

5. (a) What is the difference between reaction cross section (σ) and differential cross section ($d\sigma/d\Omega$). On what factor(s) does the rate of outgoing particle depend(s), in any nuclear reaction?

(6)

- (b) Give any three differences of compound nucleus and direct reaction. Give an example of each type of reaction.

(8)

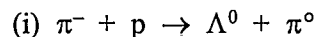
- (c) How does a heavy charged particle and an electron interact with the matter?

(4)

6. (a) What is meant by 'Isospin'? How the Isospin is related to other quantum numbers in particle physics? Calculate the values of the total Isospin (T) and the 3-axis component of the total Isospin (T_3), for all the members of Σ multiplets.

(8)

- (b) Determine whether the following reactions are allowed or forbidden on the basis of conservation of charge, baryon number, strangeness, Isospin, third component of Isospin.



(6)

- (c) Distinguish between Leptons and Mesons.

(4)

(200)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5135

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Unique Paper Code : 2224002010

Name of the Paper : Nuclear and Particle Physics

Name of the Course : B.Sc. Hons. - (Physics)_NEP:
UGCF-2022

Semester : IV / VI (GE Paper)

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **FIVE** questions in all.
3. Question No. 1 is compulsory.
4. **All** questions carry equal marks.
5. Use of non - programmable scientific calculator is allowed.

1. Attempt **any six** questions : (6×3=18)

- (a) Determine the radius of ^{208}Pb .

P.T.O.

- (b) What are magic numbers? What is their significance?
- (c) Determine the 'A' of nucleus that has a radius $1/2$ of ^{200}Hg
- (d) What is pickup and stripping reaction? Give one example of pickup reaction.
- (e) What is Townsend Avalanche?
- (f) What is Geiger-Nuttall law and represent it graphically.
- (g) Why the β -decay is called isobaric transformation? Support your answer with an example.
2. (a) Plot the curve of binding energy per nucleon versus mass number. Explain with its help the release of energy in the processes of nuclear fission and nuclear fusion. (8)
- (b) Define mass defect and binding energy of the nucleus. Give the method of calculation of binding energy for a nucleus $^A_Z\text{X}_N$. Calculate the binding energy of alpha-particle in MeV. (6)
- (c) The radii and mass of oxygen nuclide is found to be 3 fm and 2.7×10^{-26} kg respectively. Compute its density. (4)

3. (a) Explain liquid drop model. Obtain semi-empirical mass formula. Give any two achievements of the model. (8)
- (b) Calculate the coulomb energy of $^{238}_{92}\text{U}$. (4)
- (c) What are the magic numbers? Give any two experimental evidences for the existence of magic numbers. Give any two failures of Shell model. (6)
4. (a) State the assumptions of Gamow's theory of alpha decay. Derive an expression for disintegration constant of a radioactive nucleus starting from the following equation

$$\ln T = -2 \int_{R_0}^R k_2(r) dr$$

Where symbols have their usual meanings. (10)

- (b) Distinguish between β -decay and internal conversion process. (4)
- (c) An excited state nucleus ($E=2$ MeV, $I=1/2$) decay through gamma decay to ground state ($E=0.5$ MeV, $I=-1/2$). Determine the energy of emitted gamma ray and its electromagnetic moments. (4)