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Questions:

Case Study Questions

1. Rutherford performed an alpha particle scattering experiment by bombarding a thin gold foil with alpha particles. Most particles passed through, but some were deflected at large angles. This led to a nuclear model of the atom where a dense, positively charged nucleus was present at the center and electrons revolved around it.
   1. What was the key conclusion from Rutherford's experiment?
   (a) Atom is a solid sphere
   (b) Atom is mostly empty space
   (c) Electrons are embedded in a positive sphere
   (d) Nucleus is negatively charged
   2. What caused the deflection of alpha particles in Rutherford's experiment?
   (a) Orbiting electrons
   (b) Neutrons
   (c) The dense nucleus
   (d) The gold atoms' mass
   3. Which drawback of Rutherford's model led to the need for Bohr's model?
   (a) No explanation of neutron presence
   (b) Unstable orbits for electrons
   (c) No description of protons
   (d) Could not explain alpha scattering

5 Marks

2. A photon of wavelength 4×10^{-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 eV= 1.6020×10^{-19} J)

3 Marks

3. Calculate the energy required for the process
   $He^{+}(g) \longrightarrow He^{2+}(g) + e^{-}$
   The ionization energy for the H atom in the ground state is 2.18×10^{-18} J atom^{-1}

4. Define Aufbau's principle.

2 Marks

5. (a) How many subshells are associated with n = 4 ?
   (b) How many electrons will be present in the subshells having ms value of –1/2 for n = 4 ?

6. Which orbital is non-directional?

Multiple Choice Question

7. In a sodium atom (atomic number = 11 and mass number = 23) and the number of neutrons is _____.
   (a) equal to the number of protons (b) less than the number of protons (c) greater than the number of protons (d) none of these

8. The first line in the Balmer series in the H atom will have the frequency _____.
   (a) 3.29×10^{15} S^{-1} (b) 4.57×10^{14} S^{-1} (c) 8.22×10^{15} S^{-1} (d) 8.02×10^{14} S^{-1}

9. For the electrons of oxygen atom, which of the following statements is correct?
   (a) Z_{eff} for an electron in a 2s orbital is the same as Z_{eff} for an electron in a 2p orbital (b) An electron in the 2s orbital has the same energy as an electron in the 2p orbital
   (c) Z_{eff} for an electron in Is orbital is the same as Z_{eff} for an electron in a 2s orbital (d) The two electrons present in the 2s orbital have spin quantum numbers ms but of opposite sign

10. Magnetic moment 2.83 BM is given by which of the following ions? [Atomic number Ti = 22, Cr = 24, Mn = 25, i = 28]
    (a) Ti^{3+} (b) Ni^{2+} (c) Cr^{2+} (d) Mn^{2+}

11. Which of the following is wrong statement?
    (a) The uncertainty principle is $\Delta x . \Delta v \geq \frac{h}{4\pi}$.
    (b) Half filled and fully filled orbitals have greater stability due to greater exchange energy, greater symmetry and more balanced arrangement
    (c) The energy of 2s orbital is less than the energy of 2p-orbitals in case of hydrogen like atoms. (d) de Broglie wavelength, $\lambda = \frac{h}{2\pi}$.

12. Which of the following sets of quantum numbers are correct?

(a)	(b)	(c)	(d)
n = 1	n = 2	n = 3	n = 3
l = 1	l = 1	l = 2	l = 4
m_l = +2	m_l = +1	m_l = -2	m_l = -2