



US – 334

VI Semester B.Sc. Examination, May 2017
(F+R) (CBCS – Fresh – 2016-17 and Onwards/NS – Repeaters –
2013-14 and Onwards)
PHYSICS – VII
Atomic 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. Explain the different quantum numbers associated with vector atom model. 8
2. a) State Pauli's exclusion principle.
b) Obtain an expression for the maximum number of electrons that can be filled in a shell. (2+4+2)
c) What is Bohr Magneton ? Mention its S.I. Unit.
3. a) Outline the quantum theory of Raman effect.
b) Mention any two applications of Raman effect. (6+2)
4. a) What are the assumptions made by Rutherford to explain alpha-ray scattering ?
b) What is the path of an alpha particle ? When it is scattered through a large angle by a nucleus ?
c) Define "Impact Parameter" and "Scattering angle" and write the relation between them. (4+1+3)
5. Describe the construction and working of a Geiger-Muller counter and explain the features of its characteristic curve. 8
6. a) Distinguish between endoergic and exoergic nuclear reactions.
b) Derive an expression for the threshold energy of an endoergic nuclear reaction. (2+6)

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7. a) What are nanomaterials ? Mention the two approaches to synthesize nanomaterials.
 b) Describe lyotropic liquid crystal. Mention any one application of liquid crystal. (3+5)
8. Describe the various kinds of polarization when a dielectric material is placed in an external electric field. 8

PART - B

Answer **any five** problems. **Each** problem carries **4** marks : (5×4=20)

9. In the Stern-Gerlach experiment silver atoms travels a distance of 0.15 m in a non-homogeneous magnetic field of gradient 60 Tm^{-1} . If the velocity of silver atoms is 400 ms^{-1} , calculate the separation between the two traces on a collector plate placed 0.5m from the pole pieces of the magnet. Given

$$\text{mass of silver atom} = 1.79 \times 10^{-25} \text{ Kg}$$

$$\text{Bohr magneton } (\mu_B) = 9.2 \times 10^{-24} \text{ JT}^{-1}$$

10. Calculate the Zeeman shift produced in normal Zeeman effect when a spectral line of wavelength 590 nm is subject to a magnetic field of 0.5T. Assume the

$$\text{specific charge } \left(\frac{e}{m} \right) \text{ of the electron is } 1.76 \times 10^{11} \text{ ckg}^{-1}.$$

11. Determine the value of the rotational constant of H-F molecule from the following data. Reduced mass of H-F molecule = $9.583 \times 10^{-28} \text{ Kg}$

$$\text{Bond length of H-F molecule} = 1.2 \text{ \AA}$$

$$\text{Planck's constant} = 6.632 \times 10^{-34} \text{ JS.}$$

12. Find the threshold energy for the reaction ${}_8\text{O}^{18}(\text{p},\text{n}){}_9\text{F}^{18}$, given the Q value of the reaction is 2.742 MeV. Use the following data.

$$\text{Mass of } {}_8\text{O}^{18} = 17.99916 \text{ u,}$$

$$\text{Mass of Proton} = 1.00783 \text{ u,}$$

$$\text{Mass of neutron} = 1.00866 \text{ u,}$$

$$\text{Mass of } {}_9\text{F}^{18} = 18.00095 \text{ u.}$$





13. ${}_{19}\text{K}^{40}$ decays into ${}_{20}\text{Ca}^{40}$ by β^- emission. Find the Q value of the decay given the following data. Mass of ${}_{19}\text{K}^{40} = 39.96399$ u and Mass of ${}_{20}\text{Ca}^{40} = 39.96259$ u.
14. A magnetic field of 4T is employed in a cyclotron to accelerate protons. Find the frequency of reversal of the electric field applied between the Dees,
Given mass of proton = 1.67×10^{-27} Kg
Charge of proton = 1.60×10^{-19} C.
15. Calculate the radius of He atom if its electronic polarizability is 1.85×10^{-41} Fm².
Given $\epsilon_0 = 8.85 \times 10^{-12}$ Fm⁻¹.
16. The dielectric constant of sulphur is 3.4. If a sample of sulphur contains 3.76×10^{28} sulphur atoms per m³, find the polarizability of sulphur atom. Given $\epsilon_0 = 8.85 \times 10^{-12}$ Fm⁻¹.

PART – C

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

17. a) What is the direction of magnetic moment of an electron with respect to its orbital angular momentum ? Explain.
- b) How does the finite size of the nucleus affect the value of Rydberg's constant ? Explain.
- c) Are the rotational energy levels of a rigid diatomic molecule equally spaced ? Explain.
- d) Why is Quenching necessary in a GM tube ? Explain.
- e) Can a photon be used as a projectile in a nuclear reaction ? Justify your answer.
- f) How does order parameter of a liquid crystal change with temperature ? Explain.
- g) Is the electric field experienced by a dipole in a sample of dielectric material the same as the applied electric field ? Explain.
- h) What is electron confinement in a nano system ? Explain.

