



61621

Sixth Semester B.Sc. Degree Examination, September/October 2023

(CBCS Scheme)

PHYSICS – VII

Atomic, Molecular and Nuclear Physics

Time : 3 Hours

Max. Marks : 70

PART – A

Answer **any five** of the following. **Each** question carries **eight** marks. (5×8=40)

1. Explain the quantum numbers associated with the vector atom model. **8**
2. a) Distinguish between Normal and Anomalous Zeeman effect.
b) Explain Debye's quantum theory of Normal Zeeman effect. **(2+6)**
3. a) Mention the different types of molecular spectra.
b) Obtain an expression for rotational energy levels of a diatomic molecule. **(3+5)**
4. Assuming the relation between impact parameter and angle of scattering, derive Rutherford's scattering formula. **8**
5. a) Explain the different types of beta decay.
b) What is Pauli's Neutrino hypothesis ? **(6+2)**
6. With a neat diagram explain the variation of ionization current with applied voltage in gas ionization detectors. **8**
7. a) Distinguish between direct nuclear reaction and compound nuclear reaction.
b) Derive an expression for threshold energy of an endoergic reaction. **(4+4)**
8. a) What are elementary particles ?
b) Explain the classification of elementary particles. **(1+7)**

P.T.O.





PART – B

Answer **any five** of the following problem. **Each** problem carries **four** marks. **(5×4=20)**

9. The experimental value of Bohr magneton is $9.274 \times 10^{-24} \text{ JT}^{-1}$ and Planck's constant is $6.625 \times 10^{-34} \text{ Js}$. Calculate the specific charge of electron.

10. A beam of silver atoms in the Stern-Gerlach experiment, obtained from an oven pass through an inhomogeneous magnetic field of field gradient 5 Tm^{-1} perpendicular to the beam. The pole pieces are 0.15 m long. Calculate the separation between the two traces on a photographic plate kept closed to the magnets if the velocity of silver atoms is 589 ms^{-1} . Given : $\mu = 9.2 \times 10^{-24} \text{ JT}^{-1}$, Mass of silver atoms = $1.79 \times 10^{-25} \text{ kg}$.

11. The spacing between vibrational levels of CO molecule is 0.082 eV . Calculate the value of force constant.

Given : Reduced mass of CO molecule = $1.14 \times 10^{-26} \text{ kg}$.

$$h = 6.625 \times 10^{-34} \text{ Js}$$

$$e = 1.6 \times 10^{-19} \text{ C}$$

12. Calculate the distance of closest approach of α -particle of energy 3 MeV being scattered by a gold nucleus ($Z = 79$). Given : $\epsilon_0 = 8.85 \times 10^{-12} \frac{\text{f}}{\text{m}}$.

13. Neptunium (${}_{93}\text{Np}^{237}$) emits α -particles of energy 4.19 MeV . Calculate the kinetic energy of daughter nucleus and alpha disintegration energy.

14. Potassium – 40 is an isotope which decays by β^- emission. Find the Q-value of the decay and write the reaction.

Given : Mass of $\text{K}^{40} = 39.96399 \text{ u}$

Mass of $\text{Ca}^{40} = 39.96259 \text{ u}$

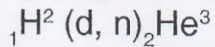
15. A self quenched GM counter operates at 1000 V and has a wire of diameter of 0.2 mm . The radius of the cathode is $2 \times 10^{-2} \text{ m}$ and the tube has a guaranteed life time of 10^9 counts. What is the maximum radial field and how long will the counter last if it is used on an average for 30 hours per week at 3000 counts per minute ?

Assume 52 weeks per year.





16. Calculate the Q value of the reaction



Given : ${}_1\text{H}^2 = 2.0141 \text{ u}$

$${}_2\text{He}^3 = 3.0160 \text{ u}$$

$${}_0\text{n}^1 = 1.00866 \text{ u}$$

Is it exoergic or endoergic ?

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**

- 17. a) Can an electron revolve round the nucleus in an orbit of any radius ? Justify.
- b) Why α -particles have high ionising power ?
- c) Can radioactivity be controlled ? Explain.
- d) Do electron exist in atomic nuclei ? Explain.
- e) Can ionization chambers be used to detect electrons ? Explain.
- f) Can we accelerate neutron in a cyclotron ? Explain.
- g) Give the quart composition of a proton and a neutron.
- h) Does a weak interaction obey strangeness ? Explain.

