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Reg. No. : .....

Name : .....

Sixth Semester B.Sc. Degree Examination, March 2021

First Degree Programme Under CBCSS

PHYSICS

Core Course X

PY 1642 : NUCLEAR AND PARTICLE PHYSICS

(2015-2017 Admission)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer **all** questions. Each question carries **1** mark.

1. What is meant by nuclear isotopes?
2. Give the expression for nuclear magneton.
3. Define rutherford (rd), a unit of radioactivity.
4. Is nuclear force spin dependant? Give an example.
5. What is meant by the saturation of nuclear forces?
6. Write down the resonance condition for the acceleration of charged particles in a cyclotron.
7. Define threshold energy of a nuclear reaction.
8. Define nuclear fission.
9. What is meant by secondary cosmic rays?
10. Which are the carrier particles of weak interaction?

(10 × 1 = 10 Marks)

P.T.O.

SECTION – B

Answer any **eight** questions. **Each** question carries **2** marks.

11. Explain nuclear quadrupole moment.
12. Give any four evidences for the existence of magic numbers.
13. Derive the radioactive decay law.
14. Write a note on spin and magnetic moment of deuteron.
15. Briefly explain the working of scintillation counter.
16. What is the advantage of synchrocyclotron over ordinary cyclotron?
17. What is meant by a compound nucleus? Give an example.
18. Explain chain reaction.
19. What is meant by a breeder reactor?
20. Explain the origin of cosmic rays.
21. What is meant by Baryon number conservation? Give an example.
22. Calculate the binding energy of the last neutron on $m^{23}_{11}Na$. Mass of $^{23}_{11}Na$ = 22.989767 u. mass of $^{22}_{11}Na$ = 21.9944 u, mass of neutron = 1.008665 u

(8 × 2 = 16 Marks)

SECTION – C

Answer any **six** questions. Each question carries **4** marks.

23. The radius of Holmium ($^{165}_{67}Ho$) nucleus is 7.731 fermi. Deduce the radius of $^{4}_{2}He$.
24. $^{11}_{6}C$ decays to $^{11}_{5}B$ by positive β emission. What is the maximum energy the neutrino can have? What is the minimum energy? Atomic mass of $^{11}_{6}C$ = 11.011433 u, atomic mass of $^{11}_{5}B$ = 11.009305 u.
25. Compute the mass of an exchange particle, if the range of the force is about 0.25 fm.
26. A GM counter wire collects 10^8 electrons per discharge. When the counting rate is 500 counts per minute, calculate the average current in the circuit.

27. The voltage across the dees of a cyclotron is 50 kV. How many revolutions do protons make to reach a kinetic energy of 20 MeV?

28. The Q-value of the raction ${}^{23}_{11}\mathrm{Na}(n,\alpha){}^{20}_{9}\mathrm{F}$ is –5.4 MeV. Determine the threshold energy of the neutrons for this reaction. Mass of n = 1.008665 u, mass of ${}^{23}_{11}Na$ = 22.9898 u.

29. A reactor is developing energy at the rate of 3000 kW. How many atoms of U^{235} undergo fission per second? How many kilograms of U^{235} would be used in 1000 hours of operation assuming that 200 MeV of energy is released per fission? Avogadro number = 6.022×10^{23}

30. An electron and positron at rest annihilate to produce two gamme ray photons. Calculate the wavelength of gamma ray photon. h = $6.625 \times 10^{-34} Js$, mass of electron = 9×10^{-31}kg

31. Are the following reactions allowed on the basis of conservation laws? For those that are forbidden, which laws are violated?

(a) $K^- + p \rightarrow \lambda^\circ + \pi^\circ$ (b) $p + p \rightarrow p + n + K^+$

(6 × 4 = 24 Marks)

SECTION – D

Answer any **two** questions. Each question carries **15** marks.

32. Explain liquid drop model of a nucleus and arrive at the semi-empirical mass formula.

33. Explain the Gamow's theory of alpha decay and derive an expression for decay constant.

34. Explain nuclear fusion? Explain the reactions involved in the production of stellar energy. Explain the possibility of controlling nuclear fusion.

35. Explain the different types of nuclear reactions. Give one examples for each. Explain with examples, the conservation laws to be obeyed in a nuclear reaction.

(2 × 15 = 30 Marks)