STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI - 600086.
(For candidates admitted during the academic year 2004-05 \& thereafter)
SUBJECT CODE : PH/MC/AN64

## B.Sc. DEGREE EXAMINATION APRIL 2008

BRANCH III - PHYSICS SIXTH SEMESTER

REG. No. $\qquad$
COURSE : MAJOR - CORE PAPER : ATOMIC AND NUCLEAR PHYSICS TIME 30 MINS.

## SECTION - A

## TO BE ANSWERED IN THE QUESTION PAPER ITSELF

## ANSWER ALL QUESTIONS:

$(30 \times 1=30)$
I CHOOSE THE CORRECT ANSWER:

1. The Bragg law is
a) $2 \sin \theta=d \lambda$
b) $2 d \sin \theta=n \lambda$
c) $d \sin \theta=n \lambda$
d) $\sin \theta=d \lambda$
2. Positive rays consists of
a) Protons
b) Positrons
c) Positively charged ions
d) all the above
3. The maximum kinetic energy acquired by a photoelectron is equal to
a) $h v$
b) $h v_{0}$
c) $h\left(v+v_{0}\right)$
d) $h\left(v-v_{0}\right)$
4. The energy required to remove an electron from a given orbit to an infinite distance from the nucleus is called as $\qquad$ potential.
a) excitation
b) ionization
c) second excitation
d) second ionization
5. The Zeeman shift is directly proportional to
a) $\lambda^{2}$
b) $\lambda$
c) $1 / \lambda$
d) $1 / \lambda^{2}$
6. The $L$ shell gets completed when it contains $\qquad$ electrons.
a) 2
b) 8
c) 18
d) 6
7. The Bhor electron magneton is equal to
a) $e \hbar / 2 \mathrm{~m}$
b) $2 \mathrm{~m} / \mathrm{e} \hbar$
c) $e \hbar^{2} / 2 \mathrm{~m}$
d) $2 \mathrm{~m} / \mathrm{e} \hbar^{2}$
8. Lorentz unit is a unit of
a) momentum
b) direction
c) energy
d) magnetic moment
9. 

a) charge
c) electric quadrupole moments
b) mass-energy
d) parity is not conserved in nuclear reactions
10. The ${ }_{4} \mathrm{Be}^{9}+{ }_{2} \mathrm{He}^{4} \rightarrow_{6} \mathrm{C}^{12}+{ }_{0} n^{1}$ is a $\qquad$ reaction
a) $(\mathrm{p}, \alpha)$
b) $(\mathrm{d}, \alpha)$
c) $d, p$ )
d) $(\alpha, \mathrm{n})$
11. The magic number is
a) 120
b) 80
c) 18
d) 20
12. The Volume energy of a nucleus is directly proportional to
a) $\mathrm{A}^{2 / 3}$
b) A
c) $\mathrm{A}^{1 / 3}$
d) $\mathrm{A}^{3 / 4}$
13. Neutron is an example of
a) meson
b) lepton
c) hyperon
d) baryon
14. The weakest of the four types of fundamental interactions is $\qquad$ interaction.
a) Gravitational
b) Electromagnetic
c) Weak
d) Coulomb
15. In pair production, $\qquad$ is created.
a) a proton
b) a proton - neutron pair
c) an electron
d) an electron - positron pair

II FILL IN THE BLANKS:
16. The velocities of positive rays range from $\qquad$ to $\qquad$ -.
17. An atom is said to be in the $\qquad$ state when its energy is least.
18. The Stern and Gerlach experiment is based on the behaviour of atomic magnet in a $\qquad$ magnetic field.
19. The semi-empirical mass formula for binding energy of a nucleus is $\qquad$ -.
20. The Cyclotron frequency is $\qquad$ .

III STATE WHETHER TRUE OR FALSE:
21. X-rays are produced when fast moving electrons are suddenly stopped by a solid target.
22. The velocity of the electron moving in an elliptical orbit varies at different parts of the orbit.
23. Sommerfeld's theory could not explain the complex spectra of alkali metals like sodium.
24. The nuclei containing a magic number of nucleons of the same kind form closed shell structure.
25. Hypercharge is not conserved in strong interaction.

IV ANSWER BRIEFLY:
26. What is photoelectric effect?
27. What is stark effect?
28. Distinguish between normal Zeeman effect and anomalous Zeeman effect.
29. What is radiative capture? Give an example.
30. State the Soddy Fajan's displacement law.

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| COURSE | $:$ | MAJOR - CORE |  |
| :--- | :--- | :--- | :--- |
| PAPER | $:$ | ATOMIC AND NUCLEAR PHYSICS |  |
| TIME | $:$ | $211 / 2$ HOURS | MAX. MARKS : 70 |

## SECTION - B

ANSWER ALL QUESTIONS:
$(5 \times 5=25)$

1. Calculate the work function of a metal (in eV ) which has a threshold wavelength of $6800 \AA$ (Given $\mathrm{h}=6.625 \times 10^{-34} \mathrm{Js}$ ).
2. The Spacing between principal planes of NaCl crystal is $2.82 \AA$. Calculate the wavelength of X-rays for first order Bragg reflection occurring at the angle of $10^{0}$.
3. Explain anomalous Zeeman effect and derive the expression for Lande $g$ factor.
4. Find the threshold energy for the reaction ${ }_{7} N^{14}(n, \alpha)_{5} B^{11}$. Given mass of Nitrogen $=14.003074 \mathrm{amu}$ neutron $=1.008665 \mathrm{amu}$, alpha $=4.002603 \mathrm{amu}$ and Boron $=11.00935 \mathrm{amu}$.
5. Find the binding energy, binding energy per nuclean of ${ }_{15} \mathrm{P}^{31}$ given mass of proton $=1.007825 \mathrm{amu}$, mass of neutron $=1.008665 \mathrm{amu}$ mass of phosphorus $=30.973763 \mathrm{amu}$.
6. A cyclotron with dees of radius 90 cm is operated with magnetic field of 0.6 Tesla. Calculate the energy to which a proton is accelerated. Given mass of proton $=1.67 \times 10^{-27} \mathrm{~kg}$ and charge $=1.6 \times 10^{-19}$ coulomb.
7. 1 Kg of radium is reduced by 2.1 g in 5 years by $\alpha$ decay. Calculate the half life period of radium.

## SECTION - C

ANSWER ANY THREE QUESTIONS:

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(3 \times 15=45)
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8. Give the theory of Compton effect and explain its experimental verification.
9. Describe the construction of Aston's mass spectrograph with necessary theory and explain how it can be used for the detection of isotopes.

10．Describe the vector atom model and explain the various quantum numbers associated with it．

11．Describe the construction and working of a nuclear reactor．When is the reactor said to be critical？

12．Give the theory of successive disintegration of radioactive substances． Explain secular and transient equilibrium．

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