

ATOMIC- STRUCTURE

- Rutherford's alpha particle scattering experiment eventually lead to the conclusion that-**
 - mass and energy are related
 - electrons occupy space around the nucleus
 - Neutrons are buried deep in the nucleus
 - the point of impact with matter can be precisely determined
- Rutherford's scattering experiment is related to the size of the**
 - nucleus
 - atom
 - electron
 - neutron
- Bohr's model can explain**
 - the spectrum of hydrogen atom only
 - the spectrum of an atom or ion containing one electron only
 - the spectrum of hydrogen molecule.
 - the solar spectrum
- Any p-orbital can accommodate upto**
 - four electrons
 - six electrons
 - two electrons with parallel spins
 - two electrons with opposite spins
- The ratio of the radius of Bohr first orbit for the electron orbiting the hydrogen nucleus to that of the electron orbiting the deuterium nucleus (mass nearly twice that of H nucleus) is approximately**
 - 1 : 1
 - 1 : 2
 - 2 : 1
 - 1 : 4
- Correct set of four quantum number for the valence (outermost) electron of rubidium ($z = 37$) is**
 - $5, 0, 0, +\frac{1}{2}$
 - $5, 1, 0, +\frac{1}{2}$
 - $5, 1, 1, +\frac{1}{2}$
 - $6, 0, 0, +\frac{1}{2}$
- Which electronic level would allow the hydrogen atom to absorb a photon but not to emit a photon ?**
 - $3s$
 - $2p$
 - $2s$
 - $1s$
- The principal quantum number of an atom is related to the**
 - size of the orbital
 - spin angular momentum
 - orientation of the orbital in spin
 - orbital angular momentum
- Rutherford's experiment on scattering of α - particles showed for the first time the atom has**
 - electrons
 - protons

(c) nucleus

(d) neutrons

10. Which one of the following sets of quantum numbers represents an impossible arrangement?

- | | n | l | m | s |
|-----|----|----|-----|----------------|
| (a) | 3, | 2, | -2, | $\frac{1}{2}$ |
| (b) | 3, | 2, | -3, | $\frac{1}{2}$ |
| (c) | 4, | 0, | 0, | $\frac{1}{2}$ |
| (d) | 5, | 3, | 0, | $-\frac{1}{2}$ |

11. The triad of nuclei that is isotonic is

- (a) ${}^{14}_6\text{C}, {}^{15}_7\text{N}, {}^{17}_9\text{F}$ (b) ${}^{12}_6\text{C}, {}^{14}_7\text{N}, {}^{19}_9\text{F}$
(c) ${}^{14}_6\text{C}, {}^{14}_7\text{N}, {}^{17}_9\text{F}$ (d) ${}^{14}_6\text{C}, {}^{14}_7\text{N}, {}^{19}_9\text{F}$

12. The wavelength of spectral line for an electronic transition is inversely related to

- (a) the number of electrons undergoing the transition
(b) the nuclear charge of the atom
(c) the difference in the energy of the energy levels involved in the transition
(d) the velocity of the electron undergoing the transition

13. The outermost electronic configuration of the most electronegative element is

- (a) $ns^2 np^3$ (b) $ns^2 np^4$
(c) $ns^2 np^5$ (d) $ns^2 np^6$

14. The correct ground state electronic configuration of chromium atom is

- (a) $[\text{Ar}] 3d^5 4s^1$ (b) $[\text{Ar}] 3d^4 4s^2$
(c) $[\text{Ar}] 3d^6 4s^0$ (d) $[\text{Ar}] 4d^5 4s^1$

15. In the Bohr's model of the hydrogen atom, the ratio of the kinetic energy to the total energy of the electron in a quantum state n is-

- (a) 1 (b) 2 (c) -1 (d) -2

16. Three isotopes of an element have mass numbers, m, (m+1) and (m+2). if the mean mass number is (m+0.5) then which of the following ratios may be accepted for m, (m+1), (m+2) in that order ?

- (a) 1:1:1
(b) 4:1:1
(c) 3:2:1
(d) 2:1:1

17. Which of the following relates to photons both as wave motion and as stream of particles?

- (a) Interference (b) $E = mc^2$
 (c) Diffraction (d) $E = hv$
- 18. The orbital angular momentum of an electron in 2s orbital is**
- (a) $+\frac{1}{2} \cdot \frac{h}{2\pi}$ (b) zero
 (c) $\frac{h}{2\pi}$ (d) $\sqrt{2} \cdot \frac{h}{2\pi}$
- 19. Which of the following has the maximum number of unpaired electrons?**
- (a) Mg^{2+} (b) Tu^{3+}
 (c) V^{3+} (d) Fe^{2+}
- 20. The first use of quantum theory to explain the structure of atom was made by**
- (a) Heisenberg (b) Neils Bohr
 (c) Max Planck (d) Albert Einstein
- 21. For a d-electron, the orbital angular momentum is**
- (a) $\sqrt{6} \left(\frac{h}{2\pi} \right)$ (b) $\sqrt{2} \left(\frac{h}{2\pi} \right)$ (c) $\left(\frac{h}{2\pi} \right)$ (d) $2 \left(\frac{h}{2\pi} \right)$
- 22. The electronic configuration of an element is $1s^2, 2s^2, 2p^6, 3s^2, 3d^5 4s^1$, This represents its**
- (a) excited state (b) ground state
 (c) Cationic form (d) anionic form
- 23. The number of nodal planes in a p_x orbital is**
- (a) one (b) two
 (c) three (d) zero
- 24. The wavelength associated with a golf ball weighing 200g and moving at a speed of 5 m/h is of the order**
- (a) $10^{-10}m$ (b) $10^{-20}m$
 (c) $10^{-30}m$ (d) $10^{-40}m$
- 25. Rutherford's experiment, which established the nuclear model of the atom, used a beam of**
- (a) β - particles, which impinged on a metal foil and got absorbed
 (b) α rays, which impinged on a metal foil and ejected electrons
 (c) helium atoms, which impinged on a metal foil and got scattered
 (d) helium nuclei, which impinged on a metal foil and got scattered
- 26. Which hydrogen like species will have same radius as that of Bohr orbit of hydrogen atom ?**
- (a) $n = 2, Li^{2+}$ (b) $n = 2, Be^{3+}$
 (c) $n = 2, He^+$ (d) $n = 3, Li^{2+}$
- 27. The number of radial nodes of 3s and 2p orbitals are respectively**
- (a) 2, 0 (b) 0, 2

(c) 1, 2

(d) 2, 11

28. Which of the following statements regarding Bohr theory of hydrogen atom is not correct?

- (a) Kinetic energy of an electron in an orbit is equal to half of magnitude of its potential energy
- (b) Kinetic energy of an electron in an orbit is equal to the magnitude of its potential energy
- (c) Total energy of an electron is equal to negative of its kinetic energy
- (d) Potential energy of an electron in an orbit is equal to $-mv^2$.

29. The probability of finding 1s electron is maximum

- (a) at the nucleus
- (b) at the Bohr radius
- (c) at a large distance than Bohr radius
- (d) in between the nucleus and the first Bohr radius

30. Which of the following statements on quantum numbers is not correct ?

- (a) Quantum numbers n, l, m and m_s are needed to describe completely an electron in an atom
- (b) Quantum numbers n, l, m and m_s are obtained by solving the Schrodinger wave equation
- (c) A subshell in an atom can be designated with two quantum numbers n and l
- (d) The maximum value of l is equal to $n - 1$ and that of m is ± 1 .

31. Which of the following expressions for the energy of electron in Bohr orbits is correct?

- (a) $E \propto Z^2 / n^2$
- (b) $E \propto Z / n^2$
- (c) $E = -n^2 / Z$
- (d) $E \propto -z^2 / n^2$

32. The outer electronic configuration of cerium ($z = 58$) is

- (a) $(4d)^{10} (5s)^2 (5p)^6 (4f)^3 (6d)^1$
- (b) $(4d)^{10} (5s)^2 (5p)^3 (4f)^1 (6s)^2$
- (c) $(4d)^{10} (5s)^2 (5p)^6 (5d)^3 (6s)^2$
- (d) $(4d)^{10} (5s)^2 (5p)^6 (4f)^2 (6s)^2$

33. Which of the following sets of quantum numbers are not allowed ?

- (a) $n = 2, l = 1, m = +2$
- (b) $n = 2, l = 0, m = +1$
- (c) $n = 2, l = 0, m = 0$
- (d) $n = 2, l = 1, m = -1$

34. In which of the following orbitals, the electrons has the maximum energy ?

- (a) 3p
- (b) 4f
- (c) 4p
- (d) 4s

35. The correct statement on the aufbau principle is that

- (a) $(n - 1)d$ subshell is always lower in energy than ns orbital
- (b) $(n - 1)f$ subshell always has energy more than np orbital
- (c) 5d is lower in energy than 4f

- (d) 6p is lower in energy than 5d
36. The Pz orbital corresponds to the magnetic quantum number m is equal to
(a) 0 (b) + 1
(c) - 1 (d) +2
37. If the radius of first Bohr orbit is r , the wavelength of an electron in the third orbit of a hydrogen atom is equal to
(a) $6\pi r$
(b) $2\pi r$
(c) $9\pi r$
(d) $3r$
38. For which of the following species, the electronic distribution is spherically symmetrical ?
(a) H (b) Na (c) Cl^- (d) B
39. The electronic velocity in the fourth Bohr orbit of hydrogen is v . The velocity of the electron in the first orbit would be
(a) $4v$
(b) $16v$
(c) $v/4$
(d) $v/1$
40. The ratio of the difference in energy between the first and second Bohr orbits to that between the second and third Bohr orbit is
(a) $1/2$
(b) $1/3$
(c) $4/9$
(d) $27/5$
41. The designation of an orbital with $n=4$ and $l = 1$, is
(a) 4d
(b) 4s
(c) 4f
(d) 4p
42. Which of the following sets of quantum numbers is possible for an electron in a 4f orbital
(a) $n=4, l=2, m=2, s=+1/2$
(b) $n=4, l=4, m=+4, s=+1/2$
(c) $n=4, l=3, m=+1, s=-1/2$
(d) $n=4, l=3, m=4, s=+1/2$
43. Total number of nodal planes are same in
(a) 3s, 4d
(b) 4s, 3p
(c) 5s, 4d

(d) 4s, 4p

44. As we move away from nucleus, the energy of orbit

- (a) decreases
- (b) increases
- (c) remains unchanged
- (d) none of these.

45. Consider the following statements. The d-orbitals have

1. four lobes and two nodes
2. four lobes and one nodes
3. same sign in the opposite lobes
4. opposite sign in the opposite lobes

Which of the above statements are correct ?

- (a) 1 alone
- (b) 1 and 3
- (c) 2 and 3
- (d) 1 and 4

46. Electronic configuration of niobium (Nb = 41) is ?

- (a) [Kr] 4d¹, 5s¹
- (b) [Kr] 4d⁵
- (c) [Kr] 4d³, 5s²
- (d) [Kr] 5s², 5p³

47. The maximum number of electrons in a subshell is given by the expression

- (a) 4l - 2
- (b) 4l + 2
- (c) 2l + 1
- (d) 2n²

48. The principal quantum number of an atom represents-

- (a) Size of the orbital
- (b) Spin angular momentum
- (c) Orbital angular momentum
- (d) Space orientation of the orbital.

49. Consider the following ions

1. Ni²⁺ 2. Co²⁺ 3. Cr²⁺ 4. Fe³⁺

(Atomic no. Cr = 24, Fe = 26, Co = 27, Ni = 28)

The correct sequence of the increasing order of the number of unpaired electrons is

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

50. The outer electronic configuration of 3s² 3p⁵ is possessed by ?

- (a) 0
- (b) Cl

(c) Br

(d) Ar.

51. Which of the following explains the sequence of filling electrons in different shells ?

- (a) Hund's rule
- (b) Octet rule
- (c) Aufbau principle
- (d) All of these

52. For which of the following species, Bohr's theory is not applicable ?

- (a) Be^{3+}
- (b) Li^{2+}
- (c) He^{2+}
- (d) H.

53. The correct set of quantum numbers for a 4d electron is

- (a) 4, 3, 2, + 1/2
- (b) 4, 2, 1, 0
- (c) 4, 3 —2, + 1/2
- (d) 4, 2, 1, — 1/2

54. Which one of the following pairs of ions have the same electronic configuration ?

- (a) Cr^{3+} , Fe^{3+}
- (b) Fe^{3+} , Mn^{2+}
- (c) Fe^{3+} , Co^{3+}
- (d) Sc^{3+} , Cr^{3+}

55. The radius of hydrogen atom in the ground state is 0.53 Å. The radius of Li^{2+} ion (atomic number =3) in similar state is

- (a) 0.17 Å
- (b) 1.06 Å
- (c) 0.53 Å
- (d) 2.12 Å

56. In H-atom or one electron system energy levels of orbitals of a shell are degenerate whereas in many electron system energy levels of orbitals of a shell are non degenerate because of -

- (a) different ionisation energy
- (b) different electron affinity
- (c) different penetration and shielding effect
- (d) different atomic radii

57. If the velocity of an electron in the first Bohr orbit of a hydrogen atom is V, then its velocity in the third Bohr orbit will be

- (a) $V/9$
- (b) $V/3$
- (c) $9V$
- (d) $3V$.

58. In a hydrogen atom, if the energy of an electron in the ground state is 13.6 eV, that in the 2nd excited state is

(a) 1.51 eV

(b) 3.4 eV

(c) 6.04 eV

(d) 13.6 eV

59. The work function of a metal is 4.2 eV. If radiation of 2000 Å fall on the metal then then the kinetic energy of the fastest photo electron is

(a) 1.6×10^{-19} J

(b) 16×10^{10} J

(c) 3.2×10^{-19} J

(d) 6.4×10^{10} J.

60. Two particles A and B are in motion. If the wavelength associated with the particle A is 5.0×10^{-8} m, then wavelength of particle B having momentum half of A is-

(a) 2.5×10^{-8} m

(b) 1.25×10^{-8} m

(c) 1.0×10^{-7} m

(d) 1.0×10^{-8} m.

61. A particle A moving with a certain velocity has a de Broglie wavelength of 1 Å. If particle B has mass 25% of that A and velocity 75% of that of A, the de Broglie wavelength of B will be approximately

(a) 1 Å

(b) 5.3 Å

(c) 3 Å

(d) 0.2 Å

62. The kinetic energy of an electron in He^+ maximum when it is present in the orbit having

(a) $n = 1$

(b) $n = 2$

(c) $n = 3$

(d) $n = \infty$

63. Which of the following species will produce the shortest wavelength for the transition

$n = 2$ to $n = 1$?

(a) Hydrogen atom

(b) Singly ionized helium

(c) Deuterium atom

(d) Doubly ionized lithium.

64. The third line of the Balmer series, in the emission spectrum of the hydrogen atom, is due to the transition from the

(a) fourth Bohr orbit to the first Bohr orbit

(b) fifth Bohr orbit of the second Bohr orbit

(c) sixth Bohr orbit of the second Bohr orbit

(d) seventh Bohr orbit of the third Bohr orbit

(e) sixth Bohr orbit of the second Bohr orbit.

65. Which of the following is not isoelectronic ?

(a) Na^+

(b) Mg^{2+}

(c) O^{2-}

(d) Cl^-

ANSWER-SHEET - ATOMIC STRUCTURE

1	(b)	34	(b)
2	(a)	35	(b)
3	(b)	36	(a)
4	(d)	37	(a)
5	(a)	38	(c)
6	(a)	39	(a)
7	(d)	40	(d)
8	(a)	41	(d)
9	(c)	42	(c)
10	(b)	43	(d)
11	(a)	44	(b)
12	(c)	45	(b)
13	(c)	46	(a)
14	(a)	47	(b)
15	(c)	48	(a)
16	(b)	49	(a)
17	(d)	50	(b)
18	(b)	51	(c)
19	(d)	52	(c)
20	(b)	53	(d)
21	(a)	54	(b)
22	(b)	55	(a)
23	(a)	56	(c)
24	(c)	57	(b)
25	(d)	58	(a)
26	(b)	59	(c)
27	(a)	60	(c)
28	(b)	61	(b)
29	(a)	62	(a)
30	(d)	63	(d)
31	(d)	64	(b)
32	(d)	65	(d)
33	(a)		

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