

**2103000206021003**  
**EXAMINATION FEBRUARY-MARCH 2024**  
**BACHELOR OF SCIENCE (SIXTH SEMESTER)**  
**PHYSICS PAPER - VIII (PH-608-ATOMIC AND NUCLEAR**  
**PHYSICS) - LEVEL 2**

[Time: As Per Schedule]

[Max. Marks: 50]

**Instructions:**

**1. Fill up strictly the following details on your answer book**

a. Name of the Examination: **BACHELOR OF SCIENCE (SIXTH SEMESTER)**

Name of the Subject: **PHYSICS PAPER - VIII (PH-608-ATOMIC AND NUCLEAR PHYSICS) - LEVEL 2**

b. Subject Code No: **2103000206021003**

2. Sketch neat and labelled diagram wherever necessary.
3. Figures to the right indicate full marks of the question.
4. All questions are compulsory.
5. Students are allowed to use a non-programmable scientific calculator.

Seat No:

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Student's Signature

**Q.1 Answer in brief:**

**10**

1. What are lanthanide elements?
2. A closed d-subshell of the atom holds \_\_\_\_\_ electrons.
3. Give two examples of halogens.
4. Molecular vibrational spectra are in the \_\_\_\_\_ region
5. What is a molecule?
6. Define resolving time for Geiger tube.
7. What is the full form of LINAC?
8. What are dynodes in Photomultiplier tube?
9. All the chemical and biological reactions are basically controlled by the \_\_\_\_\_ interactions.
10. What is pair creation?

**Q.2 A. Answer anyone in detail:**

**7**

1. Discuss shells and subshells of electrons in atom with its capacities.
2. Explain total angular momentum. Discuss how magnitude and direction are quantized.

**B. Answer anyone:****3**

1. The  $K_{\alpha}$  x-ray line of an unknown material has an energy of 66.9 KeV. Find the atomic number  $Z$  of the material.
2. An electron beam enters a uniform magnetic field of flux density 0.9 T. Find the energy difference between electrons having spins parallel and anti-parallel to the field. Take value of the Bohr magneton  $\mu_B = 9.27 \times 10^{-24} J/T$

**Q.3****A. Answer anyone in detail:****7**

1. Obtain an expression for rotational energy levels of a diatomic molecule and discuss the rotational spectra.
2. Explain How fluorescence and phosphorescence occur.

**B. Answer anyone:****3**

1. The equivalent force constant of HCl molecule is about 470 N/m, estimate the energy difference between the lowest and first excited vibrational state of HCl. Reduced mass of HCl is  $1.615 \times 10^{-27} kg$ . (Planck's constant  $h = 6.625 \times 10^{-34} J - s$ )
2. Reduced mass and moment of inertia of HF molecule are  $1.58 \times 10^{-27} kg$  and  $1.38 \times 10^{-47} kg - m^2$  respectively. Calculate its bond length.

**Q.4****A. Answer anyone in detail:****7**

1. Explain principle, Construction and working of linear accelerator.
2. Explain principle, Construction and working of proportional counters.

**B. Answer anyone:****3**

1. In a linear accelerator, protons are accelerated from 0.8 MeV to 125 MeV. A.C. voltage applied has a frequency of 195 MHz. Find the length of first drift tube.  
Mass of the proton  $m = 1.67 \times 10^{-27} kg$
2. Calculate the electric field at the surface of the wire of a proportional counter. The radius of the wire is 0.1 mm and the inner radius of the outer cylinder is 2 cm. The potential applied between the two electrodes is 1000 V.

**Q.5**

**A. Answer anyone in detail:**

**7**

1. Discuss in detail about three main sources of elementary particles
2. Write detailed notes about electromagnetic interactions, strong interactions and weak interactions.

**B. Answer anyone:**

**3**

1. How electrons are produced? Give two different methods.
2. The  $\tau^+$  has a mean lifetime of  $0.29 \times 10^{-12} \text{ s}$ . Estimate its decay width. Take value of  $h = 6.625 \times 10^{-34} \text{ J - s}$ .

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