

**Bhairab Ganguly College**  
4<sup>th</sup>-SEM, Class Test-2020  
Paper-CORET9, Physics Honours  
Paper Name: Nuclear Physics  
Class Teacher: Dr. D. Bhadra

Time: 1 and half hour

Full Marks: 30

1. Answer any **five** from the following 2X5=10

- i) Is the reaction  $p \rightarrow n + e^+ + \nu_e$  possible? Give reasons.
- ii) What do you mean by mirror nuclei? Give an example.
- iii) Calculate the mass of 1 Curie of U-234.
- iv) Sketch the  $N$ - $Z$  plot where  $N$  is the neutron number and  $Z$  is the atomic number. Briefly explain the significance of the plot.
- v) Define mass defect and binding energy of a nucleus. Draw the curve of Binding Energy with mass number.
- vi) What are the different quantities that are conserved in a nuclear reaction?
- vii) What is pair production? Find the threshold energy for this process.
- viii) Given the nuclear radius parameter  $r_0 = 1.2 \times 10^{-15} m$ , calculate the number densities of neutrons and protons in  $^{16}_8O$ .

Answer any **two** from the following. 2X10=20

Q2. (a) Give one example of each of  $\beta^-$  decay,  $\beta^+$  decay and electron capture.

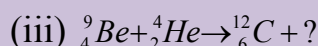
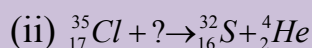
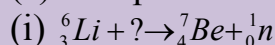
3

(b) Why is the existence of electron within a nucleus ruled out? How is the emission of  $\beta^-$  particles from a nucleus explained?

4

(c) Complete the following nuclear reactions:

3



Q3. (a) Using the semi empirical mass formula, find the atomic number of the most stable nuclei for a given mass number  $A$ . Hence explain which one is the most stable among  $^6_2He$ ,  $^6_4Be$  and  $^6_3Li$ . Given  $a_c=0.71$  MeV,  $a_n=22.7$  MeV.

4

(b) What is the 'end point energy' related to  $\beta$  decay?

2

(c) What are magic numbers? Why are they so called?

2

(d) What is a nuclear chain reaction? How a controlled chain reaction is achieved in a nuclear reactor?

2

- Q4. (a) Why does  ${}_{92}^{235}\text{U}$ , but not  ${}_{92}^{238}\text{U}$  nucleus undergo fission with thermal neutrons? 3
- (b) On the basis of extreme single particle shell model, find ground state spin and parity of  ${}^{13}\text{C}_6$ . 2
- (c) Explain with the help of energy level diagram the fine structure of  $\alpha$ -spectrum. 2
- (d) To what minimum distance will an  $\alpha$ -particle with kinetic energy 0.4 MeV approach a stationary  ${}_{82}^{208}\text{Pb}$  nucleus in a head on collision? 3