen, oxygen, nitrogen and helium at the same temperature. Arrange them in the increasing order of the de Broglie wavelengths of their molecules.

A. Hydrogen, helium, nitrogen, oxygen

B. Oxygen, netrogen, hydrogen, helium

C. Oxygen, nitrogen, helium, hydrogen

D. Nitrogen, oxygen, helium, hydrogen

Answer: C

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11. A particle of mass 4m at rest decays into two particles of masses m and 3m having non-zero velocities. The ratio of the de Broglie wavelengths of the particles 1 and 2 is

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

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

C. 2

D. 1

Answer: D

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12. If a proton and electron have the same de Broglie wavelength, then

A. kinetic energy of electron $<$ kinetic energy of proton

B. kinetic energy of electron = kinetic energy of proton

C. momentum of electron = momentum of proton

D. momentum of electron $<$ momentum of proton

Answer: C

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13. The energy that should be added to an electron to reduce its de - Broglie wavelength from one $nm \rightarrow 0.5nm$ is

A. four times the initial energy

B. equal to the initial energy

C. twice the initial energy

D. thrice the initial energy

Answer: D

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14. If alpha particle, proton and electron move with the same momentum, them their respective de Broglie wavelengths $\lambda_\alpha, \lambda_p, \lambda_e$ are related as

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

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

C. $\lambda_\alpha > \lambda_p > \lambda_e$

D. $\lambda_p > \lambda_e > \lambda_\alpha$

Answer: A

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

A. their momenta are the same.

B. their energies are the same.

C. momentum of A_1 is less than the momentum of A_2.

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

Answer: A

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

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

B. The particle could be moving in an 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. Both (a) and (c)

Answer: B

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

A. $\frac{h}{2m_{A^v}}\left[\frac{(m_A+m_B)}{(m_A-m_B)}-1\right]$

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

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

D. $\frac{2h}{m_{A^v}}\left[\frac{(m_A+m_B)}{(m_A-m_B)}+1\right]$

Answer: C

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18. The de Broglie wavelength associated with a ball of mass 150 g travelling at 30 m s^{-1} is

A. $1.47 \times 1^{-34} m$

B. $1.47 \times 1^{-16} m$

C. $1.47 \times 1^{-19} m$

D. $1.47 \times 1^{-31} m$

Answer: A

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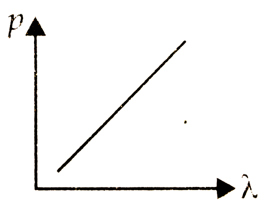
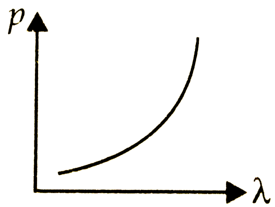
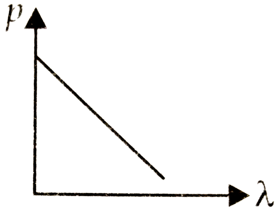
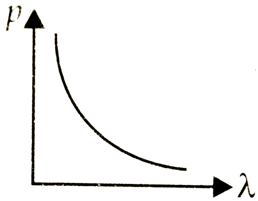
19. Which of the following figure represents the variation of particle momentum and the associated de - Broglie wavelength ?

A. 

B. 

C. 

D. 

Answer: D

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

A. $\lambda = 1nm$

B. $\lambda = 10nm$

C. $\lambda = 10^{-1}$

D. $\lambda = 10^{-4}$

Answer: D

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

A. $\sqrt{2} : 1$

B. $\sqrt{4} : 1$

C. $\sqrt{6} : 1$

D. $\sqrt{8} : 1$

Answer: D

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22. The deBroglie wavelength of a particle of kinetic energy K is λ. What would be the wavelength of the particle, if its kinetic energy were $\frac{K}{4}$?

A. λ

B. 2λ

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

D. 4λ

Answer: B

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23. When the velocity of an electron increases, its de Broglie wavelength

A. increases

B. decreases

C. remains same

D. may increase or decrease

Answer: B

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

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

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

C. $\frac{P_e}{E_{e}c} = 10^{-1}$

D. $\frac{P_e}{E_{e}c} = 10^{-4}$

Answer: B

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25. A particle is moving three times as fast as an electron. The ratio of the de- Broglie wavelength of the particle to that of the electron is 1.813×10^{-4}. Calculate the particle's mass and identify the particle. Mass of electron $= 9.11 \times 10^{-31} kg$.

A. $1.67 \times 10^{-27} kg$

B. $1.67 \times 10^{-31} kg$

C. $1.67 \times 10^{-19} kg$

D. $1.67 \times 10^{-14} kg$

Answer: A

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26. The de Broglie wavelength of an electron with kinetic energy 120 e V is

$\left(\text{Given h} = 6.63 \times 10^{-34} Js, m_e = 9 \times 10^{-31} kg, 1eV = 1.6 \times 10^{-19} J\right)$

A. $2.13\tilde{A}\ldots$

B. $1.13\tilde{A}\ldots$

C. $4.15\tilde{A}\ldots$

D. $3.14\tilde{A}\ldots$

Answer: B

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27. The de Broglie wavelength λ of an electron accelerated through a potential V in volts is

A. $\frac{1.227}{\sqrt{V}} nm$

B. $\frac{0.1227}{\sqrt{V}} nm$

C. $\frac{0.01227}{\sqrt{V}}nm$

D. $\frac{12.27}{\sqrt{V}}nm$

Answer: A

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28. Assuming an electron is confined to a 1 nm wide region. Find the uncertainty in momentum using Heisenberg uncertainty principle.

$\left(\text{Take h} = 6.63 \times 10^{-34} Js\right)$

A. $1.05 \times 10^{-25} \text{kg m s}^{-1}$

B. $2.03 \times 10^{-31} \text{kg m s}^{-1}$

C. $3.05 \times 10^{-34} \text{kg m s}^{-1}$

D. $3.05 \times 10^{-32} \text{kg m s}^{-1}$

Answer: A

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29. An EM wave of wavelength λ is incident on a photosensitive surface of negligible work function. If the photoelectrons emitted from this surface have the de-Broglie wavelength λ_1, prove that

$$\lambda = \left(\frac{2mc}{h}\right)\lambda_1^2$$

A. $\lambda = \frac{mc}{h}\lambda^{'2}$

B. $\lambda = \frac{3mc}{2h}\lambda^{'2}$

C. $\lambda = \frac{2mc}{h}\lambda^{'2}$

D. $\lambda = \frac{5mc}{h}\lambda^{'2}$

Answer: C

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

A. 200p

B. 400p

C. $\frac{p}{200}$

D. 100p

Answer: A

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31. If the kinetic energy of the particle is increased to 16 times its previous value , the percentage change in the de - Broglie wavelength of the particle is

A. $25\ \%$

B. $75\ \%$

C. $60\ \%$

D. $50\ \%$

Answer: B

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32. The de Broglie wavelength of an electron in a metal at $27^{\circ}C$ is

$\left(\text{Given} m_e = 9.1 \times 10^{-31} kg, k_B = 1.38 \times 10^{-23} JK^{-1}\right)$

A. $6.2 \times 10^{-9} m$

B. $6.2 \times 10^{-10} m$

C. $6.2 \times 10^{-8} m$

D. $6.2 \times 10^{-7} m$

Answer: A

Watch Video Solution

33. What is the de-Broglie wavelength of nitrogen molecule in air at 300K ? Assume that the molecule is moving with the root mean square speed of molecules at this temperature. (Atomic mass of nitrogen $= 14.0076U$) Plank's constant=$6.63 \times 10^{-34} Js$, Boltzmann constant $= 1.38 \times 10^{-23} JK^{-1}$

A. $2.75 \times 10^{-11} m$

B. $2.75 \times 10^{-12} m$

C. $3.24 \times 10^{-11} m$

D. $3.24 \times 10^{-12} m$

Answer: A

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34. A α -parhticle moves in a circular path of radius $0.83cm$ in the presence of a magnetic field of $0.25Wb/m^2$. The de-Broglie wavelength assocaiated with the particle will be

A. $1\tilde{A}...$

B. $0.1\tilde{A}...$

C. $10\tilde{A}...$

D. $0.01\tilde{A}...$

Answer: D

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35. Electrons with de-Broglie wavelength λ fall on the target in an X-ray tube. The cut-off wavelength of the emitted X-ray is

A. $\lambda_0 = \frac{2mc\lambda^2}{h}$

B. $\lambda_0 = \frac{2h}{mc}$

C. $\lambda_0 = \frac{2m^2c^2\lambda^2}{h^2}$

D. $\lambda_0 = \lambda$

Answer: A

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36. Find the (a) maximum frequency and (b) minimum wave-length of X-rays produced by 30 kV electrons. Given, $h = 6.63 \times 10^{-34} Js.$

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37. The potential energy of particle of mass m varies as

$$U(x) = \begin{cases} E_0 \text{for} 0 \leq x \leq 1 \\ 0 \quad \text{for} \quad > 1 \end{cases}$$

The de Broglie wavelength of the particle in the range

$0 \leq x \leq 1$ is λ_1 and that in the range $x > 1$ is λ_2.

If the total of the particle is $2E_0$, find λ_1 / λ_2.

A. $\sqrt{2}$

B. $\sqrt{3}$

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

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

Answer: A

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Davisson And Germer Experiment

1. In Davisson and Germer experiment, the tungsten filament is coated with

A. aluminium oxide

B. barium chloride

C. titanium oxide

D. barium oxide

Answer: D

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2. In the Davisson and Germer experiment , the velocity of electrons emitted from the electron gun can be increased by

A. increasing the potential difference between the anode and filament

B. increasing the filament current

C. decreasing the filament current

D. decreasing the potential difference between the anode and filament

Answer: A

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3. G.P Thomson experimentally confirmed the existence of matter waves by the phenomena

A. diffraction

B. refraction

C. polarization

D. scattering

Answer: A

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Higher Order Thinking Skills

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

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

A. $1.33 \times 10^{6} ms^{-1}$

B. $1.33 \times 10^{7} ms^{-1}$

C. $2.66 \times 10^{7} ms^{-1}$

D. $2.66 \times 10^{6} ms^{-1}$

Answer: C

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

A. λ_A

B. $\lambda_A \lambda_B / (\lambda_A + \lambda_B)$

C. $\lambda_A \lambda_B / |\lambda_A - \lambda_B|$

D. both (b) and (c)

Answer: D

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3. A silver of radius $1cm$ and work function $4.7eV$ is suspended from an insulating thread in freepace. It is under continuous illumination of $200nm$ wavelength light. As photoelectron are emitted the sphere gas charged and acquired a potential . The maximum number of photoelectron emitted from the sphere is $A \times 10^{e}(where 1 < A < 10)$ The value of z is

A. 6

B. 7

C. 8

D. 9

Answer: B

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

A. 7

B. 9

C. 11

D. 13

Answer: A

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5. Two metallic plates A and B, each of area $5 \times 10m$ are placed parallel to each other at a separation of 1 cm . Plate B carries a positive charge of 33.7 pc . A monochromatic beam of light, with photons of energy 5 eV each, starts falling on plate A at t = 0, so that 10 photons fall on it per square meter per second. Assume that one photoelectron is emitted for every 10 incident photons. Also assume that all the emitted photoelectrons are collected by plate B and the work function of plate A remains constant at the value 2 eV . Electric field between the plates at the end of 10 seconds is

A. 5×10^6

B. 7×10^7

C. 5×10^7

D. 9×10^6

Answer: C

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6. In question number 5, find the kinetic energy of the most energetic photoelectron emitted at t = 10 s when it reaches plate B.

(Neglect the time taken by the photoelectron to reach plate B)

A. 23 eV

B. 30 eV

C. 15 eV

D. 20 eV

Answer: A

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

Take $1eV = 1.6 \times 10^{-19}J$.

A. 6.25×10^8

B. 1.25×10^9

C. 1.25×10^6

D. 6.25×10^{11}

Answer: D

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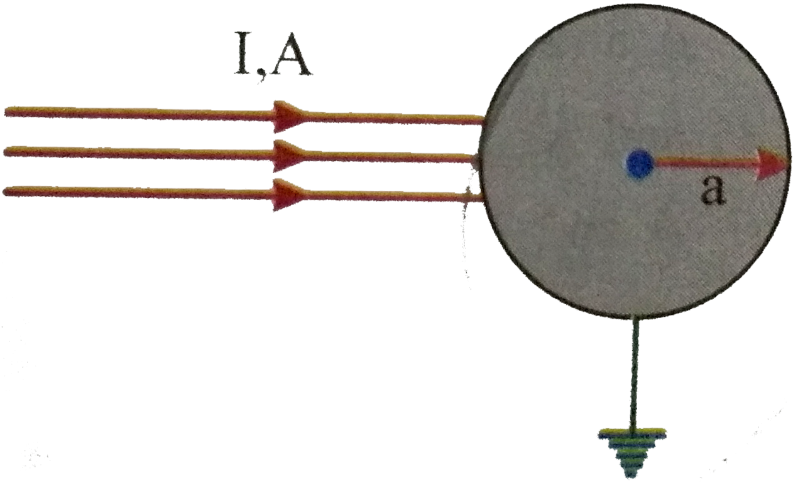
8. A parallel beam of monochromatic radiation of cross-section area $A(<\pi a^2)$, intensity I and frequency v is incident on a solid conducting sphere of work function$\phi_0[hv > \phi_0]$ and radius $'a'$. The sphere is grounded by a conducting wire. Assume that for each incident photon one photoelectron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



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

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

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

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

Answer: A

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Exemplar Problems

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

A. H

B. $H^{1/2}$

C. H^{0}

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

Answer: D

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

A. 1.2 nm

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

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

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

Answer: B

Watch Video Solution

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 $E_0 - \phi (\phi \text{is the work function})$.

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

Answer: D

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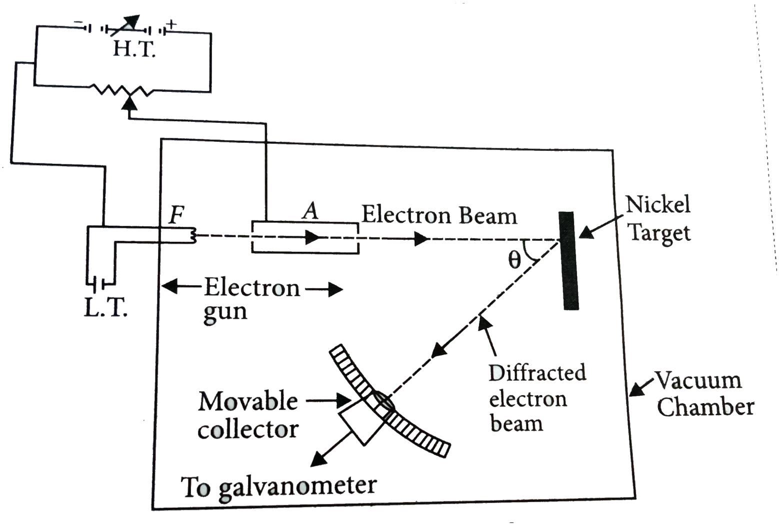
4. Consider figure. Suppose the voltage applied to A is increased. The diffracted beam will have the maximum at a value of θ that



A. will be larger then 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

Watch Video Solution

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

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

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

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

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

Answer: B

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

A. remains constant

B. increases with time

C. decreases with time

D. increases and decreases periodically

Answer: A

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7. An electron (mass m) with an initial velocity $v = v_0 \hat{i} (v_0 > 0)$ is in an electric field $E = -E_0 \hat{l} (E_0 = \text{constant} > 0)$. Its de-Broglie wavelength at time t is given by

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

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

A. λ_0

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

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

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

Answer: C

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Assertion Reason Corner

1. Assertion : Millikan's experiment established that electric charge is quantised.

Reason : From this experiment mass of the electron could not be determined.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C

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2. Assertion : Though light of a single frequency (monochromatic) is incident on a metal , the energies of emitted photoelectrons are different.

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

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

Watch Video Solution

3. Assertion : The stopping potential depends on the frequency of incident light.

Reason : The stopping potential is related to maximum kinetic energy by $eV_0 = K_{\max}$.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

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4. Assertion : Photosensitivity of a metal is high if its work function is small.

Reason : Work function $= hf_0$ where f_0 is the threshold frequency.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: B

Watch Video Solution

5. Assertion : If the frequency of the incident light on a metal electrons is more than doubled.

Reason : The metal will provide additional energy to the emitted photoelectron for light of higher frequency than for lower frequency.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

Watch Video Solution

6. Assertion : All the photoelectrons emitted from the matal do not have the same energy.

Reason : The maximum kinetic energy of photoelectrons depends on the light soures and the emitted plate material.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: B

Watch Video Solution

7. Assertion : Photoelectric effect supports the quantum nature of light.

Reason : Photoelectric emission is instantaneous.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: B

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8. Assertion : Photoelectric effect is the phenomenon of emission of photon by metal when illuminated by light of suitable frequency.

Reason : An electron beam carries sufficient energy to release photons from the metal.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: D

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9. Assertion : Photoelectric current depends on the intensity of incident light.

Reason : Number of photoelectrons emitted per second is directly proportional to intensity of incident radiation.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

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10. Assertion : Free electrons inside a metal are free to move out of the metal.

Reason : Free electrons inside conductor do not need additional energy to get out of the metal.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: D

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11. Assertion : The threshold frequency of photoelectric effect supports the particle nature of light.

Reason : If frequency of incident light is less than the threshold frequency, electrons are not emitted from metal surface.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: B

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12. Assertion : In photon-particle collision the total energy and total momentum are conserved. Reason : The number of photons are conserved in a collision.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C

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13. Assertion : A photocell is a technological application of the photoelectric effect.

Reason : Photocell is a device whose electric properties are affected by electricity.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C

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14. Assertion: photocell is called electric eye. *Reason: Photocell can see the things placed before it.*

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C

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15. Assertion : The wave nature of electrons was first experimentally verified by Davisson and Germer Experiment.

Reason : From the electron diffraction measurements, the wavelength of metter waves was found to 0.165 nm.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: B

Watch Video Solution

Ncert Exemplar

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

A. H

B. $H^{1/2}$

C. H^{0}

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

Answer: D

Watch Video Solution

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

A. 1.2 nm

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

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

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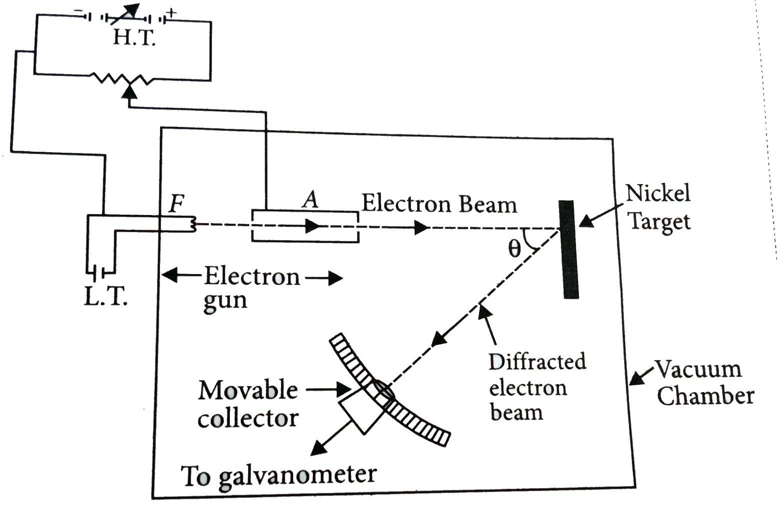

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C. will be less than the earlier value

D. will depend on the target

Answer: C

Watch Video Solution

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7. An electron (mass m) with an initial velocity $v = v_0 \hat{i} (v_0 > 0)$ is in an electric field $E = -E_0 \hat{l} \, (E_0 = \text{constant} > 0)$. Its de-Broglie wavelength at time t is given by

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

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

C. λ_0

D. $\lambda_0 t$

Answer: A

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8. An electron of mass m with an initial velocity

$\overrightarrow{v} = v_0 \hat{}(i) \, (v_0 > 0)$ enters an electric field

$\overrightarrow{E} = -E_0 \hat{j} \, (E_0 = cons \tan t > 0)$ at $t = 0$. If λ_0 is its de - Broglie

wavelength initially, then its de - Broglie wavelength at time t is

A. λ_0

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

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

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

Answer: C

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Assertion And Reason

1. Assertion : Millikan's experiment established that electric charge is quantised.

Reason : From this experiment mass of the electron could not be determined.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C

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2. *Assertion : Though light of a single frequency (monochromatic) is incident on a metal , the energies of emitted photoelectrons are different.*

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

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

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

C. *If assertion is true but reason is false.*

D. *If both assertion and reason are false.*

Answer: A

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3. *Assertion : The stopping potential depends on the frequency of incident light.*

Reason : The stopping potential is related to maximum kinetic energy by $eV_0 = K_{\max}$.

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

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

C. *If assertion is true but reason is false.*

D. *If both assertion and reason are false.*

Answer: A

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4. *Assertion : Photosensitivity of a metal is high if its work function is small.*

Reason : Work function $= hf_0$ *where* f_0 *is the threshold frequency.*

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

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

C. *If assertion is true but reason is false.*

D. *If both assertion and reason are false.*

Answer: B

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5. *Assertion : If the frequency of the incident light on a metal electrons is more than doubled.*

Reason : The metal will provide additional energy to the emitted photoelectron for light of higher frequency than for lower frequency.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A

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6. Assertion : All the photoelectrons emitted from the matal do not have the same energy.

Reason : The maximum kinetic energy of photoelectrons depends on the light soures and the emitted plate material.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: B

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7. Assertion : Photoelectric effect supports the quantum nature of light.

Reason : Photoelectric emission is instantaneous.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: B

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8. Assertion : Photoelectric effect is the phenomenon of emission of photon by metal when illuminated by light of suitable frequency.

Reason : An electron beam carries sufficient energy to release photons from the metal.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: D

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9. Assertion : Photoelectric current depends on the intensity of incident light.

Reason : Number of photoelectrons emitted per second is directly proportional to intensity of incident radiation.

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

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

C. *If assertion is true but reason is false.*

D. *If both assertion and reason are false.*

Answer: A

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10. *Assertion : Free electrons inside a metal are free to move out of the metal.*

Reason : Free electrons inside conductor do not need additional energy to get out of the metal.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: D

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11. Assertion : The threshold frequency of photoelectric effect supports the particle nature of light.

Reason : If frequency of incident light is less than the threshold frequency, electrons are not emitted from metal surface.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: B

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12. Assertion : In photon-particle collision the total energy and total momentum are conserved. Reason : The number of photons are conserved in a collision.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C

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13. Assertion : A photocell is a technological application of the photoelectric effect.

Reason : Photocell is a device whose electric properties are affected by electricity.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C

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14. Assertion: photocell is called electric eye. Reason: Photocell can see the things placed before it.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C

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15. Assertion : The wave nature of electrons was first experimentally verified by Davisson and Germer Experiment.

Reason : From the electron diffraction measurements, the wavelength of metter waves was found to 0.165 nm.

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

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

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: B

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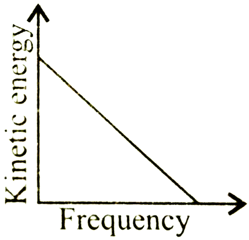
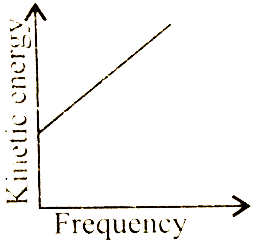
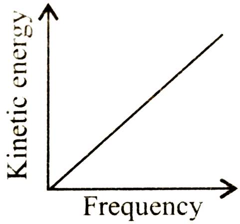
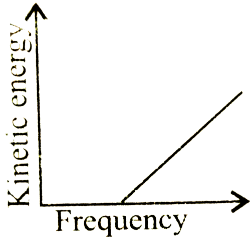
Others

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

A. 

B. 

C. 

D. 

Answer: D

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2. According to Einstein's photoelectric equation, the plot of the maximum kinetic energy of the emitted photoelectrons from a metal versus frequency of the incident radiation gives a straight line whose slope

A. depends on the intensity of incident radiation.

B. depends on the nature of the metal and also on the intensity of incident radiation.

C. is same for all metals and independent of the intensity of the incident radiation.

D. depends on the nature of the metal.

Answer: C

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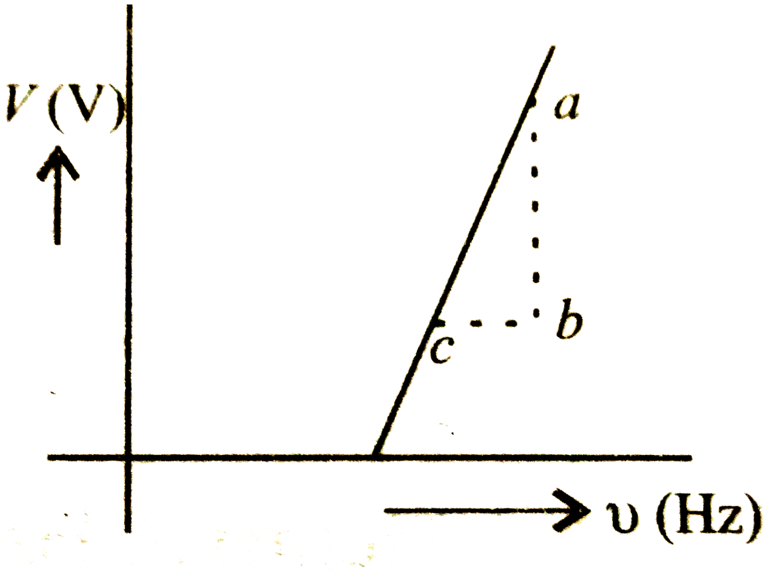
3. In a photoelectric experiment, the graph of frequency v of incident light (in Hz) and stopping potential V (in V) is as shown in the figure.

Planck's constant is (e is the elementary charge)



A. $e\dfrac{ab}{bc}$

B. $e\dfrac{cb}{ac}$

C. $e\dfrac{ac}{bc}$

D. $e\dfrac{ac}{ab}$

Answer: A

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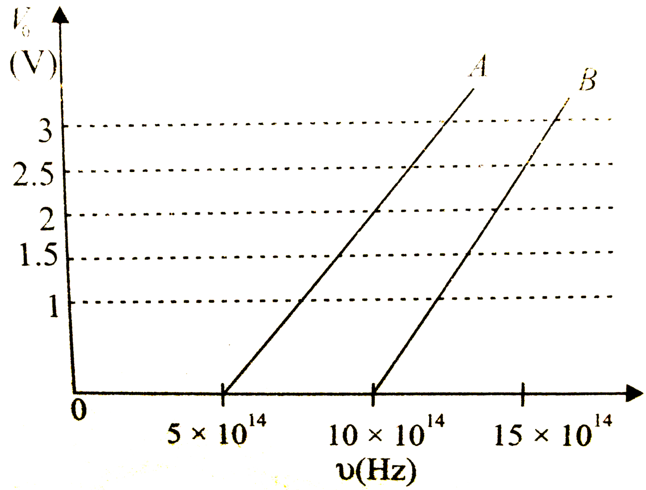
4. *A student performs an experiment on photoelectric effect using two materials A and B. A plot of stopping potential* (V_0) *vs freqency (v) is as shown in the figure.*



The value of h obtained from the experiment for both A and B respectively is

(Given electric charge of an electron $= 1.6 \times 10^{-19} C)$

A. $3.2 \times 10^{-34} Js, 4 \times 10^{-34} Js$

B. $6.4 \times 10^{-34} Js, 8 \times 10^{-34} Js$

C. $1.2 \times 10^{-34} Js, 3.2 \times 10^{-34} Js$

D. $4.2 \times 10^{-34} Js, 5 \times 10^{-34} Js$

Answer: B

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5. Light of wavelength $0.6\mu m$ from a sodium lamp falls on a photocell and causes the emission of photoelectrons for which the stopping potential is 0.5 V. With wavelength $0.4\mu m$ from a sodium lamp, the stopping potential is 1.5 V. With this data , the value of h/e is

A. $4 \times 10^{-59} Vs$

B. $0.25 \times 10^{-15} Vs$

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

D. $4 \times 10^{-8} Vs.$

Answer: C

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6. When the photons of energy hv fall on a photosensitive metallic surface of work function hv_0, electrons are emitted are from the surface. The most energetic electron coming out of the surfece have kinetic energy equal to

A. hv

B. hv_0

C. $hv + hv_0$

D. $hv - hv_0$

Answer: D

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7. The photoeletric threshold 4v is incident on the metal is v. When light of freqency 4v is incident on the metal, the maximum kinetic energy of the emitted photoelectron is

A. $4hv$

B. $3hv$

C. $5hv$

D. $\frac{5hv}{2}$

Answer: B

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

A. power

B. wavelength

C. intensity

D. frequency

Answer: D

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9. The work function for Al, K and Pt is 4.28 eV, 2.30 eV and 5.65 eV respectively. Their respective threshold frequencies would be

A. $Pt > Al > K$

B. $Al > Pt > K$

C. $K > Al > Pt$

D. $Al > K > Pt$

Answer: A

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10. *The photoelectric threshold wavelength for silver is* λ_0. *The energy of the electron ejected from the surface of silver by an incident wavelength* $\lambda(\lambda < \lambda_0)$ *will be*

A. $hc(\lambda_0 - \lambda)$

B. $\dfrac{hc}{\lambda_0 - \lambda}$

C. $\dfrac{h}{c} / \left(\dfrac{\lambda_0 - \lambda}{\lambda\lambda_0}\right)$

D. $hc\left(\dfrac{\lambda_0 - \lambda}{\lambda\lambda_0}\right)$

Answer: D

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11. *A photon of energy E ejects a photoelectron from a metel surface whose work function is* ϕ_0. *If this electron enters into a unifrom magnetic field of induction B in a direction perpendicular to the field* *and describes a circular path of radius r, then the radius r, is given by, (in the usual notation)*

A. $\sqrt{\frac{2m(E-\phi_0)}{eB}}$

B. $\sqrt{(2m(E-\phi_0))eB}$

C. $\sqrt{\frac{2m(E-\phi_0)}{mB}}$

D. $\frac{\sqrt{2m(E-\phi_0)}}{eB}$

Answer: D

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12. *Two identical photocathodes receive light of frequencies v_1 and v_2. If the velocities of the photoelectrons (of mass m) coming out are respectively v_1 and v_2. then*

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

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

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

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

Answer: A

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13. A metallic surface is irradiated by a monochromatic light of frequency v_1 and stopping potential is found to be V_1. If the light of frequency v_2 irradiates the surface, the stopping potential will be

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

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

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

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

Answer: B

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14. *If* K_1 and K_2 *are maximum kinetic energies of photoelectrons emitted when light of wavelength* λ_1 and λ_2 *respectively are incident on a metallic surface. If* $\lambda_1 = 3\lambda_2$ *then*

A. $K_1 > (K_2/3)$

B. $K_1 < (K_2/3)$

C. $K_1 = 3K_2$

D. $K_2 = 3K_1$

Answer: B

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15. *The work function of cesium is 2.14 eV. The threshold freqency of caesium is*

A. $5.16 \times 10^{19} Hz$

B. $5.16 \times 10^{16} Hz$

C. $5.16 \times 10^{18} Hz$

D. $5.16 \times 10^{14} Hz$

Answer: D

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16. *The work function of Cs is 2.14 ev find the wavelength of the incident light if the stopping potential is 0.6 V.*

A. 326 nm

B. 454 nm

C. 524 nm

D. 232 nm

Answer: B

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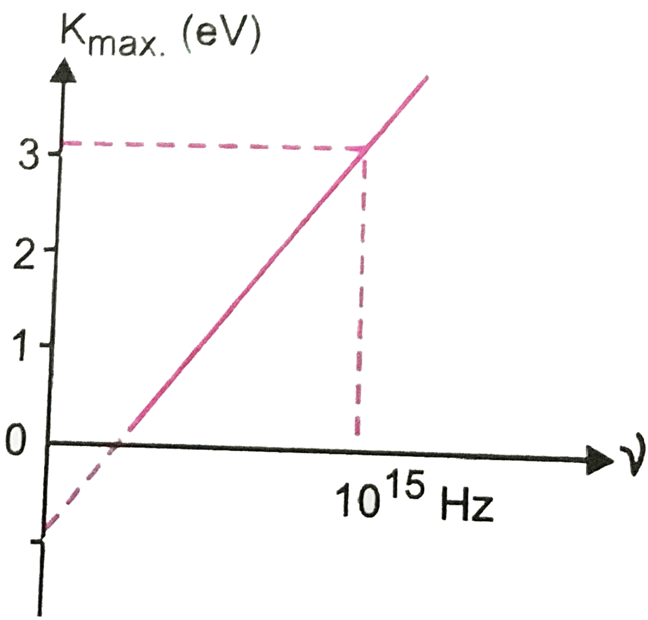
17. *represents a graph of most energetic photoelectrons $K_{\max}$ (in eV) and frequency v for a metal used as cathode in photoelectrons experiment. The threshold frequency of light for the photoelectric emission from the metal is*



A. $1 \times 10^{14} Hz$

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

C. $2 \times 10^{14} Hz$

D. $2.7 \times 10^{14} Hz$

Answer: D

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18. Light of frequency $7.21 \times 10^{14} Hz$ is incident on a metal surface. Electrons with a maximum speed of $6.0 \times 10^{5} ms^{-1}$ are ejected from the surface. What is the threshold frequency for photoemission of electrons? $h = 6.63 \times 10^{-34} Js, m_e = 9.1 \times 10^{-31} kg$.

A. $2.32 \times 10^{14} Hz$

B. $2.32 \times 10^{12} Hz$

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

D. $4.74 \times 10^{12} Hz$

Answer: C

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19. For a certain metal v is the five times of v_0 and the maximum velocity of coming out photons is $8 \times 10^6 m / s$. If $v = 2v_0$, then maximum velocity of photoelectrons will be

A. $4 \times 10^6 m \quad s^{-1}$

B. $6 \times 10^6 m \quad s^{-1}$

C. $8 \times 10^6 m \quad s^{-1}$

D. $1 \times 10^6 m \quad s^{-1}$

Answer: A

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20. *A light of wavelength 600 nm is incident on a metal surface. When light of wavelength 400 nm is incident, the maximum kinetic energy of the emitted photoelectrons is doubled. The work function of the metals is*

A. 1.03 eV

B. 2.11 eV

C. 4.14 eV

D. 2.43 eV

Answer: A

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21. *The threshold frequency of a certain metal is* $3.3 \times 10^{14} Hz$. *If light of frequency* $8.2 \times 10^{14} Hz$ *is incident on the metal, predict the cut* off voltage for photoelectric emission. Given Planck's constant, $h = 6.62 \times 10^{-34} Js.$

A. 2 V

B. 4 V

C. 6 V

D. 8 V

Answer: A

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22. A and B are two metals with threshold frequencies $1.8 \times 10^{14} Hz$ and $2.2 \times 10^{14} Hz$. Two identical photons of energy of 0.825 eV each are incident on them. Then photoelectrons are emitted in take $h = 6.6 \times 10^{-34} J/s$

A. B alone

B. A alone

C. neither A nor B

D. Both A and B

Answer: B

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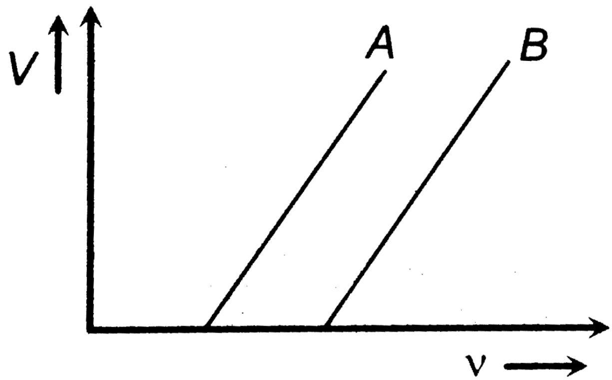
23. The stopping potential as a function of the frequency of the incident radiation is plotted for two different photoelectric surfaces A and B. The graphs show that work function of A is



A. less

B. more

C. equal

D. nothing can be said

Answer: A

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