C 21080

(Pages : 3)

Name...................................

Reg. No...............................

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, MARCH 2017

(CUCBCSS—UG)

Physics/Applied Physics

PHY 6B 12/APY 6B 13—NUCLEAR PHYSICS, PARTICLE PHYSICS AND ASTROPHYSICS

Time : Three Hours

Maximum : 80 Marks

The symbols used in this question paper have their usual meanings.

Section A (Answer in a word or a phrase)

Answer **all** *questions, each question carries 1 mark.*

1. The binding energy per nucleon versus mass number curve peaks at which element ?

2. The number of available nuclear states in a *p* shell is ————.

3. A Tokamak is used for ———— confinement of plasma.

4. Does neutrino possesses a mass ?

5. What is the ratio of brightness of two stars whose magnitudes differ by unity, according to Pogson's magnitude scale ?

Questions 6 to 10 : Write True or False

6. The hydrogen isotope tritium is radioactive.

7. Radioactive decay obeys the law of chance.

8. A scintillation counter is comparatively slow in response.

9. A particle and its antiparticle possess the same spin.

10. The total amount of energy radiated from a star from its surface per second is called brightness.

$(10 \times 1 = 10 \text{ marks})$

Section B (Answer in two or three sentences)

Answer **all** *questions, each question carries 2 marks.*

11. What are the magic numbers in the nucleus ? Why are they called so ?

12. Comment on the saturation property of nuclear forces.

13. List the different radioactive series. Mention the parent element in each case.

14. What do you mean by a breeder reactor ?

15. What are baryons ?

Turn over

16. Give the quark composition of a proton and a neutron.

17. What are the quantities on which the brightness of a star depends on? What do you mean by the term absolute magnitude of a star?

$(7 \times 2 = 14$ marks)

Section C

*Answer in a paragraph of about **half a page** to one page.*
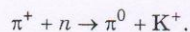*Answer any **five** questions, each question carries 4 marks.*

18. Discuss briefly the meson theory of nuclear forces.

19. Discuss the principle of radiocarbon dating. Mention its application.

20. Write short note on the proton-proton cycle in sun.

21. Draw the schematic of an ionization chamber and indicate the parts.

22. What are the fundamental interactions in nature? Mention the gauge particles involved in each case.

23. Explain the working principle of electron synchrotron.

24. Explain the term stellar parallax.

$(5 \times 4 = 20$ marks)

Section D

(Problems-write all relevant formulas, all important steps carry separate marks).
*Answer any **four** questions; each question carries 4 marks*

25. The binding energy per nucleon for two isotopes of carbon ^{12}C and ^{13}C are 7.68 MeV and 7.47 MeV respectively. What is the energy required to remove a neutron from the carbon nucleus?

26. Determine the activity of 1 mg. of a radioactive substance having atomic mass 222 amu. Given, the half life is 3.8 days.

27. Estimate the energy released by fission of 1-kg of ^{235}U. Given, the energy released per fission is 200 MeV.

28. Draw the count rate versus applied voltage of a GM tube and indicate the different regions.

29. Discuss briefly the origin of cosmic rays.

30. Check whether the following reaction is allowed or forbidden :—

$$\pi^+ + n \rightarrow \pi^0 + K^+.$$

31. Briefly explain the equatorial and ecliptic co-ordinate systems.

$(4 \times 4 = 16$ marks)

Section E (Essays-Answer in about two pages)

Answer any **two** *questions, each question carries 10 marks.*

32. Discuss the nuclear properties spin and magnetic moment. Give the essential features of the shell model of a nucleus.

33. Explain the beta and gamma decay processes.

34. List the elementary particles. Discuss the elementary particle quantum numbers baryon number, lepton number, strangeness, isospin and hyper charge and their conservation laws in particle interactions.

35. Discuss the working principle of a Cockcroft-Walton proton accelerator.

$(2 \times 10 = 20 \text{ marks})$