



Reg. No. :

Name :

V Semester B.Sc. Degree (CCSS-Reg./Supple./Improve.)
Examination, November 2015
Core Course in Physics
5B10 PHY : ATOMIC, NUCLEAR AND PARTICLE PHYSICS
(2011 and Earlier Admissions)

Time : 3 Hours

Max. Weightage : 30

SECTION - A

Choose the correct answer. Each bunch carries of weightage of 1.

1. i) In Rutherford alpha particle scattering experiment no. of alpha particles per unit area that reach the screen at a scattering angle of θ is proportional to _____

a) \sqrt{KE}	b) KE
c) KE^2	d) KE^3

- ii) $\frac{1}{\lambda} = R \left[\frac{1}{4^2} - \frac{1}{n^2} \right]$ $n = 5, 6, 7$ _____ this corresponds to

a) Lyman series	b) Paschen series
c) Brackett series	d) Pfund series

- iii) The number of electrons in a filled shell is _____

a) n	b) n^2
c) $2n$	d) $2n^2$

- iv) In periodic table, across left to right in any period ionization energy _____

a) Decreases	b) Increases
c) Remains same	d) None of these

(W = 1)



2. i) $P^+ + e^- \rightarrow n^0$ represents
- a) Alpha decay b) Beta decay
c) Positron emission d) Electron capture
- ii) The end product of Neptunium series is _____
- a) ${}_{82}^{206}\text{Pb}$ b) ${}_{83}^{209}\text{Bi}$ c) ${}_{82}^{208}\text{Pb}$ d) ${}_{82}^{207}\text{Pb}$
- iii) Which one of the following is not a Lepton
- a) Electron b) Proton c) Muon d) Tau neutrino
- iv) Strangeness quantum no. of strange quark is _____
- a) -1 b) -2 c) 0 d) +1 (W = 1)

SECTION - B

Answer **any six**. Each carries a weightage of 1.

- What do you mean by radioactive equilibrium ?
- Give the expression for reaction rate.
- λ particle consists of a u quark, a d quark and s quark. What is its charge ?
- Why is the ground state of hydrogen atom not split into two sublevels by spin-orbit coupling ?
- Define binding energy. What is BE/nucleon ?
- What happened when an electron is captured by a nucleus ?
- What is ITER ?
- Write a note on pairing energy. (6×1=6 W)

SECTION - C

Answer **any nine**. Each question carries a weightage of 2.

- Briefly explain the quantum numbers associated with an electron.
- Explain Meson Theory of Nuclear Forces.



- Derive the expression for total energy of an electron in Hydrogen atom.
- How the nuclear mass effects the wave length of spectral lines ?
- In each of the following pairs of atoms, which would you expect to be larger in size ? Why ? Li and F; Li and Na ; F and Cl ; Na and Si.
- Calculate the binding energy of an alpha particle. Given mass of $\text{He}_4 = 4.00387u$, $M_n = 1.00866u$, $M_p = 1.00728u$, and $u = 931\text{MeV}$.
- What are the assumptions and limitations of the liquid drop model of the nucleus ?
- The atomic ratio between Uranium isotopes ${}^{238}\text{U}$ and ${}^{234}\text{U}$ in a mineral sample is found to be 1.8×10^4 . The half life of ${}^{234}\text{U}$ is 2.5×10^5 yrs. Find the half life of ${}^{238}\text{U}$.
- Describe nuclear fission on the basis of liquid drop model.
- What are the four fundamental interactions ? Discuss.
- Which of the following reactions can occur ? State the conservation principles violated by others.

a) $P + P \rightarrow n + P + \pi^+$	b) $P + P \rightarrow P + \lambda^0 + e^+$
c) $e^+ + e^+ \rightarrow \mu^+ + \pi^-$	d) $P + P \rightarrow P + \pi^+ + K^0 + \lambda^0$
- What do you mean by electron spin ? Explain the significance of Stern-Gerlach Experiment. (9×2=18 W)

SECTION - D

Answer **any one**. Each question carries a weightage of 4.

- What are magic numbers ? Give an account of the shell model of the binding energy and indicate how the model explains the existence of magic numbers.
- Derive the exponential law of radioactive disintegration. Hence deduce the expression for half and mean life. Show mean life is 1.44 times the half life. (1×4=4 W)