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**RAN-2103000206021003****T.Y.B.Sc. (Sem. VI) Examination September - 2023****Physics : Paper-VIII (PH-608) : Atomic and Nuclear Physics****Time: 2 Hours ]****[ Total Marks: 50****सूचना : / Instructions**

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**नीचे दशविले निशानीवाणी विगतो उत्तरवली पर अवश्य लपववी.  
Fill up strictly the details of signs on your answer book**

Name of the Examination:

☛ **T.Y.B.Sc. (Sem. VI)**

Name of the Subject :

☛ **Physics : Paper-VIII (PH-608) : Atomic and Nuclear  
Physics**Subject Code No.: **2103000206021003**

Seat No.:

Student's Signature

- (2) Figures to the right indicate total marks carried by the question.  
(3) All symbols used have their usual meaning.  
(4) Students are allowed to use a non-programmable scientific calculator.

**Q.1 Answer in brief:****[10]**

- (1) Which elements are in group-8 of the periodic table?
- (2) How many electrons are occupied in a closed d-subshell?
- (3) Give electronic configuration of sodium ( $Z=11$ )
- (4) Molecular rotational spectra are in the \_\_\_\_\_ region.
- (5) What is the principle of Tandem Accelerator?
- (6) Which gas is filled in the proportional counter for detecting slow neutrons?
- (7) What is the main drawback of GM counter?
- (8) What is the order of the range of the weak interaction?
- (9) What is pair creation?
- (10) Give relation between decay width of any unstable particle and its lifetime.

**Q.2 (A) Answer anyone in detail:****[07]**

- (1) Explain spin-orbit coupling. Derive necessary equation of magnetic potential energy and show that how quantum state splits into two sub-states.

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- (2) Which two basic principles determine the structures of atoms with more than one electron? Discuss shells and subshells of electrons in atom.

**(B) Answer anyone:** [03]

- (1) Prove that for an atom the total number of electrons accommodated in the shell with principal quantum number  $n$  is equal to  $2n^2$ .
- (2)  $K_{\alpha}$  x-ray line from molybdenum ( $Z=42$ ) has a wavelength of  $0.7078 \text{ \AA}$ . Calculate the wavelength of  $K_{\alpha}$  x-ray line of Zinc ( $Z=30$ ).

**Q. 3 (A) Answer anyone in detail:** [07]

- (1) Explain molecular rotational energy levels.
- (2) Explain in detail about molecular bond.

**(B) Answer anyone:** [03]

- (1) Moment of inertia and reduced mass of HF molecule are  $1.38 \times 10^{-47} \text{ kg-m}^2$  and  $1.58 \times 10^{-27} \text{ kg}$  respectively. Calculate bond length of HF molecule.
- (2) The moment of inertia of HCl molecule has the value  $I = 2.66 \times 10^{-47} \text{ kg-m}^2$ . estimate the energy difference between the lowest and first excited rotational state of HCl.  
(Planck's constant  $h = 6.625 \times 10^{-34} \text{ J-s}$ )

**Q. 4 (A) Answer anyone in detail:** [07]

- (1) Explain principle, Construction and working of ionization chamber.
- (2) Explain principle, Construction and working of linear accelerator.

**(B) Answer anyone:** [03]

- (1) A Geiger counter consists of a 25 mm radius grounded tube with a central wire of having radius of  $10 \text{ }\mu\text{m}$ . 1600 V potential is applied between tube and the central wire. What is the electric field at the tube wall?
- (2) In a linear accelerator, protons are accelerated from 0.50 MeV to 200 MeV, AC voltage applied has a frequency of 150 MHz. Find the length of the first tube of the accelerator.

**Q. 5 (A) Answer anyone in detail:**

**[07]**

- (1) Discuss in detail about the gravitational and electromagnetic interaction.
- (2) Explain classification of elementary particles. Discuss about quanta of force and matter particles.

**(B) Answer anyone:**

**[03]**

- (1) 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

- (2) Mean lifetime of  $K^\pm$  is  $1.24 \times 10^{-8}$  s. Determine its decay width.

Take value of  $h = 6.625 \times 10^{-34}$  J-s.

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