PHYSICS

BOOKS - MODERN PUBLICATION PHYSICS (KANNADA ENGLISH)

ELECTRONS & PHOTONS

Multiple Choice Questions Level I

1. If an electron is accelerated by $8.8 \times 10^{14} ms^{-2}$, then electric field required for this acceleration is (given specific charge of the electron $= 1.76 \times 10^{11} Ckg^{-1}$):

A. $40 Vcm^{-1}$

B. $50 Vcm^{-1}$

C. $60 Vcm^{-1}$

D. $70Vcm^{-1}$

Answer: B

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2. Momentum of an electron, when a potential difference of 500 volt is applied across the electrodes of CRT in SI units is :

A. 1.6×10^{-19}

B. 1.9×10^{-27}

C. 9.1×10^{-27}

D. 1.2×10^{-23}

Answer: D

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3. Magnitude of acceleration of an electron having speed $2.5 \times 10^6 ms^{-1}$ in a magnetic field of value 2.0 G, is (given : specific charge of the electron $= 1.76 \times 10^{11} Ckg$)

A. $6.6 \times 10^{23} cms^{-2}$

B. $6.6 \times 10^{27} ms^{-2}$

C. $8.8 \times 10^{13} ms^{-2}$

D. $9.1 \times 10^{15} ms^{-2}$

Answer: C

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4. An electron enters a magnetic field of 0.01 T with a speed of $10^7 ms^{-1}$ and describes a circle of radius 6 mm there. Then specific charge of the electron is given by:

A. $1.76 \times 10^{11} Ckg^{-1}$

B. $1.67 \times 10^{11} Ckg^{-1}$

C. $6.71 \times 10^{11} Ckg^{-1}$

D. $1.9 \times 10^{11} Ckg^{-1}$

Answer: B

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5. If an electron moving with a speed of $2.5 \times 10^{7} ms^{-1}$ is deflected by an electric field of $1.6k(V)m^{-1}$ perpendicular to its circular path, then $\frac{e}{m}$ for the electron will be (given radius of circular path =2.3m):

A. $1.67 \times 10^{11} Ckg^{-1}$

B. $1.76 \times 10^{11} Ckg^{-1}$

C. $1.7 \times 10^{11} Ckg^{-1}$

D. $1.59 \times 10^{11} Ckg^{-1}$

Answer: C

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6. If an electron accelerated through a potential difference of 500 volt attains a speed of $1.33 \times 10^7 ms^{-1}$, then specific charge of the electron should be:

A. $1.67 \times 10^{11} Ckg^{-1}$

B. $1.8 \times 10^{11} Ckg^{-1}$

C. $1.92 \times 10^{11} Ckg^{-1}$

D. $1.76 \times 10^{11} Ckg^{-1}$

Answer: D

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7. The ratio of kinetic energies of an electron and a proton which are accelerated from rest by a potential difference of 10 volt is:

A. $\frac{1}{1840}$

B. 1840

C. $\frac{1}{\sqrt{1840}}$

D. 1

Answer: D

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8. To obtain the X-rays of shortest wavelength of 0.5Å, potential difference applied across the electrodes of the tube should be:

A. 13.89 kV

B. 19.72kV

C. 21.7kV

D. 24.8kV

Answer: D

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9. In photoelectric effect, the current depends on the

A. frequency of light, but is independent of intensity

B. intensity of light, but is independent of frequency

C. intensity as well as on the frequency of light

D. nature of the metal, but is independent of frequency and intensity of light.

Answer: B

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10. Which of the following happens when a monochromatic light wave passes from air to glass?

A. Both, the frequency and wavelength decrease.

B. Frequency increases and wavelength decreases.

C. Frequency remains the same, but wavelength decreases.

D. Frequency and wavelength are unchanged.

Answer: C

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11. Shortest wavelength limit of X-rays produced by an X-ray tube to be operating at 30 kV is 0.414Å. Planck's constant is:

A. $5.623 \times 10^{-34} J - \sec$

B. $5.89 \times 10^{-34} J - \sec$

C. $6.52 \times 10^{-34} J - \sec$

D. $6.624 \times 10^{-34} J - \sec$

Answer: D

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12. If work function of a metal plate is negligible, then find the K.E. of the photoelectrons emitted when radiations of 1000Å are incident on the metal surface

A. 11.6 eV

B. 12:4 eV

C. 13.6 eV

D. 14.4 eV

Answer: B

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13. When ultraviolet light of wavelength 1000Å is incident on molybdenum, then find the maximum velocity of ejected electrons (given : work function of molybdenum = 5.0 eV):

A. $2.1 \times 10^6 cms^{-1}$

B. $3.1 \times 10^7 cms^{-1}$

C. $1.6 \times 10^8 cms^{-1}$

D. $2.51 \times 10^8 cms^{-1}$

Answer: C

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14. Wavelength of light incident on a photo cell is $3000019Å$ if stopping potential is 2.5 volt, then work function of the cathode of photo cell is :

A. 1.41 eV

B. 1.52 eV

C. 1.56 eV

D. 1.64 eV

Answer: D

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15. The number of photons of wavelength $13.2A^{\circ}$ in 6J of energy is $(h = 6.6 \times 10^{-34} J.\ s)$

A. 2×10^{12}

B. 4×10^{16}

C. 6×10^{20}

D. 4×10^{24}

Answer: B

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16. de-Broglie wavelength associated with an electron having kinetic energy 500 eV is :

A. 0.55Å

B. 0.69Å

C. 0.78Å

D. 1.31Å

Answer: A

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17. An electron is accelerated to a potential of 200 V and acquires a velocity of $8.4 \times 10^6 ms^{-1}$. The e/m is:

A. $1.76 \times 10^9 C/kg$

B. $1.76 \times 10^{10} C/kg$

C. $1.76 \times 10^{11} C/kg$

D. $1.76 \times 10^{12} C/kg$

Answer: C

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18. The momentum of a photon of an electromagnetic radiation is 3.3×10^{-29} kg m/s. The frequcncy of the associated wave is $\left(h = 6.6 \times 10^{-34} Js, c = 3 \times 10^{8} m/s\right)$

A. $3.0 \times 10^{3} Hz$

B. $6.0 \times 10^{3} Hz$

C. $7.5 \times 10^{12} Hz$

D. $1.5 \times 10^{13} Hz.$

Answer: D

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19. The photoelectric surface is receiving light of wave length 5000Å at the rate of 10^{-7} J/s. The no. of photoelectron received per sec is:

A. 2.5×10^{12}

B. 2.5×10^{11}

C. 2.5×10^{10}

D. 2.5×10^{9}

Answer: B

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20. The work function of a metallic surface in 5.0/eV. Photoelectrons are emitted when light of $\lambda = 2000\text{Å}$ falls-on it. The P.D. to stop fastest photoelectrons is :

A. 1.2 V

B. 2.4 V

C. 3.6 V

D. 4.8 V.

Answer: A

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21. The momentum of a photon of an electron-magnetic radiation is $6.6 \times 10^{-29} kgms^{-1}$. If $h = 6.6 \times 10^{-34}$ js and $c = 3 \times 10^{8}$ m/s the frequency of the radiation is

A. $3 \times 10^{12} Hz$

B. $1.5 \times 10^{13} Hz$

C. $3 \times 10^{13} Hz$

D. $1.5 \times 10^{12} Hz.$

Answer: C

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22. A uniform magnetic field exists in vertical downward direction in a room. If an electron is moving in horizontal direction, it gets deflected in circular path with constant speed. Its direction is :

A. clockwise in vertical plane

B. clockwise in horizontal plane

C. anti-clockwise in vertical plane

D. anti-clockwise in horizontal plane.

Answer: B

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23. A uniform electric and magnetic fields are produced pointing in the same direction. An electron is projected pointing in the same direction

A. the electron turns to right

B. the electron turns to its left

C. the velocity of electron increases

D. the velocity of electron decreases.

Answer: D

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24. A cathode ray tube has potential difference V between the cathode and anode. The speed v of electrons ejected is :

A. $v \propto V$

B. $v \propto V^2$

C. $v \propto \sqrt{V}$

D. $v \propto \frac{1}{V}$

Answer: D

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25. K. E. of protons, when accelerated to one volt potential

A. $\frac{1}{1840} eV$

B. 1eV

C. 1840 eV

D. 0.5 eV

Answer: B::C

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26. The ratio of specific charge of proton to that of α-particle is:

A. $1:4$

B. $1:2$

C. $4:1$

D. $2:1$

Answer: D

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27. A beam of α-particles passes undeflected through crossed electric and magnetic fields with $E = 6.6 \times 10^6 Nc^{-1}$ and B = 1.2 tesla. The speed of α -particles is

A. $1.8 \times 10^5 ms^{-1}$

B. $5.5 \times 10^6 ms^{-1}$

C. $7.8 \times 10^6 ms^{-1}$

D. $1.1 \times 10^6 ms^{-1}$

Answer: B

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28. In Thomson's mass spectrograph, the velocity of the positive ions so that they may strike the vertex of the parabola is :

A. infinite

B. zero

C. small but not zero

D. large but not infinite

Answer: A

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29. When a photon of energy 7eV is made incident on a metal then the emitted electron is stopped by a stopping potential of -5.5 V. The work function of metal will be:

A. $-1.5eV$

B. $1.5eV$

C. $12.5eV$

D. $37.5eV$

Answer: B

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30. The recoil energy of an electron of wavelength 0.1Å in eV will be :

A. 1.506×10^4

B. 3×10^4

C. 6×10^4

D. 9×10^4

Answer: A

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31. If the distance of 100 W lamp is increased from a photo cell, the saturation current in the photo cell varies with distance d as:

A. $i \propto d^2$

B. $i \propto d$

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

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

Answer: D

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32. For a certain metal, v is twice v_0 and electrons come out with a maximum velocity of $4 \times 10^6 ms^{-1}$. If value of $v = 5v_0$, then the maximum velocity of photoelectrons will be:

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

B. $8 \times 10^4 ms^{-1}$

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

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

Answer: A

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33. A radio transmitter works at a frequency of 880 KHz and a power of 10 KW. The no. of photons emitted per second are :

A. 1.72×10^{31}

B. 1327×10^{34}

C. 13.27×10^{34}

D. 0.075×10^{-34}

Answer: A

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34. Work function of tungsten and sodium are 4.4 eV and 2.3eV resp. If threshold wavelength of sodium is 5460Å then threshold wavelength of tungsten is:

A. 11360Å

B. 8000Å

C. 6000Å

D. 2840Å

Answer: D

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35. An X-ray photon is found to have its wavelength doubled on being scattered through 90°. Find the energy of the incident photon:

A. $8.1 \times 10^{-14} J$

B. $8.1 \times 10^{12} J$

C. $8.1 \times 10^{-10} J$

D. $8.1 \times 10^{-8} J$

Answer: A

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36. Find the frequency of light which ejects electrons from a metal surface, fully stopped by a retarding potential of 3V. The photoelectric effect begins in this metal at frequency $6 \times 10^{14} s^{-1}$

A. 10^5

B. 10^{16}

C. 1.324×10^{15}

D. none of these.

Answer: C

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37. In a photoelectric cell, the wavelength of incident light is changed from 4000Å to 3600Å. The change in stopping potential will be:

A. 0.14 V

B. 0.24 V

C. 0.35 V

D. 0.44 V

Answer: C

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38. A stopping potential of 0.82 volt is required to stop the photoelectrons emitted from a metallic surface by light of wavelength 4000Å. The stopping potential for wavelength 3000Å will be :

A. 1.85 V

B. 2.85 V

C. 3.0 V

D. 4.1 V.

Answer: A

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39. When a metallic surface is illuminated by light of frequency $8 \times 10^{14} Hz$ a photoelectron of energy 0.5eV is emitted. When the same surface is illuminated by light of frequency $12 \times 10^{14} Hz$ photoelectron of maximum energy 2 eV is emitted. The work function is :

A. 0.5 eV

B. 1.5 eV

C. 2.5 eV

D. 3.5 eV

Answer: C

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40. The de-Broglie wavelength of neutrons in thermal equilibrium is :

A. $\frac{30.8}{\sqrt{T}} \text{Å}$

B. $\frac{3.08}{\sqrt{T}}\text{Å}$

C. $\frac{0.308}{\sqrt{T}}\text{Å}$

D. $\frac{0.0308}{\sqrt{T}}\text{Å}$

Answer: A

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41. de-Broglie wave length is expressed as:

A. $\frac{2.3}{\sqrt{V}}\text{Å}$

B. $\frac{1.2}{\sqrt{V}}\text{Å}$

C. $\frac{12.27}{\sqrt{V}}\text{Å}$

D. $\frac{220}{\sqrt{V}}\text{Å}$

Answer: C

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42. Two radiations containing photons of energy twice and five times the work function of a metal are incident successively on the metal surface. The ratio of the maximum velocities of the emitted electrons in the two cases will be

A. $1:3$

B. $1:4$

C. $1:2$

D. $1:1$

Answer: C

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43. An electron and a photon possess the same de-Broglie wavelength. If E_e and E_{ph} are respectively the energies of electron and photon and v and c are their respective velocities, then $\frac{E_e}{E_{ph}} =$

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

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

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

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

Answer: B

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44. if the velocity of electron is 25% of the velocity of photon, then $\frac{E_e}{E_{ph}}$:

A. $1:2$

B. $1:4$

C. $1:8$

D. $1:16$

Answer: C

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45. An electron and a photon, each has a wavelength of 1.2Å What is the ratio of their energies ?

A. $1:10$

B. $1:10^2$

C. $1:10^3$

D. $1:10^4$

Answer: B

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

A. $12.4 \times 10^3\text{Å}$

B. $2.4 \times 10^3\text{Å}$

C. $0.4 \times 10^2\text{Å}$

D. 1000Å

Answer: A

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47. What is the ratio of the wavelengths of a photon and that of an electron of the same energy ?

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

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

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

D. $\sqrt{mE}$

Answer: A

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48. If λ_1 and λ_2 denote the wavelengths of de-Broglie waves for electrons in the first and second Bohr orbits in hydrogen atom, then $\frac{\lambda_1}{\lambda_2}$ is equal to :

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

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

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

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

Answer: B

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49. The frequency of the incident light falling on a photosensitive metal plate is doubled. The kinetic energy of the emitted photoelectron is :

A. unchanged

B. doubled

C. less than doubled

D. more than doubled.

Answer: D

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50. If the energy of a photon corresponding to a wavelength of 6000Å is $3.32 \times 10^{-19} J$, the photon energy in J) for a wavelength of 4000Å will be :

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51. The de-Broglie wavelength of helium atom at a temperature of $89^\circ C$, will be:

A. 0.47Å

B. 0.58Å

C. 0.66Å

D. 0.73Å

Answer: C

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52. Statement I: Photoemission from a photosensitive metal is possible only if the incident radiation has a frequency above the threshold frequency.

Statement II : In photoelectric emission, the maximum energy of photoelectrons increases with increasing intensity of incident light.

A. A. Statement-I is false, statement-II is true.

B. Statement-I is true, statement-II is false.

C. Statement-I is true, statement-II is true. Statement-II is correct explanation of statement-I

D. Statement-I is true, statement-II is true and statement - II is not correct explanation of statement-I.

Answer: B

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53. Statement I: The de-Broglie wavelength λ of a particle of mass m moving with a velocity v is given by relation $\lambda = \frac{h}{mv}$

Statement II : The de-Broglie wavelength of an electron which is accelerated from rest through a potential of 150 volt 1Å.

A. A. Statement-I is false, statement-II is true.

B. Statement-I is true, statement-II is false.

C. Statement-I is true, statement-II is true. Statement-II is correct explanation of statement-I

D. Statement-I is true, statement-II is true and statement - II is not correct explanation of statement-I.

Answer: C

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54. Statement I: The wavelength of $K_{\propto}$ X-ray line of an anticathode element of atomic no.

Z is proportional to $\left(\frac{1}{Z-1}\right)^2$

Statement II: The frequency of Kg X-ray line equals the sum of the frequencies of K and La X-ray lines of same anticathode element.

A. A. Statement-I is false, statement-II is true.

B. Statement-I is true, statement-II is false.

C. Statement-I is true, statement-II is true. Statement-II is correct explanation of statement-I

D. Statement-I is true, statement-II is true and statement - II is not correct explanation of statement-I.

Answer: D

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55. Statement I: If the accelerating potential in an X-ray tube is increased, the wavelengths of the characteristic X-rays do not change.

Statement II: When an electron beam strikes the target in an X-ray tube part of the kinetic energy is converted into X-ray energy.

A. A. Statement-I is false, statement-II is true.

B. Statement-I is true, statement-II is false.

C. Statement-I is true, statement-II is true. Statement-II is correct explanation of statement-I

D. Statement-I is true, statement-II is true and statement - II is not correct explanation of statement-I.

Answer: A

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56. Statement I: Stopping potential depends upon the frequency of incident light but is independent of the intensity of the light.

Statement II: The maximum kinetic energy of the photoelectrons is proportional to stopping potential.

A. A. Statement-I is false, statement-II is true.

B. Statement-I is true, statement-II is false.

C. Statement-I is true, statement-II is true. Statement-II is correct explanation of statement-I

D. Statement-I is true, statement-II is true and statement - II is not correct explanation of statement-I.

Answer: A

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57. Direction : The questions 57, 58 and 59 are based on following paragraph : Radiation emitted when an electron jumps from n = 3 to n=1

orbit in H_2 atom, fall on a metal to produce photoelectrons. Electrons fall on the metal surface with maximum K.E. in a direction perpendicular to a magnetic field of 1/320 T in a radius of $10m^{-3}$.

The K.E. of the electrons is

A. $2 \times 10^{-19} J$

B. $3 \times 10^{-19} J$

C. $1 \times 10^{-19} J$

D. $3.18 \times 10^{-19} J$

Answer: D

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58. Direction : The questions 57, 58 and 59 are based on following paragraph : Radiation emitted when an electron jumps from n = 3 to n=1 orbit in H_2 atom, fall on a metal to produce photoelectrons. Electrons fall on the metal surface with maximum K.E. in a direction perpendicular to a

magnetic field of 1/320 T in a radius of $10m^{-3}$.

Work function of metal

A. 1 eV

B. 2 eV

C. 1.03 eV

D. 3 eV

Answer: C

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59. Direction : The questions 57, 58 and 59 are based on following paragraph : Radiation emitted when an electron jumps from n = 3 to n=1 orbit in H_2 atom, fall on a metal to produce photoelectrons. Electrons fall on the metal surface with maximum K.E. in a direction perpendicular to a magnetic field of 1/320 T in a radius of $10m^{-3}$.

Wavelength of radiation is

A. 5200 A

B. 6563 A

C. 4500 A

D. 7000 A

Answer: B

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60. Direction : The questions 60 and 61 are based on following paragraph :

An X-ray tube operated at a D.C, voltage of 40 kV produces heat at the target at the rate of 720 W. If 0.5% of the energy of the incident electron is converted into X-ray radiation, then (sp. charge is $1.8 \times 10^{11} C / kg$). Number of electrons striking the target per/sec is

A. 2.2×10^{-17}

B. 1.1×10^{17}

C. 2.2×10^{18}

D. 71.1×10^{18}

Answer: B

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61. Direction : The questions 60 and 61 are based on following paragraph : An X-ray tube operated at a D.C, voltage of 40 kV produces heat at the target at the rate of 720 W. If 0.5% of the energy of the incident electron is converted into X-ray radiation, then (sp. charge is $1.8 \times 10^{11} C / kg$). The velocity of the incident electron is

A. $1.2 \times 10^{8} m / s$

B. $2.4 \times 10^{8} m / s$

C. $3.4 \times 10^{7} m / s$

D. $2.4 \times 10^{7} m / s$

Answer: A

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62. Direction : The questions 62 and 63 are based on following paragraph :

de-Broglie wave associated with electron forms a standing wave when distance (d) between atoms of the array of material is 2Å. A similar standing wave is again formed, when distance is increased to 2.5Å.

Then energy of electron is

A. 92.51 eV

B. 112.4 eV

C. 150.9 eV

D. 170.2 eV

Answer: C

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63. Direction : The questions 62 and 63 are based on following paragraph :

de-Broglie wave associated with electron forms a standing wave when distance (d) between atoms of the array of material is 2Å. A similar standing wave is again formed, when distance is increased to 2.5Å.

Least value of distance (d) for which standing wave can be formed is

A. 0.2Å

B. 0.3Å

C. 0.4Å

D. 0.5Å

Answer: D

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64. The work function of caesium metal is 2.14 ev. When light of frequency $6 \times 10^{14} Hz$ 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?

A. $0.92 \times 10^{-19} J$

B. $0.558 \times 10^{-19} J$

C. $1.2 \times 10^{-19} J$

D. $1.7 \times 10^{-19} J$

Answer: B

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65. The work function of caesium metal is 2.14 ev. When light of frequency $6 \times 10^{14} Hz$ 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?

A. 0.349 V

B. 0.67 V

C. 0.81 V

D. 1.2 V

Answer: A

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66. The work function of caesium metal is 2.14 ev. When light of frequency $6 \times 10^{14} Hz$ 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?

A. $12 \times 10^4 m/s$

B. $6 \times 10^5 m/s$

C. $350 \times 10^3 m/s$

D. $10^8 m/s$

Answer: C

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67. Eye detects the green light $(\lambda = 5000\text{Å})$, 5×10^4 photons per square metre per second and the ear can detect 10^{-13} watt per square metre. In form of power 10^{-13} watt per square metre. In form of power detector, the eye is sensitive in comparison to the ear by

A. 2 times

B. 3 times

C. 4 times

D. 5 times

Answer: D

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68. In an experiment on photo electric effect, the slope of cut - off voltage versus frequency, incident light is found to be 4.12×10^{-15} Vs. Calculate the of Planck's constant.

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

B. $3.3 \times 10^{-34} Js$

C. $2.2 \times 10^{-34} Js$

D. None of these.

Answer: A

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69. In Millikans oil drop experiment, a charged drop of mass $1.8 \times 10^{-14} kg$ is stationary between its plates. The distance between its plates is 0.90 cm and potential difference is 2.0 kilo volts. The number of electrons on the drop is

A. 500

B. 50

C. 5

D. 0

Answer: C

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

A. $1:5$

B. $1:2$

C. $1:4$

D. $1:1$

Answer: B

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71. From the following, what charges can be present on oil drops in Millikan's experiment

A. Zero, equal to the magnitude of charge on a particle

B. $2e$, $1.6 \times 10^{-18} C$

C. $1.6 \times 10^{-19} C$, $2.5e$

D. $1.5e$, e (Here e is the electronic charge)

Answer: B

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

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

B. $-\frac{eht}{m}$

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

D. $-\frac{h}{eE}$

Answer: A

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73. Photo electrons are emitted with a maximum speed of $7 \times 10^5 ms^{-1}$ from a surface when light of frequency $8 \times 10^{14} Hz$ is incident on it, the threshold frequency for this surface is :

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

B. $4.64 \times 10^{14} Hz$

C. $4.64 \times 10^{20} Hz$

D. $6.64 Hz$

Answer: B

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74. The K.E. of the most energetic electrons emitted from a metallic surface is doubled when the wavelength, λ of the incident radiation is reduced from 400 nm to 310 nm. The work function of the metal is

A. 0.9 eV

B. 2.2 eV

C. 1.7 eV

D. 3.1 eV

Answer: B

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75. Mass of a photon of frequency ν is given by

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

B. $\frac{h\lambda}{c^2}$

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

D. $\frac{h\lambda^2}{c}$

Answer: A

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76. The energy flux of sunlight reaching the surface of Earth is $1.388 \times 10^3 Wm^{-2}$. How many photons per square meter are incident

on Earth per second? Assume the wavelength of photon at an average of 550 nm.

A. 2×10^{10}

B. 5×10^{7}

C. 2.25×10^{17}

D. 3.85×10^{21}

Answer: D

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77. Sodium and copper have work functions 2.3eV and 4.5 eV. Then ratio of their wavelengths is nearest to :

A. $1:2$

B. $4:1$

C. $2:1$

D. $1:4$

Answer: C

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78. Formation of covalent bonds in compounds exhibits :

A. wave nature of electron

B. particle nature of electron

C. both wave and particle nature of electron

D. none of these.

Answer: A

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79. The energy of a photon is equal to the K.E. of a proton. The energy of a photon is E. If λ_1 and λ_2 are the de broglie wavelengths of proton and photon, then $\frac{\lambda_1}{\lambda_2}$ is proportional to :

A. E°

B. $E^{1/2}$

C. E^{-1}

D. E^{-2}

Answer: B

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80. According to Einstein's photoelectric equation the graph of K.E. of the photoelectron emitted from the metal versus the frequency of the incident radiation gives a straight line graph whose slope

A. depends upon intensity of radiation

B. depends upon nature of metal used

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

D. depends upon both intensity of radiation and metal used.

Answer: B

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81. K.E. of free electron doubles, its de-broglie wavelength changes by a factor :

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

B. $\sqrt{2}$

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

D. 2

Answer: A

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82. A photocell is illuminated by a small bright source placed 1 m away. When same source of light is placed 1/2 m away, the no. of photoelectrons emitted would :

A. decrease by a factor of 2

B. increase by a factor of 2

C. decrease by a factor of 4

D. increase by a factor of 4.

Answer: D

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83. The time taken by a photoelectron to come out after the photon strikes is nearly :

A. $10^{-1}S$

B. $10^{-4}S$

C. $10^{-10}S$

D. $10^{-16}S$

Answer: C

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84. The threshold frequency of a metal surface is 6.2 eV energy. Stopping potential for incident radiation is 5V. Then incident radiation lies in :

A. X-rays region

B. Ultraviolet region

C. Infrared region

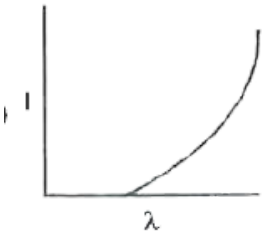
D. Visible region.

Answer: B

Watch Video Solution

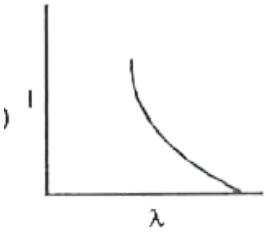
85. The anode voltage of photocell is kept fixed. The wavelength of incident light on cathode is gradually changed. The plate current I of photocell varies as :

A.

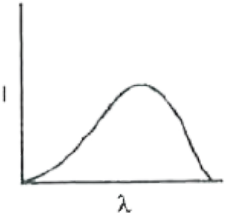


B.

C.



D.



Answer: C

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86. A photon of frequency v has momentum associated with it equal to (c is velocity of photon):

A. hv_c

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

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

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

Answer: C

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87. A charged particle with charge q enters a region of constant, uniform and mutually orthogonal fields $\overrightarrow{E}$ and $\overrightarrow{B}$ with a velocity $\overrightarrow{v}$ perpendicular

to both $\vec{E}$ and $\vec{B}$, and comes out without any change in magnitude or direction of $\vec{v}$. Then

A. $\vec{v} = \vec{B} \times \vec{E} / B^2$

B. $\vec{v} = \vec{E} \times \vec{B} / E^2$

C. $\vec{v} = \vec{B} \times \vec{E} / E^2$

D. $\vec{v} = \vec{E} \times \vec{B} / B^2$

Answer: D

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88. Which one of the following statements is WRONG in the context of X-rays generated from a X-ray tube ?

A. Wavelength of characteristic X-rays decreases when the atomic number of the target increases.

B. Cut-off wavelength of the continuous X-rays depends on the atomic number of the target.

C. Intensity of the characteristic X-rays depends on the electrical power given to the X-ray tube.

D. Cut-off wavelength of the continuous X-rays depends on the energy of the electrons in the X-ray tube,

Answer: B

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89. Direction : Question number 89 contain Statement-1 and Statement-2. Of the four choices given after the statements, choose the one that best describes the two statements.

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

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

A. Statement-1 is true, Statement-2 is false.

B. Statement-1 is true, Statement-2 is true , Statement 2 is the correct explanation of Statement-1.

C. Statement-1 is true, Statement-2 is true, Statement 2 is not the correct explanation of Statement-1.

D. Statement-1 is false, Statement-2 is true.

Answer: A

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90. If a source of power 4 kW produces 10^{20} photons per second, the radiation belongs to a part of spectrum called

A. γ-rays

B. X-rays

C. ultraviolet rays

D. microwaves.

Answer: B

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

A. 1

B. 2

C. 3

D. 4

Answer: C

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Multiple Choice Questions Level Ii

1. Maximum frequency of the photon produced by the union of a proton and a antiproton is (given : $m_p = 1.67 \times 10^{-27} kg$):

A. $4.56 \times 10^{21} Hz$

B. $4.56 \times 10^{23} Hz$

C. $5.46 \times 10^{25} Hz$

D. $6.45 \times 10^{25} Hz$

Answer: B

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2. If the frequency of incident light on a certain metal is $8.2 \times 10^{14} Hz$, having threshold frequency $3.3 \times 10^{14} Hz$, then cut off potential is :

A. 3. 0 V

B. 4.0 V

C. 5.1 V

D. None of these.

Answer: D

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3. Threshold wavelength for metal is $10,000\text{Å}$. If light of wavelength 5461Å is incident on it, then stopping potential is 1.02 V, then value of Planck's constant is :

A. $6.45 \times 10^{-34} J - \sec$

B. $6.45 \times 10^{-34} J - \sec$

C. $6.60 \times 10^{-3} J \sec$

D. $6.67 \times 10^{-34} J - \sec$

Answer: C

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4. An electron moving with a speed of $10^7 ms^{-1}$ traces a circular path of radius 0-57 cm, when subjected to a magnetic field of 10^{-2} T perpendicular to the direction of motion of electron, what is elm ?

A. $1.76 \times 10^9 C/kg^{-1}$

B. $1.76 \times 10^{10} C/kg^{-1}$

C. $1.76 \times 10^{-12} C/kg^{-1}$

D. $1.76 \times 10^{11} C/kg^{-1}$

Answer: D

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5. An electron beam passes through a magnetic field of 2×10^{-3} T and electric field of 3×10^{-4} V/m at right angles to it. Its specific charge is $1.75 \times 10^{11} C/kg^{-1}$. What is the radius of the path in which it is deflected, if there is no deflection, when both fields are acting ?

A. 0.43 m

B. 4.3 cm

C. 0.43 cm

D. none of the above.

Answer: B

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6. A proton, a deuteron and an a-particle have same kinetic energies. Their velocities are in the ratio of:

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

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

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

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

Answer: A

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7. A stream of electrons moving with $3 \times 10^7 ms^{-1}$ gets deflected by electric field of 18 V/ cm normal to their path. What is its transverse deflection in travelling through a horizontal distance of 10 cm in the field ? $\left(m_e = 9 \times 10^{-31} kg\right)$:

A. 0.177 cm

B. 1.77 cm

C. 17.7 cm

D. 1. 77 cm

Answer: A

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8. In a Thomson's set up for elm, the same high tension d.c. supply provides potential to anode for acceleration and also the positive voltage to the deflecting plate in the region of crossed fields. If the supply voltage is doubled, by what factor the magnetic field be increased to keep the electron beam undeflected ?

A. 2 times

B. $\sqrt{2}$ times

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

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

Answer: B

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9. The increasing order of the specific charge on (i) electron (e) (ii) proton (p) (iii) neutron (n) and (iv) O-particle (a) is :

A. e, p, n, α

B. n, p, e, α

C. n, p, α, e

D. n, α, p, e

Answer: D

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10. Doubly ionised helium atoms and hydrogen ions are final velocities of helium and of the hydrogen ions is :

A. 2

B. $\sqrt{2}$

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

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

Answer: D

View Text Solution

11. In Bainbridge's mass spectroscope the singly ionised ion of N_e^{20} strike the photographic plate at a distance of 20 cm from the slit. Then the distance at which singly ionised ions of N_e^{22} strike the photographic plate is :

A. 10 cm

B. 11 cm

C. 20 cm

D. 22 cm

Answer: D

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12. H^+, He^+ and O^{++} all having same kinetic energy while they pass through a region in which there is a uniform magnetic field perpendicular to their velocities. The masses of H^+, He^+ and O^{++} are 1, 4 and 16 a.m.u respectively then,

A. H^+ is deflected most

B. O^{++} is deflected most

C. He^+ and O^{++} are deflected equally

D. All are deflected equally.

Answer: A

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13. The ratio of momenta of an electron and an alpha particle which are accelerated from rest through a potential difference of 100 volts is :

A. 1

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

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

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

Answer: D

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14. A cyclotron is operating at a frequency of $12 \times 10^6 Hz$. Mass of deuteron is 3.3×10^{-27} kg and its charge is 1.6×10^{-19} C. To accelerate the deuterons, the magnetic induction of the field required is :

A. 16 T

B. 1.6 T

C. 0.16 T

D. 0.016T

Answer: B

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15. A charged oil drop is held stationary in an electric field. The space containing the drop is exposed to a radioactive source and drop moves with different terminal velocities v, 2v, 30, 40 ..... etc. It suggests :

A. the charge is quantised

B. the drop carries positive charge

C. the drop carries negative charge

D. charge is conserved.

Answer: A

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16. In an electron microscope, if the potential is increased from 20 kV to 80 kV, the resolving power R of the microscope will become :

A. R

B. 2R

C. 4R

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

Answer: B

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17. The total energy of H_2 atom, when the electron is in the second quantum state is E_2. The total energy of He^+ ion in the third quantum state is :

A. $\frac{3}{2}E_2$

B. $\frac{2}{3}E_2$

C. $\frac{4}{9}E_2$

D. $\frac{16}{9}E_2$.

Answer: D

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18. The wavelength of K_α line from an element of atomic number 41 is λ. Then the wavelength of K_α line of an element of atomic number 21 is :

A. 4λ

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

C. 3.08λ

D. 0.26λ

Answer: A

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19. In an experiment of photoelectric emission for incident light of 4000Å, the stopping potential is 2V. If the wavelength of incident light is made

3000Å, then stopping potential will be :

A. less than 2 volt

B. More than 2 volt

C. 2 volt

D. zero.

Answer: B

Watch Video Solution

20. In Davisson-Germer experiment, an electron beam of energy 60 eV is incident normally on a crystal surface. The maximum intensity is obtained at an angle of 60° from the direction of incident beam, then the inter atomic distance in the crystal lattice will be :

A. 1.83Å

B. 3.6Å

C. 18Å

D. 0.18Å

Answer: A

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21. In an X-rays tube, if the electrons are accelerated through 140 KV, then anode current obtained is 30 mA. If the whole energy of electrons is converted into heat, then the rate of production of heat at anode will be :

A. 968 calorie

B. 892 calorie

C. 1000 calorie

D. 286 calorie.

Answer: C

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22. When X-rays of wavelength $0-5\text{Å}$ pass through 7 mm thick aluminium sheet, then their intensity reduces to one fourth. The coefficient of absorption of aluminium for these X-rays will be :

A. $0.198mm^{-1}$

B. $0.227mm^{-1}$

C. $0.752mm^{-1}$

D. $0.539mm^{-1}$

Answer: A

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23. The kinetic energies of the photoelectrons are E_1 and E_2 with wavelength of incident light λ_1 and λ_2. The work function of the metal is :

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

B. $\frac{E_1E_2}{\lambda_1 - \lambda_2}$

C. $\frac{(E_1 - E_2)\lambda_1\lambda_2}{\lambda_1 - \lambda_2}$

D. $\frac{\lambda_1\lambda_2 E_1}{(\lambda_1 - \lambda_2)E_2}$

Answer: A

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24. The K.E. of the electron is E, when the incident wavelength is λ. To increase the K.E. of the electron to 2E, the incident wavelength must be :

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

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

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

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

Answer: B

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25. K_α radiation of Mo (Z = 42) has a wavelength of 0.71Å. Calculate wavelength of the corresponding radiation of Cu (Z=29)

A. 1.45Å

B. 1.52Å

C. 0.52Å

D. 1.02Å

Answer: B

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26. A long solenoid of 20 turns/ cm carries a current of 1.0 A. Radiation of wavelength λ fall on a target placed within the solenoid. It is observed that electrons emitted move in a circle of largest radius 1 cm. Find the value of λ. Given work function is 1 eV:

A. 1000Å

B. 7975Å

C. 5000Å

D. 8320Å

Answer: B

 Watch Video Solution

27. Radiation of wavelength 180 nm eject photoelectrons from a plate whose work function is 2.0 eV. If a uniform magnetic field of flux density $5.0 \times 10^{-5} T$ is applied parallel to plate, what should be the radius of the path followed by electrons ejected normally from the plate with maximum energy:

A. 0.074 m

B. 0.592m

C. 0.419m

D. 0.149

Answer: D

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28. A potassium surface is placed 75 cm away from a 100 W bulb. It is found that energy radiated by the bulb is 5% of the input power. Consider each potassium atom as a circular disc of diameter 1Å and determine the time required for each atom to absorb an amount of energy equal to its work function of 2:0 eV:

A. 76.5 sec

B. 57.6 sec

C. 5.76 sec

D. 5.0 sec

Answer: B

Watch Video Solution

29. For a particle of mass m enclosed in a one-dimentional box of length L, the de-Broglie concept would lead to stationary waves, with nodes at the two ends. The energy values allowed for such a system (with n as integers) will be:

A. $\frac{h^2}{8mL^2}n^2$

B. $\frac{h^2}{4mL}n^2$

C. $\frac{h}{4mL}n$

D. $\frac{h^2}{4mL^2}n^2$

Answer: A

Watch Video Solution

30. Two beams P and Q of light of the same wavelength fall upon the same metal surface causing photoemission of electrons. The photoelectric current produced by P is four times that produced by Q.

Which of the following gives the ratio

$$\frac{\text{wave amplitude of beam P}}{\text{wave amplitude of beam Q}}?$$

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

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

C. 2

D. 4

Answer: C

Watch Video Solution

31. Light of wavelength 5000Å and intensity $39.8Wm^{-1}$ is incident on a metal surface. If only 1% photons of incident light emit photoelectrons, then the number of electrons emitted per second per unit area from the surface will be nearly :

A. 10^{18}

B. 10^{20}

C. 10^{22}

D. 10^{24}

Answer: A

Watch Video Solution

32. The distance between two consecutive atoms of the crystal lattice is 1.227Å. The maximum order of diffraction of electrons accelerated through 10^4 volt is :

A. 1

B. 100

C. 10

D. 20

Answer: C

Watch Video Solution

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

A. $400p_m$

B. $200p_m$

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

D. $\frac{p_m}{400}$

Answer: A

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34. A 20 a.m.u. atom emits photon of 6.6Å while making a transition from excited state to ground state. The recoil energy of the atom will be :

A. $1.5 \times 10^{-23} J$

B. $3.5 \times 10^{-23} J$

C. $5.1 \times 10^{-23} J$

D. $7.5 \times 10^{-23} J$

Answer: C

View Text Solution

35. In a photoelectric set up, a point source of light of power 3.2×10^{-3} W emits monoenergetic photons of energy 5.0 eV. The source is located at a distance of 0.8 m from the centre of a stationary metallic sphere of work function 3.0 eV and of radius 8.0×10^{-3} m. The efficiency of photoelectron emission is one for every 10^6 incident photon. Assume that state is isolated and initially neutral and that the photoelectrons are instantly swept away after emission. Calculate the number of photoelectron emitted per sec, by sphere :

A. 10^2

B. 10^3

C. 10^4

D. 10^5

Answer: D

Watch Video Solution

36. In Ques, 126, ratio of the wavelength of incident light to the de-Broglie wavelength of the fastest electron emitted is :

A. 100

B. 200

C. 286

D. 300

Answer: C

View Text Solution

37. A light source emitting three wavelength $5000\text{Å}, 6000\text{Å}, 7000\text{Å}$ has a total power of 10^{-3} m. W and the beam of diameter 2×10^{-3}m. The power density is distributed equally amongst the three wavelengths. The beam shines normally on a metallic surface of area $10^4 m^2$ which has a work function of 1.9 eV. Assuming that each proton liberates an electron, calculate the charge emitted per unit area in one second :

A. 94 C

B. 54 C

C. 47 C

D. 74 C

Answer: A

Watch Video Solution

38. Radiation of wavelength 180 nm eject photoelectrons from a plate whose work function is 2.0 eV. If a uniform magnetic field of flux density

$5.0 \times 10^{-5} T$ is applied parallel to plate, what should be the radius of the path followed by electrons ejected normally from the plate with maximum energy:

A. 0.074 m

B. 0.592 m

C. 0. 419 m

D. 0. 144 m

Answer: D

Watch Video Solution

39. One milliwatt of light of wavelength 4560Å is incident on a cesium surface. Calculate the photoelectric current liberated, assuming a quantum efficiency of 0.5%. Given work function for cesium = 1.93 eV :

A. 1.856 mA

B. $1.856 \mu A$

C. $18.56\mu A$

D. none of these.

Answer: B

Watch Video Solution

40. A cylindrical rod of some laser material $5 \times 10^{-2}m$ long and $10^{-2}m$ diameter contains 2×1025^{25} ions per m^3. If on excitation all the ions in the upper energy level de-excite simultaneously emitting photons in the same direction, calculate the maximum energy contained in a pulse of radiation of wavelength $6.6 \times 10^{-7}m$

A. $3 \times 10^{-17}J$

B. $3 \times 10^{-18}J$

C. $3 \times 10^{-19}J$

D. $3 \times 10^{-20}J$

Answer: C

Watch Video Solution

41. In Ques. 131, if the pulse lasts for 10^{-7} sec, calculate average power of the laser during the pulse :

A. $235.5 \times 10^{6} W$

B. $215.5 MW$

C. $205.0 MW$

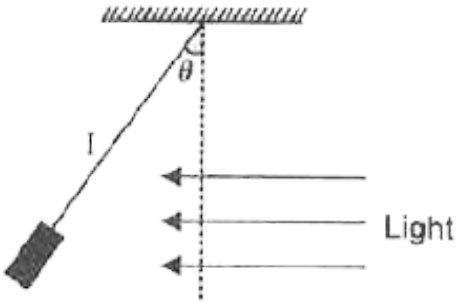
D. $105.0 W$

Answer: A

View Text Solution

42. Fig. shows a small plane strip suspended from a fixed support through a string of length 1. A continuous beam of monochromatic light is incident horizontally on the strip and is completely absorbed. The energy falling on the strip per unit area per sec is P. The deflection of the

string from the vertical, if the strip stays in equilibrium.



A. $\theta = \sin^{-1}\frac{P}{mgC}$

B. $\theta = \cos^{-1}\frac{P}{mgC}$

C. $\theta = \tan^{-1}\frac{P}{mgC}$

D. $\theta = \cot^{-1}\frac{P}{mgC}$

Answer: C

Watch Video Solution

43. In Q. 133, if the strip is deflected slightly from its equilibrium position in the plane of the figure, the time period of the resulting oscillation is given by :

A. $\frac{\sqrt{l}}{\left[g^2+\left(\frac{P}{mc}\right)^2\right]^{\frac{1}{4}}}$

B. $\sqrt{\frac{l}{g^2+\frac{P}{mc}}}$

C. $\sqrt{\frac{g^2+\frac{P}{mc}}{l}}$

D. none of these

Answer: A

View Text Solution

44. The radiation emitted when an electron jumps from n=3 to n = 2 orbit in a hydrogen atom, falls on a metal to produce photoelectron. The electron with maximum kinetic energy are made to move perpendicular to a magnetic field of $\frac{1}{320}$ T in a radius of 10^m. The work function of the metal is :

A. 3.03 eV

B. 2.03 eV

C. 1.03 eV

D. 0.03 eV

Answer: A

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45. A monochromatic light source of frequency villuminates a metallic surface and ejects photoelectron. The electron with maximum energy are just able to ionize the hydrogen atom in the ground state. When the whole experiment is repeated with an incident radiation of frequency 5/6 v, the photoelectrons so emitted are able to excite the hydrogen atom beam which then emits a radiation of the wavelength 1215Å. Find the work function of the metal :

A. 6.875 eV

B. 8.756 eV

C. 7.568 eV

D. 5.687 eV

Answer: A

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46. In Ques, 136, the frequency v of the source is :

A. $5 \times 10^{16} Hz$

B. $5 \times 10^{13} Hz$

C. $5 \times 10^{15} Hz$

D. $5 \times 10^{18} Hz$

Answer: C

View Text Solution

47. Let n_r and n_b be respectively the number of photons emitted by a red bulb and a blue bulb of equal power in a given time. Then :

A. $n_r = n_b$

B. $n_r < n_b$

C. $n_r > n_b$

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

Answer: C

Watch Video Solution

48. For a particle of mass m enclosed in a one-dimentional box of length L, the de-Broglie concept would lead to stationary waves, with nodes at the two ends. The energy values allowed for such a system (with n as integers) will be:

A. $\frac{h^2}{8mL^2}n^2$

B. $\frac{h^2}{4mL}n^2$

C. $n_r > n_b$

D. $\frac{h^2}{4mL^2}n^2$

Answer: A

Watch Video Solution

49. An electron accelerated under a potential difference V volt has a certain wavelength λ. Mass of the proton is 2000 times the mass of the electron. If the proton has to have the same wavelength λ, then it will have to be accelerated under a potential difference of:

A. V volt

B. 2000 V volt

C. $\frac{V}{2000}$ volt

D. $\sqrt{2000}$ V volt.

Answer: C

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50. In Davisson-Germer experiment, the correct relation between angle of diffraction and glancing angle is :

A. $\theta = 90^\circ - \frac{\phi}{2}$

B. $\theta = 90^\circ + \frac{\phi}{2}$

C. $\theta = \frac{\phi}{2}$

D. $\theta = \phi$

Answer: A

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51. The potential difference applied to an X-ray tube is 5kV and current is 3.2 mA. Then no. of electrons striking the target per sec is :

A. 2×10^{16}

B. 5×10^{6}

C. 1×10^{17}

D. 4×10^{15}

Answer: A

Watch Video Solution

52. The work function of a substance is 4.0 eV. The longest wavelength of light that can cause photoelectric emission for it will be :

A. 400 mm

B. 540 mm

C. 220 mm

D. 310 mm

Answer: D

Watch Video Solution

53. A charged oil drop is suspended in a uniform field of 3×10^4 V/m so that it neither falls nor rises. The charge on drop will be (Take mass of charge $= 9.9X10^{-15}kg$ and $g = 10m/s^2$).

A. $2.3 \times 10^{-18}C$

B. $3.3 \times 10^{-18}C$

C. $4.8 \times 10^{-18}C$

D. $1.6 \times 10^{-18}C$

Answer: B

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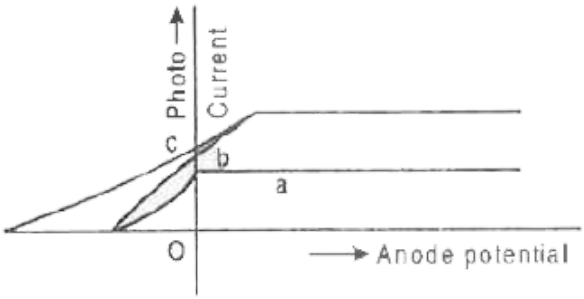
54. Fig. shows variation of photocurrent with anode potential for photosensitive surface for three different radiations. Let I_a, I_b and I_c be

the intensities and f_a, f_b and f_c the frequencies for curves a, b to c, then:



A. $f_a = f_b, I_a \neq I_b$

B. $f_a = f_c, I_a = I_c$

C. $f_a = f_b, I_a = I_b$

D. $f_b = f_c, I_b = I_c$

Answer: A

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55. An element with Z = 11 emits $K\alpha$-X-ray with wavelength λ. The atomic no. of element which emits $K\alpha$ X-ray of wavelength 4λ is:

A. 6

B. 4

C. 11

D. 44

Answer: A

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56. The wavelength of K_α line of an X-ray spectrum of an element of atomic no. Z= 11 is λ.. The wavelength of same line of element of atomic no. Z' is 4λ, then Z' is :

A. 4

B. 6

C. 44

D. 11

Answer: B

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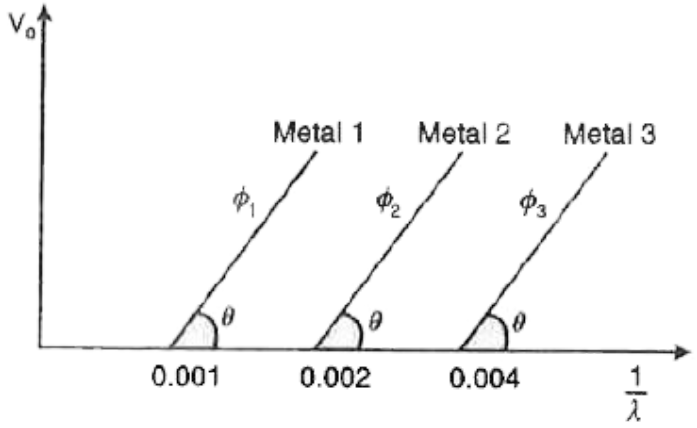
57. The graph between the stopping potential (V_0) and wave number $(1/\lambda)$ is as shown in the figure.



ϕ is the work function, then:

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

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

C. $\tan\theta \propto hC/e$ where θ is the slope

D. ultraviolet light can be used to eject photoelectron from metal 2 and metal 3 only

Answer: A::C

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

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

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

C. $\lambda_0 = \frac{2m^2c^2\lambda^3}{h^2}$

D. $\lambda_0 = \lambda$

Answer: A

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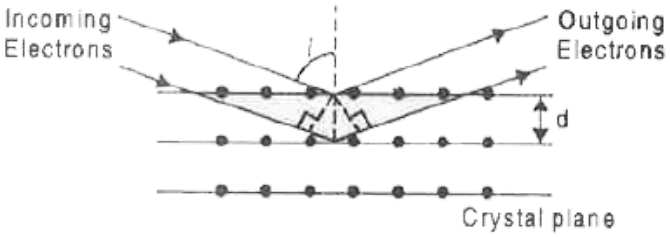
59. Direction : Question Numbers. 150 and 151 are based on the following paragraph.

Wave property of electrons implies that they will show diffraction effects. Davisson and Germer demonstrated this by diffracting electrons from crystals. The law governing the diffraction from a crystal is obtained by requiring that electron waves reflected from the planes of atoms in a crystal interfere constructively (See figure).



Electrons accelerate by potential V are diffracted from a crystal. If $d = 1\text{Å}$ and $i = 30^\circ$, V should be about $\left(h = 6.6 \times 10^{-34} Js, m_e = 9.1 \times 10^{-31} kg, e = 1.6 \times 10^{-19} C\right)$

A. 1000 V

B. 2000 V

C. 50 V

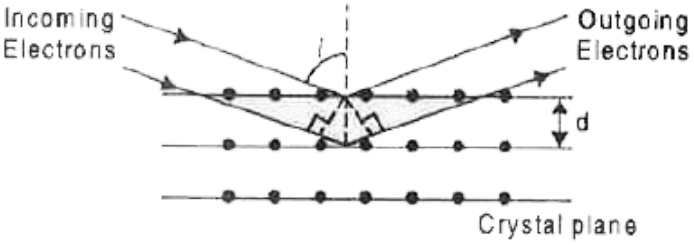
D. 500 V

Answer: C

Watch Video Solution

60. Direction : Question Numbers. 150 and 151 are based on the following paragraph.

Wave property of electrons implies that they will show diffraction effects. Davisson and Germer demonstrated this by diffracting electrons from crystals. The law governing the diffraction from a crystal is obtained by requiring that electron waves reflected from the planes of atoms in a crystal interfere constructively (See figure).



If a strong diffraction peak is observed when electrons are incident at an angle i from the normal to the crystal planes with distance d between them (see tigure), de-Broglie wavelength λ_{dB} of electrons can be calculated by the relationship (n is an integer)

A. $d\cos i = n\lambda dB$

B. $d\sin i = n\lambda dB$

C. $2d\cos i = n\lambda dB$

D. $2d\sin i = n\lambda dB$

Answer: C

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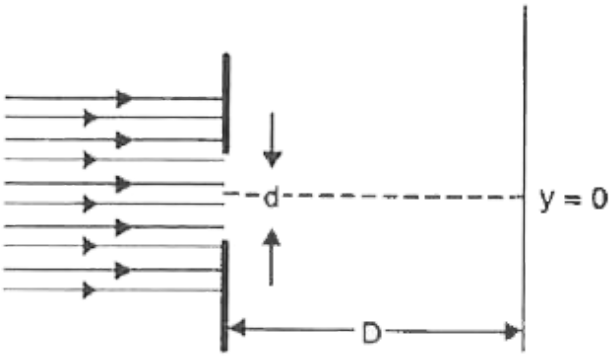
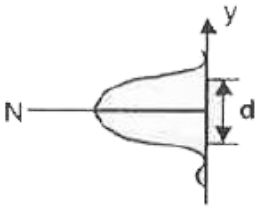
61. In an experiment, electrons are made to pass through a narrow slit of width d comparable to their de-Brogile wavelength. They are detected on a screen at a distance D from the slit.



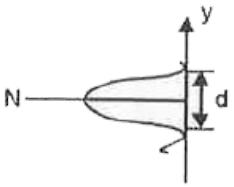
Which of the following graphs can be expected to represent the number

of electrons N detected as a function of the detector position y(y = 0 corresponds to the middle of the slit)?

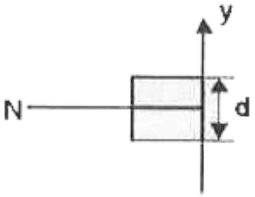
A.



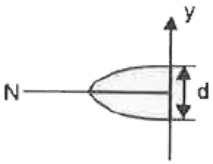
B.



C.



D.



Answer: A

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62. The surface of a metal is illuminated with the light of 400 nm. The kinectic energy of the ejected photoelectrons was found to be 1.68 eV. The work function of the metal is (hc = 1240 eV nm)

A. 1.51 eV

B. 1.68 eV

C. 3.09 eV

D. 1.42eV

Answer: D

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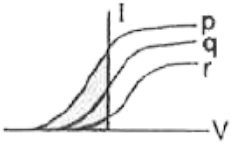
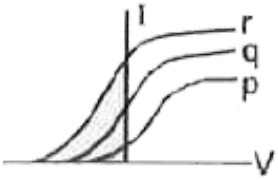
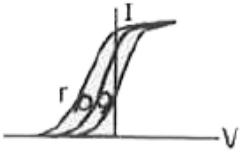
63. Photoelectric effect experiments are performed using three different metal plates p, and r having work functions $\phi_P = 2.0eV, \phi_q = 2.5eV$ and wavelengths of 550 nm, 450 nm and 350 nm with equal intensities illuminates each of the plates. The correct I-V graph for the experiment is (Take hc = 1240 eV nm)

A. 

B. 

C. 

D. 

Answer: A

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Multiple Choice Questions Level Iii

1. Energy required for the electron excitation in Li^{++} from the first to the third Bohr orbit is :

A. 36.3 eV

B. 108.8 eV

C. 122.4 eV

D. 12.1 eV

Answer: B

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2. This question has Statement - 1 and Statement - 2. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement-1 : A metallic surface is irradiated by a monochromatic light of frequency $v > v_0$ (the threshold frequency). The maximum kinetic energy and the stopping potential are $K_{\max}$ and V_0 respectively. If the frequency

incident on the surface doubled, both the $K_{\max}$ and V_0 are also doubled.

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

A. Statement-1 is true, Statement-2 is true, Statement 2 is the correct explanation of Statement-1.

B. Statement-1 is true, Statement-2 is true, Statement 2 is not the correct explanation of Statement-1.

C. Statement-1 is false, Statement-2 is true.

D. Statement-1 is true, Statement-2 is false.

Answer: C

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3. After absorbing a slowly moving neutron of Mass m_N (momentum ≈ 0) a nucleus of mass M breaks into two nuclei of masses

m_1 and $5m_1(6m_1 = M + m_N)$ respectively. If the de Broglie wavelength of the nucleus with mass m_1 is λ the de Broglie wavelength of the nucleus will be

A. 5λ

B. $\lambda/5$

C. λ

D. 25λ

Answer: C

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4. Estimate the wavelength at which plasma reflection will occur for metal having the density of electrons $N \approx 4 \times 10^{27} m^{-3}$. Taking $\varepsilon_0 = 10^{-11}$ and $m = 10^{-30}$ where these quantities are in proper SI units.

A. 800 nm

B. 600 mn

C. 400 nm

D. 200 nm

Answer: B

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

A. 2

B. 3

C. 4

D. 7

Answer: D

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6. This question has Statement 1 and Statement 2. Of the four choices given after the Statements, choose the one that best describes the two statements.

Statement 1. Davisson-Germer experiment established the wave nature of electrons.

Statement 2. If electrons have wave nature, they can interfere and show diffraction.

A. Statement 1 is true, Statement 2 is true, Statement 2 is not the correct explanation of Statement 1

B. Statement 1 is false, Statement 2 is true

C. Statement 1 is true, Statement 2 is false

D. Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation for Statement 1.

Answer: D

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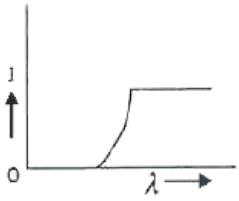
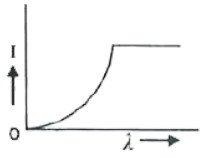
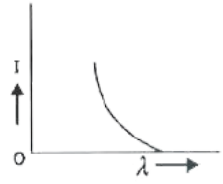
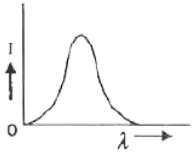
7. The anode voltage of photocell is kept fixed. The wavelength of incident light on cathode is gradually changed. The plate current I of photocell varies as :

A. 

B. 

C. 

D. 

Answer: C

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8. 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 $3 \times 10^{-4}T$. 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. 1.6 eV

B. 1.8 eV

C. 1.1 eV

D. 0. 8 eV

Answer: C

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9. Match List - I (Fundamental Experiment) with List - II (its conclusion) and select the correct option from the choices given below the list :

	List-I		List-II
(A)	Franc-Hertz Experiment.	(i)	Particle nature of light
(B)	Photo-electric	(ii)	Discrete energy levels of atom
(C)	Davison-Germer Experiment.	(iii)	Wave nature of electron
		(iv)	Structure of atom

A. (A) (i) (B) -(iv) (C) -(iii)

B. (A)-(ii) (B)-(iv) (C) -(iii)

C. (A)-(ii) (B)-(i) (C) -(iii)

D. (A)-(iv) (B)-(iii) (C) -(ii)

Answer: C

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Recent Competitive Questions

1. According to Einstein's photoelectric equation the graph of K.E. of the photoelectron emitted from the metal versus the frequency of the incident radiation gives a straight line graph whose slope

A. depends on the intensity of the 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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2. An electron is moving in an orbit of a hydrogen atom from which there can be a maximum of six transitions. An electron is moving in orbit of another hydrogen atom from which there can be a maximum of three transitions. The ratio of velocity of the electron in these two orbits is

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

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

C. $\frac{5}{4}$

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

Answer: D

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3. v_1 is the frequency of the series limit of Lyman series, v_2 is te frequency of the first line of Lyman series and v_3 is the frequency of the series limit of the Balmer series. Then

A. $v_1 - v_2 = v_3$

B. $v_1 = v_2 - v_3$

C. $\frac{1}{v_2} = \frac{1}{v_1} + \frac{1}{v_3}$

D. $\frac{1}{v_1} = \frac{1}{v_2} + \frac{1}{v_3}$

Answer: A

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4. The de-Broglie wavelength of the electron in the ground state of the hydrogen atom is (radius of the first orbit of hydrogen atom $= 0.53\text{Å}$

A. 1.67Å

B. 3.33Å

C. 1.06Å

D. 0.53Å

Answer: B

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5. The photoelectric threshold wavelength for silver in 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. $\frac{hc}{\lambda_0 - \lambda}$

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

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

Answer: C

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6. An electron of mass m_e and a proton of mass m_p are moving with the same speed.The ration of their de-Broglie's wavelengths $\frac{\lambda_e}{\lambda_p}$ is

A. 1

B. 1836

C. $\frac{1}{1836}$

D. 918

Answer: B

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7. Pick out the wrong statement.

A. An electron at rest experiences no force in the magnetic field

B. The gain in the KE of the electron moving at right angles to the magnetic field is zero

C. When an electron is shot at right angles to the electric field, it traces a parabolic path

D. An electron moving in the direction of the electric field loses KE.

Answer: D

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8. A proton and an α particle are accelerated through the same potential difference V. The ratio of their de Broglie wavelengths is

A. 2

B. $\sqrt{8}$

C. $\frac{1}{\sqrt{8}}$

D. 1

Answer: B

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9. In hydrogen atom , electron excites from ground state of higher energy state and its orbital velocity is reduced to $\left(\frac{1}{3}\right)^{rd}$ of its initial value . The

radius of the orbit in the ground state is R . The radius of the orbit in that higher energy state is ...

A. R 9

B. 2 R

C. 3 R

D. 27 R

Answer: C

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10. An α - particle and a proton moving with the same kinetic energy enter a region of uniform magnetic field at right angles to the field . The ratio of the radii of the paths of α- particle to that of the proton is

A. $1:8$

B. $1:1$

C. $1:2$

D. $1:4$

Answer: B

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11. X- rays, gamma rays and microwaves travelling in vacuum have

A. same velocity and same frequency

B. same wavelengths but different velocities

C. same frequency but different velocities

D. same velocity but different wavelengths.

Answer: A

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12. If n is the orbit number of the electron in a hydrogen atom , the correct statement among the following is

A. electron energy varies as n^2

B. electron energy increases as n increases

C. hydrogen emits infrared rays for the electron transition from $n = \infty$ to n=1

D. electron energy is zero for n=1

Answer: A

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13. A charged particle with a velocity $2 \times 10^3 ms^{-1}$ passes undeflected through electric field and magnetic fields in mutually perpendicular directions. The magnetic field is 1.5 T. The magnitude of electric field will be

A. $1.5 \times 10^3 NC^{-1}$

B. $2 \times 10^3 NC^{-1}$

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

D. $1.33 \times 10^3 NC^{-1}$

Answer: C

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14. Maximum velocity of the photoelectron emitted by a metal is $1.8 \times 10^6 ms^{-1}$. Take the value of specific charge of the electron is $1.8 \times 10^{11} Ckg^{-1}$. Then the stopping potential in volt is

A. 1

B. 8

C. 9

D. 6

Answer: C

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15. λ_1 and λ_2 are used to illuminated the slits. β_1 and β_2 are the corresponding fringe widths. The wavelength λ_1 can produce photoelectric effect when incident on a metal. But the wavelength λ_2 cannot produce photoelectric effect. The correct relation between β_1 and β_2 is

A. $\beta_1 < \beta_2$

B. $\beta_1 = \beta_2$

C. $\beta_1 > \beta_2$

D. $\beta_1 \neq \beta_2$

Answer: A

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16. What is the de Broglie wavelength of the electron accelerated through a potential difference of 100 volt ?

A. 12.27Å

B. 1.227Å

C. 0.1227Å

D. 0.001227Å

Answer: B

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17. The maximum kinetic energy of emitted photoelectrons depends on

A. potential

B. frequency

C. incident angle

D. pressure.

Answer: B

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18. Find the de-Broglie wavelength of an electron with kinetic energy of 120 eV.

A. 102

B. 124 pm

C. 95 pm

D. 112 pm

Answer: D

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19. Light of two different frequencies whose photons have energies 1 eV and 2.5 eV respectively, successively illuminate a metallic surface whose

work function is 0.5 eV. Ratio of maximum speeds of emitted electrons will be

A. $1:4$

B. $1:1$

C. $1:5$

D. $1:2$

Answer: D

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20. The best waves for emission of electrons from a surface :

A. Microwaves

B. Ultra violet rays

C. Infrared rays

D. X-rays.

Answer: D

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