



**INDIAN SCHOOL MUSCAT**  
**CLASS: XI**  
**CHEMISTRY**  
**STRUCTURE OF ATOM**



**I. Choose The Best Answer**

1. Packet of energy is called -

- (a) Electron    (b) Photon    (c) Position    (d) Proton

2. The principal quantum number of an atom is related to the

- (a) size of the orbital    (b) spin angular momentum    (c) orbital angular momentum  
(d) orientation of the orbital in Space

3. What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition  $n = 4$  to  $n = 2$  in the  $\text{He}^+$  spectrum?

- (a)  $n = 4$  to  $n = 1$     (b)  $n = 3$  to  $n = 2$     (c)  $n = 3$  to  $n = 1$     (d)  $n = 2$  to  $n = 1$

4. An electron is moving in Bohr's orbit. Its de Broglie wavelength is  $\lambda$ . What is the circumference of the fourth orbit?

- (a)  $2/\lambda$     (b)  $2\lambda$     (c)  $3\lambda$     (d)  $3/\lambda$

5. For principle quantum number,  $n = 4$ , the total number of orbitals having  $l = 3$  is

- (a) 3    (b) 7    (c) 5    (d) 9

**II. Fill In the Blanks**

1. Bohr's theory is based on \_\_\_\_\_ of radiation.

2. The maximum number of electrons in  $\text{Fe}^{3+}$  (At. No. 26) is \_\_\_\_\_.

3.  $\text{Li}^{2+}$  and  $\text{He}^+$  ions have spectrum similar to \_\_\_\_\_ atom.

4. The space or three-dimensional region round the nucleus where there is maximum probability of finding an electron of specific energy is called an \_\_\_\_\_.

5. When there are two electrons in the same orbital they have \_\_\_\_ spins.

### **III. Assertion and Reasoning Questions:**

**Directions: (Questions 1 to 4).**

- A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion.
- B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion.
- C. If Assertion is true statement but Reason is false.
- D. If both Assertion and Reason are false statements.

1. Assertion: Number of orbitals in 3rd shell is 9.

Reason: Number of orbitals for a particular value of  $n = n^2$ .

2. Assertion: Two nodal planes are present in  $3d_{xy}$ .

Reason: Number of nodal planes = 1

3. Assertion: The energy of an electron is largely determined by its principal quantum number.

Reason: The principal quantum number is a measure of the most probable distance of finding the electrons around the nucleus.

4. Assertion: An orbital cannot have more than two electrons, moreover, if an orbital has two electrons they must have opposite spins.

Reason: No two electrons in an atom can have same set of all the four quantum numbers.

### **IV. Two Marks, Three Marks and Five Marks Questions:**

1. Calculate the energy of each of the photons which
  - i) correspond to light of frequency  $3 \times 10^{15}$  Hz
  - ii) have wavelength of  $0.50 \text{ \AA}$
2. Calculate the energy and radius of the first orbit of  $\text{He}^+$  ion.
3. Calculate the wavelength of the photon that is emitted when an electron in Bohr's orbit  $n=2$  returns to the orbit  $n=1$  in the hydrogen atom.

4. Calculate the de Broglie wavelength of a bullet of mass  $2.2 \times 10^{-3}$  Kg fired with a velocity of 300 m/s.
5. Calculate the speed of an electron if its de Broglie wavelength is twice its displacement in one second.
6. Calculate the uncertainty in the velocity of a cricket ball if the mass is 200 g. Uncertainty in the position is 1pm.
7. An electron beam from an accelerator is with kinetic energy  $1.6 \times 10^{-17}$ J. What is its de Broglie wavelength?
8. A photon of wavelength  $4 \times 10^{-7}$  m strikes on metal surface, the work function of the metal being 2.13 eV. Calculate
  - (i) the energy of the photon (eV)
  - (ii) the kinetic energy of the emission, and
  - (iii) The velocity of the photoelectron ( $1 \text{ eV} = 1.6020 \times 10^{-19}$ J).
9. Show that the wavelength related to a 250g object moving with a speed of 100 m/s is too short to be observed.
10.
  - i. State Heisenberg's uncertainty principle.
  - ii. A table tennis ball has mass 10g and a speed of 90m/s. If speed can be measured with an accuracy of 4% what will be the uncertainty in the speed and position?
11. Two particles A and B are in motion. If the momentum of A is half of that of B and if the wavelength of A is  $4.5 \times 10^2$  nm, what is the wavelength of B?
12. What is meant by "Energy of an electron in a hydrogen atom is quantized"
13.
  - i. Explain the dual nature of light.
  - ii. When would the wavelength associated with an electron be equal to the wavelength associated with a proton?
14. Electrons are emitted with zero velocity from a metal surface when it is exposed to radiation of wavelength  $6800\text{\AA}$ . Calculate the threshold frequency and work function of the metal.
15. Why is the electronic energy of hydrogen negative?
16. Define
  - i. Photoelectric effect

- ii. Black body radiation
  - iii. Threshold energy
  - iv. Node
  - v. Degenerate orbitals
17. Differentiate
- i. Absorption and emission spectrum
  - ii. Orbit and orbital
18. Why is the concept of orbit replaced by the concept of orbital?
19. Draw the shapes (boundary surfaces) of the following orbitals.
- (i)  $2p_y$  (ii)  $3d_z^2$  (iii)  $3d_x^2 - y^2$  (iv)  $3d_{xy}$
20. i) What do you understand by quantum numbers? What is their significance?  
 ii) Describe the orbital: a)  $n=2, l=0$  b)  $n=6, l=4$  c)  $n=2, l=3$
21. i) State  $(n+l)$  rule.  
 ii) Give reason: In the building up of atoms, 4s is filled before 3d
22. How many electrons are possible in a) 4p b)  $5p_z$  c)  $n=3, l=2$  d)  $n=4, l=2, s=+\frac{1}{2}$
23. Why are half filled and completely filled orbitals more stable?
24. With the help of Pauli's exclusion principle and the concept of atomic numbers for orbitals, show that an M shell cannot accommodate more than 18 electrons.
25. List the quantum numbers of a) unpaired electron in F b) valence electrons in P, Ca
26. What are the possible values of  $l$  and  $m$  for a)  $n=3$  b)  $n=2$
27. (a) How many electrons in an atom may have the following quantum number?  
 (i)  $n=4, m_s=+\frac{1}{2}$  (ii)  $n=3, l=0$   
 (b) What are the atomic numbers of elements whose outermost electrons are represented by  
 (i)  $3s^1$  (ii)  $2p^3$  (iii)  $3d^6$
28. Based on Bohr Bury rules arrange the following orbitals in the increasing order of energy.  
 (i)  $5f, 4d, 7s, 7p$  (ii)  $5p, 4d, 5d, 4f, 6s$
29. Discuss the similarities and differences (two each) between a 1s and a 2s orbital.
30. i. Which is more stable a)  $Mn^{2+}$  or  $Mn^{3+}$  b)  $Fe^{2+}$  or  $Fe^{3+}$ ? Give reason.  
 ii. Which rule is disobeyed while writing electronic configuration of carbon as  $1s^2, 2s^2, 2p_x^2$ ?  
 State the rule and write the correct configuration.

- iii. Electronic configuration in Copper is  $[\text{Ar}] 4s^1, 3d^{10}$  and not  $[\text{Ar}] 4s^2, 3d^9$ . Why?
  - iv. Among the following pairs of orbitals which orbital will experience the larger effective nuclear charge? (i) 2s and 3s, (ii) 4d and 4f, (iii) 3d and 3p.
- 31.
- i. Line spectrum of an element is known as fingerprints of its atoms. Why?
  - ii. Explain the line spectrum of hydrogen.
  - iii. Why are there so many lines in hydrogen spectrum although there is only one electron in its atom?