C 80283 (Pages : 4) Name.....

Reg. No.....

SIXTH SEMESTER B.A./B.Sc. DEGREE EXAMINATION, MARCH 2020

(CUCBCSS—UG)

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.*
Each question carries 1 *mark.*

1. The particle represented by the quark composition **uud** ————.
2. When a target nucleus is bombarded by an appropriate beam of particles, it is possible to produce ————.
3. What force is responsible for the radioactive decay of the nucleus ————.
4. The materials used to decelerate fast moving neutrons is called ————.
5. The main hazard of radiation is ————.
6. What is the mass of the products of a nuclear fission reaction compared to the mass of the original products ————.
7. These are high energy photons ————.
8. A small star consisting of elements lighter than iron which has reached the stage where no further nuclear burning is possible is called a ————.
9. As per radioactive decay law, the small amount of disintegration of the isotope in a small period is equal to ————.
10. An unknown chemical element is presented by the following formula : ${}_{Z}X^{A}$. What is the name of index Z ————.

(10 × 1 = 10 marks)

Turn over

Section B

Answer in a short paragraph.
Answer **all** *questions.*
Each question carries 2 *marks.*

11. What is meant by magnetic bottle ?
12. What is nuclear isomerism ?
13. Define Meson.
14. Give the drawbacks of liquid drop model.
15. What is a breeder reactor.
16. Define Nuclear fusion.
17. Define Q value of a nuclear reaction.

(7 × 2 = 14 marks)

Section C

Answer in a paragraph.
Answer any **five** *questions.*
Each question carries 4 *marks.*

18. Briefly explain the working of a Gas filled counters.
19. Explain Meson theory of nuclear forces.
20. Briefly Explain working of semiconductor detector.
21. Deduce a relationship between apparent and absolute stellar magnitude ?
22. Explain Quarks.
23. What do you meant by binding energy ? How is it related to mass defect ?
24. What is isospin ? What is its significance ?

(5 × 4 = 20 marks)

Section D

Problems-write all relevant formulas.
Answer any **four** *questions.*
Each question carries 4 *marks.*

25. A 10 *e*V electrons is circulating in plane at right angle to a uniform magnetic field of $1.0*10^{-4}$T.
    (i) What is its orbit radius ?
    (ii) What is the cyclotron frequency ?
    (iii) What is the period of revolution ?

26. Show that for a most stable isobar of a nucleus having odd mass number A, the atomic number Z is given by, the constants in the semi empirical $\left[A \Big/ \left(0.015\, A^{\frac{2}{3}} + 2 \right) \right]$, the constants in the semi empirical mass formula $a_3 = 0.58$ Mev, $a_4 = 19.3$ Mev.

27. In a certain betatron the maximum magnetic field was 5000 gauss, operating at 50 cycles/sec with a stable orbit diameter of 50 inches. Calculate the average energy gained per revolution and the final energy of the electrons.

28. Find the threshold energy for the reaction ${}_7N^{14}(n, \alpha)_5B^{11}$.

29. 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.

30. Predict on the basis of shell model, the ground state spin and parity of the following nuclei.

(i) ^{11}B. (ii) ^{17}O.

(iii) ^{12}C. (iv) ^{16}N.

31. Some nuclear reactions involving elementary particles is given below. Among them which reaction are possible ?

(i) $\pi^+ + n \rightarrow K^0 + K^+$

(ii) $\bar{\upsilon}_e + p \rightarrow n + e^+$.

(iii) $\pi^+ + \pi \rightarrow \Lambda^0 + K^+$.

(4 × 4 = 16 marks)

Section E (Essays)

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

32. Write the working of cyclotron accelerators with neat diagram.

33. Explain classification of an elementary particles with the associated quantum numbers. Give examples

34. Explain the principle, construction and working of a G.M counter

35. Explain the tunnelling theory of alpha decay

(2 × 10 = 20 marks)