



MS – 300

VI Semester B.Sc. Examination, May 2016

(NS) (2013-14 and Onwards)

PHYSICS – VII

Atomic and Molecular Physics, Nuclear Physics and Material Science

Time : 3 Hours

Max. Marks : 70

Instruction : Answer five questions from each Part.

PART – A

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

1. a) What are the limitations of Bohr's model of atom ?
b) Write a note on spatial quantisation and spin of electron. (2+6)
2. a) Distinguish between normal and anomalous Zeeman effect.
b) Explain Debye's quantum theory of normal Zeeman effect. (2+6)
3. a) Distinguish between Rayleigh scattering and Raman scattering.
b) Explain quantum theory of Raman effect and obtain the expression for Raman shift. (2+6)
4. a) State the assumptions of theory of Rutherford's alpha ray scattering.
b) Obtain the relation between the impact parameter and angle of scattering in alpha ray scattering. (2+6)
5. a) Derive an expression for the Q value of alpha decay.
b) Write a note on Geiger-Nuttal law. (5+3)
6. a) With the help of diagram, explain the construction and working of a cyclotron.
b) Arrive at the expression for maximum energy of emerging particle. (5+3)
7. a) What are top-down and bottom-up methods of synthesis of nanomaterials ?
b) What are zero, one and two dimensional nanosystems ? Give one example each. (2+6)
8. a) Explain different types of thermotropic liquid crystals.
b) Mention any two applications of liquid crystals. (6+2)

P.T.O.



PART – B

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

9. Find the value of Bohr magneton. Given, Planck's constant, $h = 6.625 \times 10^{-34}$ Js, mass of electron $m_e = 9.1 \times 10^{-31}$ kg, charge on the electron $e = 1.602 \times 10^{-19}$ C.
10. In a Stern-Gerlach experiment silver atoms traverse a distance of 0.1 m through a non-uniform magnetic field of gradient 60 Tm^{-1} . If the separation between two tracings on the recording plate is 0.15 mm. Find the velocity of silver atoms. (mass of silver atom = 1.79×10^{-25} kg, Bohr magneton = $9.28 \times 10^{-24} \text{ JT}^{-1}$).
11. The force constant of CO molecule is 187 Nm^{-1} . Find the frequency of vibration of CO molecule and spacing between the vibrational levels. (The reduced mass of CO molecule is 1.145×10^{-26} kg).
12. An α -particle of energy 10 MeV is moving towards gold nucleus ($Z = 79$). Calculate the distance of closest approach.
13. Potassium-40 decays into calcium by beta emission. Find the Q value of reaction. Given, mass of potassium atom is 39.96399 U, mass of calcium atom is 39.96259 U.
14. The Q value of reaction ${}_5\text{B}^{10} (n\alpha) {}_3\text{Li}^7$ is 2.7935 MeV. Calculate Threshold energy. Given mass of ${}_5\text{B}^{10}$ atom is 10.012394 U, and mass of neutron is 1.008665 U.
15. If a sodium-chloride crystal is subjected to an electric field of 1000 Vm^{-1} and resulting polarization is $4.3 \times 10^{-8} \text{ cm}^{-2}$. Calculate the dielectric constant.
16. The electronic polarization of the atom is $3.28 \times 10^{-40} \text{ Fm}^2$. If the sulphur solid has cubical symmetry, calculate its dielectric constant. (Given $N = 3.914 \times 10^{28} \text{ m}^{-3}$).

PART – C

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

17. a) The path of an electron is a rosette according to Sommerfield Model. Explain.
b) The alkali metals have hydrogen-like spectra. Explain.
c) Do the electrons of target atom affect the scattering of alpha particles ? Explain.
d) Can there be a transition from E_3 to E_1 of rotational energy levels ? Explain.
e) Is alpha ray spectrum discrete or continuous ? Explain.
f) Can G-M counter detect neutrons ? Explain.
g) Do polar dielectric material posses dipole moment in absence of external electric field ? Explain.
h) Does the colour of liquid crystals change with temperature ? Explain.
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