Unit: 6. Atomic Physics (25 marks)	
1 mark → 4 Questions	5 mark → 1 Question 57
3 mark → 2 Questions 40,41	10 mark→ 1 Question 67

UNIT – 6. Atomic Physics – 1 mark Questions

1. In a discharge tube the source of positive rays (canal rays) is -
a) cathode b) anode
c) gas in the discharge tube d) fluorescent screen [M-09]

2. Cathode rays are ----- [M-11]
a) a stream of electrons b) a stream of positive ions
c) a stream uncharged particles d) a stream of photons

3. In Millikan's oil drop experiment, charged oil drop is balanced between the two plates. Now the viscous force ---- [J-11]
a) acts downwards b) acts upwards
c) is zero d) acts either upwards or downwards

4. e/m of cathode ray particle ----- [J-10,13, M-13]
a) depends upon the nature of the cathode
b) depends upon the nature of the anode
c) depends upon the nature of the gas present inside the discharge tube
d) is independent of all these

5. The direction of viscous force in Millikan's oil drop experiment is [S-09]
a) always downward b) always upward
c) opposite to the direction of motion of oil drop
d) either upwards or downwards

6. According to Bohr's postulates, which of the following quantities takes discrete values? [S-09,J-12M-07,J-07,S-7,S-08]
a) Kinetic energy b) potential energy
c) angular momentum d) momentum

7. According to Rutherford atom model, the spectrum emitted by an atom is : [M-13]
a) line spectrum ***b) continuous spectrum***
c) continuous absorption spectrum d) band spectrum

8. The spectral series of Hydrogen atom in UV region are called -
a) Balmer series ***b) Lymen series***
c) Paschen series d) Pfund series [J-08]

9. The number of waves per unit wavelength is known as -----
a) wavelength ***b) wave number***
c) bandwidth d) frequency [S-08]

10. Wave number is defined as the number of waves ---- [M-06]
a) produced in one second ***b) in a distance of 1 metre***
c) in a distance of 3×10^8 m d) in a distance of λmetre

11. The wave number of spectral line of hydrogen atom is equal to Rydberg's constant. The line is ----- [M-11]
a) the 1st limit of Lymen series ***b) series limit of Lymen***
c) 1st line of Pfund series d) series limit of Pfundseris

12. The value of Rydberg's constant is ----- [J-09]
a) $1.094 \times m^1$ b) $1.094 \times 10^{-7}\ m^{-1}$
c) $1.094 \times 10^{-7} m^{-1}$ d) $1.094 \times 10^7 m^1$

13. The unit of Rydberg's constant is ---- [S-07]
a) m b) no unit
c) m^{-2} d) m^{-1}

14. The elliptical orbits of electron in the atom were proposed by -
a) J.J.Thomson b) Bohr
c) Sommerfield d) de-Broglie [O-10,M-12,13]

15. If 'a' and 'b' are semi-major and semi-minor axes of the ellipse respectively and 'l' is the orbital quantum number, then the expression to find the possible elliptical orbits is ---- [M-07]
a) b/a = (l+1)/n b) b/a = (l-1)/n
c) a/b = (l+1)/n d) a/b = (l-1)/n

16. When an electric field is applied to an atom each of the spectral lines split into several lines. This effect is known as --
a) Zeeman effect b) Stark effect
c) Raman effect d) Seebeck effect [J-09]

17. In an X-ray tube, the intensity of emitted X-ray beam is increased by ---[J-06,13]
a)increasing the filament current b) decreasing the filament current
c) increasing the target potential d) decreasing the target potential

18. X-ray is ------- [M-07, J-09,M-10,J-11,12,M-13]
a) phenomenon of conversion of KE into radiation
b) conversion of momentum c) conversion of mass into energy
d) conversion of light into heat energy

19. The energy of Photon of characteristic X-ray from a Coolidge tube comes from ----- [J-08]
a) theKE of the free electrons of the target
b) The KE of ions of the target c) the KE of the striking electron
d) an atomic transition in the target

20. The value of stopping potential when the frequency of light is equal to the threshold frequency is ----- [M-06]
a) maximum ***b) zero***
c) minimum d) infinity

21. chromium ions doped in the ruby rod --------
[M-06,J-06,10,S-08,M-09,10,M-12,J-13]
a) absorbs red light b) absorbs blue light
c) absorbs green light d) emits green light

22. In holography, which of the following is (are) recorded on the photographic film? ---- [O-06,S-09,J-11, J-07,12,S-12]
a) frequency and amplitude b) phase and frequency
c) phase and amplitude d) frequency only

23. A 3D image of an object can be formed by ------ [S-08]
a) atomicspectrography ***b) holography***
c) molecularspectrography d) MASER

24. Maser materials are ----- [J-08]
a) diamagnetic ions ***b) paramagnetic ions***
c) ferromagnetic ions d) non-magnetic ions

25. If γ is the frequency of characteristic X-ray line emitted by a target element of atomic number Z, then Mosley's law is ---- [O-11]
a) $\gamma \propto Z$ ***b) $\gamma \propto Z^2$*** c) $\gamma \propto \sqrt{Z}$ d) $\gamma \propto Z^3$

26. Arrange the spectral lines H_α, H_β, H_γ, H_δ in the increasing order of their wavelength:--- [J-12]
a) $H_\alpha, H_\beta, H_\gamma, H_\delta$ ***b) $H_\delta, H_\gamma, H_\beta, H_\alpha$***
c) $H_\beta, H_\alpha H_\delta, H_\gamma$ d) $H_\alpha, H_\beta, H_\delta H_\gamma$

UNIT – 6. Atomic Physics – 1 mark Problems

1. A narrow electron beam passes undeviated through an electric field E of 3×10^4 V/m and an overlapping magnetic field of 2×10^{-3} Wb/m^2. The electron motion, electric filed and magnetic field are mutually perpendicular. The speed of electron is –
a) 60 ms^{-1} b) $10.3 \times 10^7 ms^{-1}$
c) $1.5 \times 10^7 ms^{-1}$ d) $0.67 \times 10^7 ms^{-1}$ [S-12]

2. An electron moving with a veleocity of 3 x 10^6ms^{-1} perpendicular toa uniform magnetic field of induction 0.5 T. The force experienced by the electron is [M-11]
a) 2.4 x 10^{-13} N b) 13.6 x 10^{-27} N c) 13.6 x 10^{-11} N d) zero

3. In Millikan's experiment , the plates are kept at a distance of 16 mm and are maintained at a potential difference of 10000 V. The electric intensity is ---- [J-10]
a) 62.5 V/m b) 62.5 x 10^5 V/m
c) 6.25 x 10^5 V/m d) 1.6 x 10^5 V/m

4. In Millikan's experiment , an oil drop of mass 4.9 x 10^{-14} kg is balanced by applying a potential difference of 2 kV between two plates which are 2 mm apart. The charge of the drop is equal to --- [DPM]
a) 1.96 x 10^{-18} C b) 1.602 x 10^{-19} C
c) 12 C d) ***4.9 x 10^{-19} C***

5. If R is Rydberg's constant, the maximum wavelength of hydrogen spectrum is ----- [J-07]
a) 1/R b) R/4 c) 4/R d) R

6. If R is Rydberg's constant, the shortest wavelength of Paschen series is ------ [J-10]
a) R/9 b) ***9/R*** c) 16/R d) 25/R

7. The ionization potential of Hydrogen atom is ---- [M-09]
a) 13.6 eV b) -13.6 eV c) 13.6 V d) -13.6 V

8. The first excitation potential energy or the minimum energy require to excite the atom from the ground state of hydrogen atom is -----
a) 13.6 eV ***b) 10.2 eV*** c) 3.4 eV d) 1.89 eV [M-08,O-10,12]

9. The ratio of areas enclosed by first three orbits of hydrogen atom is –
a) 1 : 2 : 3 b) 1 : 8 : 27
c) 1 : 4 : 9 ***d) 1 : 16: 81*** [O-06,M-10]

10. The ratio of radii of first three orbit of Bohr's orbit is ----
a) 1 : 2 : 3 b) 1 : ½ : 1/3
c) 1 : 8 : 27 ***d) 1 : 4 : 9*** [DPM,J-07,M-08,J-11]

11. The energy of electron in the first orbit of hydrogen atom is -13.6 eV. Its potential energy is ---- [J-06]
a) -13.6 eV b) 13.6 eV
c) ***27.2 eV*** d) 27.2 eV

12. In Somerfield atom model, for principle quantum number n = 3, which of the following subshells represents circular orbit? [M-10]
a) 3s b) 3p ***c) 3d*** d) None of these

13. In Sommer field atom model, for a given value of n, the number of values l can take is
a) n b) n + 1 c) n – 1 d) 2n + 1 [O – 06,M-11]

14. When an electron jumps from M shell to K shell it gives ------
a) K_α ***b) K_β*** c) L_α d) L_β[M-12]

15. In hydrogen atom which of the following transitions produces maximum wavelength [M-08,12]
a) 2 → 1 b) 4 → 1 ***c) 6 → 5*** d) 5 → 3

16. In hydrogen atom which of the following transitions produces maximum frequency – [DPM,J-06,M-11,O-11,S-12]
a) 2 → 1 b) 6 → 2 c) 4 → 3 d) 5 → 1

17. In hydrogen atom which of the following transitions produces minimum wavelength [J-13]
a) 2 → 1 b) 6 → 2 c) 4 → 3 d) 5 → 2

18. A Coolidge tube operates at 24800 V. The minimum Wavelength of X-ray radiation emitted from Coolidge tube is [J-09,O-10]
a) 6 x 10^{18} m b) 3 x 10^{18} m
c) 0.6 X 10^{-10} m d) ***0.5 X 10^{-10} m***

19. If the minimum WL of X-rays produced from a Coolidge tube is 0.062 nm. Then the P.D between the cathode and target material is ---
a) 2000 V ***b) 20,000 V*** c) 2 x 10^5 V d) 6.2 x 10^3 V [M-08]

20. If the minimum WL of X-rays produced from a Coolidge tube is 0.062 A^0 . Then the P.D between the cathode and target material is ---
a) 20 k V b) 0.2 k V c) 2 k V d) 10 k V [M-06]

21. The minimum WL of X-rays emitted from X-ray tube operating at 1000 kV is ---- [M-09]
a) ***0.0124 A^0*** b) 0.124 A^0
c) 1.24 A^0 d) 0.00124 A^0

22. If the potential difference between cathode and the target of Coolidge tube is 1.24 x 10^5 V, then the minimum wavelength of continuous X –rays is ---- [DPM]
a) 10 A^0 b) 1 A^0 c) ***0.1 A^0*** d) 0.01 A^0

23. A Coolidge tube operates at 18600 V. The maximum frequency of X-ray radiation emitted from it is ---- [S-07]
a) ***4.5 X 10^{18} Hz*** b) 45 x 10^{18} Hz
c) 4.05 x 10^{18} Hz d) 45.5 x 10^{18} Hz

24. For the first order X-ray diffraction, the wavelength X-ray is equal to the lattice spacing at a glancing angle of -- [S-07]
a) 15^0 b) 60^0 c) 45^0 d) ***30^0***

25. A crystal diffracts monochromatic X-rays. If the angle of diffraction for the second order is 90, then the for the first order will be [M-07]
a) 60^0 b) 45^0 ***c) 30^0*** d) 15^0

UNIT – 6. Atomic Physics – 3 mark Questions

1. Write the principle of Millikan's oil drop experiment. [J-06,M-12]
2. Explain any one of the drawbacks of the Rutherford atom model. [S-08]
3. State postulates of Bohr atom model. [DPM]
4. What are the drawbacks of Sommerfiled atom model? [O-11]
5. Rydberg's constant for hydrogen atom is 1.097 x 10^7 m^{-1}. Calculate the shortest WL of the spectral line of its Lymen series. [O-06]
6. State Mosley's law. Write its equation [M-07,08,09,11]
7. Write the applications of Mosley's law. [S-12,J-13]
8. Define ionization potential [m-07,J-09,O-10]
9. Write down two important facts of the Laue experiment. On X-ray diffraction. [S-07,J-08]
10. Define ionization potential energy [J-07]
11. What are the characteristics of laser? [O-06,J-09,M-10,J-10,12,S-12]
12. Write the condition to achieve laser action. [M-06,J-07]
13. Write any three applications of Laser. [J-08]
14. Write any three industrial applications of Laser. [J-08]
15. Write any three medical applications of Laser. [M-08,J-11,S-09,11]
16. What is halogram? [S-07]

UNIT – 6. Atomic Physics – 3 mark Problems

1. A beam of electrons moving with a speed of 4 X 10^7ms^{-1} is projected normal to the uniform magnetic field where B = 10^{-3}Wb/m^2. What is the path of the beam in magnetic field? [M-12]
2. Rydberg's constant for hydrogen atom is 1.097 x 10^7 m^{-1}. Calculate the shortest WL of the spectral line of its Lymen series. [O-06]
3. Calculate the short wavelength limit of Lymen series (R= 1.097 x 10^7 m^{-1}) [S-09]
4. Calculate the longest wavelength that can be analysed by a rock salt crystal of spacing d = 2.82 A^0 in first order [J-06,S-08, M-09,J-10,O-10,M-11,J-12]

5. In Bragg's spectrometer, the glancing angle for first order spectrum was observed to be 8^0 . Calculate the crystal lattice spacing, if the wavelength of the X-ray is 0.7849 A^0. [DPM]
6. An X-ray diffraction of crystal gave the first line at an glancing angle of $6^0 27'$. If the wavelength of X-ray is 0.58 A^0, find the distance between two cleavage planes. [M-06]
7. How much should be the voltage of an X-ray tube so that the electrons emitted from the cathode may give an X-ray tube so that electrons from the cathode may give an X-ray of wavelength 1 A^0 after striking the target? [J-07,M-13]
8. Find the minimum wavelength of X-rays produced by an X-ray tube operating at 1000 kV. [M-10,J-13]
9. The minimum wavelength of X-rays produced by Coolidge tube is 0.05 nm. Find the operating voltage of Coolidge tube. [J-11]

UNIT – 6. Atomic Physics – 5 mark Questions

1. Write any 5 properties of cathode rays. [S-08 ,J-09]
2. Prove that the energy of electron for hydrogen atom in the n^{th} orbit is $E_n = - me^4/8\varepsilon_0^2 n^2 h^2$ [S-07]
3. Obtain an expression for the radius of n^{th} orbit of hydrogen atom using Bohr's theory. [J-13]
4. Explain the spectral series of hydrogen atom. [DMP, M-06, M-10,J-10,M-12,13]
5. Mention any five properties of X-rays. [J-06]
6. Explain the origin of characteristic X-rays. [M-09,11,J-12,S-12]
7. What is characteristic X- ray spectrum? Explain its origin. [J-11]
8. Describe Laue's experiment. What are the facts established by it?
9. State and obtain Bragg's law [J-08,S-09,11]

UNIT – 6. Atomic Physics – 5 mark Questions

1. An electron beam passes through a transverse magnetic field of 2 x 10^{-3} tesla and an electric field E of 3.4 x 10^4 V/m acting simultaneously. If the path of electrons remainundeviated, Calculate the speed of electrons. If the electric field is removed, what will be the radius of the electron path [O-10]
2. Wavelength of Balmer second line is 4861 A^0. Calculate the wavelength of the first line. [M-07]
3. In Bragg's spectrometer, the glancing angle for first order spectrum was observed to be 8^0 . Calculate the wavelength of the X-rays if d = 2.82 x 10^{-10} m. At what angle will the second maximum occur?
4. An α- particle is projected with an energy of 4 MeV directly towards a gold nucleus. Calculate the distance of closest approach. Given: Atomic number of gold = 79, Atomic number of α- particle = 2. [M-08]

UNIT – 6. Atomic Physics – 10 mark Questions

1. Describe the J.J Thomson method of determining the specific charge of an electron. [S-09,10,11M-10,J-10,J-12]
2. Explain Millikan's oil drop experiment to determine the charge of an electron. [J-08,S-08]
3. State Bohr's postulates. Obtain an expression for the radius of n^{th} orbit of hydrogen atom. [M-06,M-08,J-09,M-12]
4. How will you determine the wavelength of X-rays using Bragg spectrometer? Write any five properties of X-rays. [M-07]
5. Derive Bragg's law. Explain how Bragg's spectrometer can be used to determine the wavelength of X –rays? [J-07]
6. Draw a neat sketch of Ruby Laser. Explain its working with the help of energy level diagram. [O-06,S-07, M-09,J-11,S-12,M-13]
7. With the help of energy level diagram explain the working of He-Ne laser. [DPM, J-06,13]

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