C 60057 (Pages : 3) Name.....

Reg. No.....

# SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, MARCH 2019

(CUCBCSS)

Physics/Applied Physics

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

Time : Three Hours Maximum : 80 Marks

## Section A

*Answer in a word* **or** *phrase.*

*Answer* **all** *questions.*

1. For chain reaction to continue, the multiplication factor (K) should be ————.
2. A reaction that releases more energy than is put into it is called ————.
3. A small star consisting of elements lighter than iron which has reached the stage where no further nuclear burning is possible is called a ————.
4. The nucleus consists of ————.
5. What are bosons ?
6. A device for increasing the kinetic energy of electrically charged particle is ————.
7. Fission chain reaction in a nuclear reactor can be controlled by introducing ————.
8. Fundamental particles of an atom ————.
9. When nucleons form a stable nucleus, binding energy is ————.
10. Minimum energy required to pull nucleus apart is called ————.

(10 × 1 = 10 marks)

## Section B

*Answer in a short paragraph.*

*Answer* **all** *questions.*

11. What is isospin ?
12. Define Chandrasekhar limit.
13. What do you mean by electron capture ?
14. Define Meson.

**Turn over**

15. What is a breeder reactor ?

16. What is semiconductor detector ?

17. What is Dark matter ?

(7 × 2 = 14 marks)

## Section C

*Answer in* **a paragraph.**
*Answer any* **five** *questions.*

18. What do you mean by chain reaction in the context of nuclear fission reactors ?

19. Explain the process of death of a star.

20. What are the different types of beta decay ?

21. Explain Meson theory of nuclear forces.

22. Briefly explain the working of a scintillation counter.

23. Briefly explain sources of stellar energy.

24. State some merits and demerits of liquid drop model.

(5 × 4 = 20 marks)

## Section D

*Problems-write all relevant formulas.*
*Answer any* **four** *questions.*

25. Deuterons in a cyclotron describe a circle of radius 0.32 m just before emerging from the dress. The frequency of the applied e.m.f. is 10 MHz. find the flux density of the magnetic field and the velocity of the deuterons emerging out of the electron.

26. Determine the strong interaction is allowed or not ?

$$p + p \rightarrow K^{+} + \sum^{+}$$

27. A nuclear reactor having power out put of 100 MW. The half of the filled fuel is used by the reactor in three years. How much $U^{235}$ fuel does the reactor contain before the power production ? Energy released per fission of is $U^{235}$ is 200 MeV.

28. Consider a single helium nucleus formed by the fusion of two deuterium nuclei. Find amount of energy released ?

29. It is required to operate a proportional counter with a maximum radial field of $10^{7} Vm^{-1}$. What is the applied voltage required if the radii of the wire and tube are 0.002 cm and 1 cm respectively.

30. Find out the contributions of coulomb energy and surface energy for the nucleus $_{92}U^{235}$ nucleus.

Given = $\left(\frac{1}{4\pi\varepsilon_0}\right)$ $8.9 \times 10^{9} NM^2C^2$ and $a_3 = -16.8$ MeV, $R_0 = 1.2$ f.

31. A self quenched G-M counter operates at 1000 volts and has a wire diameter of 0.2 mm. The radius of the cathode is 2 cm and the tube has a guaranteed lifetime of $10^9$ counts. What is the maximum radial field and how long will the counter last if it is used on an average for 30 hours per week at 3000 counts per minute ? Consider 50 weeks to a year.

(4 × 4 = 16 marks)

## Section E (Essays)

*Answer any* **two** *questions.*
*Answer in about* **two pages.**

32. What are quarks ? Describe quark model of elementary particles. Also give two factors which do not support the existence of quarks.

33. Explain the methods by which particles are accelerated in linear accelerators and storage rings.

34. Explain the tunnelling theory of alpha decay.

35. Obtain the expression for the binding energy of a nucleus based on liquid drop model. State the semi-empirical formula of Weizacker.

(2 × 10 = 20 marks)