



RAN - 2103000206021003

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T.Y.B.Sc. (Sem. VI) Examination March - 2025

Physics Paper VIII

(Atomic and Nuclear Physics)

Time: 2 Hours]

[Total Marks: 50

सूचना : / Instructions

(१)

नीचे दशावलि निशानीवाणी विगतो उत्तरवही पर अवश्य लपवी.
Fill up strictly the details of signs on your answer book

Name of the Examination:
☛

Name of the Subject :
☛

Subject Code No.:

Seat No.:

- (2) Question paper carries total five questions. Numbers on right indicate full marks of the question.
- (3) Draw neat diagram wherever necessary.
- (4) Symbols used in paper have their conventional meanings.

Q-1

Answer in short as directed:

10

1. Which subshell of an atom can accommodated maximum 14 electrons?
2. An element is positioned at 4th period and 5th group of periodic table. How many electrons does it have in outermost orbit?
3. What is the possible value of total angular momentum of electron with $l = 0$
4. How an ionic bond is formed?
5. Information of covalent bonds in atom why do only outermost orbit electrons be involved?
6. Define recovery time for Geiger tube.
7. What are dynodes in PM tube?
8. Which gas is filled in the proportional counter for detecting slow neutrons?
9. What are the force carriers in weak interaction?
10. Give decay mode of free neutron.

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[1]

[P.T.O.]

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- Q.2 (a) Attempt any one of the following: 07**
- (1) Explain in detail the modern periodic table and its important features with reference to atomic structure.
 - (2) Explain in detail the total angular momentum and its quantization.
- (b) Attempt any one of the following: 03**
- (1) What is the atomic number Z of the element for that wavelength of K_{α} x-ray line is 0.180 nm? (Take Rydberg constant $R = 1.097 \times 10^7 \text{ m}^{-1}$)
 - (2) Prove that for an atom the total number of electrons accommodated in the shell with principal quantum number n is equal to $2n^2$.
- Q.3 (a) Attempt any one of the following: 07**
- (1) Explain formation and stability of hydrogen molecule using concept of wave functions.
 - (2) Explain electronic spectra of molecules and discuss fluorescence and phosphorescence.
- (b) Attempt any one of the following: 03**
- (1) NO molecule has a bond length R of 1.15 Å. Calculate the moment of inertia of NO. Masses of nitrogen and oxygen atoms are 14amu and 16amu respectively. (Take 1 amu = 1.67×10^{-27} kg.)
 - (2) In carbon monoxide (CO) molecule the $J = 0 \rightarrow J = 1$ absorption line occurs at a frequency of 1.15×10^{11} Hz. What is the bond length of the CO molecule? (Reduced mass of CO molecule is 1.14×10^{-26} kg)
- Q.4 (a) Attempt any one of the following: 07**
- (1) Explain principle, Construction and working of drift tube accelerator.
 - (2) Explain in detail about Cerenkov counters. Mention its advantages and limitations.
- (b) Attempt any one of the following: 03**
- (1) In a drift tube portion of a linear accelerator, protons are accelerated from 0.75 MeV to 100 MeV. A.C. voltage applied has a frequency of 200 MHz. Find the length of the first tube.
 - (2) An α -particle of energy 5.48 MeV is completely stopped in an ionization chamber. What is the pulse height in an external resistance of 1 M Ω ? Energy required to produce an ion-pair is 35 eV and the capacitance of the chamber is 50 pF.

Q5. (a) Attempt any one of the following:

07

- (1) Explain classification of elementary particles. Discuss about quanta of force and matter particles.
- (2) What are mesons? Explain production and decay modes for π - mesons, K - mesons and η - meson.

(b) Attempt any one of the following:

03

- (1) The Σ^0 - hyperon decays to $\Lambda^0 + \gamma$ with a mean lifetime of 7.4×10^{-20} s. Estimate its decay width in keV. Take value of $h = 6.625 \times 10^{-34}$ J-s.
- (2) Find the value dimensionless coupling constant for electromagnetic interaction.

Take $e = 1.6 \times 10^{-19}$ C, $\epsilon_0 = 8.854 \times 10^{-12}$ SI $h = 6.626 \times 10^{-34}$ J-s
