ATOMIC STRUCTURE

Set 1

1. Who proposed the atomic theory that regarded the atom as the ultimate indivisible particle of matter?
a) J.J. Thomson
b) John Dalton
c) Ernest Rutherford
d) Niels Bohr

2. The cathode rays start from the _____ and move towards the _____ .
a) anode, cathode
b) cathode, anode
c) nucleus, electron
d) proton, neutron

3. Who determined the charge-to-mass ratio (e/m_e) of the electron?
a) R.A. Millikan
b) J.J. Thomson
c) James Chadwick
d) Michael Faraday

4. The charge on an electron was determined by:
a) Rutherford's gold foil experiment
b) Millikan's oil drop experiment
c) Thomson's cathode ray experiment
d) Bohr's atomic model

5. Which subatomic particle was discovered by James Chadwick?
a) Electron
b) Proton
c) Neutron

d) Positron

6. The positively charged particles discovered in the modified cathode ray tube are called:
a) Anode rays
b) Canal rays
c) Alpha rays
d) Beta rays

7. Thomson's atomic model is also known as the:
a) Nuclear model
b) Planetary model
c) Plum pudding model
d) Quantum model

8. Rutherford's α-particle scattering experiment led to the discovery of:
a) Electron
b) Proton
c) Nucleus
d) Neutron

9. Most of the space in an atom is:
a) Filled with positive charge
b) Occupied by neutrons
c) Empty
d) Occupied by electrons

10. The radius of the nucleus is approximately _____ times smaller than the radius of the atom.
a) 10
b) 100
c) 10,000
d) 100,000

11. The number of protons in the nucleus of an atom is called its:
a) Mass number
b) Atomic number
c) Neutron number
d) Nucleon number

12. Atoms of the same element with the same atomic number but different mass numbers are called:
a) Isobars
b) Isotones
c) Isotopes
d) Isomers

13. The mass number (A) of an atom is given by:
a) Z + n
b) Z - n
c) n - Z
d) Z * n

14. Which isotope of hydrogen has one proton and two neutrons?
a) Protium
b) Deuterium
c) Tritium
d) Hydronium

15. A major drawback of Rutherford's model was that it could not explain:
a) The presence of a nucleus
b) The stability of the atom
c) The positive charge of the nucleus
d) The scattering of alpha particles

16. According to Maxwell's theory, an accelerating charged particle should:
a) Gain mass
b) Emit electromagnetic radiation

c) Lose charge
d) Become stable

17. The phenomenon where certain metals emit electrons when exposed to light is called:
a) Black body radiation
b) Photoelectric effect
c) Atomic spectra
d) Radioactivity

18. The minimum frequency of light required to eject an electron from a metal surface is called:
a) Critical frequency
b) Threshold frequency
c) Peak frequency
d) Work frequency

19. Who explained the photoelectric effect using Planck's quantum theory?
a) Max Planck
b) Albert Einstein
c) Niels Bohr
d) de Broglie

20. The energy of a photon is given by:
a) $E = h/c$
b) $E = h\lambda$
c) $E = hv$
d) $E = c/v$

21. The constant 'h' in Planck's equation is known as:
a) Rydberg constant
b) Planck's constant
c) Boltzmann constant
d) Avogadro's constant

22. The spectrum of white light is:
a) A line spectrum
b) An absorption spectrum
c) A continuous spectrum
d) A band spectrum

23. The spectrum produced by excited hydrogen atoms is a:
a) Continuous spectrum
b) Band spectrum
c) Line spectrum
d) Absorption spectrum

24. The series of lines in the hydrogen spectrum that lies in the visible region is the:
a) Lyman series
b) Balmer series
c) Paschen series
d) Brackett series

25. The formula for the wave number ($\tilde{\nu}$) of the hydrogen spectrum is given by:
a) Rydberg
b) Bohr
c) Planck
d) Einstein

26. Bohr's model of the atom was successful in explaining the spectrum of:
a) Hydrogen atom
b) Helium atom
c) Lithium atom
d) All atoms

27. According to Bohr's postulate, the angular momentum of an electron is:

a) Constant
b) Zero
c) Quantized
d) Random

28. The expression for the angular momentum of an electron in a Bohr orbit is:
a) $mvr = n$
b) $mvr = n/h$
c) $mvr = nh/2\pi$
d) $mvr = 2\pi/nh$

29. The radius of the first Bohr orbit for hydrogen is:
a) 52.9 pm
b) 105.8 pm
c) 211.6 pm
d) 0.529 pm

30. The energy of an electron in the nth Bohr orbit is given by:
a) $E_n = -R_H / n$
b) $E_n = -R_H / n^2$
c) $E_n = +R_H / n^2$
d) $E_n = -R_H * n^2$

31. For a hydrogen-like ion (He^+, Li^{2+}), the energy of an electron:
a) Decreases with increasing Z
b) Is independent of Z
c) Increases with increasing Z
d) Becomes positive

32. The de Broglie equation relates a particle's wavelength to its:
a) Energy
b) Frequency
c) Momentum

d) Velocity

33. The de Broglie wavelength (λ) is given by:
a) λ = h/mv
b) λ = mv/h
c) λ = hc/E
d) λ = E/h

34. Heisenberg's Uncertainty Principle states that it is impossible to know precisely both the:
a) Energy and spin of an electron
b) Mass and charge of an electron
c) Position and momentum of an electron
d) Speed and volume of an atom

35. The mathematical expression for Heisenberg's Uncertainty Principle is:
a) $\Delta x * \Delta p \geq h/4\pi$
b) $\Delta x * \Delta p \leq h/4\pi$
c) $\Delta E * \Delta t \geq h/4\pi$
d) $\Delta v * \Delta t \geq h/4\pi$

36. The concept that matter exhibits both particle and wave-like properties is known as:
a) Quantum mechanics
b) Wave-particle duality
c) Uncertainty principle
d) Corpuscular theory

37. The fundamental equation of quantum mechanics was developed by:
a) Heisenberg
b) de Broglie
c) Schrödinger
d) Bohr

38. The solution to the Schrödinger equation for an electron is called a:
a) Orbit
b) Orbital
c) Shell
d) Subshell

39. An atomic orbital is defined by which quantum numbers?
a) n and l
b) n, l, and m_l
c) n and m_s
d) l and m_l

40. The principal quantum number (n) defines the:
a) Shape of the orbital
b) Size and energy of the orbital
c) Orientation of the orbital
d) Spin of the electron

41. The azimuthal quantum number (l) defines the:
a) Size of the orbital
b) Energy of the orbital
c) Shape of the orbital
d) Orientation of the orbital

42. For a given value of n, the possible values of l range from:
a) 1 to n
b) 0 to n
c) 0 to n-1
d) 1 to n-1

43. The number of orbitals in a subshell is given by:
a) n^2
b) $2l + 1$
c) $2n + 1$

d) l^2

44. The magnetic quantum number (m_l) defines the:
a) Energy of the orbital
b) Shape of the orbital
c) Orientation of the orbital
d) Spin of the electron

45. The spin quantum number (m_s) can have values of:
a) -1, 0, +1
b) 0, +1
c) -1/2, +1/2
d) -1, +1

46. How many orbitals are there in the n=3 shell?
a) 3
b) 6
c) 9
d) 18

47. The maximum number of electrons that can be accommodated in a shell is given by:
a) n
b) 2n
c) n^2
d) $2n^2$

48. The shape of an s orbital is:
a) Dumbbell
b) Spherical
c) Double dumbbell
d) Complex

49. How many electrons can a single orbital hold?

a) 1
b) 2
c) 6
d) 10

50. The rule that electrons fill orbitals singly before pairing up is:
a) Aufbau principle
b) Pauli exclusion principle
c) Hund's rule
d) Heisenberg's principle

Answer Key: Set 1

1. b) John Dalton
2. b) cathode, anode
3. b) J.J. Thomson
4. b) Millikan's oil drop experiment
5. c) Neutron
6. b) Canal rays
7. c) Plum pudding model
8. c) Nucleus
9. c) Empty
10. d) 100,000 (or 10^5)
11. b) Atomic number
12. c) Isotopes
13. a) Z + n
14. c) Tritium
15. b) The stability of the atom
16. b) Emit electromagnetic radiation
17. b) Photoelectric effect
18. b) Threshold frequency
19. b) Albert Einstein
20. c) E = hv
21. b) Planck's constant
22. c) A continuous spectrum

23. c) Line spectrum
24. b) Balmer series
25. a) Rydberg
26. a) Hydrogen atom
27. c) Quantized
28. c) $mvr = nh/2\pi$
29. a) 52.9 pm
30. b) $E_n = -R_H / n^2$
31. a) Decreases with increasing Z (becomes more negative)
32. c) Momentum
33. a) $\lambda = h/mv$
34. c) Position and momentum of an electron
35. a) $\Delta x * \Delta p \geq h/4\pi$
36. b) Wave-particle duality
37. c) Schrödinger
38. b) Orbital
39. b) n, l, and m_l
40. b) Size and energy of the orbital
41. c) Shape of the orbital
42. c) 0 to n-1
43. b) $2l + 1$
44. c) Orientation of the orbital
45. c) -1/2, +1/2
46. c) 9
47. d) $2n^2$
48. b) Spherical
49. b) 2
50. c) Hund's rule