



K23U 0527

Reg. No. :

Name :

**VI Semester B.Sc. Degree (CBCSS – OBE – Regular/Supplementary/
Improvement) Examination, April 2023
(2019 and 2020 Admissions)**

Core Course in Physics

6B12 PHY – NUCLEAR, PARTICLE AND ASTROPHYSICS

Time : 3 Hours

Max. Marks : 40

SECTION – A

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

1. Give the dimension and unit of nuclear cross section.
2. A star at a distance of 100 parsec has a parallax of _____ arcseconds.
3. Particles with integral spin are called _____
4. Quark model of neutron is _____
5. Which nucleus has highest binding energy per nucleon ?
6. Give an example for strong force.

(6×1=6)

SECTION – B

Answer **any six** questions. **Each** carries **2** marks.

7. What is meant by the Astronomical Unit ? Which are the most commonly used units of stellar distance ?
8. Briefly explain Wein's displacement law.
9. What are resonant particles ? Give example.

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10. What are called white dwarfs ?
11. What are called main sequence stars ? Give example.
12. Write a short note on the inertial confinement in fusion reactor.
13. What is meant by neutron activation analysis ? Give its application.
14. Which are conservation laws in radioactive decay ? (6×2=12)

SECTION – C

Answer **any four** questions. **Each** carries **3** marks.

15. Find the kinetic energy of the alpha particle emitted in the alpha decay process
 $\text{Ra}^{226} \rightarrow \text{Rn}^{222} + \text{He}^4$.
 Mass of $\text{Ra}^{226} = 226.025410$, Mass of $\text{Rn}^{222} = 222.017578$, Mass of $\text{He}^4 = 4.002603$
16. The half-life of ${}_{198}\text{Au}$ is 2.70 days.
 - a) What is the decay constant of ${}_{198}\text{Au}$?
 - b) What is the probability that any ${}_{198}\text{Au}$ nucleus will decay in one second ?
17. Fill the missing particle in the following reactions :
 - a) ${}^4\text{He} + {}^{14}\text{N} \rightarrow {}^{17}\text{O} + \underline{\hspace{2cm}}$
 - b) ${}^9\text{Be} + {}^4\text{He} \rightarrow {}^{12}\text{C} + \underline{\hspace{2cm}}$
 - c) ${}^{27}\text{Al} + {}^4\text{He} \rightarrow {}^1_0\text{n} + \underline{\hspace{2cm}}$
18. Sirius A has a magnitude of – 1.44, while the Sun has a magnitude of – 26.8. Find the ratio of their brightness.
19. Star 1 is at half the distance of Star 2 and appears twice as bright. Compare their luminosities.
20. Find the total binding energy and also the average binding energy per nucleon for the nucleus ${}^{40}_{20}\text{Ca}$. Atomic mass of Ca = 39.962589u, mass of neutron = 1.008665u, mass of proton = 1.007825u. (4×3=12)



SECTION – D

Answer **any two** questions. **Each** carries **5** marks.

21. Explain how stars are grouped in Hertzsprung Russell diagram. Discuss the mass variation of main sequence stars.
22. With the help of a neat diagram, explain the parts of a nuclear fission reactor. How is it used for the production of electrical power ?
23. Explain the Quark model of mesons and baryons with examples.
24. What is the binding energy curve ? Explain nuclear fission and nuclear fusion on the basis of binding energy curve. **(2×5=10)**

