45. The maximum increase in X-ray wavelength that can occur during Compton scattering is
1) 5.84×10^{-12}m 2) 6.84×10^{-3} m
3) 7.84×10^{-10}m 4) 4.84×10^{-12}m

46. X-rays of $1.0A^0$ are scattered from a carbon block. The wavelength of the scattered beam in a direction making 90^0 with the incident beam is
1) $1.024A^0$ 2) $2.024A^0$
3) $3.024A^0$ 4) $4.024A^0$

47. In the above problem, the K.E. imparted to the recoil electron is
1) 396 eV 2) 290 eV
3) 496 eV 4) 390 eV

48. Given $h = 6.62 \times 10^{-34}$ Js, $m_o = 9.1 \times 10^{-31}$ kg, $c = 3 \times 10^8$ m/s, the value of compton wavelength being
1. 0.0121 A° 2. 0.0484 A°
3. 0.0242 A° 4. 0.0363 A°

MATTER WAVES:

49. When the mass of an electron becomes equal to thrice its rest mass, its speed is
1. $\frac{2\sqrt{2}}{3}c$ 2. $\frac{2}{3}c$ 3. $\frac{1}{3}c$ 4. $\frac{1}{4}c$

50. An electron moves with a speed of $\frac{\sqrt{3}}{2}$ c. Then its mass becomes.......... times its rest mass.
1. 2 2. 3 3. $1\frac{1}{2}$ 4. 4

51. The velocity of a particle is 60% of velocity of light. Then the percentage increase in its mass is
1. 75% 2. 40% 3. 25% 4. 60%

52. A microscopic particle of mass 10^{-12} kg is moving with a velocity of 10^2 m/s. Then the de Broglie wavelength associated with the particle is
1. 6.6×10^{-24}m 2. 6.6×10^{-34} m
3. 3.3×10^{-24} m 4. 0

53. The de Broglie wavelength associated with a particle at rest is
1. 0 2. ∞
3. finite 4. data insufficient

54. A particle having a de Broglie wavelength of 1.0 A° is associated with a momentum of (given $h = 6.6 \times 10^{-34}$ Js)
1. 6.6×10^{-26} kg m/s 2. 6.6×10^{-25} kg m/s
3. 6.6×10^{-24} kg m/s 4. 6.6×10^{-22} kg m/s

55. The momentum of a photon of wavelength 0.01 A^0 is
1) 6.6×10^{-32} kg m/s 2) 6.6×10^{-20} kg m/s
3) 6.6×10^{-22} kg m/s 4) 6.6×10^{-12} kg m/s

KEY

1.1	2.2	3.3	4.4	5.2	6.1	7.2	8.3
9.4	10.1	11.4	12.2	13.2	14.4	15.4	16.1
17.2	18.3	19.4	20.1	21.2	22.3	23.4	24.3
25.1	26.2	27.1	28.2	29.3	30.1	31.2	32.3
33.4	34.2	35.3	36.1	37.3	38.1	39.2	40.4
41.3	42.3	43.1	44.4	45.4	46.1	47.2	48.3
49.1	50.1	51.3	52.1	53.2	54.3	55.3	

LEVEL-II

CATHODE RAYS:

56. An electron is accelerated through a p.d. of 1000 V. The velocity it acquires is (given $e/m = 1.76 \times 10^{11}$ C/kg for electron)
1. 3.75×10^7 ms^{-1} 2. 1.87×10^7 ms^{-1}
3. 2.50×10^7 ms^{-1} 4. 4.00×10^7 ms^{-1}

57. When a cathode ray tube operates at 2500 V, electrons acquire a velocity of 3×10^7 m/s. When the same tube operates at 5000 V, the velocity of electrons is
1. $3\sqrt{2}\times 10^7$ m/s 2. 3×10^6 m/s
3. 3×10^7 m/s 4. 3×10^8 m/s

58. The p.d. at the ends of a cathode ray tube is increased to 9 times its original p.d. Then
I. The velocity of cathode rays increases to .... times
II. The energy of cathode rays increases to...... times
1. 9,3 2. 9,9 3. 3,9 4. 3,3

59. A proton and an α-particle enter a magnetic field in a direction perpendicular to it. If the force acting on the proton is twice that acting on the α-particle, the ratio of their velocities is
1. 4 : 1 2. 1. : 4 3. 1 : 2 4. 2 : 1

60. A cathode ray beam is bent into an arc of a circle of radius 0.02 m by a field of magnetic induction 4.55 milli tesla. The velocity of electrons is (given $e = 1.6\times10^{-19}$ c and $m = 9.1 \times 10^{-31}$ kg)
1. 2×10^7m/s 2. 3×10^7m/s
3. 1.6×10^7 m/s 4. 3.2×10^7m/s

61. In Thomson's experiment, a magnetic field of induction 10^{-2} wb/m^2 is used. For an undeflected beam of cathode rays, a p.d. of 500 V is applied between the plates which are 0.5 cm apart. Then the velocity of the cathode ray beam is .... m/s.
1. 4×10^7 2. 2×10^7 3. 2×10^8 4. 10^7

62. If an electron revolves in the path of a circle of radius 0.5×10^{-10} m at a frequency of $5 \times 10^{+15}$ cycles / sec, the electric current in the circle is (given $e=1.6\times 10^{-19}$ c)
1. 0.08 mA 2. 0.8 mA 3. 8 mA 4. 8.8 mA

63. The velocity of a helium nucleus travelling in a curved path in a magnetic field is V. The velocity of a proton moving in the same curved path in the same magnetic field is

1.V 2. 4V 3. 2V 4. V/2

64. An electron enters a magnetic field of 0.01 T with a velocity of 10^7 m/s, describing a circular path of radius 0.6 cm. Then the value of e/m of electron is

1. 1.76 $\times$ 10^{11} C/kg 2. 2.04 $\times$ 10^{11} C/kg
3. 1.72 $\times$ 10^{11} C/kg 4. 1.66 $\times$ 10^{11} C/kg

65. In Thomson's method, a beam of electrons accelerated through a p.d. of 285 volt, passes undeflected through perpendicular electric and magnetic fields of intensities 10^5 V/m and 10^{-2} wb/m^2 respectively. Then the value of e/m of electron is

1. 1.75 $\times 10^{11}$ C/kg 2. 1.66 $\times$ 10^{11} C/kg
3. 1.84 $\times$ 10^{11} C/kg 4. 1.89 $\times$ 10^{11} C/kg

66. A proton, a deuteron and an α-particle with the same K.E. enter a region of uniform magnetic field at right angles to the field. The ratio of the radii of their circular paths being

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

67. A proton, a deuteron and an α-particle are accelerated through the same p.d. of V volt. The velocities acquired by them are in the ratio

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

68. An electron enters a magnetic field of intensity 10^{-4} Wb/m^2, with a velocity of 10^6 m/s and describes a circular path of radius 5.6 cm. The value of e/m of electron is

1. 1.78 x 10^{11} C/kg 2. 1.88 x 10^{11} C/kg
3. 1.68 x 10^{11} C/kg 4. 1.66 x 10^{11} C/kg

69. Electrons enter a uniform magnetic field of intensity 150 x 10^{-4} T, perpendicular to it with a velocity of 1.76 x 10^8 m/s. Then the radius of the circular path in which they travel is
(given e/m of electron = 1.76 x 10^{11} C/kg).

1. 0.0033 m 2. 0.066m
3. 0.0044m 4. 0.0055m

70. An electron moving with a speed of 2 x 10^7 m/s enters a magnetic field of intensity 1.5 Wb/m^2, in a direction perpendicular to it. The force acting on it is (given e=1.6 x 10^{-19} c)

1. 4.8 x 10^{-19} N 2. 4.8 x 10^{-17} N
3. 4.8 x 10^{-12} N 4.1.6 x 10^{-17} N

71. An electron and a proton of same velocity enter a magnetic field in transverse direction. The ratio of the radii of their paths is

1) 1:1 2) 1:8 3) 1: 1847 4) 1847:1

72. A proton projected with kinetic energy K describes a circle of radius r in a uniform magnetic field. With what kinetic energy should an a-particle be projected in the same magnetic field so that it describes a circle of radius 2r?

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

73. In Thomson's experiment for determining e/m, the potential difference between the cathode and the anode is same as that between the deflecting plates (in the region of crossed fields). If the potential difference is doubled, by what factor should the magnetic field be increased to ensure that the electron beam remains undeflected?

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

74. An electron starts from rest and travels 0.9 m in an electric field of 200 V/m. After this, it enters a magnetic field at right angles to its direction of motion. If the radius of circular path of the electron is 9 cm, the magnetic field induction is (Given e=1.6 x 10^{-19}C, m=9x10^{-31}kg)

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

75. The electric field can just support a water droplet 1.0x10^{-6}m in diameter carrying one electron charge?

1) 3.21x10^4 v/m 2) 2.31x10^4 v/m
3) 1.32 x10^4 v/m 4) 6.42 x 10^4 v/m

76. An α-particle of mass 6.65x10^{-27}kg travels at right angles to a magnetic field of 0.2T with a speed of 6x10^5m/s. The acceleration of the α-particle will be

1) 7.55x10^{11} m/s^2 2) 5.77x10^{11} m/s^2
3) 7.55x10^{12} m/s^2 4) 5.77x10^{12} m/s^2

77. A proton and an a-particle are accelerated through the same potential. The ratio of their velocities is

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

MIllikan's oil drop experiment

78. A water drop of radius 10^{-6} m is charged with one electron. The electric field required to keep it stationary is (given density of water ρ =1000 kg/m^3; g = 9.8 m/s^2)

1.2.566 x 10^5 V/m 2. 1.283 x 10^5 V/m
3. 3.849 x 10^5 V/m 4. 5.132 x 10^5 V/m

79. In a Millikan's oil drop experiment, an oil drop of mass 0.64×10^{-14} kg, carrying a charge 1.6×10^{-19} C remains stationary between two plates seperated by a distance of 5 mm. Given g=9.8 m/s^2; the voltage that must be applied between the plates being
1. 980 V 2. 1960 V 3. 3920V 4. 2880V

80. The voltage required to balance an oil drop carrying 10 electrons between the plates of a capacitor which are 10 mm apart, is (Given mass of the oil drop = 3.2×10^{-15} kg, e = 1.6×10^{-19} C)
1.16 V 2. 160 v 3. 196 V 4. 19.6V

81. In Millikan's oil drop experiment, an oil drop having charge is held stationary with an external p.d of 400 V. If the radius of the drop is doubled without any change in charge, the p.d required to keep the drop stationary is
1) 800 V 2) 1600 V 3) 3200 V 4) 200 V

PHOTO ELECTRIC EFFECT:

82. In a photoelectric effect experiment, photons of energy 5 eV are incident on a metal surface. They liberate photoelectrons which are just stopped by an electrode at a potential of -3.5 V with respect to the metal. The work function of the metal is
1.1.5 eV 2. 3.5 eV 3. 5. 0 eV 4. 8.5 eV

83. Photons of energy 6 eV are incident on a potassium surface whose work function is 2.1 eV. The corresponding stopping potential required is
1. 8.1 eV 2. 6 eV 3. 2. 1 eV 4. 3.9 eV

84. A source of light is kept at a distance of 1 m from a photocell. The stopping potential is found to be V volt. If the distance is doubled, the stopping potential in volt will be
1. $\frac{V}{2}$ 2. 2 V 3. V 4. 4 V

85. Light of wavelength 5000 A^o is incident on a metallic surface of work function 3.31 eV. Will there be photoelectric emission or not?
1. Yes 2. No
3. may or may not be emitted
4. data insufficient

86. Light of wavelength 4000 A^o is incident on a metal surface of work function 2.5 eV. Given h=6.62 x 10^{-34} Js, c = 3 x 10^8 m/s, the maximum KE of photoelectrons emitted and the corresponding stopping potential are respectively
1. 0. 6 eV, 0.6 V 2. 2.5 eV, 2.5 V
3. 3.1 eV, 3.1 V 4. 0.6 eV, 0.3 V

87. The photoelectric threshold wavelength for a metal is 5000 A^o. Light of wavelength 4000 A^o is incident on it. The maximum KE of photoelectrons emitted is [given ch= 2 x 10^{-25} Jm]
1. 3.1 eV 2. 2.48 eV
3. 0.62 eV 4. 5. 58 eV

88. Light from a hydrogen discharge tube is incident on the cathode of a photocell. The work function of the cathode surface is 3.8 eV. In order to reduce the photoelectric current to zero, the voltage of anode relative to cathode must be
1.+9.8V 2.-9.8 V 3.+0.4 V 4.-2.3 V

89. When light of wavelength 2480 A^o is incident on a metal surface electrons are emitted with a maximum KE of 2 eV. The maximum KE of photoelectrons, if light of wavelength 1240 A^o is incident on the same surface would be
1. 4eV 2. 1 eV 3. 2eV 4. 7eV

90. The kinetic energies of photoelectrons ejected from a metal surface by light of wavelength 2000 A^o range from 0 to 3.2 x 10^{-19} J. The stopping potential required will be equal to
1. 2 V 2. 6.2 V 3. 4.2 V 4. 9 eV

91. The cutoff voltage in a photoelectric experment is 3V. Then the maximum KE of photoelectrons emitted is
1. 3V 2. 3 eV 3. 6 eV 4. 9 eV

92. In Millikan's experiment, the slope of ν versus V_o graph was found to be 4.125 x 10^{-15} Vs. Given e = 1.6 x 10^{-19} C, the value of Planck's constant is
1. 6.2 x 10^{-34}Js 2. 6.4 x 10^{-34}Js
3. 4.125 x 10^{-34}Js 4. 6.6 x 10^{-34} Js

93. U.V Light of wavelength 300 A^o is incident on sodium surface. Then the maximum velocity of photoelectrons emitted is [neglect the work function of sodium].
1. 3.8 x 10^6 ms^{-1} 2. 4.8 x 10^6 ms^{-1}
3. 6 x 10^5 ms^{-1} 4. 3 x 10^5 ms^{-1}

94. A photoelectron is moving with a maximum velocity of 10^6 m/s. Given e = 1.6 x 10^{-19} c, and m = 9.1 x 10^{-31} kg, the stopping potential is
1.2.5 V 2. 2.8 V 3. 2.0 V 4. 1.4 V

95. If U.V. Light of wavelengths 800 A^o and 700 A^o can liberate electrons with kinetic energies of 1.8 eV and 4 eV respectively from hydrogen atom in ground state, then the value of planck's constant is
1. 6.57 x 10^{-34} Js 2. 6.63 x 10^{-34} Js
3. 6.66 x 10^{-34} Js 4. 6.77 x10^{-34} Js

96. Light of wavelength 4 x 10^{-7} m, incident on a photocell using caesium photo cathode. Then the corresponding stopping potential found will be (given work function of ceasium as 1.9 eV)
1. 3.1 eV 2. 1.9 V 3. 1.2 eV 4. 1.2 V

97. A 5 mW radiating source operates at 662 nm. Then the number of photons emitted by it per sec- ond is (given h=6.62 x 10^{-34} Js, c = 3 x 10^{8} m/s)
1. 1.9 x 10^{16} 2. 1.67 x 10^{16}
3. 2.5 x 10^{16} 4. 2.0 x 10^{16}

98. A monochromatic source of light operating at 200 W emits 4 x 10^{20} photons / second. Then the wavelength of light used is
1. 3000 A° 2. 5000 A° 3. 4000 A° 4.6000 A°

99. The work functions of sodium and copper are 2 eV and 4 eV respectively. If the photoelectric cell operates at 4000A° wavelength, then the metal to be used will be
1.sodium 2. copper
3. both 4. data insufficint

100. If the frequency of light incident on a photosensitive metal plate be doubled, then the KE of photoelectrons will be
1. doubled 2. halved 3. quadrupled
4. More than twice the previous value

101. Photons of frequencies 2.2 x 10^{15} Hz and 4.6 x 10^{15} Hz are incident on a metal surface. The corresponding stopping potentials were found to be 6.6 V and 16.5 V respectively. Given e = 1.6 x 10^{-19} c, the value of universal planck's constant is
1. 6.6 x 10^{-34} Js 2. 6.7 x 10^{-34} Js
3. 6.5 x 10^{-34} Js 4. 6.8 x 10^{-34} Js

102. The number of photons emitted per second by a 62 W source of monochromatic light of wavelength 4800 A° is
1. 1.5 x 10^{19} 2. 1.5 x 10^{20}
3. 2. 5x 10^{20} 4. 4 x 10^{20}

103. Light quanta of energy 4.9 eV eject photoelectrons from a metal with work function 4.5 eV. Then the maximum momentum transmitted to the surface of metal when each electron flies out is
1. 3.4 x 10^{-25} kg ms^{-1} 2. 6. 8x 10^{-25} kg ms^{-1}
3. 4.0 x 10^{-25} kg ms^{-1} 4. 1.7 x 10^{-25} kg ms^{-1}

104. Lights of wavelengths 2000 A° and 3000 A° emit photoelectrons from a metal surface whose threshold wavelength is 4000 A°. The ratio of the maximum KE's of the photo electrons emitted is nearly
1. 1:3 2. 3:1 3. 6:1 4. 2 : 1

105. Photons of energies 1 eV and 2.5 eV are incident on a metal surface of work function 0.5 eV. Then the ratio of maximum velocities with which the photoelectrons are emitted being
1. 1 : 4 2. 4 : 1 3. 2 : 1 4. 1 : 2

106. Light of wavelength 5000 A° falls on a sensitive surface. If the surface has received 10^{-7} Joule of energy, then the number of photons incident on the surface is nearly (given h= 6.6 x 10^{-34} Js , c = 3 x 10^{8} m/s)
1. 2.5 x 10^{11} 2. 5.0 x10^{11}
3. 2.5 x 10^{10} 4. 5.0 x 10^{10}

107. An electromagnetic radiation of frequency 3 x 10^{15} Hz falls on a photosurface whose workfunction is 4 eV. Then the maximum velocity of the photo electrons emitted from the surface is
(given h = 6.6 x 10^{-34} Js, m = 9 x 10^{-31} Kg)
1.1.7 x 10^{6} ms^{-1} 2. 3.4 x 10^{6} ms^{-1}
3. 2.5 x 10^{6} ms^{-1} 4. 2.0 x 10^{6} ms^{-1}

108. The work function of sodium is 2.46 eV and its threshold wavelength is 5040 A°. Then the value of universal planck's constant is (given c = 3 x10^{8} m/s)
1.6.7 x 10^{-34} Js 2. 6.6 x 10^{-34} Js
3. 6.8 x 10^{-34} Js 4. 6.5 x 10^{-34} Js

109. Monochromatic light is incident on a metal surface of work function 2.2 eV. Photo electrons are emitted from it with a maximum kinetic energy of 0.8 eV. Then the wavelength of incident radiation is
1.6133 A° 2. 5133 A°
3. 4133 A° 4. 7133 A°

110. The wavelength of incident light falling on a photosensitive surface is changed from 2000 to 2050 A^0. The corresponding change in the stopping potential is nearly
1) 0.012V 2) 2.1V 3) 1.2V 4) 0.15V

111. The work functions of metals A and B are in the ratio 1:2. If light of frequencies f and 2f are incident on metal surfaces of A and B respectively, the ratio of the maximum kinetic energies of photo electrons emitted is (f is greater than threshold frequency of A. 2f is greater than threshold frequency of B)
1) 1:1 2) 1:2 3) 1:3 4) 1:4

112. The work function of a metal surface is 1 eV. A light of wavelength 3000A^0 is incident on it. The maximum velocity of the photoelectrons is nearly
1) 10^{6} ms^{-1} 2) $10^{4}$$ms^{-1}$ 3) 10^{2} ms^{-1} 4) 10 ms^{-1}

113. If the work function of a metal is 5 eV and photons of energy 20 eV are incident on the surface, then the stopping potential of the surface is
1) 5 V 2) 10 V 3) 15 V 4) 20 V

114. A small metal plate (work function =2ev) is placed at a distance of 2m from a monochromatic light source of wavelength 3.8 x 10^{-7} m and power 1.0 watt. If the light falls normally on the plate, the maximum K.E. of electrons emitted from the plate is
1) 2.053 x 10^{-19}J 2) 3.253 x 10^{-19}J
3) 5.253 x 10^{-19}J 4) 2.532 x 10^{-19} J

115. In the above problem the maximum speed of emitted electrons will be nearly
1) 7.036×10^7m/s   2) 7.036×10^6m/s
3) 7.036×10^5m/s   3) 7.036×10^4m/s

X-RAY SPECTRA:

116. The λ_{min} of a continuous X-Ray spectrum is 0.414 A^o , when it operates at a p.d. of 30 KV. The value of planck's constant, h, is (given e = 1.6 x 10^{-19} C, c = 3 x 10^8 m/s)
1. 6.624×10^{-34} Js   2. 6.524×10^{-34} Js
3. 6.674×10^{-34} Js   4. 6.724×10^{-34} Js

117. According to Moseley, for $K_\alpha line\sqrt{v}$ = a(z-b) where a = 5 x 10^7 Hz and b = 1. For a given element, the wavelength of K_α line is 1/3 A^o. Then the atomic number of the element is
1. 51   2. 61   3. 41   4. 55

118. An X-Ray tube operates at a p.d. of 12.4 KV. Then the X-Rays emitted will have a maximum frequency of
1. 3×10^{15} Hz   2. 3×10^{16} Hz
3. 3×10^{17} Hz   4. 3×10^{18} Hz

119. If the p.d. applied across an X-Ray tube is 5 KV and the current through it is 2 mA, then the number of electrons striking the target per second and the speed with which the electrons strike the target are
1. 1.25×10^{16}, 4.2×10^7 ms^{-1}
2. 2.5×10^{16} , 4.2×10^7 ms^{-1}
3. 2×10^{16}, 4×10^7 ms^{-1}
4. 0, 0

120. An X-Ray tube allows 5 mA at a p.d. of 100 KV. Then the rate of production of heat at the target is (assuming that only 0.1% of incident energy is converted into X-Radiations)
1. 500 cal s^{-1} 2. 5 cal s^{-1}
3. 119.4 cal s^{-1} 4. zero

121. An X-Ray tube operates at 18KV. The velocity of the electrons bombarding the target being nearly
1. 8×10^7 ms^{-1} 2. 6×10^7 ms^{-1}
3. 8×10^6 ms^{-1} 4. 6×10^6 ms^{-1}

122. Given R=1.097×10^7 m^{-1}, the wavelength of K_α line of silver (z = 47) being (take b=1 for K series)
1. 0.674 A^o 2. 0.574 A^o
3. 0.774 A^o 4. 0.287 A^o

123. The frequency of an X-Ray photon of momentum 2.25×10^{-23} kg m/s is nearly
(given h = 6.63×10^{-34} Js, c = 3 x 10^8 m/s)
1.10^{18} Hz   2. 10^{17} Hz   3. 10^{16} HZ   4. 10^{19} Hz

124. The K_α X-Ray emission line of Tungsten occurs at 0.021 nm. Then the energy difference between K and L levels in these atoms is about
1. 59 KeV   2.29 KeV
3. 118 KeV   4. 87 KeV

125. The voltage applied to an X-ray bulb increases to 1.5 times the initial voltage. The short wavelength limit of continuous X-ray spectrum shifts by 25 pm. Then
1) initial voltage applied is 160 x 10^3kv
2) initial voltage applied is 80 x 10^3kv
3) initial wavelength is 75pm
4) final wavelength is 150pm

126. When a beam of accelerated electrons hits a target, a continuous x-ray spectrum is emitted from the target. Which of the following wavelength is absent in the x-ray spectrum if the x-ray tube is operating at 40,000 volt?
1) 1.5 A^0 2) 0.5 A^0 3) 0.25 A^0 4) 1.0 A^0

Compton effect

127. In a Compton effect experiment, the wavelength of incident photons is 3A^o. If the incident radiation is scattered through 60^o, the wavelength of scattered radiation is nearly (given h =6.62x10^{-34} Js, m_o = 9.1 x 10^{-31} kg, c = 3 x 10^8 m/s)
1. 3.024 A^o 2. 3.012 A^o
3. 3.048A^o 4. 2.988 A^o

128. A photon of energy 1.02 Mev undergoes compton scattering from a block through 180^o. Then the energy of the scattered photon is(Assume the values of h, m_o , c)
1. 0.206 MeV   2. 0.103 MeV
3. 0.412 MeV   4. Zero

129. A photon recoils back after striking a free electron. Then the value of compton shift is (Assume the values of h, m_om c)
1. 0.0242 A^o 2. 0.0484 A^o
3. 0.0121 A^o 4. 0.242 A^o

MATTER WAVES:

130. The de Broglie wavelength of an electron which falls through a p.d. of 100 V is
1. 1.227 A^o 2. 12.27 A^o
3. 0.1227 A^o 4. 2.454 A^o

131. Electrons are accelerated through a p.d. of 150V. Given m = 9.1 x 10^{-31} kg, e = 1.6 x 10^{-19} c, h = 6.62 x 10^{-34} Js, the de Broglie wavelength associated with it is
1. 1.5 A^o 2. 1.0 A^o 3. 3.0 A^o 4. 0.5 A^o

132. The de Broglie wavelength associated with an electron of energy 500 eV is given by
(take h = 6.63 x 10^{-34} Js, m = 9.11 x 10^{-31} kg)
1. 0.28A° 2. 1.410 A° 3.0.66 A° 4.0.55 A°

133. A proton when accelerated through a p.d of V volt has wavelength λ associated with it. An α-particle to have the same λ must be accelerated through a p.d of
1) V volt 2) 4V volt 3) 2V volt 4) $\frac{V}{8}$ volt

134. An electron and a proton are accelerated through the same potential difference. The ratio of their de Broglie wavelengths (λ_e / λ_p) is
1) 1 2) $\frac{m_e}{m_p}$ 3) $\frac{m_p}{m_e}$ 4) $\sqrt{\frac{m_p}{m_e}}$

135. A proton and an α-particle are accelerated through the same p.d. The ratio of their deBroglie wavelengths is
1) $\sqrt{2}$ 2) $\frac{1}{\sqrt{2}}$ 3) $2\sqrt{2}$ 4) 2

136. If the momentum of an electron is changed by p_m, then the de Broglie wavelength associated with it changes by 0.5%. The initial momentum of electron will be
1) p_m/200 2) p_m/100 3) 200p_m 4) 100p_m

137. If the energy of a particle is reduced to one fourth, then the percentage increase in its de Broglie wavelength will be
1) 41% 2) 141% 3) 100% 4) 71%

138. If the velocity of a particle is increased three times, then the percentage decrease in its de Broglie wavelength will be
1) 33.3% 2) 66.6% 3) 99.9% 4) 22.2%

KEY

56.2	57.1	58.3	59.1	60.3	61.4	62.2
63.3	64.4	65.1	66.2	67.4	68.1	69.2
70.3	71.3	72.4	73.1	74.1	75.1	76.4
77.4	78.1	79.2	80.3	81.3	82.1	83.4
84.3	85.2	86.1	87.3	88.2	89.4	90.1
91.2	92.4	93.1	94.2	95.1	96.4	97.2
98.3	99.1	100.4	101.1	102.2	103.1	104.2
105.4	106.1	107.1	108.2	109.3	110.4	111.2
112.1	113.3	114.1	115.3	116.1	117.2	118.4
119.1	120.3	121.1	122.2	123.4	124.1	125.3
126.3	127.2	128.1	129.2	130.1	131.2	132.4
133.4	134.4	135.3	136.3	137.3	138.2	

HINTS

56) $v = \sqrt{\frac{2Ve}{m}}$

57) $\frac{v_1}{v_2} = \sqrt{\frac{V_1}{V_2}}$

58) $(i)\ v \propto \sqrt{V}$
$(ii)\ E \propto V$

59) $\frac{F_1}{F_2} = \frac{q_1}{q_2} \times \frac{v_1}{v_2}$

60) $v = \frac{rBe}{m}$

61) $v = \frac{V}{dB}$

78) $E = \frac{mg}{e} = \frac{\frac{4}{3}\pi r^3 \rho\ g}{e}$

62) $i = ef$ where f = frequency

63) $r = \frac{mv}{eB} \Rightarrow v \propto \left(\frac{e}{m}\right)$

79) $Eq = mg \Rightarrow \left(\frac{V}{d}\right)q = mg$

64) $r = \frac{mv}{eB} \Rightarrow \left[\frac{e}{m}\right] = \frac{v}{rB}$

65) $\left(\frac{e}{m}\right) = \frac{E}{rB^2}$

80) $Eq = mg \Rightarrow \left(\frac{V}{d}\right)ne = mg$

66) $r = \frac{mv}{eB} = \frac{\sqrt{2m(KE)}}{eB}$

67) $v = \sqrt{\frac{2eV}{m}} \Rightarrow v \propto \sqrt{\frac{e}{m}}$

68. $\frac{e}{m} = \frac{v}{rB}$

69. $r = \frac{v}{\left(\frac{e}{m}\right)B}$

70. $F = qvBSin\theta$

71 $r=\frac{mv}{eB}$

72. $r=\frac{\sqrt{2mKE}}{eB}\Rightarrow\sqrt{\frac{KE_1}{KE_2}}=\frac{r_1}{r_2}\times\frac{e_1}{e_2}\sqrt{\frac{m_2}{m_1}}$

73 $\frac{1}{2}mv^2=eV$, where $v=\frac{E}{B}=\frac{V}{dB}$

74. $B=\frac{mv}{er}$, where $v=\sqrt{\frac{2e(Ed)}{m}}$

75. $\left(\frac{4}{3}\pi r^3\rho\ g\right)=Eq$

76. $a=\frac{Bqv}{m}$

77. $V\propto r^3\Rightarrow\frac{V_2}{V_1}=\frac{r_2^3}{r_1^3}$

81. $\frac{1}{2}mv^2=qV$

82. $E(\text{in } eV)=eV_0+W_0(\text{in } eV)$

83. $eV_0=E\quad(ev)-W(ev)$

84. Stopping potential is independent of distance between light source and Photo electric cell.

85. Since $E<\frac{hc}{\lambda}$ Photo electric emission will not takes place.

86. $K.E_{max}=\frac{12400}{\lambda\quad(\overset{0}{A})}-w(\text{in } eV)$

stopping potential $=\frac{K.E_{max}}{e}$

87. $K.E=12400\left(\frac{1}{\lambda_1}-\frac{1}{\lambda_2}\right)$

where λ_1 = wave length of the incident light, λ_2 = wave length of the work function

88. Stopping potential

$V_0=-\left(\frac{E-w}{e}\right)=-\left(\frac{13.6ev-3.8ev}{e}\right)=-9.8V$

Q maximum K.E. of emitted electrons=ground state energy level of hydrogen=13.6 eV

89. $w=\frac{12400}{\lambda\ (A^0)}-K.E._{max}$

90. $V_0=\frac{K.E\max}{e}$

91. KEmax = eV_0

92. h = slope x Electron charge

93. $\frac{1}{2}mv^2=\frac{hc}{\lambda}$

94. $\frac{1}{2}mv^2=eV_0$

95. $(E_1-E_2)=hc\left\{\frac{1}{\lambda_1}-\frac{1}{\lambda_2}\right\}$

96. $eV_0=\frac{hc}{\lambda}$ - w

97. $P=\left(\frac{n}{t}\right)E$

98. $P=\left(\frac{n}{t}\right)\left(\frac{hc}{\lambda}\right)$

99. For the photo electric cell the minimum energy $\left(\frac{hc}{\lambda}\right)$ required is 3.1eV, so sodium is suitable

100. K.E. = E-W_0

K.E^1=2E-W_0=2(E-W_0)+W_0=2K.E.+W_0

101. $h(v_1-v_2)=e(V_1-V_2)$

102. $P=\left(\frac{n}{t}\right)\left(\frac{hc}{\lambda}\right)$

103. $KE=\frac{P^2}{2m}=(E-w)\Rightarrow P=\sqrt{2m(E-w)}$

104. $\frac{KE_1}{KE_2}.=\left(\frac{E_1-w}{E_2-w}\right)=\left(\frac{\frac{1}{\lambda_1}-\frac{1}{\lambda_0}}{\frac{1}{\lambda_2}-\frac{1}{\lambda_0}}\right)$

105. $\frac{KE_1}{KE_2}=\left(\frac{E_1-w}{E_2-w}\right)$

106. $E=\frac{nhc}{\lambda}$

107. $\frac{1}{2}mv^2 = (hv - w)$

108. w=$\frac{hc}{\lambda_0}$

109. Incident energy is E=2.2+0.8=3ev

$\therefore \lambda = \frac{12400}{3} A^o$

110. $hc\left\{\frac{1}{\lambda_1} - \frac{1}{\lambda_2}\right\} = e(V_1 - V_2)$

111. $\frac{\upsilon_1^2}{\upsilon_2^2} = \frac{E_1 - w_1}{E_2 - w_2}$

112. $\frac{hc}{\lambda} = w + \frac{1}{2}mv^2$

113. $V_0 = \left(\frac{E - w}{e}\right)$

114. $\left(\frac{hc}{\lambda}\right) = w + KE$

115. $\frac{hc}{\lambda} = w + \frac{1}{2}mv^2$

116. eV = $\frac{hc}{\lambda_{\min}}$

117. $\sqrt{\frac{c}{\lambda}} = a(z - b)$

118. eV= $h\upsilon$

119. $i = \frac{ne}{t} \Rightarrow \frac{n}{t} = \frac{i}{e}; eV = \frac{1}{2}mv^2$

120. $\frac{H}{t} = \left(\frac{iV \times 99.1}{100}\right)$

121. $\upsilon = \sqrt{\frac{2eV}{m}}$

122. $\frac{1}{\lambda_\alpha} = R[z - b]^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

123. Frequency $\upsilon = \frac{pc}{h}$

124. $\Delta E = \frac{12400}{\lambda(\text{in } A^o)}$

125. $eV_0 = \frac{hc}{\lambda_{\min}} \Rightarrow V_0 \alpha \frac{1}{\lambda_{\min}}$

126. $\lambda_{\min} = \frac{hc}{eV_0}$ any wave length which is lessthen $\lambda_{\min}$ will not be present.

127. $(\lambda^1 - \lambda) = 0.0242(1 - \cos\phi)$

128. $\Delta\lambda = \frac{h}{m_0 c}(1 - \cos\phi); E_2 = E_1 - \left(\frac{12400}{\Delta\lambda}\right)$

129. $\Delta\lambda = 0.0242(1 - \cos\phi)$

130. $\lambda = \sqrt{\frac{150}{v}}$

131. $\lambda = \sqrt{\frac{150}{v}}$

132. $\lambda = \frac{h}{\sqrt{2m(KE)}}$

133. $\lambda = \frac{h}{\sqrt{2mqV}} \Rightarrow V_1 q_1 m_1 = V_2 q_2 m_2$

134 $\lambda = \frac{h}{\sqrt{2Vqm}} \Rightarrow \frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_p}{m_e}}$

135. $\frac{\lambda_p}{\lambda \propto} = \sqrt{\frac{q_\alpha}{q_p} \times \frac{m_\alpha}{m_p}}$

136. $\frac{\lambda_1}{\lambda_2} = \frac{P_2}{P_1}$

137. $\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{KE_2}{KE_1}}$

138. $\frac{\lambda_1}{\lambda_2} = \frac{V_2}{V_1}$

LEVEL-III
CATHODE RAYS:

139. The path of the cathode rays in an electric field can be approximated to a circle. In order to double the radius of the circular path keeping velocity constant

1) Double the electric field
2) Halve the electric field
3) Increase the electric field to four times
4) Triple the electric field

140. A doubly ionized He^{+2} atom travels at right angles to a magnetic field of induction 0.4 T at a velocity of 10^5 m/s describing a circle of radius r. A proton traveling with same speed in the same direction in the same field will describe a circle of radius
1) r/4 2) r/2 3) r 4) 2r

141. In a Millikan's set-up, a charged oil drop falls under gravity with a certain terminal speed. The drop is held stationary applying suitable electric field and is found to carry 2 excess electrons. Suddenly the drop is found to move upwards with the same terminal velocity. In this observation which of the following possibilities appear to be most be fitting?
1) the electric field stops acting
2) the drop looses the excess electrons
3) the drop picks up some additional electrons
4) data insufficient

142. In the Millikan's experiment, the oil drop is subjected to a horizontal electric field of 2 N/C and the drop moves with a constant velocity making an angle of 45^0 with the horizontal. If the weight of the drop is W, then the electric charge, in coulomb, on the drop is
1) W 2) W/2 3) W./4 4) W/8

143. A charged oil drop falls with terminal velocity V_0 in the absence of electric field. An electric field E keeps it stationary. The drop acquires additional charge q and starts moving upwards with velocity V_0. The initial charge on the drop was
1) 4q 2) 2q 3) q 4) q/2

144. A charged oil drop is held stationary in an electric field. The space surrounding the drop is exposed to a radioactive source and the drop moves with different terminal velocities v, 2v, 3v etc. It is inferred that
1) Charge is conserved
2) Drop carries negative charge
3) Charge is quantised
4) Drop carries positive charge

145. A stream of electrons enters an electrical field normal to the lines of force with a velocity of $3x10^7$ m/s. The electric intensity is 1800 v/m. While traveling through a distance of 10 cm ,the electron beam is deflected by 2mm.Then e/m value in coulomb per kg is
1) $2x10^{10}$ 2) $2x10^7$ 3) $2 x10^{11}$ 4) $2x10^4$

146. In Millikan's oil drop experiment, an oil drop of radius r and charge Q is held in equilibrium between the plates of a charged parallel plate capacitor when the potential difference is V.To keep a drop of radius 2r and charge 2Q in equilibrium between the plates ,the potential difference required will be
1)8 V 2)4 V 3) 2 V 4)1 V

147. A charged particle is moving in a uniform magnetic field in a circular path. The energy of the particle is doubled. If the initial radius of the circular path was R, the radius of the new circular path after the energy is doubled will be
1) R/2 2) $\sqrt{2}$ R 3) 2R 4) R/ $\sqrt{2}$

148. A charged dust particle of radius 5 x 10^{-7} m is located in a horizontal electric field having an intensity of 6.28x 10^5v/m. The surrounding medium is air with coefficient of viscosity η=1.6 x 10^{-5} NS/m^2. If this particle moves with a uniform horizontal speed of 0.02 m/s, the number of electrons on it will be
1) 10 2) 20 3) 30 4) 40

149. An electron travels in a circular path of radius 20 cm in a magnetic field of 2 x 10^{-3} tesla. The speed and the potential difference through which the electron should be accelerated to acquire this speed are (e=1.6x1^{-19}c, m=9.1 x 10^{-31}kg)
1) $7x10^7$m/s,13.9kV 2) $6x10^4$m/s, 9.4kV
3) $4.2x10^4$m/s,12.4kV 4) $7x10^8$m/s, 1.39 kV

150. An electron describing a circle is in a magnetic field of 10^{-4} tesla. The angular frequency of revolution, if mass is 9.1 x 10^{-31}kg and charge is $1.6x10^{-19}$coulomb, is
1) 1.24 X 10^7rad/s 2) 2.42 X 10^7rad/s
3) 1.62 X 10^7rad/s 4) 1.758 X 10^7rad/s

151. Two parallel plates 5cm apart are connected to a 500 V d.c supply. Assuming that an electron starts from rest, its velocity after a nano second is
1) 1.56 x 10^6m/s 2) 1.66 x 10^6m/s
3) 1.76 x 10^6m/s 4) 1.86 x 10^6m/s

152. A proton accelerated by a potential difference V gets into the uniform electric field of a parallel plate capacitor whose plates extend over a length 'l' in the motion direction. The field strength varies with time as E=at, where a is a constant. Assuming the proton to be non-relativistic, the angle between the motion directions of the proton before and after its flight through the capacitor is, if the proton gets in the field at the moment t=0. (The edge effects are to be neglected)

1) $\tan^{-1}\left[\frac{eal^2}{2m}\left(\frac{m}{2eV}\right)^{3/2}\right]$ 2) $\tan^{-1}\left[\frac{el^2}{2}\left(\frac{m}{2eV}\right)^{1/2}\right]$

3) $\tan^{-1}\left[\frac{eal^2}{2E}\left(\frac{m}{2V}\right)\right]$ 4) $\tan^{-1}\left[\frac{l^2E}{2m}\left(\frac{m}{2V}\right)^{3/2}\right]$

153. In a cathode-ray tube, an electron is accelerated from rest through a potential difference of 1000volt and enterd in a perpendicular electric field across two parallel plates. The length of the deflecting plates is 2cm and the distance between them is 0.5mm. If the deflection of the electron in the electric field is 0.25 mm, the p.d. between the plates is

1) 11.2 volt 2) 12.5 volt
3) 10.5 volt 4) 16.4 volt

154. A beam of protons with a velocity 4×10^5 m/s enters a uniform magnetic field of 0.3 tesla at an angle of 60^0 to the magnetic field. The radius of the helical path taken by the proton beam is nearly

1) 12×10^{-3}m 2) 12×10^{-5}m
3) 12×10^{-4}m 4) 21×10^{-3}m

155. An electron beam accelerated from rest through a potential difference of 5000V in vacuum is allowed to impinge on a surface normally. The incident current is 50mA, and if the electrons come to rest on striking the suface, the force on it is

1) 1.924×10^{-8}N 2) 2.1×10^{-8}N
3) 1.6×10^{-8}N 4) 1.6×10^{-6}N

156. A particle of mass 1×10^{-20}kg and charge $+1.6 \times 10^{-19}$C traveling with a velocity 1.28×10^6 m/s in the + x direction enters a region in which a uniform electric field E and a uniform magnetic field of induction B are present such that $E_x = E_y = 0$, $E_z = 102.4$kV/m and $B_x = B_z = 0$; $B_y = 8 \times 10^{-2}$wb/m^2. The particle enters this region at the origin at time t=0. The x,y and z coordinates of the particle at t=5×10^{-6}s are

1) (4.2,0,2) 2) (6.4,0,0) 3) (2,1.2,0) 4) (1,0,2)

157. A particle of mass 9×10^{-31}kg, negative charge of 1.6×10^{-19} coulomb is projected horizontally with a velocity of 10^6m/s into a region between two infinite horizontal parallel plates of metal. The distance between the plates is 0.3cm and the particle enters 0.1cm below the top plate. The top and bottom plates are connected to positive and negative terminals of a 30volt battery respectively. The component of velocity just before it hits one of the plates is

1) 4.2×10^4m/s 2) 1.88×10^{-6}m/s
3) 1.88×10^6m/s 4) 1.78×10^3m/s

158. In the Millikan's Oil drop method, the p.d's applied to the plates are measured as 750V, 250V, 187.5V and 150V so that the same oil drop is stationary, when it is made to pick up different charges by ionizing the space between the plates continuously. The charges picked up are multiples of fundamental charge (Assume that the mass of the drop remains to be constant)

1) 1 : 3 : 4 : 5 2) 1 : 2 : 3 : 4
3) 2 : 4 : 6 : 3 4) 4 : 3 : 2 : 1

159. In the absence of electric field the oil drop falls freely under gravity through a distance of 2.0 mm in 35.7 s. The radius of the drop, if the viscosity of air is 1.8×10^{-5} Nsm^{-2} and density of oil is 880 Kg/m^3, is (neglect the buouyancy)

1) 8.25×10^{-8}C 2) 7.25×10^{-7}C
3) 6.25×10^{-8}C 4) 6.25×10^{-7}C

160. A charged drop of radius 1.92mm is kept stationary by the application of an electric field of 1.65×10^6 N/C in Millikan's oil drop experiment. The charge, if the density of oil is 920 Kg/m^3, is

1) 1.72×10^{-18} 2) 1.62×10^{-19}
3) 1.82×10^{-17} 4) 1.92×10^{-17}

161. A drop of oil of radius 10^{-6} m carries a charge of four times that of electron. If the density of oil is 2000 kg/m^3, the potential difference which must be applied across the plates in Millikan's experiment in order that the drop may float, when the distance between the plates is 5mm apart, is

1) 620 V 2) 641 V 3) 541 V 4) 341 V

162. A charged drop with a mass of 5×10^{-14}Kg is in a plane horizontal capacitor, with the plates separated by 0.01 m apart. When the electric field is absent, the air resistance makes the drop to fall with a certain constant velocity. If a p.d of 6000 volt is applied to the capacitor plates, the drop falls with half the velocity. The charge on the drop is

1) 3.083×10^{-13}C 2) 4.083×10^{-19}C
3) 5.083×10^{-12}C 4) 4.083C

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

1) H^+ will be deflected most
2) O^{++} will be deflected most
3) He^+ and O^{++} will be deflected equally
4) both 1 and 3 are correct

164. A proton (mass m, charge e) projected with a velocity v passes undeviated through a region of crossed electric and magnetic fields. With what velocity should an alpha particle (mass 4m, charge -2e) be projected so that it passes undeviated through the same region?

1) V 2) 2V 3) 4V 4) 8V

PHOTO ELECTRIC EFFECT:

165. A small metal plate (work function =2ev) is placed at a distance of 2m from monochromatic light source of wavelength 4.8 x 10^{-7} m and power 1.0 watt. The light falls normally on the plate. If a constant magnetic field of strength 10^{-4} T is applied parallel to the metal surface, then the radius of the largest circular path followed by the photo electrons is
1) 0.04 m 2) 0.04 cm 3) 0.04 mm 4)0.04 km

166. For certain photosensitive material, a stopping potential of 3.0 V is required for light of wavelength 300 nm, 2.0 V for 400 nm and 1.0V for 600nm. The work function of the material is
1) 2.5 ev 2) 1.5 ev 3) 2.0 ev 4)1.0 ev

167. When a certain metallic surface is illuminated with monochromatic light of wavelength λ, the stopping potential for photoelectric current is $3v_0$. when the same surface is illuminated with light of wavelength 2λ, the stopping potential is v_0. The threshold wavelength for this surface for photoelectric effect is
1) 6λ 2) 4λ 3) $\frac{\lambda}{4}$ 4) 8λ

168. Photons of energy 2.0 eV fall on a metal plate and release photoelectrons with a maximum velocity V. By decreasing λ by 25% the maximum velocity of photoelectrons is doubled. The work function of the metal of the material plate in eV is nearly
1) 2.22 2) 1.985 3) 2.35 4) 1.80

169. 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
1) 2hc x 10^6 J 2) 1.5hc x 10^6 J
3) hc x 10^6 J 4) 0.5hc x 10^6 J

170. A small metal plate (work function =2ev) is placed at a distance of 2m from a monochromatic light source of wavelength 4.8 x 10^{-7} m and power 1.0 watt. The light falls normally on the plate. The number of photons striking the metal plate per second per unit area will be
1) 4.82 x 10^{12} 2) 4.82 x 10^{14}
3) 4.82 x 10^{16} 4) 4.82 x 10^{18}

171. A source of light is placed above a sphere of radius 10cm. How many photoelectrons must be emitted by the sphere before emission of photoelectrons stops? The energy of incident photon is 4.2 eV and the work function of the metal is 1.5 eV.
1) 2.08 x 10^{18} 2) 1.875 x 10^{8}
3) 2.88 x 10^{18} 4) 4 x 10^{19}

172. Photoelectrons emitted from a photo sensitive metal of work function 1eV describe a circle of radius 0.1cm in a magnetic field of induction 10^{-3} tesla. The energy of the incident photons is (mass of electron = 9 x 10^{-31}kg)
1) 1.09 ev 2) 2.9 ev 3) 0.9 ev 4) 0.81 ev

X- RAY SPECTRA:

173. The X-ray wavelength of L_α line of platinum (z=78) is 1.30 A^0. The X-ray wavelength of L_α line of Molybdenum (z=42) is (constant b=7.4)
1) 5.41 A^0 2) 4.20 A^0 3) 2.70 A^0 4)1.35 A^0

174. In a Compton effect experiment, X-ray photons of wavelength 0.22 A^0 suffer a Compton shift of 0.02 A^0. The fractional change in the energy of the incident photons is
1) $\frac{1}{12}$ 2) $\frac{6}{7}$ 3) $\frac{5}{12}$ 4) $\frac{5}{7}$

MATTER WAVES:

175. The de Broglie wavelength associated with an electron of velocity 0.3 c and rest mass 9.1 x 10^{-31}kg is
1) 7.68 x 10^{-10} m 2) 7.68 x 10^{-12} m
3) 5.7 x 10^{-12} m 4) 9.1 x 10^{-12} m

KEY

139.2	140.2	141.3	142.2	143.3	144.3	145.3
146.2	147.2	148.3	149.1	150.4	151.3	152.1
153.2	154.1	155.1	156.2	157.3	158.1	159.2
160.2	161.2	162.2	163.4	164.1	165.1	166.4
167.2	168.4	169.1	170.3	171.2	172.1	173.1
174.1	175.2					

HINTS

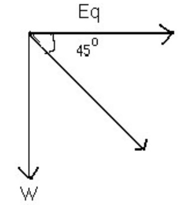
139. Eq = $\frac{mv^2}{r} \Rightarrow E\alpha\frac{1}{r}$

$$r = \frac{mv}{qB} \Rightarrow r \propto \frac{1}{\left(\frac{e}{m}\right)}$$

.

142. Tan $45^0 = \frac{Eq}{w}$

Eq = w



143. $6\pi \eta r V_0 = mg$

$Eq^1 = mg$

$E(q^1 + q) = 6\pi\ \eta r V_0 + mg = 2mg = 2Eq^1$

145. $y = \frac{1}{2}\left(\frac{Eq}{m}\right)\left(\frac{x}{v}\right)^2$

146. Eq=$\frac{4}{3}\pi\ r^3\ dg \Rightarrow \frac{Vq}{d} = \frac{4}{3}\pi\ r^3\ dg \Rightarrow \frac{V_1 q_1}{r_1^3} = \frac{V_2 q_2}{r_2^3}$

147. $r \propto \sqrt{KE} \Rightarrow \frac{r_2}{r_1} = \sqrt{\frac{KE_2}{KE_1}}$

148. $Eq = 6\pi \eta rv \Rightarrow E(ne) = 6\pi\ \eta rv$

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

150. $w = \frac{Bq}{m}$

151. V= $\frac{Eq}{m}t$

152. $V_y = \left(\frac{Ee}{m}\right)t = \left(\frac{ate}{m}\right)t = \frac{eat^2}{2m}$

$V_x = V$

$\tan\theta = \frac{V_y}{V_x}$ *and substituting*

$t = \frac{1}{v} = \frac{1}{\sqrt{\frac{2Ve}{m}}}$

153. $y = \frac{1}{2}\frac{Eql^2}{mv^2}$ and $\frac{1}{2}mv^2 = Vq$

$\frac{q}{mv^2} = \frac{1}{2V}$

$y = \frac{1}{2}El^2 \times \frac{1}{2V} = \frac{El^2}{4V}$ *find V*

154. $r = \frac{mV\sin\theta}{Bq}$

155. $i = \frac{ne}{t} \Rightarrow n = \frac{it}{e}$

Force = n mv = n $\sqrt{2m \times K.E.}$

156. F=Eq and E is along Z-axis
Fis along Z-axis
F=Bqv and B and q are along
y and x axis this force is along negative
Z-axis. The resultant force is zero.
Displacement along x-axis=x=Vt

157. $a = \frac{Eq}{m}$

and $V^2 = 2as$ *Where* $s = 0.1\ cm$

158. $mg = Eq = \frac{V}{d}q$

For the same oil drop m is constant

$\therefore q\,\alpha\,\frac{1}{V} \Rightarrow q_1 : q_2 : q_3 = \frac{1}{V_1} : \frac{1}{V_2} : \frac{1}{V_3}$

159. $r = \sqrt{\frac{9\eta v}{2\rho g}}$ *Where* $v = \frac{S}{t}$

160. $mg = Eq$

$\frac{4}{3}\pi\ r^3\rho\ \ g = \frac{V}{d}q$

161. $mg = Eq$

$\frac{4}{3}\pi\ r^3\rho\ \ g = \frac{V}{d}q$

162. When there is no E,
mg
when thereE,

$mg - Eq = 6\pi\ \eta\ r\frac{V}{2} ------(2)$

166. $V_s e = h\nu - w = \frac{12400}{\lambda\ \ in\ A^0} - w$

$3 = 4.18 - w$

168. $\frac{1}{2}mv_{max}^2 = h\nu - w$ *and*

$h\nu = \frac{hc}{\lambda}$

170. $\frac{n}{t} = \frac{p}{h\nu}$ *Where* $\frac{n}{t}$ *is* number of photons emitted per second. These are distributed over a sphere of radius 2m. The number of photons per unit area

$$\frac{\frac{n}{t}}{Surface\ of\ the\ Sphere} = \frac{\frac{n}{t}}{4\pi r^2}$$

171. Stopping potential =4.2-1.5=2.7V

$$v=\frac{Q}{4\pi\ \varepsilon_0 r}\Rightarrow Q=3\times10^{-11}$$

$$ne=3\times10^{-11}$$

172. $$r=\frac{mV}{Bq}=\frac{p}{Bq}=\frac{\sqrt{2m\times KE}}{Bq}$$

$$KE=\frac{B^2q^2r^2}{2m}=hv-w$$

LEVEL IV

I. Read the passage given below

X-rays are generated when high speed electrons are suddenly stopped by high atomic number targets. X-rays are electromagnetic waves of wavelength between $100A^0$ to $0.1\ A^0$. They travel with velocity of light. There are two types of X-rays.

a) Continuous X-rays b) Characteristic X-rays

When electron with high energy penetrate target atoms, they strikes the electrons of inner shells and knock out them from the atoms, then deficiency of electrons is created in the inner shell. Electrons from higher shell jumps into this shell to full fill this deficiency. In this process photons with energies equal to difference of energies of initial and final shells are emitted. These are characteristic X-rays. So, the frequency of characteristic X-rays depends on the nature of target and independent of applied voltage across filament and target.

Moseleys law for characteristic X-rays is

$\frac{1}{\lambda}=R(z-b)^2\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$. Moseleys law is Applicable to characteristic X-rays only. It means it is applicable to only those transitions of atoms during which an X-ray photon is emitted. Hence it can't be applied to all the transitions.

For higher values of n_1 and n_2, energy difference will be small.Therefore, emitted photon will not be an X-ray photon. Hence Moseley's law can't be applicable for such transitions. As an example hydrogen can't emit X-ray as the energy levels in hydrogen atoms are very close to each other.

Answer the following questions.

1. Moseleys law is
   1) applicable to all those atoms to which Bohr's theory is not applicable.
   2) applicable to all energy levels of same atoms only.
   3) not applicable for higher values of n_1 and n_2.
   4) not applicable for higher values of z
2. The frequency of characteristic X-rays
   1) Nature of target 2) Nature of filament
   3) Applied voltage across filament and target
   4) All are correct
3. Hydrogen atom does not emit X-rays because
   1) it has single electron 2) it is very small in size
   3) its energy levels are too far apart
   4) its energy levels are too close to each other
4. Characteristic X-rays are produced when
   1) high energy incident electrons are accelerated
   2) low energy incident electrons are accelerated
   3) high energy incident electrons knock out electrons from the inner shells of the target atoms.
   4) when valence electrons of the target element are are knocked out
5. X-rays are
   1) stream of electrons 2) stream of protons
   3) electromagnetic radiations
   4) stream of uncharged particles

II. Read the following passage

If a particle of mass m moves with velocity v, then de Broglie waves as associated with the moving particle. The Wavelength of de Broglie wave is

$\lambda=\frac{h}{\sqrt{2mK}}$, where K in the energy of the moving particle.

When photons of energy 4.25 eV strike the surface of a metal A, the ejected photo electrons have maximum kinetic energy K_A eV and de-broglie wavelength λ_A. The maximum K.E. of photo electrons liberated from another metal B by photons of energy 4.7 eV is K_B. The Kinetic energies are related as K_A-K_B=1.5eV. If the de-Broglie wavelength of these photoelectron is $\lambda_B=2\lambda_A$, then answer the following questions.

1. The value of K_A is
   1) 2 eV 2) 2.25 eV 3) 4.5 eV 4) 4.7 eV
2. The value of K_B is
   1) 1.2 eV 2) 0.5 eV 3) 1 eV 4) 1.5 eV
3. The work function of A is
   1) 2.25 eV 2) 4.20 eV 3) 2.5 eV 4) 1.5 eV
4. The work function of B is
   1) 2.25 eV 2) 4.2 eV 3) 2.5 eV 4) 4 eV

KEY

I. 1. 3 2. 1 3. 4 4. 3 5. 3

II. 1. 1 2. 2 3. 1 4. 2

PREVIOUS EAMCET QUESTIONS

1. According to Moseley's law the frequency ν of k_α line and the atomic number (z) of the element have the relation (A & B are constants) [EAMCET2005E]

1) $\frac{\nu}{Z-A}=B$ 2) $\frac{\sqrt{\nu}}{Z-A}=B$

3) $\nu(Z-A)=B$ 4) $\nu(Z-A)^2=B$

2. The incident photon involve in the photo electric effect experiment [EAMCET2005M]
1) completely disappears
2) comes out with increased frequency
3) comes out with a decreased frequency
4) comes out with out change in frequency

3. According to Moseley's law the frequency ν of k_α line and the atomic number (z) of the element have the relation (C = constant) [EAMCET2005M]

1) $\nu\alpha(Z-C)$ 2) $\nu\alpha(Z-C)^2$

3) $\sqrt{\nu}(Z-A)=B$ 4) $\nu\alpha\left(\frac{1}{Z-C}\right)^2$

4. $\Delta\lambda$ is the difference between the wavelength of K_α line and the minimum wavelength of the continuous X-ray spectrum when the X-ray tube is operated at a voltage *V*. If the operating voltage is changed to $\frac{V}{3}$, then the above difference is $\Delta\lambda'$. Then [EAMCET2004E]

1) $\Delta\lambda^1=5\Delta\lambda$ 2) $\Delta\lambda^1=4\Delta\lambda$

3) $\Delta\lambda^1=3\Delta\lambda$ 4) $\Delta\lambda^1<3\Delta\lambda$

5. 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] [EAMCET2004E]
1) 7.5 x 10^{13} 2) 13.5 x 10^{13}
3) 13.5 x 10^{14} 4) 7.5 x 10^{15}

6. 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 [EAMCET2004M]

1) $K_1>\frac{K_2}{3}$ 2) $K_1<\frac{K_2}{3}$

3) $K_1=3K_2$ 4) $K_2=3k_1$

7. Light rays of wavelengths 6000 A^o 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}] [EAMCET2004E]
1) 12 x 10^{18} 2) 10 x 10^{18}
3) 12 x 10^{17} 4) 12 x 10^{15}

8. Two ions having masses in the ratio 1:1 and charges 1:2 are projceected into uniform magnetic field perpendicular to the field with speeds in the ratio 2:3 .The ratio of the radii of circular paths along which the two particles move is [EAMCET2003M]
1) 4:3 2) 2:3 3) 3:1 4) 1:4

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 ratio of double the wavelength then the stopping potential becomes 1.6 volts. Then the threshold wavelength for the surface is [EAMCET2003E]
1) 2λ 2) 4λ 3) 6λ 4) 8λ

10. An X-ray tube is operated at a constant potential difference and it is required to get X-ray of wavelength not less then 0.2 nano-meters. Then the potential difference in kilo-volts is
$\left[h=6.63\times10^{-34}J-\text{sec}; e=1.6\times10^{-19}C; c=3\times10^8 ms^{-1}\right]$
[EAMCET2003M]
1) 24.8 2) 12.4 3) 6.2 4) 3.1

11. The de-Brogile wavelength of a particle moving with a velocity 2.25 x 10^3 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}] [EAMCET2003M]
1) 1/8 2) 3/8 3) 5/8 4) 7/8

12. 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. $\sqrt{2}$:1 2. $\sqrt{3}$: 1 3. $\sqrt{3}$: $\sqrt{2}$ 4.1 : $\sqrt{2}$

13. In Compton scattering process, the incident X-radiation is scattered at an angle 60^o. The wavelength of the scattered radiation is 0.22 A^o. The wavelength of the incident X-radiation in A^o

$\left(Take\ \frac{h}{m_0c} = 0.024\ A^o\right)$

1. 0.508 2. 0.408 3. 0.232 4. 0.208

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

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

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

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

1. 11 A° 2. 111A° 3. 211 A° 4. 311 A°

17. Monochromatic X-rays of wavelength 0.12 A° undergo Compton scattering through an angle 60° from a carbon block. The wavelength of the scattered X-rays, in A° $\left(Take\ \frac{h}{m_0c} = 0.024\ A^o\right)$

1. 0.112 2. 0.132 3. 0.156 4. 0.182

18. The work function of Potassium is 2.0 eV. When it is illuminated by light of wavelength 3300 A°, photoelectrons are emitted. The stopping potential of photoelectrons is [Planck's constant = 6.6×10^{-34} Js, 1eV = 1.6×10^{-19} J, Velocity of light, c = $3 \times 10^8 ms^{-1}$]

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

19. A positron and a proton are accelerated by the same accelerating potential. Then the ratio of the associated wavelengths of the positron and the 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. $\sqrt{\frac{m}{M}}$

20. In Compton scattering, x-rays of 1 A° are scattered from a carbon block (Z=6)and a Zinc block (Z=30) at 90^0 with the incident beam. The ratio of scattered wavelengths is,

1. 1:5 2. 5:1 3. 1:1 4. 1:25

21. A particle of mass 0.6 g and having charge of 26 nc is moving horizontally with a uniform velocity $1.2 \times 10^4\ ms^{-1}$ in a uniform magnetic field. Then the value of the magnetic induction is approximately $(g = 10 ms^{-2})$

1. Zero 2. 10T 3. 20T 4. 200T

22. Photoelectric emission is observed from a metallic surface for frequencies ν_1 and ν_2 of the incident light rays ($\nu_1 > \nu_2$). 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. $\frac{\nu_2 - \nu_1}{K - 1}$ 2. $\frac{K\nu_1 - \nu_2}{K - 1}$
3. $\frac{K\nu_2 - \nu_1}{K - 1}$ 4. $\frac{\nu_2 - \nu_1}{K}$

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

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

24. Consider the following statements A and B and identify the correct choice in the given answers.
A. Tightly bound electrons of target material scatter X-ray photon, resulting in the Compton effect.
B. Photoelectric effect takes place with free electrons.

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

25. If an electron revolves in the path of a circle of radius of 0.5×10^{-10} m at a frequency of 5×10^{15} cycles/second, the electric current in the circle is

1. 0.4 mA 2. 0.8 mA 3. 1.2 mA 4. 16 mA

26. 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

27. Consider the following two statements A and B and identify the correct choice in the given answers
A. The characteristic X-ray spectrum depends on the nature of the material of the target.
B. The short wavelength limit of continuous X-ray spectrum varies inversely with the p.d. applied to the X-ray tube.

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

28. A charged particle of mass $5x10^{-6}$ kg is held stationary in space by placing it in an electric field of strength $10^6\ NC^{-1}$ directed vertically downwards. The charge of the particle is ($g = 10ms^{-2}$)
1. $-20x10^{-4}\mu C$ 2. $-5x10^{-5}\mu C$
3. $5x10^{-5}\mu C$ 4. $20\times10^{-5}\mu C$

29. 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
1. $2\lambda cx10^6 J$ 2. $1.5\lambda cx10^6 J$
3. $\lambda cx10^6 J$ 4. $0.5\lambda cx10^6 J$

30. The energy of X-ray photon of wavelength 1.65 A° is
1. 3.5 keV 2. 5.5 keV 3. 7.5 keV 4. 9.5 keV

31. In a photoelectric experiment, the maximum velocity of photoelectrons emitted
1. depends on intensity of incident radiation
2. does not depend on cathode material
3. depends on frequency of incident radiation
4. does not depend on wavelength of incident radiation

32. The threshold frequency for photoelectric effect of a metal surface is found to be $4.8x10^{16}$ Hz. The stopping potential required when the metal is irradiated by radiation of frequency $5.6x10^{16}$ Hz is (taking $h = 6.6x10^{-34}$ Js and $e = 1.6x10^{-19} C$)
1. 22.4 V 2. 33V 3. 66 V 4. 198 V

33. If the operating voltage of an X-ray tube is increased
1. X-ray intensity increases
2. X-ray wavelength limit on the maximum side increases
3. X- ray wavelength limit on the maximum side decreases
4. X-ray intensity decreases.

34. The photoelectric threshold wavelength for potassium (work function being 2 eV) is
1. 310 nm 2. 620 nm 3. 6200 nm 4. 3100 nm

35. The photoelectric work function of a metal surface is 2 eV. When light of frequency $1.5x10^{15}$ Hz is incident on it, maximum kinetic energy of the photoelectrons, approximately is
1. 8 eV 2. 6 eV 3. 2 eV 4. 4 eV

36. The $\frac{e}{m}$ value of electron is
1. $1.6x10^{11} C/kg$ 2. $1.6x10^{-19} C/kg$
3. $1.759x10^{11} C/kg$ 4. $9.1x10^{-31} C/kg$

37. The number of electrons emitted by a surface exposed to light is directly proportional to
1. Frequency of light 2. Work function
3. Thereshold wavelength 4. Intensity of light

38. Moseley's law states that
1. $\sqrt{\upsilon} = a(Z-b)$ 2. $\upsilon = a^2(Z-b)$
3. $\upsilon = \sqrt{a(Z-b)}$ 4. $\sqrt{\upsilon} = a(Z-b)^2$

39. In a photo electric phenomenon, the number of photo electrons emitted depends on
1. the intensity of incident radiation
2. the frequency of incident radiation
3. the velocity of incident radiation
4. the work function of the photocathode

40. According to Moseley's law, the frequency of a spectral line in X-ray spectrum varies as
1. atomic number of the element
2. square of atomic number of the element
3. square root of atomic number of the element
4. fourth power of atomic number of the element

41. The photo electric work function for a metal surface is 4.125 eV. The cut-off wavelength for this surface is
1. 4125 A° 2. 2062.5 A° 3. 3000 A° 4. 6000 A°

42. X-rays are
1. stream of electrons
2. stream of protons
3. electromagnetic radiation
4. stream of uncharged particles

43. The threshold wavelength is 2000 A°. The work function is
1. 6.25 eV 2. 6.2 eV 3. 6.2 MeV 4. 6.2 keV

44. A particle carrying a charge e perpendicular to a uniform magnetic field of induction B with a momentum p, then the radius of the circular path is
1. $\frac{Be}{p}$ 2. $\frac{pe}{B}$ 3. $\frac{p}{Be}$ 4. Bep

45. A photon of energy 2.5 eV and wavelength λ falls on a metal surface and the ejected electrons have velocity 'v'. If the λ of the incident light is decreased by 20%, the maximum velocity of the emitted electrons is doubled. The work function of the metal is
1. 2.6 eV 2. 2.23 eV 3. 2.5 eV 4. 2.284 eV

46. A charged particle accelerated through a potential difference of 100V passes through uniform electric and magnetic fields so as to experience no deflection.
$E = 15x10^6\ Vm^{-1}$ and $B = 5x10^3 T$. Then the specific charge $\frac{e}{m}$ is
1. $4.5x10^4 C/kg$ 2. $9x10^7 C/kg$
3. $4.5x10^3 C/kg$ 4. $9x10^5 C/kg$

47. Photo electric current can be increased by using
1. higher frequency radiation
2. higher intensity radiation
3. higher work function metal plates
4. none of these

48. Emission of electrons in photo electric effect is possible, if
1. metal surface is highly polished
2. the incident light is of sufficiently high intensity
3. the light is incident at right angles to the surface
4. the incident light is of sufficiently low wavelength

49. The force experienced by the cathode rays when they pass through uniform electric field of intensity $\overline{E}$ is
1. in the direction of the electric field
2. in the direction opposite to that of the electric field
3. at right angles to the electric field
4. zero, because cathode rays do not have any charge

50. Light of frequency 1.5 times the threshold frequency is incident on a photosensitive material. If the frequency of the incident light is halved and the intensity is doubled, photoelectric current becomes
1. quadrupled 2. doubled
3. halved 4. zero

51. In photo electric effect, the photo electric current
1. increases when the frequency of incident photon increases
2. decreases when the frequency of incident photon decreases
3. does not depend upon the photon frequency but depends on the intensity of incident beam
4. depends both on the intensity and frequency of the incident beam.

KEY

1. 2	2. 1	3.2	4. 4	5. 3	6. 2	7. 3	
8. 1	9. 2	10. 3	11. 2	12.4	13.3	14.3	15.4
16.1	17.2	18.2	19.2	20.3	21.3	22.2	23.4
24.4	25.2	26.2	27.3	28.2	29.1	30.3	31.3
32.2	33.1	34.2	35.4	36.3	37.4	38.1	39.1
40.2	41.3	42.3	43.2	44.3	45.4	46.1	47.2
48.4	49.2	50.4	51.3				

QUESTIONS FROM OTHER COMPETITIVE EXAMS

1. In an x-ray tube, x-rays are produced by electrons accelerated by V volt. The maximum frequency of x-rays produced is
1. eVh 2. $\frac{hV}{e}$ 3. $\frac{eh}{V}$ 4. $\frac{eV}{h}$

2. Electrons with energy 80 keV are incident on tungsten target of an x-ray tube. X-rays emitted by the tube contain only
1. a continuous x-ray spectrum (Bremsstrahlung) with a minimum wavelength of 0.155 A°
2. a continuous x-ray spectrum (Bremsstrahlung) with all wavelength
3. the characteristic x-ray spectrum of tungsten.
4. a continuous x-ray spectrum with minimum wavelength of 0.155 A° and the characteristic x-ray spectrum of tungsten.

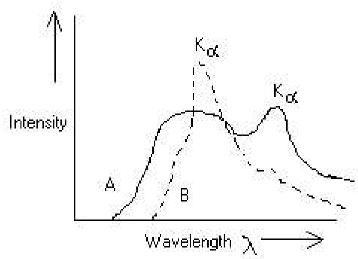
3. Cathode rays produced in a certain discharge tube are deflected in the same direction if
1. A magnetic field is applied tangential
2. An electric field is applied tangential
3. An electric field is applied normally
4. A magnetic field is applied normally

4. The work function of caesium is 1.8eV. Light of 5000 A° is incident on it. The maximum velocity of emitted electrons is nearly
1. $5x10^6 m/s$ 2. $5x10^5 m/s$
3. $5x10^4 m/s$ 4. $5x10^3 m/s$

5. The frequency of X- rays, γ - rays and UV rays are respectively a,b and c. Then
1. a < b ; b < c 2. a> b ; b < c
3. a < b ; b > c 4. a > b ; b > c

6. The work function of a substance is 4.0 eV. The longest wavelength of light that can cause photoelectric emission from this substance is approximately
1. 220 nm 2. 310 nm 3. 540 nm 4. 400 nm

7. The following figure represents the observed intensity of X-rays emitted by two different tubes A and B as a function of wavelength λ. For tube A, the potential difference between the filament and target is V_A and atomic number of target is Z_A. For the tube B, corresponding potential difference is V_B and atomic number is Z_B. The solid curve is for tube A and dotted curve for tube B; then

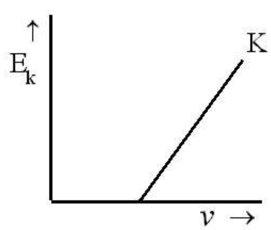


1. $Z_A > Z_B$, $V_A > V_B$ 2. $Z_A = Z_B$, $V_A = V_B$
3. $Z_A < Z_B$, $V_A < V_B$ 4. $Z_A < Z_B$, $V_A > V_B$

8. K_α characteristic X- ray refers to the transition
1. n = 2 to n = 1 2. n = 3 to n = 2
3. n = 3 to n= 1 4. n = 4 to n = 2

9. The wavelength of most energetic X-ray emitted when it is bombarded by 40 keV electrons is approximately
1. 300 A° 2. 10 A° 3. 4 A° 4. 0.31A°

10. The maximum kinetic energy (E_k) of emitted photoelectrons against frequency ν of incident radiation is plotted as shown in fig. The slope of the graph is equal to



1. charge on electron
2. work function of emitter
3. Planck's constant
4. ratio of Planck's constant and charge on electron

11. When orange light falls on a photo sensitive surface the photocurrent begins to flow. The velocity of emitted electrons will be more when surface is hit by
1. red light 2. violet light
3. thermal radiationas 4. radio waves

12. When the amplitude of the light wave incident on a photometal sheet is increased then
1. the photoelectric current increases
2. the photoelectric current remains unchanged
3. the stopping potential increases
4. the stopping potential decreases

13. When a point source of mono chromatic light is at a distance of 0.2 m from a photoelectric cell, the cut off voltage and the saturation current are 0.6 V and 18 mA respectively. If the same source is placed 0.6 m away from the photoelectric cell then
1. the stopping potential will be 0.2 V
2. the saturation potential will be 0.6 V
3. the stopping current will be 6 mA
4. the saturation current will be 18 mA

14. The wavelength of K_α line for an element of atomic number 43 is λ. Then the wavelength of K_α line for an element of atomic number 29 is

1. $\frac{9}{4}\lambda$ 2. $\frac{43}{29}\lambda$ 3. $\frac{4}{9}\lambda$ 4. $\frac{42}{28}\lambda$

15. The velocity of the most energetic electrons emitted from a metal surface is doubled when the frequency ν of incident radiation is doubled. The work function of the metal is

1. $\frac{2}{3}h\nu$ 2. $\frac{h\nu}{2}$ 3. $\frac{h\nu}{3}$ 4. zero

16. For light of certain frequency (i)........ the threshold frequency, the photoelectric current is (ii) .... proportional to the intensity of light. The blank spaces (i) and (ii) in above statement must be filled with
1. (i) below (ii) directly 2. (ii) above (ii) inversely
3. (i) above (ii) directly 4. (i) below (ii) inversely

17. Relation between the stopping potential V_o of a metal and the maximum velocity v of the photoelectrons is

1. $V_o \alpha \frac{1}{v^2}$ 2. $V_o \ \alpha \ v^2$

3. $V_o \ \alpha \ v$ 4. $V_o \ \alpha \frac{1}{v}$

18. de Broglie wavelength 'λ' is proportional to

1. $\frac{1}{\sqrt{E}}$ for photons and $\frac{1}{E}$ for particles

2. $\frac{1}{E}$ for photons and $\frac{1}{\sqrt{E}}$ for particles

3. $\frac{1}{E}$ for both photons and particles in motion

4. $\frac{1}{\sqrt{E}}$ for both photons and particles

19. X-rays are produced in an X-ray tube operating at a given accelerating voltage. The wavelength of continuous X-ray has values from
1. 0 to ∞
2. l_{min} to ¥ where $l_{min} > 0$
3. 0 to l_{min} where l_{max} < ¥
4. λ_{min} to λ_{max} where $0<\lambda_{min}$ and $\lambda_{max} < \infty$

20. The maximum velocity of an electron emitted by light of wavelength λ incident on the surface of a metal of workfunction ϕ is
1. $\left[\frac{2(hc+\lambda\phi)}{m\lambda}\right]^{1/2}$ 2. $\frac{2(hc-\lambda\phi)}{m}$
3. $\left[\frac{2(hc-\lambda\phi)}{m}\right]^{1/2}$ 4. $\left[\frac{2(hc\lambda-\phi)}{m}\right]^{1/2}$
where h = Planck's constant, m = mass of electron and c=speed of light

21. A photon of energy 8.6 eV is incident on a metal surface of threshold frequency 1.6×10^{15} Hz. The kinetic energy of the photoelectrons emitted (in eV) nearly
1. 1.6 2. 6 3. 2 4. 1.2

22. The photoelectric threshold wave length sof a certain metal is 3000 A°. If radiation of 2000 A° is incident on the metal
1. protons will be emitted
2. electrons will be emitted
3. positrons will be emitted
4. electrons will not be emitted

23. The work function of a substance is 4.0 eV. The longest wavelength of light that can cause photoelectron emission from this substance is approximately
1. 540 nm 2. 400 nm 3. 310 nm 4. 220 nm

24. Light of wavelength 5000 A° falls on a sensitive plate with photoelectric work function 1.9 eV. The kinetic energy of the photoelectrons emitted will be
1. 0.58 eV 2. 2.48 eV 3. 1.24 eV 4. 1.16 eV

25. In a photoemissive cell with exciting wavelength λ, the fastest electron has a speed v. If the exciting wavelength is changed to $\frac{3\lambda}{4}$, the speed of the fastest emitted electrons will be
1. $v\left(\frac{3}{4}\right)^{1/2}$ 2. $v\left(\frac{4}{3}\right)^{1/2}$
3. less than $v\left(\frac{4}{3}\right)^{1/2}$ 4. greater than $v\left(\frac{4}{3}\right)^{1/2}$

26. Which of the following is dependent on the intensity of incident radiation in a photoelectric experiment
1. work function of the surface
2. amount of photoelectric current
3. stopping potential
4. maximum kinetic energy

27. Light of certain wavelength and intensity ejects photoelectrons from a metal plate. Then the beam is replaced by another beam of smaller wavelength and smaller intensity. As a result
1. emission of photoelectrons stops
2. no change occurs
3. KE of photoelectrons increases but the strength of photoelectric current decreases
4. KE of photoelectrons decreases but the strength of photocurrent increases

28. The energy of incident photon is 12.375 eV while the energy of scattered photon is 9.375 eV. The the KE of recoil electrons is
1. 3 eV 2. less than 3 eV
3. more than 3 eV 4. 21.75 eV

29. An electron beam in x-ray tube is accelerated through a potential difference of 50,000 volt. These are then made to fall on a tungsten target. The shortest wavelength of the X-rays emitted by the tube is
1. 2.5 A° 2. 0.25 nm 3. 0.25 cm 4. 0.025 nm

30. The photoelectric current can be increased by
1. increasing frequency 2. increasing intensity
3. decreasing intensity 4. decreasing wavelength

31. Light of wavelength λ strikes a photosensitive surface and electrons are ejected with kinetic energy E. If the kinetic energy is to be increased to 2E, the wavelength must be changed to λ' where
1) $\lambda' = \frac{\lambda}{2}$ 2) $\lambda' = 2\lambda$ 3) $\frac{\lambda}{2} < \lambda' < \lambda$ 4) $\lambda' > \lambda$

32. Einstein's photoelectric equation states that $E_k = h\nu - W$, In this equation E_k refers to :
1. kinetic energy of all ejected electrons
2. mean kinetic energy of emitted electrons
3. minimum kinetic energy of emitted electrons
4. maximum kinetic energy of emitted electrons

33. Maximum velocity of photoelectrons emitted by a photometer is 1.8×10^6 m/s. Taking $\frac{e}{m} = 1.8\times10^{11}$ C/kg for electrons, the stopping potential of emitter is
1. 9 V 2. 11.8 V 3. 1.8 V 4. 10^6 V

34. If an electron and a proton have the same KE, the ratio of the de Broglie wavelengths of proton and electron would approximately be
1. 1 : 1837 2. 43 : 1 3.1837 : 1 4.1 : 43

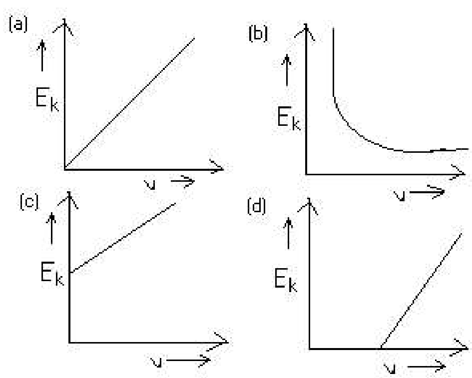
35. The minimum wavelength of X-rays produced by electrons accelerated through a potential difference of V volt is directly proportional to
1.$V^{1/2}$ 2.V^2 3.$V^{-1/2}$ 4.V^{-1}

36. For modern X-ray tube, the wavelength of emitted X-rays and applied potential V of the tube are related as
1. $\lambda = \frac{12400}{V} A^o$ 2. $\lambda = \frac{12400}{\sqrt{V}} A^o$
3. $\lambda = \frac{1240}{\sqrt{V}} A^o$ 4. $\lambda = 12400\ A^o$

37. The wavelength of K_α X-rays produced in an X-ray tube is 0.76 A°. The atomic number of the anode material of the tube is (Rydberg's constant, R= $1.097 \times 10^7\ m^{-1}$)
1. 38 2.40 3.41 4.42

38. An X-ray tube is being operated at 10 kV. The maximum frequency of X-rays produced is
1. 2.4×10^{20} Hz 2.2.4×10^{19} Hz
3. 2.4×10^{18} Hz 4.2.4×10^{11} Hz

39. Maximum kinetic energy (E_k) of a photoelectron varies with the frequency (ν) of the incident radiation as :



1. (a) 2. (b) 3. (c) 4. (d)

40. Which one of the following is true in photoelectric emission
1. photoelectric current is directly proportional to the amplitude of light of given frequency
2. photoelectric current is directly proportional to the intensity of light of given frequency at moderate intensities
3. above the threshold frequency the maximum kinetic energy of photoelectrons is inversely proportional to the frequency of incident light
4. the threshold frequency depends on the wavelength of incident light

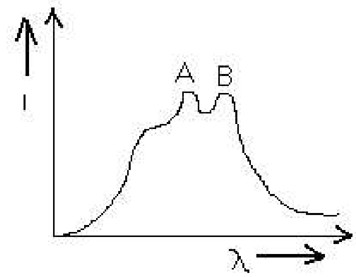
41. Threshold wavelength for a metal having work function ω_o is λ. What is the threshold wavelength for the metal having work function 2 ω_o?
1.4 λ 2. 2 λ 3. λ/2 4. λ/4

42. A potential difference of 42,000 volt is used in an X- ray tube to accelerate electrons. The maximum frequency of the X- radiations produced is
1. 10^{19} Hz 2. 10^{18} Hz 3. 10^{16} Hz 4. 10^{20} Hz

43. X-rays are produced due to
1. Break up of molecules
2. Change in atomic energy level
3. Change in nuclear energy level
4. Radioactive disintegration

44. X-rays will not show the phenomenon of
1. Diffraction 2. Polarization
3. Interference 4. Deflection by electric field

45. The fig. represents the observed intensity of X-rays emitted by an X-ray tube as a function of wavelength. The sharp peaks A and B denote



1. band spectrum 2. continuous spectrum
3. characteristic spectrum 4. white radiation

46. If the work function of the metal is W and the frequency of the incident light is υ, then there is no emission of photoelectrons if
1. ν < W/h 2. ν > W/h
3. $\nu \geq$ W/h 4. $\nu \gtrless$ W/h

47. Ultraviolet light of wavelength 300 nm and intensity 1.0 W/m^2 falls on the surface of a photoelectric material. If one percent of the incident photons produce photoelectrons, then the number of photoelectrons emitted from an area of 1.0 cm^2 of the surface is nearly
1. 9.61×10^{14} per second
2. 4.12×10^{13} per second
3. 1.51×10^{12} per second
4. 2.13×10^{11} per second

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

1. $\frac{I}{2}$ 2. I 3. 2I 4. 4I

49. The photoelectric threshold of tungsten is 2300 A°. The energy of electrons ejected from the surface if ultra-violet light of wavelength 1800 A° is incident on it is

1. 1.5 eV 2. 2 eV 3. 3.2 eV 4. 6 eV

50. The work function of a metal is 1.6×10^{-19} J. When the metal surface is illuminated by the light of wavelength 6400 A°, then the maximum kinetic energy of emitted photoelectrons will be ($h = 6.4 \times 10^{-14}$ Js)

1. 14×10^{-19} J 2. 2.8×10^{-19} J
3. 1.4×10^{-19} J 4. 1.4×10^{-19} eV

51. Kinetic energy with which the electrons are emitted from a metal surface due to photoelectric effect is

1. Independent of the intensity of illumination
2. Dependent on the frequency of light
3. Inversely proportional to the intensity of illumination
4. Directly proportional to the intensity of illumination

52. Work function of a metal is 2.1 eV. Which of the waves of the following wavelengths will be able to emit photoelectrons from its surface?

1. 4000 A°, 7500 A° 2. 5500 A°, 6000 A°
3. 4000 A°, 5000 A° 4. 5500 A°, 7500 A°

53. When a metal surface is illuminated by a monochromatic light of wave - length λ, then the potential difference required to stop the ejection of electrons is 3V. When the same surface is illuminated by the light of wavelength 2λ, then the potential difference required to stop the ejection of electrons is V. Then for photoelectric effect, the threshold wavelength for the metal surface will be

1. 6λ 2. $4\lambda/3$ 3. 4λ 4. 8λ

54. An electron beam after collision with the target produces X-rays of wavelength 4 A°. The velocity of the electron beam is

1. 3.31×10^7 m/s 2. 6.31×10^7 m/s
3. 8.31×10^7 m/s 4. 9.31×10^7 m/s

55. The potential difference applied to an X-ray tube is increased. As a result, in the emitted radiation

1. The intensity decreases
2. The minimum wavelength increases
3. The intensity remains unchanged
4. The minimum wavelength decreases

56. Compton effect is associated with

1. α -rays 2. β - rays
3. X-rays 4. Positive rays

57. Which of the following is accompanied by the characteristic X-ray emission?

1. α - particle emission 2. Electron emission
3. Positron emission 4. K-electron capture

58. When photons of energy 4.25 eV strike the surface of a metal A, the ejected photoelectrons have maximum kinetic energy T_A eV and de Broglie wavelength λ_A. The maximum kinetic energy of photoelectrons liberated from another metal B by photons of energy 4.70 eV is $T_B = (T_A - 150)$ eV. If the de Broglie wavelength of these photo electrons is $\lambda_B = 2\lambda_A$, then

1. Work function of A is 2.25 eV
2. Work function of B is 4.20 eV
3. $T_A = 2.00$ eV 4. $T_B = 2.75$ eV

59. What wavelength is corresponding to a beam of electrons whose kinetic energy is 100 eV? ($h = 6.6 \times 10^{-34}$ Js, 1 eV = 1.6×10^{-19} J, $m_e = 9.1 \times 10^{-31}$ kg)

1. 4.8 A° 2. 3.6 A° 3. 1.2 A° 4. 2.4 A°

60. A photocell is receiving light from a source placed at a distance of 1 m. If the same source is to be placed at a distance of 2 m, then the ejected electron

1. Moves with one - fourth energy as that of the initial energy
2. Moves with one-fourth of momentum as that of the initial momentum
3. Will be half in number
4. Will be one - fourth in number

61. The maximum energy of photo electrons emitted in a photocell is 2 eV. For no photo-electrons to reach the anode, the stopping potential should be

1. 2 V 2. -2 V 3. 4 V 4. -4 V

62. The wavelength associated with an electron having kinetic energy is given by the expression:

1. $h/\sqrt{2mE}$ 2. 2h/mE 3. 2 mhE 4. $\frac{2\sqrt{2mE}}{h}$

63. The photoelectric threshold of certain metal is 3 eV. If light of wavelength 3000 A° is incident on the metal, then :

1. Electrons will be emitted
2. Positrons will be emitted
3. Protons will be emitted
4. Electrons will not be emitted

64. When the accelerating voltage applied on the electrons increased beyond a critical value:
1. Only the intensity of the various wavelengths is increased
2. Only the wavelength of characteristic radiation is affected
3. The spectrum of white radiation is unaffected
4. The intensities of characteristic lines relative to the white spectrum are increased but there is no change in their wavelength

65. In producing X-rays, a beam of electrons accelerated by a potential difference V is made to strike a metal target. For what value of V, X-rays will have the lowest wavelength of 0.3094 A°?
1. 10 kV 2. 20 kV 3. 30 kV 4. 40 kV

66. A radio transmitter operates at a frequency of 880 KHz and a power of 10 KW. The number of photons emitted per second are
1. 1.72×10^{31} 2. 1327×10^{34}
3. 13.274×10^{34} 4. 0.075×10^{-34}

67. The kinetic energy of photoelectrons depends upon the:
1. Intensityof incident light
2. The difference between the frequency of the incident light and the threshold frequency
3. The sum of the frequency of incident light and threshold frequency
4. The ratio of the frequency of light used and the threshold frequency

68. The threshold wavelength for sodium is 5×10^{-7} m. Photoemission occurs for light of :
1. Wavelength of 6×10^{-7} m and above
2. Wavelength of 5×10^{-7} m and below
3. Any wavelength
4. All frequencies below 5×10^{14} Hz

69. If Planck's constant is denoted by h and electronic charge by e, then photoelectric effect allows determination of:
1. Only h 2. Only e 3. Both h and e 4.Only h/e

70. If the work function for a certain metal is 3.2×10^{-19} joule and it is illuminated with light of frequency 8×10^{14} Hz. The maximum kinetic energy of the photo-electrons would be: ($h = 6.63 \times 10^{-34}$ Js)
1. 2.1×10^{-19} J 2. 8.5×10^{-19} J
3. 5.3×10^{-19} J 4. 3.2×10^{-34} Js

71. In an X-ray tube, electrons accelerated through a potential difference of 15000 V strike a copper target. The speed of the emitted X-rays inside the tube is: [e= charge on electron, m=mass of electron, Z= atomic numbe of target]
1. $\sqrt{\frac{2 \times 2e \times 15000}{m}}$ 2. $\sqrt{\frac{2 \times e \times 15000}{m}}$
3. $\sqrt{\frac{2Ze \times 15000}{m}}$ 4. 3×10^8 m/s

72. When ultraviolet radiation is incident on a surface, no photoelectrons are emitted. If a second beam causes photoelectrons to be ejected, it may consist of :
1. radio waves 2. infrared rays
3. visible light rays 4. X-rays

73. A cathode of photoelectric cell is changed such that the work function changes from W_1 to W_2 ($W_1 < W_2$). If the current before and after changes are I_1 and I_2 all other conditions remaining unchanged, then (assuming $h\nu > W_2$):
1. $I_1 = I_2$ 2. $I_1 < I_2$
3. $I_1 > I_2$ 4. $I_1 > I_2 < 2I_1$

74. The electron behaves as waves because they can
1. be diffracted by a crystal
2. ionise a gas
3. be deflected by magnetic fields
4. be deflected by electric fields

75. A particle of mass 10^{-31} kg is moving with a velocity equal to 10^5 ms^{-1}. The wavelength of the particle is equal to
1. 6.6×10^{-8} cm 2. 0.66×10^{-4}cm
3. 6.6×10^{-8} m 4. 10 cm

76. If electron is having a wavelength of 100 A°, then momentum is (gm cm s^{-1}) units
1. 6.6×10^{-32} 2.6.6×10^{-29}
3. 6.6×10^{-25} 4. 6.6×10^{-21}

77. An electron accelerated under a p.d. of V volt has a certain wavelength λ. Mass of the proton is 2000 times the mass of an electron. If the proton has to have the same wavelength λ, then it will have to be accelerated under p.d. of
1. 100 V 2. 2000 V 3.V/2000V 4. $\sqrt{2000}$ V

78. A proton when accelerated through a p.d. of V volt has a wavelength λ associated with it. An α - particle in order to have the same wavelength λ must be accelerated through a p.d. of
1. V/8 volt 2. V/4 volt 3. V volt 4. 2V volt

KEY

1.4	2.4	3.2	4.2	5.3	6.2	7.4	
8.1	9.4	10.3	11.2	12.1	13.2	14.1	15.1
16.3	17.2	18.2	19.4	20.3	21.3	22.2	23.3
24.1	25.3	26.2	27.3	28.1	29.4	30.2	31.3
32.4	33.1	34.2	35.4	36.1	37.3	38.3	39.4
40.2	41.3	42.1	43.2	44.4	45.3	46.1	47.3
48.2	49.1	50.3	51.2	52.3	53.3	54.2	55.4
56.3	57.4	58.1	59.3	60.4	61.2	62.1	63.1
64.4	65.4	66.1	67.2	68.2	69.4	70.1	71.4
72.4	73.1	74.1	75.3	76.4	77.3	78.1	