Dual Nature of Matter and Radiation

1. **The work function of a certain metal is** $3.31\times10^{-19}J$ **. Then the maximum kinetic energy of photoelectrons emitted by incident radiation of wavelength 5000** $\overset{0}{A}$ **is-**

   1) 2.48 eV 2) 0.41 eV 3) 2.07 eV 4) 0.82 ev

2. **An electron beam travels with a velocity of 1.6 x 10^7 ms^{-1} perpendicular to magnetic field of intensity 0.1 T. The radius of the path of the electron beam (m_e = 9 x10^{-31} kg)**

   1) 9 x 10^{-5} m 2) 9 x 10^{-2} m 3) 9 x 10^{-4} m 4) 9 x 10^{-3} m

3. **The work function of nickel is 5eV. When light of wavelength 2000A^0 falls on it, it emits photoelectrons in the circuit. Then the potential difference necessary to stop the fastest electrons emitted is (given h=6.67×10^{-34}Js)**

   1) 1.0V 2) 1.75V 3) 1.2V 4) 0.75V

4. **In an experiment on photoelectric emission from a metallic surface, wavelength of incident light is 2 x 10^{-7} m and stopping potential is 2.5V. The threshold frequency of the metal (in Hz) approximately (charge of electron e = 1.6 x 10^{-19}C, Plank's constant h = 6.6 x 10^{-34} JS)**

   1) 12 x 10^{15} 2) 9x 10^{15} 3) 9 x 10^{14} 4) 12 x 10^{13}

5. **A particle of mass 1 x 10^{-26} kg and charge 1.6 x 10^{-19}C travelling with a velocity 1.28 x 10^6 ms^{-1} along the positive X-axis enters a region in which a uniform electric field $\vec{E}$ and a uniform magnetic field of induction $\vec{B}$ are present. If** $\vec{E}=-102.4\times10^{3}\hat{k}NC^{-1}$ and $B=8\times10^{-2}\hat{j}Wbm^{-2}$**, the direction of motion of the particles is**

   1) Along the positive X-axis 2) Along the negative X-axis

   3) At 45° to the positive X-axis 4) At 135° to the positive X-axis

6. **Light rays of wavelengths 6000 A° and of photon intensity 39.6 watts/m^2 is incident on a metal surface. If only one percent of photons incident on the surface emit photo electrons, then the number of electrons emitted per second per unit area from the surface will be**

[Planck constant = 6.64 x 10^{-34} J - S; Velocity of light = 3 x 10^8 ms^{-1}]

1) 12 x 10^{18} 2) 10 x 10^{18} 3) 12 x 10^{17} 4) 12 x 10^{15}

7. **Electrons ejected from the surface of a metal, when light of certain frequency is incident on it, are stopped fully by a retarding potential of 3 volts. Photo electric effect in this metallic surface begins at a frequency 6 x $10^{14}s^{-1}$. The frequency of the incident light in s^{-1} is [h=6 x 10^{-34}J-sec; charge on the electron = 1.6 x 10^{-19}C]**

1) 7.5 x 10^{13} 2) 13.5 x 10^{13} 3) 14 x 10^{14} 4) 7.5 x 10^{15}

8. **Consider the two following statements A and B and identify the correct choice given in the answers**

A) In photovoltaic cells, the photoelectric current produced is not proportional to the intensity of incident light.

B) In gas filled photo emissive cells, the velocity of photoelectrons depends on the wavelength of the incident radiation.

1) Both A and B are true 2) Both A and B are false

3) A is true but B is false 4) A is false but B is true

9. **When radiation of wavelength λ is incident on a metallic surface, the stopping potential is 4.8 volts. If the same surface is illuminated with radiation of double the wavelength, then the stopping potential becomes 1.6 volts. Then the threshold wavelength for the surface is**

1) 2λ 2) 4λ 3) 6λ 4) 8 λ

10. Two photons of energies twice and thrice the work function of a metal are incident on the metal surface. Then the ratio of maximum velocities of the photoelectrons emitted in the two cases respectively is

1) $\frac{1}{2}$ 2) $\frac{1}{4}$ 3) $\frac{1}{3}$ 4) $\frac{1}{\sqrt{2}}$

11. If λ_0 is the de Broglie wavelength for a proton accelerated through a potential difference of 100 V, the de Broglie wavelength for α–particle accelerated through the same potential difference is

1) $2\sqrt{2}\lambda_0$ 2) $\frac{\lambda_0}{2}$ 3) $\frac{\lambda_0}{2\sqrt{2}}$ 4) $\frac{\lambda_0}{\sqrt{2}}$

12. Photoelectric emission is observed from a metallic surface for frequencies v_1 and v_2 of the incident light rays $(\upsilon_1 > \upsilon_2)$. If the maximum values of kinetic energy of the photoelectrons emitted in the two cases are in ratio of 1: k, then the threshold frequency of the metallic surface is

1) $\frac{k\upsilon_2 - \upsilon_1}{k-1}$ 2) $\frac{k\upsilon_1 - \upsilon_2}{k-1}$ 3) $\frac{k\upsilon_1 + \upsilon_2}{k-1}$ 4) 0

13. The de Broglie wavelength of an electron having 80 eV of energy is nearly (1eV = 1.6x 10^{-19} J), mass of the electron = 9 x 10^{-31} kg), Planck's constant = 6.6 x 10^{-34} Js)

1) 140 A° 2) 0.14 A° 3) 14 A° 4) 1.4 A°

14. When a metal surface is illuminated by light of wavelengths 400 nm and 250 nm, the maximum velocities of the photoelectrons ejected are v and 2v respectively. The work function of the metal is (h = Plank's constant, c = velocity of light in air)

1) $2hc\times10^6$ J 2) $1.5hc\times10^6$ J 3) $hc\times10^6$ J 4) $0.5hc\times10^6$ J

15. **A photon of energy 'E' ejects a photo electron from a metal surface whose work function is W_0. If this electron enters into a uniform 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):**

1) $\sqrt{\frac{2m(E+W_0)}{eB}}$ 2) $\sqrt{2m(E-W_0)eB}$ 3) $\sqrt{\frac{2m(E-W_0)}{mB}}$ 4) $\frac{\sqrt{2m(E-W_0)}}{Be}$

16. **In Millikan's oil drop experiment, a charged oil drop of mass** $3.2\times10^{-14}kg$ **is held stationary between two parallel plates 6 mm apart, by applying a potential difference of 1200V between them. How many electrons does the oil drop carry? ($g=10ms^{-2}$)**

1) 7 2) 8 3) 9 4) 10

17. **An oil drop having a charge was kept between two plates having a potential difference of 400V is in equilibrium. Now another drop of same oil with same charge but double the radius is introduced between the plates. Then the potential difference necessary to keep the drop in equilibrium is**

1) 200 V 2) 800 V 3) 1600 V 4) 3200 V

18. **The threshold frequency for a certain metal is v_0. When a certain radiation of frequency $2v_0$ is incident on this metal surface the maximum velocity of the photoelectrons emitted is $2x10^6$ ms^{-1}. If a radiation of frequency $3v_0$ is incident on the same metal surface the maximum velocity of the photoelectrons emitted (in ms^{-1}) is**

1) 2×10^6 2) $2\sqrt{2}\times10^6$ 3) $4\sqrt{2}\times10^6$ 4) $4\sqrt{3}\times10^6$

19. **The velocity of the most energetic electron emitted from a metallic surface is doubled when the frequency 'v' of the incident radiation is doubled. The work function of this metal is**

1) $\frac{h\nu}{4}$ 2) $\frac{h\nu}{3}$ 3) $\frac{h\nu}{2}$ 4) $\frac{2h\nu}{3}$

20. A proton and an alpha particle are accelerated through the same potential difference. The ratio of the wavelength associated with proton and alpha particle respectively is

1) $1:2\sqrt{2}$ 2) 2: 1 3) $2\sqrt{2}:1$ 4) 4: 1

21. The de-Broglie wavelength of an electron and the wavelength of a photon are the same. The ratio between the energy of that photon and the momentum of that electron is

1) h 2) C 3) 1/h 4) 1/C

22. A proton is projected with a velocity 10^7 ms^{-1} at right angles to a uniform magnetic field of induction 100mT. The time (in seconds) taken by the proton to traverse 90° arc is

(Mass of proton= 1.65 x 10^{-27} kg and charge of proton = 1.6 x 10^{-19}C)

1) 0.81 x 10^{-7} 2) 1.62 x 10^{-7} 3) 2.43 x 10^{-7} 4) 3.24 x 10^{-7}

23. The incident photon involved in the photoelectric effect experiment

1) Completely disappears

2) Comes out with increased frequency

3) Comes out with a decreased frequency

4) Comes out without change in frequency

24. k_1 and k_2 are the maximum kinetic energies of the photoelectrons emitted when light of wave length λ_1 and λ_2 respectively are incident on a metallic surface. If $\lambda_1 = 3\lambda_2$ then

1) $k_1 > \frac{k_2}{3}$ 2) $k_1 < \frac{k_2}{3}$ 3) $k_1 = 3k_2$ 4) $k_2 = 3k_1$

25. The de-Broglie wavelength of a particle moving with a velocity 2.25 x 10^8 ms^{-1} is equal to the wavelength of photon. The ratio of kinetic energy of the particle to the energy of the photon is

[velocity of light = 3 x 10^8 ms^{-1}]

1) 1/8 2) 3/8 3) 5/8 4) 7/8

26. The value of de Broglie wavelength of an electron moving with a speed of 6.6×10^{5} ms^{-1} is approximately

1) 11 A^{o} 2) 111A^{o} 3) 211 A^{o} 4) 311 A^{o}

27. The maximum wavelength of light that can be used to produce photoelectric effect on a metal is 250nm. The maximum K.E of the electrons in joule, emitted from the surface of the metal when a beam of light of wavelength 200 nm is used:

1) 89.61×10^{-22} 2) 69.81×10^{-22} 3) 18.96×10^{-20} 4) 19.86×10^{-20}

28. The work function of Potassium is 2.0 eV. When it is illuminated by light of wavelength 3300 A^{o}, photoelectrons are emitted. The stopping potential of photoelectrons is

1) 0.75 V 2) 1.75 V 3) 2.5 V 4) 3.75 V

29. A positron and a proton are accelerated by the same accelerating potential. Then the ratio of the associated wavelength of positron and proton will be (M-mass of proton, m=mass of positron)

1) $\frac{M}{m}$ 2) $\sqrt{\frac{M}{m}}$ 3) $\frac{m}{M}$ 4) $\sqrt{\frac{m}{M}}$

30. The work function of metals A and B are in the ratio 1:2. If light of frequencies f and 2f are incident on metal surfaces A and B respectively, the ratio of the maximum kinetic energies of the photo electrons emitted is

1) 1:1 2) 1:2 3) 1:3 4) 1:4

31. The process of photo electric emission depends on

1) Work function of surface 2) Nature of surface

3) Wave length of incident light 4) All of these

32. If the intensity of incident light is made double, then the maximum number of emitted electrons will become

1) Double 2) Four times 3) Eight times 4) Half

33. The threshold wavelength for photo electric emission from a photo sensitive surface is 5200 Å. Which out of the following can start photo electric emission?

1) 10 watt infrared bulb
2) 1 watt infrared bulb
3) 50 watt infrared bulb
4) 50 watt ultraviolet bulb

34. On decreasing the intensity of incident light

1) The photo electric current will increase.
2) The number of photoelectrons emitted will increase.
3) The number of emitted electrons will decrease.
4) All of these.

35. When green light is made incident on a metal, photo electrons are emitted by it but no photo electrons are obtained by yellow light. If red light is made incident on that metal then

1) No electrons will be emitted
2) Less electrons will be emitted
3) More electrons will be emitted
4) All of these

36. The threshold frequency for a metal is 10^{15} Hz. When light of wavelength 4000 Å is made incident on it, them

1) Photo electrons will be emitted from it with zero speed
2) Photoelectric emission will not be started by it
3) Photo electrons will be emitted with speed 10^5 m/s
4) Photo electrons will be emitted with speed 10^3 m/s

37. The necessary condition of photo electric emission is

1) $h\nu \le h\nu_0$
2) $h\nu \ge h\nu_0$
3) $E_k > h\nu_0$
4) $E_k < h\nu_0$

38. If the work function of a metal is ϕ_0, then its threshold wavelength will be

1) $hc\phi_0$
2) $c\phi_0/h$
3) $h\phi_0/c$
4) hc/ϕ_0

39. The photo electric equation is

1) $h\nu = h\nu_0 - E_k$
2) $h\nu = h\nu_0 + \frac{E_k}{\nu}$
3) $h\nu = h\nu_0 + E_k$
4) $h\nu = h\nu_0$

40. **Light of frequency $2.5\gamma_0$ is incident on a metal surface of threshold frequency $2\gamma_0$. If it s frequency is halved and intensity is made three times then the new value of photo electric current will be**

1) Zero 2) Double 3) Four times 4) Six times

41. **In a photo electric cell, the cathode with work function W_1 is replaced by another one with work function W_2 ($W_2 > W_1$). If the current before this change is I_1 and that after the change in I_2 and other circumstances remain same and if $h\nu > W_2$, then**

1) $I_1>I_2$ 2) $I_1<I_2$ 3) $I_1=I_2$ 4) $I_1<I_2<2I_1$

42. **If the frequency of light incident on metal surface is doubled, then kinetic energy of emitted electrons will become**

1) Doubled 2) Less than double

3) More than double 4) Nothing can be said

43. **The work function of a metal is X eV. When light of energy 2X is made incident on it then the maximum kinetic energy of emitted photo electron will be**

1) 2 eV 2) 2 XeV 3) XeV 4) 3 XeV

44. **W_1 and W_2 are the work functions of two different photo metals ($W_2 > W_1$). The same radiation falls on the two metals separately. i_1 and i_2 are the photo currents and K_1, K_2 are the maximum. K.E of the ejected electrons in these two cases, then**

1) $i_1 = i_2$ & $K_1 > K_2$ 2) $i_1 > i_2$ & $K_1 = K_2$

3) $i_1 = i_2$ & $K_1 = K_2$ 4) None

45. **When light is made incident on a surface then photo electrons are emitted from it. The kinetic energy of photo electrons**

1) Depends on the wavelength of incident light 2) Is same

3) Is more than a certain minimum value 4) None of these

46. The function of photo electric cell is

1) To convert electrical energy into light energy

2) To convert light energy into electrical energy

3) To convert mechanical energy into electric energy

4) To convert ac to dc

47. If the energy of photo is 10 eV and work function is 5 eV then the value of stopping potential will be

1) 15 V 2) 5 V 3) 2 V 4) 50 V

48. At stopping potential, the photoelectric current becomes

1) Minimum 2) Maximum 3) Zero 4) Infinity

49. When the photo electric cell is kept at a distance r from the light source, the stopping potential is V. The value of stopping potential, when the distance is made 3r, will be

1) V 2) 3V 3) 9V 4) 1/9V

50. The mass of electron varies with

1) Its velocity 2) Size of cathode ray tube

3) Variation of g 4) The size of electron

51. The rest mass of a photon is

1) ∞ 2) 0 3) $h\nu/c^2$ 4) $h\nu c^2$

52. Electron behaves like a wave because it

1) Ionizes the gas 2) Is affected by an electric field

3) Is affected by a magnetic field 4) Diffracted by a crystal

53. The graph between the de Broglie wavelength and the momentum of photon is a

1) Rectangular Hyperbola 2) Circle

3) Parabola 4) Straight Line

54. The wavelength of a proton and a photon are same then

1) Their velocities are same 2) Their moment are equal

3) Their energies are same 4) None

55. **The de Broglie wavelength associated with a charged particle in electric and magnetic fields are** λ_1 and λ_2**, then**

1) $\lambda_1 = \lambda_2$ 2) $\lambda_1 > \lambda_2$ 3) $\lambda_1 < \lambda_2$ 4) None

56. **The energy of a photon is E and its momentum is p. The speed of light will be**

1) E/p 2) Ep 3) $(p/E)^2$ 4) $(E/p)^2$

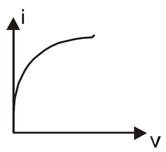
57. **De-Broglie wavelength associated with an electron of mass m and accelerated through a potential difference V is**λ**. Then wavelength associated with a proton of mass M and accelerated through the potential difference V will be**

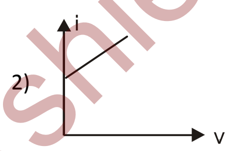
1) $\lambda\sqrt{\frac{m}{M}}$ 2) $\lambda\sqrt{(\frac{M}{m})}$ 3) $\lambda\frac{m}{M}$ 4) $\lambda^2\frac{m}{M}$

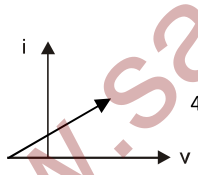
58. **The relation between the length of circumference of a stable orbit of an atom and the wavelength of stationary wave associated with the electron will be**

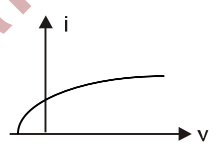
1) $2\pi r \alpha \lambda$ 2) $2\pi r \alpha \lambda^2$ 3) $2\pi r \alpha \sqrt{\lambda}$ 4) $2\pi r \alpha \frac{1}{\lambda}$

59. **The curve between current (i) and potential difference (v) for a photo cells will be**

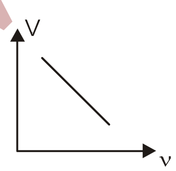
1) 

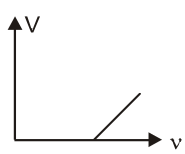
2) 

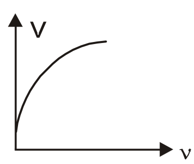
3) 

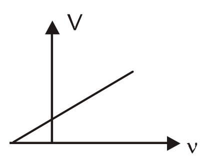
4) 

60. **The curve between the frequency (ν) and stopping potential (V) in a photo electric cell will be**

1) 

2) 

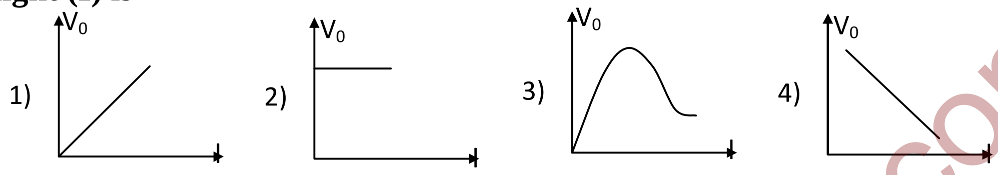
3) 

4) 

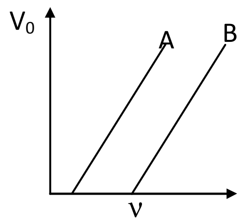
61. **A graph is drawn between frequency of the incident radiation (on-X axis) and stopping potential (on Y-axis) then the slope of the straight line indicates**

1) he 2) h/e 3) e/h 4) (e-h)

62. **The correct curve between the stopping potential (V) and intensity of incident light (I) is**



63. **The stopping potential (V_0) as a function of frequency of the incident radiation (ν) is plotted for two different photoelectric surfaces A and B. The graph shows that work function of A**



1) Is greater than that of B 2) Is smaller than that of B

3) Is equal to that of B 4) Cannot be compared from graph.

64. **A) In Thomson experiment to determine $\frac{e}{m}$ of an electron, when deflection of beam is zero, velocity of electron $\nu = \frac{E}{B}$**

B) Specific charge of cathode rays is independent of applied voltage, and material of the gas.

1) Only A is correct 2) Only B is correct

3) A and B are correct 4) A and B are false

65. **Of the following**

A) Photo cell is also called as magic eye.

B) Photo voltaic cell does not require any external source of emf (i.e. battery)

1) A is true B is false 2) B is true A is false.

3) Both A and B are true 4) Both A and B are false.

66. **Of the following**

A) Photo multiplier is also called electron multiplier.

B) In photo multiplier dynodes are coated with silver oxide-cesium layer.

1) A is true B is false
2) B is true A is false.
3) Both A and B are true
4) Both A and B are false.

67. **Of the following**

A) Photo cells are used as counting devices.

B) Photo cells are used in the reproduction of the sound in cinematography.

1) A is true B is false
2) B is true A is false.
3) Both A and B are true
4) Both A and B are false.

68. **Of the following**

A) de-Broglie waves are electromagnetic waves.

B) de-Broglie waves are produced only when particles are charged.

1) A is true B is false
2) B is true A is false.
3) Both A & B are true
4) Both A & B are false

69. **In de-Broglie waves**

A) Moving particle is always associated with a wave packet rather than a wave.

B) Velocity of a wave packet is same as that of the particle.

1) A is true B is false
2) B is true A is false
3) A and B are true.
4) A and B are false.

70. **[A]: Matter waves are not electromagnetic waves.**

[B]: Electron microscope works on the principle of de-Broglie hypothesis.

1) A is true B is false
2) B is true A is false.
3) Both A and B are true
4) Both A and B are false

71. **Statement A: An electron of velocity V and photon of velocity C have same de-Broglie wave lengths. The ratio of energies of electron and photon is V/2C.**

Statement B: The ratio of de-Broglie wavelengths of a photon and an electron of mass 'm' each with energy E is $C\sqrt{\frac{2m}{E}}$ **.**

1) A is true, B is false
2) A is false, B is true
3) A, B are false
4) A, B are true

72. **Match List – I and List – II.**

List – I	List – II
a) Particle nature of light	**e) de-Broglie hypothesis**
b) Dual nature of matter	**f) Photo electric effect**
c) Millikan's oil drop experiment	**g) Electromagnetic waves**
d) X – rays	**h) Quantization of charge**

1) a – f, b – e, c – h, d – g
2) a – e, b – f, c – g, d – e
3) a – h, b – g, c – f, d – e
4) a – g, b – c, c – f, d – h

73. **Match List – I and List – II.**

List – I	List – II
a) Photo electric effect	**e) Rontgen**
b) Specific charge of electron	**f) Hertz**
c) Charge of electron	**g) J.J Thomson**
d) X – rays	**h) Millikan**

1) a – g, b – e, c – f, d – h
2) a – f, b – g, c – e, d – h
3) a – f, b – g, c – h, d – e
4) a – h, b – f, c – e, d – g

Assertion & Reason: In each of the following questions, a statement is given and a corresponding statement or reason is given just below it. In the statements, marks the correct answer as

1) If both Assertion and Reason are true and Reason is correct explanation of Assertion.

2) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

3) If Assertion is true but Reason is false.

4) If both Assertion and Reason are false.

74. [A]: Though light of single frequency is incident on a metal, the energies of emitted photo electrons are different.

[R]: Due to collision of electron with other atoms in the metal.

75. [A]: In photo emissive cell inert gas is used.

[R]: Inert gas in the cell gives greater current.

76. [A]: Photoelectric effect can only be explained by the particle nature of light

[R]: For every metal there exists a limiting frequency of the incident light called, threshold frequency, below which electron emission is not possible.

77. [A]: Waves associated with moving particles are called 'matter waves'.

[R]: de-Broglie wavelength is inversely proportional to the mass of the particles.

78. The work function of a surface of a photosensitive material is 6.2 eV. The wavelength of the incident radiation for which the stopping potential is 5 V lies in the

1) Infrared region 2) X-ray region 3) Ultraviolet region 4) Visible region

79. A particle of mass 1 mg has the same wavelength as an electron moving with a velocity of 3×10^{6} ms^{-1}. The velocity of the particle is

1) 3×10^{-31} ms^{-1} 2) 2.7×10^{-21} ms^{-1} 3) 2.7×10^{-18} ms^{-1} 4) 9×10^{-2} ms^{-1}

80. **In the phenomenon of electric discharge through gases at low pressure, the coloured glow in the tube appears as a result of**

1) Collisions between the charged particles emitted from the cathode and the atoms of the gas

2) Collision between different electrons of the atoms of the gas

3) Excitation of electrons in the atoms

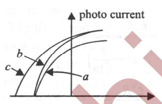
4) Collision between the atoms of the gas

81. **The number of photo electrons emitted for light at a frequency υ(higher than the threshold frequency υ_0) is proportional to**

1) Threshold Frequency (υ_0) 2) Intensity of Light

3) Frequency of Light 4) $\upsilon - \upsilon_0$

82. **The figure shows a plot of photo current versus anode potential for a photo sensitive surface for three different radiations. Which one of the following is a correct statement?**



1) Curves (a) and (b) represent incident radiations of same frequency but of different intensities.

2) Curves (b) and (c) represent incident radiations of different frequencies and different intensities.

3) Curves (b) and (c) represent incident radiations of same frequency have same intensity.

4) Curves (a) and (b) represent incident radiations of different frequencies and different intensities.

83. **Monochromatic light of wavelength 667 nm is produced by a helium neon laser. The power emitted is 9 mW. The number of photons arriving per sec. on the average at a target irradiated by this beam is**

1) 3×10^{16} 2) 9×10^{15} 3) 3×10^{19} 4) 9×10^{17}

Key

1) **2**	2) **3**	3) **3**	4) **3**	5) **1**	6) **3**	7) **3**	8) **4**	9) **2**	10) **4**
11) **3**	12) **2**	13) **4**	14) **1**	15) **4**	16) **4**	17) **4**	18) **2**	19) **4**	20) **3**
21) **2**	22) **2**	23) **1**	24) **2**	25) **2**	26) **1**	27) **4**	28) **1**	29) **4**	30) **2**
31) **4**	32) **1**	33) **4**	34) **3**	35) **1**	36) **2**	37) **2**	38) **4**	39) **3**	40) **1**
41) **3**	42) **3**	43) **3**	44) **1**	45) **1**	46) **2**	47) **2**	48) **3**	49) **1**	50) **1**
51) **3**	52) **4**	53) **1**	54) **2**	55) **3**	56) **1**	57) **1**	58) **1**	59) **2**	60) **4**
61) **2**	62) **2**	63) **2**	64) **3**	65) **3**	66) **3**	67) **2**	68) **4**	69) **3**	70) **3**
71) **4**	72) **1**	73) **3**	74) **1**	75) **2**	76) **2**	77) **2**	78) **3**	79) **3**	80) **1**
81) **2**	82) **1**	83) **1**							

Hints

1) Ans :2

Sol: From photoelectric equation $\frac{hc}{\lambda} = w_0 + \frac{1}{2}mv^2$

$$\frac{1}{2}mv^2 = \frac{hC}{\lambda} - w_0$$

2) Ans: 3

Sol: Centripetal force = Magnetic force

$$\frac{mv^2}{r} = Bqv$$

$$r = \frac{mv}{Bq}$$

3). Ans: 3

Sol: When wavelength is expressed in A° then $E = \frac{12400}{\lambda} eV$

$$\frac{hc}{\lambda} = \omega_0 + eV_0$$

$$6.2eV = 5eV + eV_0$$

$$V_0 = 1.2V$$

4) Ans: 3

Sol: $\frac{hc}{\lambda} = h\upsilon_0 + ev_0$

5) Ans: 1

Sol : $\vec{E}, \vec{B}$ are acting in Z, Y directions

Here $\frac{E}{B}$ gives velocity of charge particle

$\therefore$ The charged particle is not deviated

6) Ans: 3

Sol: Number of electrons emitted per second per unit area from the surface $n = \frac{E\lambda}{hc}$

Photon energy, $h\upsilon = \frac{1240}{600(nm)} = 2.066eV$

I = 39.6 W/m^2 = 39.6 J/s/m^2

$$= \frac{39.6}{1.6\times10^{-19}} eV/s/m^2$$

Photoelectrons emitted/s/m^2

$$= \frac{39.6}{1.6\times10^{-19}} \times \frac{1}{2.066} \times \frac{1}{100} = 12\times10^{17}$$

7) Ans:3

Sol: According to Einstein's Photo electric equation,

$$hv = hv_0 + K.E = hv_0 + ev_0$$

$$\Rightarrow v_0 = v_0 + \frac{ev_0}{h}$$

$$\Rightarrow v_0 = 13.5\times10^{14}\,Js^{-1}$$

8) Ans: 4

Sol. A) According to the laws of photoelectric effect photoelectric current is directly proportional to intensity of incident light.

9) Ans: 2

Sol From Einstein's photoelectric equation

$$: eV_0 = h\upsilon - h\upsilon_0$$

$$= \frac{hc}{\lambda} - \frac{hc}{\lambda_0} \Rightarrow e\times4.8 = \frac{hc}{\lambda} - \frac{hc}{\lambda_0} \text{.........(1)}$$

$$e\times1.6 = \frac{hc}{2\lambda} - \frac{hc}{\lambda_0} \text{..........................(2)}$$

Solving (1) and (2) $\lambda_0 = 4\lambda$

10) Ans: 4

Sol: From Einstein's photoelectric equation $hv = w + K.E$

$$K = h\upsilon - W$$

$$K_1 = 2W - W = W$$

$$K_2 = 3W - W = 2W$$

But kinetic energy = $\frac{1}{2}mv^2$

$$\frac{v_1}{v_2} = \sqrt{\frac{K_1}{K_2}} = \sqrt{\frac{W}{2W}} = \frac{1}{\sqrt{2}}$$

11) Ans: 3

Sol: de-Broglie wavelength $\lambda = \frac{h}{p} = \frac{h}{mv} = \frac{h}{\sqrt{2m(K.E)}}$

$$\lambda_p = \frac{h}{p} = \frac{h}{\sqrt{2m_p k_p}} = \frac{h}{\sqrt{2m_p eV}}$$

$$\lambda_\alpha = \frac{h}{\sqrt{2m_\alpha k_\alpha}} = \frac{h}{\sqrt{2\times 4m_p \times 2eV}}$$

$$\Rightarrow \frac{\lambda_\alpha}{\lambda_p} = \frac{1}{\sqrt{8}} \Rightarrow \lambda_\alpha = \frac{\lambda_0}{2\sqrt{2}}$$

12) Ans: 2

Sol: Let the maximum energy of the photoelectrons be x and Kx

$x = h\upsilon_1 - h\upsilon_0 = h(\upsilon_1 - \upsilon_0)$ ……………………………(1)

k $x = h\upsilon_2 - h\upsilon_0 = h(\upsilon_2 - \upsilon_0)$ ……………………………(2)

$$\frac{(2)}{(1)} \Rightarrow \upsilon_0 = \frac{k\upsilon_1 - \upsilon_2}{k-1}$$

13) Ans: 4

Sol: de-Broglie wavelength $\lambda = \frac{h}{\sqrt{2mE}}$

$$\lambda = \sqrt{\frac{150}{v}} = \sqrt{\frac{150}{80}} = 1.37A^0$$

14) Ans: 1

Sol: $\frac{hc}{4000} = W_0 + \frac{1}{2}mv^2$ ……………………….(1)

$\frac{hc}{2500} = W_0 + 4\left(\frac{1}{2}mv^2\right)$ ……………….(2)

From (1), $\frac{1}{2}mv^2 = \frac{hc}{4000} - W_0$

Substituting in equation (2)

$$\frac{hc}{2500} = W_0 + 4\times\left[\frac{hc}{400} - W_0\right] = \frac{hc}{1000} - 3W_0$$

$$W_0 = \frac{hc}{5000\times10^{-10}} = \left(2hc\times10^{6}\right)J$$

15) Ans: 4

Sol: $E = w_0 + \frac{1}{2}mv^2$

$$\Rightarrow v = \sqrt{\frac{2\left(E - w_0\right)}{m}} \;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

In the magnetic field,

$$Be\ v = \frac{mv^2}{r}$$

$$\Rightarrow r = \frac{mv}{Be} \;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Substituting (1) in (2)

$$r = \frac{\sqrt{2m\left(E - w_0\right)}}{Be}$$

16) Ans: 4

Sol: Under equilibrium

mg = Eq

$$\Rightarrow mg = \left[\frac{V}{d}\right](ne)$$

$$\Rightarrow n = \frac{mgd}{Ve} = \frac{\left(3.2\times10^{-4}\right)(10)\left(6\times10^{-3}\right)}{(1200)\left(1.6\times10^{-19}\right)}$$

$$\Rightarrow n = 10$$

17) Ans: 4

Sol: $F = Eq = mg \quad but \quad E = \frac{v}{d}$

$\frac{Vq}{d} = mg$

$\frac{Vq}{d} = \frac{4}{3}\pi R^3 \rho g$

$V \propto R^3$

$\frac{V_1}{V_2} = \frac{R_1^3}{R_2^3}$

$\frac{400}{V_2} = \frac{R^3}{8R^3}$; $\quad$ $V_2 = 3200$volt

18) Ans: 2

Sol: $K.E_1 = h(2v_0) - hv_0 = hv_0$ ……………(1)

$K.E_2 = h(3v_0) - hv_0 = 2hv_0$ ……………..(2)

Dividing (1) and (2)

$\frac{\frac{1}{2}mv_1^2}{\frac{1}{2}mv_2^2} = \frac{1}{2}$

$\therefore \; V_2 = \sqrt{2}V_1$

$V_2 = 2\sqrt{2} \times 10^6 ms^{-1}$

19) Ans: 4

Sol: $hv = \omega_0 + \frac{1}{2}mV^2$ ………………………….(1)

$h2v = \omega_0 + \left(\frac{1}{2}mV^2\right)4$ …………………..(2)

$$(1)\times 4 \Rightarrow 4hv = 4\omega_0 + 4\frac{1}{2}mv^2$$

$$(2) \qquad \Rightarrow 2hv = \omega_0 + 4\frac{1}{2}mv^2$$

Subtracting $2hv = 3\omega_0 \Rightarrow \omega_0 = \frac{2hv}{3}$

20) Ans: 3

Sol: From de-Broglie wavelength $\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2meV}}$

$$\frac{\lambda_p}{\lambda_\alpha} = \frac{\frac{h}{\sqrt{2m_p q_p V}}}{\frac{h}{\sqrt{2m_\alpha q_\alpha V}}} = 2\sqrt{2}:1$$

21) Ans: 2

Sol: $\lambda_e = \frac{h}{p_e}$

$$\lambda_{P_h} = \frac{hC}{E_{Ph}}$$

$$\Rightarrow \frac{h}{P_e} = \frac{hC}{E_{Ph}}$$

$$\Rightarrow \frac{E_{Ph}}{P_e} = C$$

22) Ans: 2

Sol: If proton is projected at right angle to the magnetic field it rotates in circular path. The required centripetal force is supplied by force due to magnetic field.

$$mr\omega^2 = Bqv \Rightarrow \omega = \sqrt{\frac{Bqv}{mr}}$$

$$T = 2\pi\sqrt{\frac{mr}{Bqv}} = \frac{2\pi m}{Bq}$$

Time taken to transverse 90^0 arc is $\frac{T}{4}$.

$$\frac{T}{4} = \frac{\pi m}{2Bq} = 1.6\times10^{-7}s$$

23) Ans: 1

Sol. As the total incident energy is completely absorbed by the electrons the incident photon completely disappears.

24) Ans: 2

Sol: From Einstein's photo electric equation $\frac{hc}{\lambda} = w + K.E$

$$K_1 = \frac{hc}{\lambda_1} - W = \frac{hc}{3\lambda_2} - W = \frac{X}{3} - W$$

$$K_2 = \frac{hc}{\lambda_2} - W = X - W$$

Where $X = \frac{hc}{\lambda_2}$

$$\frac{K_1}{K_2} = \frac{\frac{X}{3} - W}{X - W} = \frac{X/3 - W}{X - W}$$

Now x>W Hence $\frac{K_1}{K_2} < \frac{1}{3} \Rightarrow K_1 < \frac{K_2}{3}$

25) Ans: 2

Sol: $\lambda = \frac{h}{p} = \frac{c}{\upsilon}$ [From de-Broglie wavelength]

c p = h υ

$$\frac{k}{h\upsilon} = \frac{p^2}{2mh\upsilon} = \frac{p^2}{2mcp}$$

$$= \frac{p}{2mc} = \frac{v}{2c} = \frac{2.25\times10^{8}}{2\times3\times10^{8}} = \frac{3}{8}$$

26) Ans: 1

Sol: $\Rightarrow \lambda = \frac{h}{p} = \frac{h}{mv} = \frac{6.63\times10^{-34}}{9.1\times10^{-31}\times6.6\times10^{5}}$

$= 11\times10^{-10}\,m = 11A^{0}$

27) Ans: 4

Sol: When λ is expressed in A° then, $W = \frac{12400}{\lambda}$

$W = \frac{1240}{250} = 4.96eV$

$h\upsilon = \frac{1240}{200} = 6.20eV$

K =6.20 – 4.96 = 1.24eV

$=1.24\times1.6\times10^{-19}$

$= 19.84\times10^{-20}\,J$

28) Ans: 2

Sol: $\lambda = 3300A^{0} = 330nm$

$h\upsilon = \frac{1240}{330} = 3.757$

$eV_{0} = h\upsilon - W = 3.757 - 2 = 1.757eV$

$\Rightarrow V_{0} = 1.757\ V$

29) Ans: 4

Sol Since both proton and positron have the same charge

$\lambda_{proton} = \frac{h}{\sqrt{2mK}} = \frac{h}{\sqrt{2meV}}$

$$\lambda_{positron} = \frac{h}{\sqrt{2meV}} \Rightarrow \frac{\lambda_{proton}}{\lambda_{positron}} = \sqrt{\frac{m}{M}}$$

30) Ans: 2

Sol $:W_1 : W_2 = 1:2$

$v_1 : v_2$ = 1:2

According to photo – electric equation,

$\frac{1}{2}mv_1^2 = h\upsilon_1 - W_0 = hf - 1$……………………..(1)

$$\frac{1}{2}mv_2^2 = h\upsilon_2 - W_0 = 2hf - 2 = 2(hf - 1)$$

Ratio of kinetic energies = 1:2

78. (3): Work function = 6.2 eV

K.E = eV_S = 5e

Total incident energy = 6.2 + 5= 11.2 eV

$$\therefore \quad \lambda = \frac{hc}{E} = \frac{12400\,eV}{11.2\ eV} = 1107\overset{0}{A}$$

This wavelength is in the ultraviolet region.

79. (3)

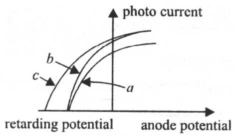
From de-broglie hypothesis $\lambda = \frac{h}{mv}$

80 (1) Collisions of the charged particles with the atoms in the gas The colour of the glow depends upon the nature of the glass.

Eg : Yellowish green for soda glass grayish blue for lead glass.

81 (2) The number of photoelectrons decide the photocurrent. Assuming that the number of electrons emitted depends on the number of photons incident, the number of photoelectrons depend on the intensity of light.

82 (1)



(a) and (b) represent radiations of the same frequency because their kinetic energies are the same. But saturation photocurrents are different. Therefore intensities are different.

83 (1) $\lambda = 6670\,\overset{0}{A}$

E of a photon = $\dfrac{12400 eV\,\overset{0}{A}}{6670\,\overset{0}{A}} = \dfrac{12400}{6670} \times 1.6 \times 10^{-19} J$

Energy emitted per second, power P = $9 \times 10^{-3} J$

$\therefore$ Number of Photons incident = $\dfrac{Power}{Energy} = \dfrac{P}{E}$

$= \dfrac{9 \times 10^{-3} \times 6670}{12400 \times 1.6 \times 10^{-19}} = 3 \times 10^{16}$