ATOMIC STRUCTURE

Set 3

1. The existence of atoms was first proposed by:
a) Indian and Greek philosophers
b) John Dalton
c) J.J. Thomson
d) Democritus

2. The phenomenon where a substance like glass gets electrically charged when rubbed with silk is due to:
a) Transfer of protons
b) Transfer of electrons
c) Transfer of neutrons
d) Creation of charge

3. In a cathode ray tube, the phosphorescent material used behind the perforated anode is:
a) Gold foil
b) Zinc sulphide
c) Sodium chloride
d) Copper sulphate

4. The characteristic of cathode rays that does NOT depend on the material of the electrodes or the gas is:
a) Their charge
b) Their mass
c) Their charge-to-mass ratio
d) Their deflection in electric field

5. Millikan's oil drop experiment measured the:
a) Mass of the electron
b) Charge of the electron

c) Charge-to-mass ratio of the electron
d) Speed of the electron

6. The mass of a proton is approximately:
a) 1.67×10^{-27} kg
b) 9.1×10^{-31} kg
c) 1.67×10^{-24} kg
d) 0 kg

7. The neutron was discovered by bombarding beryllium with:
a) Electrons
b) Protons
c) Alpha particles
d) X-rays

8. In the plum pudding model, the electrons are:
a) Revolving in orbits
b) Embedded in a positive sphere
c) Located in the nucleus
d) Not present

9. X-rays were discovered by:
a) J.J. Thomson
b) Wilhelm Röentgen
c) Henri Becquerel
d) Marie Curie

10. The radioactive element that emits α, β, and γ rays was discovered by:
a) Rutherford
b) Becquerel
c) The Curies
d) Soddy

11. The most penetrating type of nuclear radiation is:

a) Alpha rays
b) Beta rays
c) Gamma rays
d) X-rays

12. In Rutherford's experiment, the fact that most alpha particles passed through the foil undeflected proved that:
a) The nucleus is small
b) The atom is neutral
c) The atom is mostly empty space
d) The nucleus is positive

13. The symbol for an atom is written as $^{A}_{2}X$. The subscript Z represents the:
a) Mass number
b) Atomic number
c) Neutron number
d) Number of electrons

14. The number of neutrons in an atom of $^{80}_{35}Br$ is:
a) 35
b) 45
c) 80
d) 115

15. An atom has 16 protons and 18 neutrons. Its mass number is:
a) 16
b) 18
c) 34
d) 2

16. The stability of the Bohr model was explained by introducing the concept of:
a) Circular orbits

b) Quantized angular momentum
c) Positive nucleus
d) Negative electrons

17. The energy of a photon of wavelength 400 nm is:
a) 4.969×10^{-19} J
b) 3.313×10^{-19} J
c) 1.988×10^{-19} J
d) 6.626×10^{-19} J

18. The number of photons emitted per second by a 100W yellow light bulb (λ=580 nm) is of the order of:
a) 10^{10}
b) 10^{20}
c) 10^{30}
d) 10^{40}

19. If the threshold frequency for a metal is 7.0×10^{14} s^{-1}, the kinetic energy of an electron ejected by light of frequency 1.0×10^{15} s^{-1} is:
a) 1.988×10^{-19} J
b) 4.969×10^{-19} J
c) 6.626×10^{-19} J
d) 7.0×10^{-19} J

20. The series of hydrogen spectrum lines with the shortest wavelengths is the:
a) Lyman series
b) Balmer series
c) Paschen series
d) Brackett series

21. The transition of an electron from n=5 to n=2 in a hydrogen atom results in a spectral line in the:
a) Lyman series

b) Balmer series
c) Paschen series
d) Pfund series

22. The radius of the second Bohr orbit for hydrogen is:
a) 52.9 pm
b) 105.8 pm
c) 211.6 pm
d) 476.1 pm

23. The energy required to remove an electron from the first orbit of a hydrogen atom is:
a) -2.18×10^{-18} J
b) $+2.18\times10^{-18}$ J
c) -1.09×10^{-18} J
d) $+1.09\times10^{-18}$ J

24. The de Broglie wavelength of an electron moving with a velocity of 2.05×10^{7} m/s is:
a) 3.55 Å
b) 35.5 pm
c) 355 pm
d) 3.55 nm

25. According to Heisenberg's principle, if the position of an electron is measured with high accuracy, then its:
a) Momentum becomes certain
b) Momentum becomes uncertain
c) Energy becomes certain
d) Velocity becomes zero

26. The quantum mechanical model describes the electron as:
a) A particle in a fixed orbit
b) A wave with a definite path

c) A probability cloud
d) A charged sphere

27. For n=4, the total number of possible orbitals is:
a) 4
b) 8
c) 16
d) 32

28. Which set of quantum numbers is not possible?
a) n=2, l=1, m_l=0, m_s=+1/2
b) n=3, l=2, m_l=-2, m_s=-1/2
c) n=1, l=0, m_l=0, m_s=+1/2
d) n=2, l=2, m_l=-1, m_s=-1/2

29. The number of orbitals in the 4d subshell is:
a) 1
b) 3
c) 5
d) 7

30. The shape of a p orbital is best described as:
a) Spherical
b) Dumbbell
c) Cloverleaf
d) Complex

31. How many electrons can be accommodated in the M-shell (n=3)?
a) 2
b) 8
c) 18
d) 32

32. The correct order of filling of orbitals is:

a) 1s, 2s, 2p, 3s, 3p, 3d, 4s
b) 1s, 2s, 2p, 3s, 3p, 4s, 3d
c) 1s, 2s, 2p, 3s, 3d, 3p, 4s
d) 1s, 2s, 2p, 3d, 3s, 3p, 4s

33. The electronic configuration of Potassium (Z=19) is:
a) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
b) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^1$
c) $1s^2 2s^2 2p^6 3s^2 3p^7$
d) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

34. The element with the electronic configuration $[Ar]4s^2 3d^{10} 4p^5$ is:
a) Bromine (Br)
b) Selenium (Se)
c) Arsenic (As)
d) Krypton (Kr)

35. The number of unpaired electrons in a ground state fluorine atom (Z=9) is:
a) 0
b) 1
c) 2
d) 3

36. The number of unpaired electrons in a ground state chromium atom (Z=24) is:
a) 0
b) 4
c) 5
d) 6

37. The maximum number of electrons that can have n=3 and l=2 is:
a) 2
b) 6

c) 10
d) 14

38. The quantum numbers for the last electron entered into Chromium (Z=24) are:
a) n=3, l=2, m_l=-2, m_s=+1/2
b) n=4, l=0, m_l=0, m_s=+1/2
c) n=3, l=2, m_l=+2, m_s=-1/2
d) n=3, l=2, m_l=+1, m_s=+1/2

39. Isoelectronic species have the same:
a) Atomic number
b) Mass number
c) Number of electrons
d) Number of neutrons

40. Which of the following are isoelectronic?
a) Na^+, K^+
b) Mg^{2+}, O^{2-}
c) Ca^{2+}, Ar
d) S^{2-}, Cl^-

41. The wavelength of light emitted when an electron in a hydrogen atom jumps from n=4 to n=2 is:
a) 486 nm
b) 434 nm
c) 410 nm
d) 656 nm

42. The ionization enthalpy is highest for the removal of an electron from:
a) n=1
b) n=2
c) n=3
d) n=4

43. The number of spectral lines produced when an electron jumps from the n=6 level to the n=1 level is:
a) 5
b) 10
c) 15
d) 20

44. The work function for a metal is 2.13 eV. The threshold wavelength is:
a) 584 nm
b) 486 nm
c) 434 nm
d) 410 nm

45. The region of the electromagnetic spectrum with the highest energy is:
a) Radio waves
b) Microwaves
c) Visible light
d) Gamma rays

46. The number of subshells in the n=4 shell is:
a) 1
b) 2
c) 3
d) 4

47. The maximum number of electrons that can have the quantum numbers n=3 and $m_s = -1/2$ is:
a) 9
b) 18
c) 27
d) 36

48. The orbital with n=3 and l=1 is a:

a) 3s orbital
b) 3p orbital
c) 3d orbital
d) 3f orbital

49. The nodal plane in a p_x orbital is the:
a) xy-plane
b) yz-plane
c) zx-plane
d) There is no nodal plane

50. The total number of nodes for a 3p orbital is:
a) 0
b) 1
c) 2
d) 3

Answer Key: Set 3

1. a) Indian and Greek philosophers
2. b) Transfer of electrons
3. b) Zinc sulphide
4. c) Their charge-to-mass ratio
5. b) Charge of the electron
6. a) 1.67×10^{-27} kg
7. c) Alpha particles
8. b) Embedded in a positive sphere
9. b) Wilhelm Röentgen
10. c) The Curies
11. c) Gamma rays
12. c) The atom is mostly empty space
13. b) Atomic number
14. b) 45
15. c) 34

16. b) Quantized angular momentum
17. a) 4.969×10^{-19} J
18. b) 10^{20}
19. a) 1.988×10^{-19} J
20. a) Lyman series
21. b) Balmer series
22. c) 211.6 pm
23. b) $+2.18 \times 10^{-18}$ J (Ionization energy is positive)
24. b) 35.5 pm
25. b) Momentum becomes uncertain
26. c) A probability cloud
27. c) 16 ($n^2 = 4^2$)
28. d) n=2, l=2, m_l=-1, m_s=-1/2 (l cannot be equal to n)
29. c) 5
30. b) Dumbbell
31. c) 18 ($2n^2 = 2*(3)^2$)
32. b) 1s, 2s, 2p, 3s, 3p, 4s, 3d
33. a) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
34. a) Bromine (Br)
35. b) 1
36. d) 6
37. c) 10 (Number of electrons in d subshell (l=2))
38. a) n=3, l=2, m_l=-2, m_s=+1/2 (for the $3d^5$ electron)
39. c) Number of electrons
40. d) S^{2-}, Cl^- (Both have 18 electrons)
41. a) 486 nm (Transition for n=4 to n=2)
42. a) n=1 (Closest to the nucleus, strongest attraction)
43. c) 15 (Number of possible transitions: n(n-1)/2 = 6*5/2)
44. a) 584 nm
45. d) Gamma rays
46. d) 4 (l = 0, 1, 2, 3)
47. b) 9 (Half of the total electrons in n=3 shell: 18/2)
48. b) 3p orbital
49. b) yz-plane
50. c) 2 (Total nodes = n-1 = 2; for a 3p orbital, l=1, so angular nodes = 1, radial nodes = 1)