

STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.

(For candidates admitted during the academic year 2019-2020)

SUBJECT CODE :19PH/MC/AN64

B.Sc. DEGREE EXAMINATION APRIL 2022

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)

- When orange light falls on photosensitive surface, the photo current begins to flow. The velocity of ejected electrons will be more when the surface is strike by
a) red light b) violet light c) green light d) blue light
- The current in the photo electric cell
a) increases on increasing the intensity of incident light
b) increases on increasing the frequency of incident light
c) decreases on increasing the frequency of incident light
d) remains unchanged on increasing the intensity of incident light
- The Bhor magneton is equal to
a) $e\hbar/2m$ b) $2m/e\hbar$ c) $e\hbar^2/2m$ d) $2m/e\hbar^2$
- In a shell structure of atom , the maximum number of electrons that the shell corresponding to principal quantum number n can contain is
a) 2 b) n^2 c) $2n^2$ d) n
- The masses of neutron and proton are respectively 1.0087 and 1.0073 amu. If a neutron and proton combine together to form a nucleus of mass 4.0015 amu, the binding energy of nucleus will be
a) 28.4 MeV b) 2.84 MeV c) 14.2 MeV d) 142 MeV
- In the following nuclear reaction, X stands for ${}_{13}AL^{27} + {}_2He^4 \rightarrow {}_{15}P^{30} + X$
a) ${}_{+1}e^0$ b) ${}_{0n}^1$ c) ${}_{-1}e^0$ d) ${}_{1p}^1$
- Baryon number of $p + \pi^0 + \pi^+$
a) zero b) +1 c) -1 d) +1 or zero
- Which one is not a fundamental particle?
a) proton b) meson c) neutrino d) α -particle
- The fundamental postulates of vector atom model is
a) spatial quantization c) spatial quantization and spinning of electron
b) spinning of electron d) the angular momentum of quantized orbit is $nh/2\pi$
- Splitting of spectral lines due to electric field is called as
a) Zeeman b) Stark c) electric d) Paschen effect

FILL IN THE BLANKS

(5x1=5)

- The empirical formula for nuclear radius is _____
- Moseley's law is _____
- The weakest of the four types of fundamental interactions is _____ interaction.

14. Four factor formula for a neutron cycle is _____.
15. The minimum kinetic energy of the incident particle which will initiate an endoergic reaction is called _____.

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

16. What is meant by the term 'Internal conversion'?
17. State Paschen back effect.
18. What is a Nuclear magnetic bottle? Explain.
19. Give the characteristics of neutrino and antineutrino.
20. Distinguish between continuous and characteristic x-rays.

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

21. Define Nuclear fusion. Write a brief note on sources of stellar energy.
22. Compute the field gradient of a 0.4 m long Stern-Gerlach experiment that would produce a 2 mm separation at the end of the magnet between two components of beam of silver atoms emanating from an oven of 960° C.
23. Why Compton Effect cannot be observed with visible light? An X-ray photon is found to have doubled its wavelength on being scattered by 90°. Find the energy and wavelength of incident photon.
24. State the radioactive law of disintegration. A 10 gm of radioactive substance is reduced by 2.5 mg in 6 years through alpha decay. Evaluate half life and mean life time of the substance.
25. Write a short note on quark model and write the quark model of the proton, antiproton, neutron and antineutron. What is the necessity to have coloured quarks.
26. The wavelength of the photoelectric threshold of a metal is 2300 Å. Determine (i) the work function in eV, and (ii) the maximum kinetic energy (in eV) of the photoelectrons ejected by UV light of wavelength 1800 Å.
27. Calculate the threshold energy required to initiate the reaction $\text{Na}^{23} (n, \alpha) \text{F}^{20}$ ($m_{\text{Na}} = 22.9898 \text{ u}$, $m_n = 1.00866 \text{ u}$, $m_\alpha = 4.0040 \text{ u}$, $m_{\text{F}} = 19.9999 \text{ u}$)

SECTION – C**Answer any THREE questions****(3x15=45)**

28. Describe the construction of Aston's mass spectrograph with necessary theory and explain how it can be used for the detection of isotopes.
29. Give the origin and characteristics of Beta rays discrete and continuous spectrum. Outline neutrino theory of Beta decay.
30. Describe the construction and working of a nuclear reactor. When is the reactor said to be critical?
31. Discuss the classification of elementary particles. Explain the different quantum numbers associated with elementary particles.
32. What is Zeeman effect? Describe the experimental arrangement for studying the Zeeman effect. Obtain an expression for Zeeman shift.
