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**A -1278**

Reg. No. : .....

Name : .....

**Sixth Semester B.Sc. Degree Examination, April 2016**  
**First Degree Programme under CBCSS**  
**PHYSICS**  
**Core Course X**  
**PY 1642 : Nuclear and Particle Physics**  
**(2013 Admission)**

Time : 3 Hours

Max. Marks : 80

**SECTION – A**

Very short type answer (Answer **all 10** questions of **1** mark **each**) :

1. Why is the mass of an alpha particle not equal to the sum of the masses of two neutrons and protons ?
2. If in a nuclear change, there is an increase in mass, what is the source of the added mass ?
3. Explain the condition in which the daughter nuclei decay with the decay constants of the parents.
4. Explain the source of stellar energy.
5. What must be the value of the multiplication factor in the case of an atom bomb ?
6. Why is it that the Proton-Proton cycle is a slow process ?
7. What are hadrons ?
8. What is hyper charge ? Discuss the validity in different reactions.
9. Distinguish between isobars and isotopes.
10. What do you understand by primary and secondary cosmic rays ? **(10×1=10 Marks)**

**SECTION – B**

Short type questions (answer **any eight** questions). **Each** question carries **2** marks.

11. State any two conservation laws obeyed in radioactive decay.
12. Explain how the emission of a particle with the properties postulated by Pauli removes the anomalies with angular momentum in  $\beta$ -decay.

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13. Explain, why as a detector, the scintillation counter is more efficient than the Geiger-Mueller counter.
14. Define Q-value of a nuclear reaction in terms of kinetic energy of the constituents.
15. Explain how the nuclear spin  $i$  is correlated with the  $z$  and  $A$  values of nuclei.
16. Why are the atomic magic numbers not the same as the nuclear magic numbers ?
17. What do you understand by the statement “nuclear forces saturate” ?
18. What are the different parts of a nuclear reactor ? Give an example of the materials used in each of it ?
19. Write down the classification of elementary particles.
20. Describe the principle of an atom bomb.
21. Explain briefly Bohr and wheeler theory.
22. Discuss the features of Baryon.

(8×2=16 Marks)

## SECTION – C

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

23. A counter-rate meter is used to measure the activity of a given sample. At one instant the meter shows 4750 counts per minute and two minutes later it shows 2700 counts per minute. Find the decay constant.
24. The half periods of  $U^{238}$  and  $U^{235}$  are  $4.5 \times 10^9$  years and  $7 \times 10^8$  years respectively. If at the beginning of the earth, the proportion of the two were equal in natural uranium and at present the relative proportion between the two in natural uranium is 140:1, estimate the age of earth.
25. The atomic mass of  $O_8^{16}$  is 16.0 amu. Find out the binding energy per nucleon of the oxygen nucleus ( $m_p = 1.007593$  amu,  $m_n = 1.008982$  amu).
26. Find the energy equivalent of the following :
  - a) 500 gms of matter
  - b) rest mass of an electron.
27. In the nuclear fission reaction of the type
 
$${}_{92}^{235}\text{U} + {}_0^1\text{n} \rightarrow {}_{38}^{98}\text{Sr} + {}_{54}^{135}\text{Xe} + 3{}_0^1\text{n} + Q$$
 , find the energy liberated in the reaction. Given, the masses  ${}_{92}^{235}\text{U} = 235.044$  amu,  ${}_{38}^{98}\text{Sr} = 134.907$  amu,  ${}_{54}^{135}\text{Xe} = 97.906$  amu,  ${}_0^1\text{n} = 1.00866$  amu.





28. A reactor produces energy at the rate of 1000 kW. How many atoms of  $U^{235}$  undergo fission per second ? How many kilograms of  $U^{235}$  is consumed in 100 hrs. of operation, if the average energy released per fission is 200 MeV.
29. Compute Q-value and threshold energy for the reaction  $^{14}N(\alpha, p)^{17}O$ . Atomic masses are  $^{14}N = 14.003074$  amu,  $\alpha = 4.001506$  amu,  $p = 1.007276$  amu  $^{17}O = 16.999132$  amu.
30. In the reaction given, check for the conservation of charge number, Baryon number, strangeness and isospin.  $\pi^+ + n \rightarrow K^0 + K^+$ .
31. Identify the particle represented by the quark composition  $\bar{u}\bar{u}\bar{d}$ . (6×4=24 Marks)

SECTION – D

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

32. Explain the principle of magnetic bottle. Discuss the working of a tokamak along with the underlying principle.
33. Describe with diagram the magnetic spectrograph and also discuss the results of the measurements.
34. What is quark model ? Give features of the different quarks.
35. Explain the latitude and altitude effect in cosmic rays. How are they accounted for ? What are cosmic ray showers and bursts ? How do you account for the origin of showers ? (2×15=30 Marks)
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