2022

Time - 3 hours

Full Marks - 60

Answer all groups as per instructions.
Figures in the right hand margin indicate marks.
Candidates are required to answer
in their own words as far as practicable.

GROUP – A

1. Fill in the blanks. (all)   [1 × 8

   (a) The momentum of a moving photon of wavelength λ is
       _____.

   (b) The maximum kinetic energy of photo-electrons depends on
       _____.

   (c) The rest mass of photon is _____.

   (d) The total energy of electron in an atom is _____.

   (e) The ground state energy of Hydrogen atom is _____.

   (f) The wavelength of de-Broglie waves associated with a particle at rest is _____.

   (g) When an alpha particle captures an electron, it becomes a _____.

P.T.O.

(h) Average life of a neutron is 1000 seconds. Its half life is

_____.

GROUP – B

2. Answer <u>any eight</u> of the following questions within two to three sentences each. [1½ × 8

(a) What is zero point energy ?

(b) Using Bohr theory, calculate the radius of the innermost orbit of a hydrogen atom.

(c) Write Einstein's photoelectric equation.

(d) Name two elements of the periodic table, whose nucleus are stable.

(e) What is the relation between the mass number and nuclear radius ?

(f) Give two examples, where classical physics fails to explain the phenomenon.

(g) In which process more energy is released : Fission or Fusion ?

(h) What do you mean by atomic spectra ?

(i) What do you mean by Wave particle duality ?

(j) What is the law of radioactive decay ?

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GROUP – C

3. Answer <u>any eight</u> of the following questions within 75 words each.

[2 × 8

(a) State Bohr's correspondence principle.

(b) What is mass defect ? How is it related to Binding energy ?

(c) Define half life period of radioactive substance.

(d) State Heisenberg's uncertainty principle.

(e) Define 1 a.m.u and how is it related of MeV ?

(f) Show stability of the nucleus through the N-Z graph.

(g) What is the longest wavelength in Balmer series of Hydro-gen atom ?

(h) What is nuclear fission and nuclear fusion ?

(i) What is positive beta decay in the nuclear process ?

(j) What is negative beta decay in the nuclear process ?

GROUP – D

*Answer **any four** questions within 500 words each.*

4. Explain Rutherford's alpha particle scattering experiment and derive the expression for the Rutherford's scattering formula. [6

5. Explain the Franck-Hertz experiment in detail with diagram. [6

6. Write notes on within 250 words each. [3 × 2

    (a) Davisson-Germer experiment

    (b) Gaussian wave packet

7. (a) Discuss the Heisenberg uncertainty principle in detail with examples. [3

    (b) Explain the ground state energy of one dimensional harmonic oscillator. [3

8. Briefly discuss about the nonexistence of electrons in a nucleus on the basis of uncertainty principle. [6

9. Derive semi-empirical masse formula alongwith the discussion of significance of each term. [6

10. Discuss the difference between fission and fusion reaction. Calculate the amount of energy released by fission of 1 kg U-235 in kwh. [6

11. Write a note on Electron-positron pair creation by gamma photons. [6