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G – 1399

Reg. No. :

Name :

Sixth Semester B.Sc. Degree Examination, April 2019

First Degree Programme under CBCSS

PHYSICS

Core Course X

PY 1642 : Nuclear and Particle Physics

(2013 Admission Onwards)

Time : 3 Hours

Max. Marks : 80

SECTION – A

Answer **all** questions in **one** or **two** sentences. Each question carries **one** mark.

1. What are the constituents of a nucleus? What is meant by atomic number of a nucleus?
2. What does electric quadrupole moment of a nucleus signify?
3. Define activity of a radioactive sample. Define the unit curie.
4. State Gieger-Nuttal law.
5. What is the spin state of the deuteron when it is in the ground state?
6. Which species of the π meson is exchanged in the proton-proton interaction?
7. Pure sodium iodide is not used in scintillation counter. Why?
8. Explain what is meant by the Q-value of a nuclear reaction.
9. What is a breeder reactor?
10. Give the constitution of a neutron according to the quark model. (10×1=10 Marks)

P.T.O.

SECTION – B

Answer **eight** questions **not** exceeding a paragraph. **Each** question carries **two** marks.

11. Write a note on magnetic moment of the nucleus.
12. Describe how the binding energy per nucleon varies with the mass number.
13. Describe the origin of gamma rays. What are nuclear isomers ?
14. State the conservation laws obeyed by radio active decays.
15. List the four radioactive series with giving the stable end nucleus in each case.
16. What do you understand by secular radioactive equilibrium ?
17. Briefly explain the properties of nuclear forces.
18. Give an account of the mass of the pion based on the range of the nuclear force.
19. Explain what is meant by the threshold value of an endoenergetic reaction.
20. Find the missing particles or elements in each of the nuclear reactions.
 - i) ${}_5\text{B}^{10} + {}_2\text{He}^4 \rightarrow ? + {}_1\text{H}^1$
 - ii) ${}_5\text{B}^{11} + {}_2\text{He}^4 \rightarrow {}_7\text{N}^{14} + ?$
21. Explain nuclear chain reaction.
22. Briefly describe the latitude effect of cosmic rays.

(8×2=16 Marks)

SECTION – C

Answer **any six** questions. **Each** question carries **four** marks.

23. The atomic mass of the neon isotope ${}_{10}\text{Ne}^{20}$ is 19.992 u. Determine the binding energy of the neon nucleus in MeV. Mass of the proton = 1.007825 u ; mass of the neutron = 1.008665 u.
24. Half life of radon is 3.82 days. Find the time required for 60% of a sample of radon to decay.



25. A piece of wood from the ruins of an ancient dwelling was found to have 13 disintegrations per minute per gram of its carbon content. The activity of carbon in a living wood is 16 disintegrations per minute per gram. Determine how long ago did the sample was cut from the tree. Half life of carbon = 5760 year.
26. Discuss the information obtained from proton-proton and proton-neutron scattering experiments regarding the nuclear forces.
27. Discuss the meson theory of nuclear force.
28. Find the minimum kinetic energy needed by an alpha particle to cause the reaction $N^{14}(\alpha, p) O^{17}$. Masses of N^{14} , α -particle, proton and O^{17} in unified atomic mass units are 14.00307, 4.00260, 1.00783 and 16.99913 respectively. Express your answer in MeV.
29. Describe a method to determine the scattering cross section.
30. Describe the proton-proton cycle of thermonuclear reaction.
31. Determine the energy released in the fusion reaction ${}_1H^2 + {}_1H^2 \rightarrow {}_2He^3 + {}_1H^1$. Masses of ${}_1H^2$, ${}_1H^3$ and ${}_1H^1$ are 2.014102 u, 3.01609 u and 1.007825 u respectively where u denotes unified atomic mass unit. (6×4=24 Marks)

SECTION - D

Answer **any two** questions. **Each** question carries **fifteen** marks.

32. Describe the liquid drop model of nucleus. How can the semi-empirical mass formula be derived from it ? Mention the merits and demerits of this model.
33. Discuss the construction and action of a cyclotron. Point out its limitations.
34. Briefly discuss nuclear fission and chain reaction. Describe the construction and working of a nuclear reactor.
35. Describe the classification of elementary particles. (2×15=30 Marks)