SM – 350

VI Semester B.Sc. Examination, May/June 2018
(F + R)
(CBCS – 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. a) Explain Sommerfeld's atom model.
   b) Give an account of the spinning electron hypothesis. **(5+3)**
2. What is Zeeman effect ? Give the quantum theory of normal Zeeman effect. **8**
3. Explain molecular spectra. Obtain an expression for the rotational energy levels of diatomic molecule and the frequency of the rotational spectra. **8**
4. a) State the assumptions of Rutherford's α-ray scattering.
   b) Obtain the relation between the impact parameter and scattering angle in α-ray scattering experiment. **(2+6)**
5. With a neat diagram, explain the variation of ionization current with applied voltage in gas ionization detectors. **8**
6. What is a Q-value of a reaction ? Explain endothermic and exothermic reaction. Obtain an expression for the threshold energy of an endoergic reaction. **8**
7. a) Explain any three distinct properties of nano materials.
   b) Mention any two applications of nanomaterials. **(6+2)**
8. a) Deduce an expression for Lorentz field.
   b) Explain any two properties of liquid crystals. **(4+4)**

PART – B

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

9. The experimental value of Bohr magneton is 9.21×10^{-24} JT^{-1} and Planck's constant h = 6.625×10^{-34} J-S. Calculate the specific charge.

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10. In the Stern-Gerlach experiment silver atoms traverses a distance of 0.1 m in a non-homogeneous magnetic field of field gradient 55 Tm^{-1}. If the velocity of the silver atoms is 450 ms^{-1}. Calculate the separation between the two trace on the collector plate 0.5 m from the pole pieces.
Mass of silver atom = 1.79×10^{-25} kg.
$\mu_B = 9.2 \times 10^{-24}$ JT^{-1}.

11. In an experiment in the study of Raman effect using Hg green radiation of wavelength 5461 Å, a stokes line of wavelength 5543 Å was observed. Find the Raman shift and wavelength corresponding to Antistoke's line.

12. Neptunium – 237($_{93}Np^{237}$) emits alpha particles of energy 4.19 MeV. Calculate the alpha disintegration energy.

13. The Q-value of Na^{23} (n, α)F^{20} reaction is – 5.4 MeV. Determine the threshold energy of the neutrons for this reaction. Given mass of neutron = 1.00866 a.m.u. and mass of Na^{23} = 22.99097 a.m.u.

14. Determine the radial electric field and life of a GM counter tube operating at 1900V with radii of anode and cathode being 0.09 mm and 1.5 cm respectively. The GM tube has guaranteed life counts of 10^{10} and operates 20 hrs. per day at 2500 counts per minute.

15. Assuming that there are 10^{27} molecules per m^3 in HCl vapour, calculate the orientational polarization at 27°C, if the vapour is subjected to an electric field of 10^6 Vm^{-1}. The dipole moment of HCl molecule is 3.46×10^{-30} cm.

16. The atomic weight and density of sulphur are 32 and 2.08×10^3 kg m^{-3} respectively. The electronic polarizability of the atom is 3.28×10^{-40} Fm^{+2}. If sulphur solid has cubic structure, calculate the dielectric constant.

PART – C

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

a) Is the energy of the electron in the n^{th} orbit in hydrogen atom is negative. Explain.
b) What is the direction of magnetic moment of an electron with respect to its orbital angular momentum ? Explain.
c) Are Raman scattering and Rayleigh scattering similar ? Explain.
d) Is quenching necessary in a GM-counter ? Explain.
e) Can a non-radioactive element be changed into a radioactive form ? Explain.
f) Can a photon be used as a projectile in a nuclear reaction ? Justify your answer.
g) Is silver the best "swimming pool" water purifier ?
h) Does the pitch of a chiral nematic liquid crystal get affected by temperature and pressure ?
