

2023

Time - 3 hours

Full Marks - 80

Answer **all groups** as per instructions.
Figures in the right hand margin indicate marks.

GROUP - A

1. Answer all questions and fill in the blanks as required. [1 × 12]
- (a) An atomic mass unit is approximately equal to the mass of a(n) _____.
 - (b) The electron capture the atomic number decreases by _____.
 - (c) Photon has no antiparticle. (Write yes or no.)
 - (d) Nucleons do not interact with each other in _____ model.
 - (e) The number of nucleons that represent completed nuclear energy shell is known as _____.
 - (f) Scintillator's PMT is used in _____ detector.
 - (g) Van de Graaff generators use _____ energy to accelerate electrons.
 - (h) Which particles cannot participate in the strong interactions ?

[2]

- (i) Photon has no antiparticles. (Write True or False.)
- (j) The binding energy per nucleon of nuclei is almost _____.
- (k) The existence of the neutrino was postulated in order to explain _____ decay.
- (l) The electric charge of the quarks is _____ than the electron charge.

GROUP – B

2. Answer any eight of the following questions within two to three sentences each.

[2 × 8

- (a) Calculate the contributions of Coulomb energy term for ${}_{92}\text{U}^{236}$ nucleus.
- (b) Explain Geiger-Nuttal law.
- (c) Find the relation between nuclear volume and mass number.
- (d) Density of the nucleus is more than that of the atom. Explain.
- (e) The binding energy per nucleon of ${}_{6}\text{C}^{12}$ is 7.685 MeV. Find its atomic mass.
- (f) Write limitations of Shell model.
- (g) Draw the block diagram of scintillation detector.

[3]

- (h) Write limitations of Shell model.
- (i) Heavier nucleus contains more neutrons than proton. Explain.
- (j) Explain 'Isospin' quantum numbers.

GROUP – C

3. Answer any eight of the following questions within 75 words each.
[3 × 8]

- (a) What are nuclear forces ? Write their properties.
- (b) Explain the non-existence of electrons in the nucleus.
- (c) Explain Neutrino hypothesis.
- (d) What are the magic numbers and why are they so called ?
- (e) Explain the use of semi-empirical mass formula.
- (f) Explain Geiger plateau in G.M. counter.
- (g) Write a note on quarks.
- (h) What are Leptons and Baryons ?
- (i) Distinguish between photon and neutrino.
- (j) A cyclotron oscillating frequency of 1 MHz is used to accelerate protons. If the radius of the dee is 60 cm. Find the magnetic field.

P.T.O.

GROUP – D

Answer **all** questions within 500 words each.

4. Define binding energy of nucleus. How is it related to mass defect? Draw and discuss binding energy curve. [7]

OR

Explain angular momentum of the nucleons and nuclear magnetic moment.

5. Stating the main assumption, explain the Shell model of the nucleus. [7]

OR

Derive an expression for semi-empirical mass formula of liquid drop model.

6. With neat diagram, describe the principle, construction and working of a cyclotron. [7]

OR

With neat diagram, describe the construction and working of photo multiplier tube.

7. Give a brief account of classification of elementary particles mentioning their various properties. [7]

OR

State and explain with examples the conservation laws, which governs the elementary particle reactions and decay.