

ATOMIC STRUCTURE

1. The number of electrons in an atom of an element is equal to its
a. atomic weight d. electron affinity b. atomic number c. mass number
2. Neutrons are present in all atoms except
a. H b. He c. Li d. C

α -rays (α -particles) Scattering Experiment and Nuclear Model of the Atom

3. Who is credited with the development of the nuclear model of the atom?
a. Dalton b. Thomson c. Rutherford d. Niels Bohr
4. What chemical species are called α particles?
a. H_2 b. He^{2+} c. H d. He^+
5. When α - particles are passed through the thin gold foil, most of them go straight through because of
a. the space present in the atoms. c. high speed
b. dense positive charge d. negative charge
6. After the gold foil experiment, Rutherford concluded that the size of the nucleus is very small compared to the size of an atom. This is because
a. About 1 out of 10000 alpha particles bounced back after hitting the gold foil.
b. Very few alpha particles passed through the gold foil.
c. Most of the alpha particles deflected back after hitting the gold foil.
d. A few alpha particles are deflected at a small angle.
7. Rutherford's α -rays scattering experiment led to the conclusion that
a. Mass and energy are related.
b. An atom's mass and positive charge are concentrated in the nucleus.
c. Neutrons are present in the nucleus.
d. Atoms are electrically neutral.
8. Rutherford's alpha particle scattering experiment resulted in the discovery of
a. electrons b. protons c. neutrons d. nucleus
9. The existence of the nucleus as a tiny positive centre of an atom was discovered by
a. Max Planck b. Rutherford c. Niels Bohr d. de Broglie
10. Rutherford's scattering experiment is related to the size of the:
A) Atom B) Nucleus C) Neutron D) Electron
11. According to Rutherford's nuclear model of the atom, the electrons in an atom are
a. stationary b. centralized c. circular d. moving
12. Which of the following is not the conclusion of Rutherford's α -ray scattering experiment?
a. Most parts of the atoms are vacant.
b. The positive charge is concentrated in a small volume of atoms.
c. Presence of a tiny but heavy nucleus.
d. Concentric orbits of electrons
13. A student performs Rutherford's gold foil experiment but replaces the gold foil with a much thicker metal sheet. He observes that many more α -particles are scattered. Which statement best explains this observation?
a. The nucleus has become larger.
b. α -particles now pass through more atoms before emerging.
c. The positive charge of each atom has increased.
d. The α -particles have lost their positive charge.

Bohr's Atomic Model

14. The first use of quantum theory to explain the structure of atoms was made by
a. Bohr b. Heisenberg c. Planck d. de Broglie
15. Bohr's model could successfully explain
a. the spectrum of Hydrogen
b. the spectrum of species containing only one electron
c. the spectrum of multi-electron atoms
d. the spectrum of hydrogen molecules
16. The concept of quantisation of energy was introduced by:
a. Heisenberg b. Sommerfeld c. Dalton d. Bohr
17. When an electron jumps from a lower to a higher orbit, its energy:

- a. Increases b. decreases d. remains the same c. not definite
18. Which of the following occurs when an electron in an excited state moves to the ground state?
 - a. Atom undergoes spontaneous decay c. energy is absorbed
 - b. Light is emitted d. charge increases
 19. According to Bohr's theory of the hydrogen atom, which of the following is quantised for an electron?
 - a) Angular momentum b) Angular acceleration c) Acceleration d) Velocity
 20. Four students explain why electrons do not fall into the nucleus in Bohr's model.

A: Electrons continuously lose energy.
 B: Electrons move only in permitted energy levels.
 C: Electrons remain stationary.
 D: Electrons have no charge.
 Who is correct?

 - a. A b. B c. C d. D
 21. An electron in hydrogen moves $n = 1 \rightarrow n = 4 \rightarrow n = 2$
 During this process,
 - a. energy is absorbed only.
 - b. energy is emitted only.
 - c. energy is first absorbed and then emitted.
 - d. no energy change occurs.
 22. Which of the following is NOT a postulate of Bohr's model?
 - A) Electrons revolve in stationary orbits without radiating energy.
 - B) The angular momentum of an electron is an integral multiple of $h/2\pi$.
 - C) Electrons have wave-like properties.
 - D) Energy is emitted or absorbed when electrons jump between orbits.

Explanation of Hydrogen Spectra

23. In the Lyman Series, the excited electron falls from a higher energy level to:
 - a. $n = 1$ b. $n = 2$ c. $n = 3$ d. $n = 4$
24. The region of the electromagnetic spectrum where the Paschen series lies is:
 - a. Ultraviolet b. Far infrared c. Infra-red d. Visible
25. Yellow light is emitted when an electron falls from a higher energy level to
 - a. first energy level c. second energy level
 - b. third stationary orbit d. fourth shell
26. Paschen series is obtained when e^- of an excited H-atom fall from higher orbits to the
 - a. I orbit b. II orbit c. III orbit d. IV orbit
27. Which one of the following spectral series of the H-atom has wavelengths in the ultraviolet region of the electromagnetic spectrum?
 - a. Lyman b. Paschen c. Balmer d. Brackett
28. Transition from $n=3, 4, 5$ to $n=2$ gives rise to
 - a. Paschen series b. Balmer series c. Lyman series d. Brackett series
29. Which of the statements is true regarding the hydrogen spectra?
 - a. A hydrogen spectrum is produced when electrons in the first shell absorb energy and jump to higher shells.
 - b. Among the spectral series of Hydrogen, the Balmer series was discovered first, being in the visible spectrum.
 - c. The Brackett series is obtained when electrons jump to the third energy level from higher orbits.
 - d. Bohr's model of the atom could not explain the origin of the Hydrogen successfully in the presence of a magnetic field.

De Broglie Equation (Dual nature of matter) Heisenberg's Uncertainty Principle

30. What is the de Broglie wavelength of an electron moving with a velocity of 2.0×10^6 m/s?
 (Mass of electron = 9.1×10^{-31} kg $h = 6.63 \times 10^{-34}$ J.s)
 A) 3.6×10^{-10} m B) 3.6×10^{-9} m C) 1.2×10^{-10} m D) 6.6×10^{-34} m
31. Which of the following particles has the shortest de Broglie wavelength if all are moving with the same velocity?
 - A) Electron B) Proton C) Neutron D) Alpha particle (He^{2+})
32. "The exact path of the electron in a 2p orbital cannot be determined". The above statement is based upon:
 - A) Hund's rule B) Bohr's rule C) Uncertainty principle D) Aufbau principle
33. It is not possible to determine the exact position and momentum of a moving microparticle. It is known as

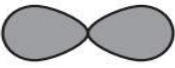
- a. Heisenberg uncertainty principle b. Aufbau principle
 - c. Pauli exclusion principle d. Le-Chatelier's principle
34. It is impossible to determine the position as well as the momentum of an electron in an atom. This principle is known as
- a. de Broglie equation c. Pauli's exclusion principle
 - b. Heisenberg's uncertainty principle d. Aufbau Principle
35. The uncertainty principle and the concept of wave nature were proposed by and ..., respectively.
- a. Heisenberg, de Broglie c. de Broglie, Heisenberg
 - b. Heisenberg, Planck d. Planck, Heisenberg

Probability Concept

36. Which of the following subshells is spherical
- a. 4s b. 4p c. 4d d. 4f
37. p orbital has ... orientations.
- a. 1 b. 2 c. 3 d. 4
38. The number of orbitals in the p-subshell is
- a. 1 b. 2 c. 3 d. 6
39. The number of electrons which can be accommodated in an orbital is
- a. 1 b. 2 c. 3 d. 4
40. Which statement is always true?
- a. Every shell contains p-orbitals. b. Every shell contains s-orbitals.
 - c. Every shell contains d-orbitals. d. Every shell contains f-orbitals.
41. Which subshell cannot exist?
- a. 2d b. 3p c. 4f d. 5d
42. Which one is incorrect?
- a. All s-orbitals are spherical.
 - b. Every orbital can hold two electrons.
 - c. Every shell contains four subshells.
 - d. Orbitals of the same subshell have equal energy.
43. Four students describe orbitals.
- A. An orbital can hold at most two electrons.
 - B. Orbitals represent regions of high probability.
 - C. Electrons move in fixed circular paths inside orbitals.
 - D. Orbitals have different shapes.
- Who is wrong?
- a. A b. B c. C d. D
44. Why does a p-subshell contain six electrons?
- a. Three orbitals × two electrons each
 - b. Six orbitals × one electron each
 - c. Two orbitals × three electrons each
 - d. Six shells

Quantum Numbers

45. Which property is **not** described by any quantum number
- a. Energy level b. Orbital shape c. Orbital orientation d. Colour of electron
46. The principal quantum number of an atom is related to
- a. the size of the shell c. shape of the subshell
 - b. orientation of the nucleus d. the spin of the electrons
47. The distance of an electron from the nucleus is determined by:
- a) Principal quantum number b) Azimuthal quantum number
 - c) Magnetic quantum number d) Spin quantum number
48. Two electrons in the K shell will differ in
- a. Principal quantum number c. Magnetic quantum number
 - b. Azimuthal quantum number d. Spin quantum number
49. $l = 3$ represents which of the following subshells:
- a. s b. p c. d d. f
50. If the value of azimuthal quantum number l is 2, the subshell will be denoted by
- a. s b. p c. d d. f

51. Which set of quantum numbers is not permitted?
 a. $n=2, l=1, m=0$ c. $n=2, l=0, m=-1$ b. $n=3, l=0, m=0$ d. $n=3, l=2, m=0$
52. Which set of quantum numbers is incorrect?
 a. $n=1, l=0, m=+1$ b. $n=1, l=1, m=+1$ c. $n=1, l=0, m=0$ d. $n=2, l=1, m=-1$
53. Which of the following is not possible?
 a. $n=2, l=1, m=0, s=+1/2$
 b. $n=2, l=2, m=+1, s=-1/2$
 c. $n=2, l=1, m=-1, s=+1/2$
 d. $n=2, l=1, m=0, s=-1/2$
54. Which of the following is not possible?
 a) $n = 3, l = 0, m = 0$ b) $n = 3, l = 1, m = -1$
 c) $n = 2, l = 0, m = -1$ d) $n = 2, l = 1, m = 0$
55. Two electrons in different orbitals
 a. must have different spin c. may have the same or different spin
 b. have the same spin d. all of the above
56. The possible value of l in terms of n is
 a. 0 to $(n+1)$ b. 0 to $(n-1)$ c. 1 to $(n-1)$ d. 1 to $(n+1)$
57. The correct set of quantum numbers for the unpaired electron of the fluorine atom is
- | | n | l | m | S |
|----|-----|-----|-----|--------|
| a. | 2 | 0 | 0 | $+1/2$ |
| b. | 2 | -1 | +1 | $+1/2$ |
| c. | 2 | 2 | 0 | $+1/2$ |
| d. | 2 | 1 | -1 | $+1/2$ |
58. Which of the following is incorrect?
 a. n represents the size of the orbital
 b. l represents the shape of the orbital
 c. m represents the orientation of the orbital
 d. s represents the path of an electron in the orbital
59. The maximum number of electrons in a sub-shell with $l = 3, n = 4$ is
 a. 10 b. 12 c. 14 d. 16
60. The azimuthal quantum number describes
 (a) orbital size (b) orbital orientation (c) orbital shape (d) nuclear stability
61. The magnetic quantum number of an atom gives:
 a. Orientation of electrons in space c. Principal shell occupied by e^-
 b. The positive and negative spin of e^- d. Orbital of e^-
62. Which atom has its outermost electron in an orbital of the shape shown, with principal quantum number 3?
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- A sodium B chlorine C calcium D bromine
63. Which statement about the electrons in a ground-state carbon atom is correct?
 A Electrons are present in four different energy levels.
 B There are more electrons in p orbitals than there are in s orbitals.
 C The occupied orbital of highest energy is spherical.
 D The occupied orbital of lowest energy is spherical.
64. Which statement about a 3p orbital is correct?
 A It can hold a maximum of 6 electrons.
 B It has the highest energy of the orbitals with principal quantum number 3.
 C It is at a higher energy level than a 3s orbital but has the same shape.
 D It is occupied by one electron in an isolated phosphorus atom.

65. The outermost electron in an atom of neon occupies a particular orbital. Which row shows the relative energy and shape of this orbital?

	energy of orbital relative to other occupied orbitals	shape of orbital
A	higher or equal	
B	higher or equal	
C	lower or equal	
D	lower or equal	

Pauli's Exclusion Principle

66. $1s^3$ is a wrong electronic configuration of Li, based on
a. the Aufbau principle b. $n+l$ rule c. Pauli's exclusion principle d. Hund's rule of maximum multiplicity

Hund's Rule of Maximum Multiplicity

67. The valence shell of the Nitrogen atom has three unpaired electrons, according to
a. Aufbau rule c. Pauli's exclusion principle
b. Hund's rule d. all of these
68. Which atom has more unpaired electrons than paired electrons in orbitals of principal quantum number 2?
A carbon **B** nitrogen **C** oxygen **D** fluorine
69. Which atom has exactly three unpaired electrons?
A an isolated gaseous aluminium atom
B an isolated gaseous carbon atom
C an isolated gaseous chromium atom
D an isolated gaseous phosphorus atom
70. Which of the following has the highest number of unpaired electrons?
a. P b. O c. Al d. S
71. A silicon atom has unpaired electrons due to:
a. Hund's rule c. Pauli's exclusion principle b. Aufbau Principle d. Bohr-Bury rule
72. The number of unpaired electrons in the element having electronic configuration $[\text{Ne}] 3s^2 3p^4$ is
a. 1 b. 2 c. 3 d. 4
73. Orbitals possessing the same energy are called:
a) hybrid orbitals b) valency orbitals c) d-orbitals d) degenerate orbitals
74. The statement "orbitals of equivalent energy are filled with an electron before spin-pairing occurs" is called
a. uncertainty principle b. Pauli exclusion principle c. Zeeman effect d. Hund's rule
75. Which atom cannot have three unpaired electrons?
a. N b. P c. As d. Ne

Aufbau Principle

76. An atom has 6 electrons in its M shell. What is its atomic number?
A) 8 B) 14 C) 16 D) 18
77. Which pair has the same number of occupied shells?
a. Na and Mg b. Li and Na c. O and S d. F and Cl
78. Which statement explains why 3d orbitals begin to fill only after 4s?
a. 4s has lower energy. b. 3d has a lower principal quantum number.
c. 3d can hold more electrons. d. Hund's rule.
79. Which of the following has maximum energy?
a) 4s b) 3p c) 2s d) 4d
80. Which of the following is not possible?
a. $6s^2$ b. $3p^5$ c. $3p^7$ d. $3d^9$

81. An element has atomic number 17. The number of valence electrons is
a. 2 b. 4 c. 6 d. 7
82. What is the number of electrons in ${}_{12}^{24}\text{Mg}^{2+}$?
a. 12 b. 24 c. 2 d. 10
83. The atomic number of Arsenic is 33; what is its outermost shell electronic configuration?
a. $4s^2 4p^1$ b. $4s^2 4p^2$ c. $4s^2 4p^3$ d. $4s^2 4p^4$
84. The electronic configuration of the Chromium atom ($\text{Cr} = 24$) is:
a. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$ c. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4 4s^2$
b. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$ d. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$
85. The outermost electronic configuration of chromium is
a. $3d^4 4s^2$ b. $3d^5 4s^1$ c. $3d^5 4s^2$ d. $3d^6 4s^2$
86. The electronic configuration of any element is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$. This represents
a. Excited state c. Cationic state b. Anionic state d. Ground state
87. The ion X^{2+} has the same electronic configuration as the atom Kr.
What is the electronic configuration of an atom of X?
A $[\text{Ar}] 4s^2 3d^{10} 4p^6$ **B** $[\text{Ar}] 4s^2 3d^{10} 4p^6 5s^2$ **C** $[\text{Ar}] 4s^2 3d^{10} 4p^6$ **D** $[\text{Ar}] 4s^2 3d^{10} 4p^6 5s^2$
88. Which ion has the same electronic configuration as Cl^- ?
A F^- **B** P^+ **C** Sc^{3+} **D** Si^{4+}
89. The electronic configuration of the two outermost shells of an atom is $3s^2 3p^6 3d^5 4s^2$.
What is this atom?
A manganese **B** phosphorus **C** strontium **D** vanadium
90. What is the electronic configuration of Mg^{2+} ?
A $1s^2 2s^2 2p^6$ **B** $1s^2 2s^2 2p^6 3s^2$ **C** $1s^2 2s^2 2p^6 3s^2 3p^2$ **D** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$
91. Which atomic orbitals are occupied in an atom of phosphorus?
A $1p 2s 2p$ **B** $2s 2p 2d$ **C** $2s 2p 3s$ **D** $2p 3s 3d$
92. The configuration $1s^2 2s^2 2p^5$ shows:
a. The excited state of Nitrogen c. The ground state of Nitrogen
b. The excited state of Fluorine d. The ground state of Fluorine
93. A neutral atom of an element has 2K, 8L, 11M, and 2N electrons. The number of s-electrons in the atom is:
a) 2 b) 8 c) 10 d) 6
94. A student writes the electronic configuration of oxygen as $1s^2 2s^2 2p^6$.
The mistake is that
a. too many electrons are present. b. oxygen has no p-electrons.
c. the Aufbau principle is violated. d. Pauli's principle is violated.
95. An atom loses one electron.
Which quantity definitely changes?
a. Atomic number b. Number of neutrons
c. Electronic configuration d. Mass number
96. Atomic orbitals are filled up in the ground state in order of increasing energy levels. This is the statement of:
a. Pauli's exclusion Principle c. Hund's rule
b. Aufbau Principle d. de Broglie's Hypothesis
97. How many protons, electrons, and neutrons are present in ${}_{21}^{43}\text{X}$?
a. 21, 21, 21 b. 21, 21, 22 c. 22, 22, 22 d. 22, 21, 22
98. Electrons enter the lowest available energy levels.
Which of the following rules or principles best justifies the above statement?
a. Hund's rule of maximum multiplicity
b. Pauli's exclusion principle
c. Heisenberg's uncertainty principle
d. Aufbau principle
99. The value of n and l for the last electron of sodium is
a. $n = 2, l = 0$ b. $n = 3, l = 0, 1, 2$ c. $n = 3, l = 0$ d. $n = 3, l = 1$

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