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 = 9.28×10^{-24} 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 $_5B^{10}(n\alpha)_3Li^7$ is 2.7935 MeV. Calculate Threshold energy. Given mass of $_5B^{10}$ 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 4.3×10^{-8} cm^{-2}. Calculate the dielectric constant.

16. The electronic polarization of the atom is 3.28×10^{-40} Fm^2. If the sulphur solid has cubical symmetry, calculate its dielectric constant. (Given $N = 3.914 \times 10^{28}$ 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.