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

(1)

नीचे दृश्यावलोकन निशानीवाणी विगतो उत्तरवही पर अवश्य लभवी.
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) What do you mean by closed atomic shell?
- (2) A closed f-subshell of the atom holds _____ electrons.
- (3) Which elements are in group one of the periodic table?
- (4) How is an ionic bond formed?
- (5) Give conventional structural formula of Ethylene(C_2H_4)
- (6) Which gases are commonly used in GM counters?
- (7) What is the full form of LINAC?
- (8) In diffused p-n junction detector _____ region is identical to a gas in the ionization chamber?
- (9) What are the force carriers in weak interaction?
- (10) Which force holds nucleons together in the nucleus?

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

- (1) Explain total angular momentum. Discuss how magnitude and direction are quantized.
- (2) Discuss shells and subshells of electrons in atomic structure. Explain how an atom's electron structure determines its chemical behavior.

(B) Answer anyone: [03]

- (1) An electron beam enters a uniform magnetic field of flux density 1.4 T. Find the wavelength of the radiation that can cause electrons whose spins are parallel to the field to flip so that their spins are anti-parallel. Take value of the Bohr magneton $\mu_B = 9.27 \times 10^{-24}$ J/T and Planck's constant $h = 6.625 \times 10^{-34}$ J-s.
- (2) Find the energy and wavelength of the K_α x-ray of Aluminum ($Z = 13$) Planck's constant $h = 6.625 \times 10^{-34}$ J-s.

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

- (1) Explain in detail about molecular bond.
- (2) Obtain an expression for rotational energy levels of a diatomic molecule and discuss the rotational spectra.

(B) Answer anyone: [03]

- (1) A $^{200}\text{Hg}^{35}\text{Cl}$ molecule emits a 4.4-cm photon when it undergoes a rotational transition from $J = 1$ to $J = 0$. Find the interatomic distance in this molecule.
Take $1u = 1.67 \times 10^{-27}\text{kg}$
- (2) 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 1.615×10^{-27} kg. (Planck's constant $h = 6.625 \times 10^{-34}$ J-s)

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

- (1) Explain principle, Construction and working of Tandem accelerator.
- (2) Explain principle, Construction and working of Geiger-Muller counters.

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

(1) In a drift tube accelerator, protons are accelerated from 1 MeV to 150 MeV. A.C. voltage applied has a frequency of 200 MHz. Find the length of first drift tube.

Mass of the proton $m = 1.67 \times 10^{-27}$ kg

(2) When 10 α -particles per second enters in an ionization chamber. Current of 2.9×10^{-13} A is produced. If 30 eV energy is required to create one ion pair, what is the energy of incident α -particle.

Q. 5. (A) Answer anyone in detail: [07]

(1) Which are the four fundamental interactions? Discuss about them.

(2) What are Hyperons? Which are well-known hyperons? Explain production and decay modes for well-known hyperons.

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

(1) Prove that the dimensionless coupling constant for electromagnetic interaction $\alpha = \frac{1}{137}$

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) The Σ^+ -hyperon has a mean lifetime of 0.80×10^{-10} s. Estimate its decay width in MeV. Take value of $h = 6.625 \times 10^{-34}$ J-s.