EXERCISE – I

CONCEPTUAL QUESTIONS

X-rays

1. If the K_α radiation of Mo has a wavelength of 0.71 Å. The wavelength of the corresponding radiation of Cu : $[Z_{Mo} = 42, Z_{Cu} = 29]$
(1) 0.52 Å (2*) 1.52 Å (3) 2.52 Å (4) 3.52 Å

2. In Coolidge tube the potential difference between cathode and anticathode is 120 kV. The maximum energy of emitted X-rays will be
(1*) 1.2×10^5 eV (2) 10^{10} eV (3) 10^{15} eV (4) 10^{20} eV

3. If the X-ray tube is working at 25 kV then the minimum wavelength of X-rays will be
(1*) 0.49 Å (2) 0.29 Å (3) 0.19 Å (4) 0.39 Å

4. The distance between interatomic lattice planes is 10Å. The maximum wavelength of X-rays which are diffracted by this crystal will be
(1) 10 Å (2*) 20 Å (3) 30 Å (4) 40 Å

5. The structure of solids is studied by
(1*) X-rays (2) γ-rays (3) Cosmic rays (4) Infrared rays

6. 50% of X-rays obtained from a Coolidge tube pass through 0.3 mm thick aluminium foil. If the potential different between the target and the cathode in increased, then the fraction of X-rays passing through the same foil will be
(1) 50% (2*) > 50% (3) < 50% (4) 0%

7. When 50 keV electrons are made incident on a target material, the wavelength of K_α X-ray line was found to be 0.5 Å. When the accelerating potential is increased to 100 kV, then the wavelength of K_α-line from the same target will be
(1) 0.25 Å (2*) 0.5 Å (3) 0.75 Å (4) 1.0 Å

8. On increasing the filament current in X-ray tube :-
(1) wavelength of X-rays increases (2) penetration power of X-ray increases
(3) intensity of X-rays decreases (4*) intensity of X-rays increases

9. Which of the following is not affected by electro-magnetic fields
(1) α-rays (2) β–rays (3*) X-rays (4) cathode-rays

10. Minimum wavelength of X-ray is 2 Å, then potential difference between anode and cathode is:-
(1*) 62 kV (2) 6.2 kV (3) 24.8 kV (4) 2.48 kV

11. X-rays obtained by coolidge tube are :-
(1) mono-chromatic
(2) of all wave lengths below a maximum wavelength
(3*) of all wave length above a minimum wave length
(4) of all wave length between a maximum and a minimum wave length

12. X-ray is an electromagnetic radiation, so X-ray photons carry
(1) an electric charge
(2) a magnetic moment
(3) both the electric charge and magnetic moment
(4*) neither electric charge nor magnetic moment

13. Characteristic X-rays are not obtained in the spectrum of H-atom because
(1) hydrogen is a gas
(2) hydrogen is very light
(3*) energy difference in energy levels of hydrogen is much less
(4) energy difference in energy levels of hydrogen is much high

14. Which of the following is related with characteristic emission of X-ray
(1) α-particle emission (2) electron emission
(3) positron emission (4*) K-electron capturing

15. Penetration power of X-rays depend on
(1) current flowing in filament (2*) applied potential difference
(3) nature of target (4) all of the above

16. Which of the following have velocity equal to light
(1) cathode rays (2) anode rays (3*) X-rays (4) position rays

17. The energy of characteristic X-rays photon obtained from coolidge tube comes from
(1) kinetic energy of. incident electron. (2) kinetic energy of free electrons of target material
(3) kinetic energy of ions of target material (4*) electron transition in target material

18. Absorption of X-ray is maximum in which of the following sheets
(1) copper (2) gold (3) beryllium (4*) lead

19. In X-ray spectrum wave length λ of line K_α depends on atomic number Z as
(1) $\lambda \propto Z^2$ (2) $\lambda \propto (Z-1)^2$ (3) $\lambda \propto \frac{1}{(Z-1)}$ (4*) $\lambda \propto \frac{1}{(Z-1)^2}$

20. If potential difference applied to an X-ray tube is V volt, then minimum wavelength of X-rays produced is about (in A) :-
(1) $\frac{1240}{V}$ (2*) $\frac{12400}{V}$ (3) $\frac{124000}{V}$ (4) $\frac{12.27}{\sqrt{V}}$

21. The minimum wavelength of X-rays produced by electrons accelerated by a potential difference of V volts is equal to
(1) $\frac{eV}{hc}$ (2) $\frac{eh}{cV}$ (3*) $\frac{hc}{eV}$ (4) $\frac{h}{V}$

22. In E.M. waves spectrum X-rays region lies between
(1) short radio waves and visible region (2) visible and ultraviolet region
(3*) gamma rays and ultra-violet region (4) short radio waves and long radio waves

23. If V be the accelerating voltage, then the maximum frequency of continuous X-rays is given by

(1) $\frac{eh}{V}$ (2) $\frac{hV}{e}$ (3*) $\frac{eV}{h}$ (4) $\frac{h}{eV}$

24. The shortest wave length emitted from an X-ray tube depends upon

(1*) the voltage applied to the tube (2) the nature of the gas in the tube

(3) the current in the tube (4) the nature of target material

25. In an X-ray tube, the intensity of the emitted X-ray beam is increased by

(l*) increasing the filament current (2) decreasing the filament current

(3) increasing the target potential (4) decreasing the target potential

26. 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 from the tube is :-

[e = charge on electron, m = mass of electron, Z = atomic number of target]

(1) $\frac{\sqrt{2\times 2e\times 1500}}{m}$ (2) $\frac{\sqrt{2\times e\times 1500}}{m}$ (3) $\frac{\sqrt{2Ze\times 1500}}{m}$ (4*) 3×10^8 m/s

27. The momentum of a photon in an X-ray beam of 10^{-10} metre wavelength is

(1) 1.5×10^{-23} kg-m/sec (2*) 6.6×10^{-24} kg-m/sec

(3) 6.6×10^{-44} kg-m/sec (4) 2.2×10^{-52} kg-m/sec

28. The energy of a photon of light with wavelength 5000 Å is approximately x eV. This way the energy of an X-ray photon with wavelength 1 Å would be

(1) $\frac{x}{5000}$ eV (2) $\frac{x}{(5000)^2}$ eV (3*) x × 5000 eV (4) x × $(5000)^2$ eV

29. The kinetic energy of an electron which is accelerated through a potential of 100 volts is

(1*) 1.602×10^{-17} joule (2) 418.6 calories

(3) 1.16×10^4 eV (4) 6.626×10^{-34} watt-second

30. The wavelength of the most energetic X-ray emitted when a metal target is bombarded by electrons having kinetic energy 100 keV is approximately:

(1) 12 Å (2) 4 Å (3) 0.31 Å (4*) 0.124 Å

31. For harder X-rays :-

(1) the wavelength is higher (2) the intensity is higher

(3*) the frequency is higher (4) the photon energy is lower

32. When cathode rays strike a metal target of high melting point with very high velocity, then :-

(1*) X-rays are produced (2) a-rays are produced

(3) p-rays are produced (4) ultrasonic waves are produced

33. Penetrating power of X-rays can be increased by

(1*) increasing the potential difference between anode and cathode

(2) decreasing the potential difference between anode and cathode

(3) increasing the cathode filament current

(4) decreasing the cathode filament current

34. 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

35. The production of characteristic X-rays is due to
(1) transfer of momentum in collision of electrons with the target atom
(2) transfer of energy in collision of electrons with the target atom
(3*) the transition of electrons in heavy target atoms from high to low energy level
(4) none of these

36. X-rays are produced in X-ray tube operating at a given accelerating voltage. The wavelength of the continuous X-rays has values from
(1) 0 to ∞ (2*) λ_{min} to ∞, where $\lambda_{min} > 0$
(3) 0 to λ_{max}, where $\lambda_{max} < \infty$ (4) λ_{min} to λ_{max}, where $0 < \lambda_{min} < \lambda_{max} < \infty$

37. The ratio of the energy of an X-ray photon of, wavelength 1 Å to that of visible light of wavelength , 5000 Å is:
(1) 1 : 5000 (2*) 5000 : 1 (3) 1 : 25 × 10^6 (4) 25 × 10^6

38. According to Mosley's law, the frequency of a characteristic spectral line in X-ray spectrum varies as :-
(1) atomic number of the element
(2*) square of the atomic number of the element
(3) square root of the atomic number of the element
(4) fourth power of the atomic number of the element

39. For the structural analysis of crystals, X-rays are used because
(1*) X-rays have wavelength of the order of interatomic spacing
(2) X-rays are highly penetrating radiations
(3) wavelength of X-rays is of the order of nuclear size
(4) X-rays are coherent radiations

40. What determines the hardness of the X-rays obtained from the Coolidge tube :
(1) current in the filament (2) pressure of air in the tube
(3) nature of target (4*) potential difference between cathode and target

41. The most penetrating radiation out of the following is
(1) X-rays (2) β-rays (3)_α-particles (4*) γ-rays

42. On increasing the number of electrons striking the anode of an X-ray tube, which one of the following parameters of the resulting X-rays would increase
(1) penetration power (2) frequency (3) wavelength (4*) intensity

43. For production of characteristics Kβ X-ray, the electron transition will be
(1) n = 2 to n = 1 (2) n = 3 to n = 2 (3*) n = 3 to n = 1 (4) n = 4 to n = 2

44. lf X-rays is passed through from strong magnetic field, then X-rays :
(1) will deviate maximum (2) will deviate minimum
(3*) undeviated (4) none of these

45. Which of the following wavelength is not possible for an X-ray tube which is operated at 40 kV
(1*) 0.25 Å (2) 0.5 Å (3) 0.52 Å (4) 0.34 Å

46. If the operating voltage of X-ray tube is 50 kV then velocity of X-rays
(1) 4×10^4 m/sec (2*) 3×10^8 m/sec (3) 10^8 m/sec (4) 3 m/sec

47. When X-rays are' projected il1 strong magnetic field it will :-
(1) deflect right
(2) deflect left
(3) move in opposite direction to magnetic field
(4*) not deflect

48. If voltage of X-ray tube is doubled then intensity of X-rays will :-
(1) halved (2*) remains constant (3) doubled (4) quadrupled

49. If minimum wavelength obtained in a X-ray tube is $2.5 \times l0^{-10}$ m. For this minimum wavelength the minimum operating voltage of the tube should be
(1) 2 kV (2) 3 kV (3) 4 kV (4*) 5 kV

50. In X-ray tube, wavelength of X-ray is the characteristic of
(1) tube voltage (2*) target material (3) filament current (4) none of these

51. 5000V is applied on an electronic X-ray. Then minimum wavelength of X-ray will be
(1) 1.24×10^{-11} m (2*) 2.48×10^{-10} m (3) 3.72×10^{-11} m (4) 4.96×10^{-11} m

52. Pressure inside the X-ray tube is :
(1) equal to 740 mm of Hg (2) equal to 76 mm of Hg
(3*) equal to 10^{-5} mm of Hg (4) equal to 10^{-7} mm of Hg

53. 20 kV potential is applied across X-ray tube, the minimum wavelength of X-ray emitted will be
(1*) 0.62 Å (2) 0.37 Å (3) 1.62 Å (4) 1.31 Å

54. What is the minimum wavelength of X-rays
(1) $\frac{eV}{hc}$ (2*) $\frac{hc}{eV}$ (3) $\frac{hc}{e}$ (4) $\frac{hc}{V}$

55. To increase the hardness of X-rays in coolidge tube we should
(1) increase filament current
(2) increase filament voltage
(3*) increase the voltage applied between cathode and anticathode
(4) none of these

56. For X-ray diffraction, order of size of obstacle is :
(1*) 1 Å (2) 10 Å (3) 20 Å (4) 30 Å

57. Voltage applied across the X-ray tube is
(1*) 1000 V (2) 100 V (3) 10 V (4) 10^6 V

58. Which of the following is the wave length of X-ray
(1) 10,000 Å (2) 1000 Å (3*) 1 Å (4) 10^{-4} Å

59. Lattice constant of a crystal is 3×10^{-8} cm and glance angle of X-ray is 30°for first order diffraction then the value of λ will be
(1) 6×10^{-8} cm (2*) 3×10^{-8} cm (3) 1.5×10^{-8} cm (4) 10^{-8} cm

60. λ_{min} of X-rays depends on
(1) Atomic number of target (2*) Energy of electron
(3) Both (1) and (2) (4) None of these

61. The order of energy of X-ray photon is
(1) MeV (2*) keV (3) eV (4) GeV

62. If vacuum tube is operated at 6.4 kV, what is the wavelength of X-ray produced
(1*) 1.93 Å (2) 1.53 Å (3) 2.67 Å (4) 0.78Å

63. When electron is incident on molybdenum then by changing energy of electron
(1*) λ_{min} changes (2) λ_{min} remains constant
(3) $\lambda_{K_\alpha}, \lambda_{K_\beta}$ changes (4) λ_{min}, λ_{K_α} and λ_{K_β} all changes

64. In Coolige tube the relation between used voltage V and minimum wavelength λ_{min} is
(1) $\lambda_{min} \propto V$ (2) $\lambda_{min} \propto \sqrt{V}$ (3) $\lambda_{min} \propto \frac{1}{\sqrt{V}}$ (4*) $\lambda_{min} \propto \frac{1}{V}$

65. In an X-ray tube accelerating potential is 60 kV. What is the maximum frequency of emitted X-ray?
(1*) 1.45×10^{19} Hz (2) 1.45×10^{15} Hz (3) 1.25×10^{15} Hz (4) 1.25×10^{13} Hz

Atomic Structure

66. What is the wavelength of the least energetic photon emitted in the Lyman series of the hydrogen atom spectrum
(1) 150 nm (2*) 122 nm (3) 102 nm (4) 82 nm

67. What is the ratio of the shortest wavelength of the Balmer series to the shortest wavelength of the Lyman series?
(1*) 4 : 1 (2) 4 : 3 (3) 4 : 8 (4) 5 : 9

68. Kinetic energy for Hydrogen atom in first Bohr's orbit is
(1) –13.6 eV (2*) 13.6 eV (3) –27.2 eV (4) –6.5 eV

69. According to Bohr Model for Hydrogen, energy is proportional to :
(1) $-Z^2 / n$ (2) $-n / Z^2$ (3*) $-Z^2 / n^2$ (4) $-n^2 / Z$

70. In above question radius is related as
(1*) n^2 / Z (2) n / Z (3) n / Z^2 (4) n^2 / Z^2

71. If ionization potential of Hydrogen atom is 13.6 V then what is ionization potential of He atom ?
(1) 27.6 V (2) 13.6 V (3*) 54.2 V (4) None of these

72. Which of the following statements is correct?
(1) Lyman series is continuous (2) Balmer series lies in ultraviolet region
(3*) Paschen series lies in infrared region (4) Brackett series lies in visible region

73. According to the Bohr theory of Hydrogen atom, the speed of the electron, its energy and the radius of its orbit varies with the principal quantum number n, respectively, as
(1*) $\frac{1}{n}, \frac{1}{n^2}, n^2$ (2) $\frac{1}{n}, n^2, \frac{1}{n^2}$ (3) $n^2, \frac{1}{n^2}, n^2$ (4) $n, \frac{1}{n^2}, \frac{1}{n^2}$

74. If the ionization potential of hydrogen atom is 13.6 eV, its energy in then = 3 is approximately
(1) –1.14 eV (2*) –1.51 eV (3) –3.4 eV (4) –4.53 eV

EXERCISE-I (Conceptual Questions) Build Up Your Understanding

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