

STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2019-2020 and thereafter)
SUBJECT CODE : 19PH/MC/AN64

B.Sc. DEGREE EXAMINATION APRIL 2023
BRANCH III - PHYSICS
SIXTH SEMESTER

COURSE : MAJOR – CORE
PAPER : ATOMIC AND NUCLEAR PHYSICS
TIME : 3 HOURS

MAX. MARKS :100

SECTION – A

ANSWER ALL QUESTIONS:

25 MARKS

I CHOOSE THE CORRECT ANSWER:

(10 X 1 = 10)

- The frequency of a spectral line in X-ray spectrum varies as
(a) $\nu \propto Z^{1/2}$ (b) $\nu \propto Z^3$
(c) $\nu \propto Z^2$ (d) $\nu \propto Z$
- Which of the following electromagnetic wavelength corresponds to X-ray?
(a) 1 Å (b) 100 Å
(c) 10 Å (d) 1000 Å
- Value of Bohr magneton is
(a) $9.274 \times 10^{24} \text{ JT}^{-1}$ (b) $9.274 \times 10^{-24} \text{ JT}^{-1}$
(c) $9.274 \times 10^{-27} \text{ JT}^{-1}$ (d) $9.274 \times 10^{27} \text{ JT}^{-1}$
- Splitting of spectral in the presence of electric field is
(a) Stark Effect (b) Zeeman Effect
(c) Compton Effect (d) Paschen Back Effect
- The quantity 3.70×10^7 disintegrations/sec of a radioactive substance is known as
(a) rutherford (Rd) (b) curie
(c) micro curie (d) milli curie
- Packing fraction is the ratio between
(a) Binding energy and mass number (b) mass defect and mass number
(c) Binding energy and atomic number (d) mass defect and atomic number
- When Q-value of the reaction is -----, the reaction is exoergic.
(a) zero (b) negative
(c) positive (d) any thing
- Magnetic bottles can be used to contain plasma to initiate
(a) fission reaction (b) fusion reaction
(c) endo ergic reaction (d) exo ergic reaction
- Field particles of weak interactions are
(a) mesons (b) intermediate mesons
(c) intermediate bosons (d) photons
- Electric charge and strangeness of s-quark are
(a) $\frac{-1}{3} e$ and 0 (b) $\frac{-2}{3} e$ and -1
(c) $\frac{-2}{3} e$ and 0 (d) $\frac{-1}{3} e$ and -1

FILL IN THE BLANKS

(5x1=5)

- For threshold frequency, velocity of photo electrons is _____
- Electronic configuration of Aluminium _____

13. The process of an excited nucleus coming down to ground state giving its excess energy to one of the orbital electrons around it is known as _____
14. For the study of circulatory disorder in blood vessels radio ----- is injected.
15. Inner zone of Van Allen belts consists of ----- of high energy of the order of -----.

ANSWER BRIEFLY**(5x2=10)**

16. What is Compton Effect?
17. Define ionization potential.
18. List the properties of nuclear forces.
19. What does a breeder reactor do?
20. What are antiparticles? Give an example of particle and antiparticle pair.

SECTION B**ANSWER ANY FIVE QUESTIONS****(5x6=30)**

21. X-rays from a tube operated at 50 kV are analyzed with Bragg spectrometer using a calcite crystal cut along the cleavage plane. If grating space of calcite be given as 3.02945 Å, calculate the smallest angle between the crystal plane and X-ray beam at which the shortest wavelength produced by the tube can be detected.
22. Explain the important concepts of vector atom model.
23. 1 gram of radium is reduced by 2.1 mg in 5 years by α -decay, calculate the life period and mean life of period of the radium
24. Explain how carbon-nitrogen cycle can account to produce stellar energy.
25. i) What are cosmic rays? Distinguish between primary and secondary cosmic rays.
ii) Write short notes on the Van Allen Belts
26. The photoelectric threshold for certain metal is 300nm. Determine the maximum energy of the electrons ejected by a radiation of 200 nm. Given $h=6.6 \times 10^{-34}$ Js.
27. The numbers of disintegrations per minute of a certain radioactive substance are 6050 and 4465 at the end of 2nd and 3rd hour. Calculate the decay constant, half- life and mean-life of the substance.

SECTION – C**ANSWER ANY THREE QUESTIONS:****(3x15=45)**

28. Describe with theory, the Aston's mass spectrograph for the detection of isotopes.
29. Describe the Stern-Gerlach experiment with theory and indicate the importance of the results obtained.
30. Write a note on (i) neutrino theory of β decay and (ii) k-electron capture.
31. Describe the construction and explain the working of a nuclear reactor. When is the reactor said to be critical?
32. What are the broad categories into which elementary particles are classified? Mention important elementary particle in each category and discuss their chief characteristics.

