



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.
c) What is Bohr Magneton ? Mention its S.I. Unit. (2+4+2)
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)

P.T.O.



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 specific charge $\left(\frac{e}{m}\right)$ 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 ${}_{19}\text{K}^{40} = 39.96399 \text{ u}$ and Mass of ${}_{20}\text{Ca}^{40} = 39.96259 \text{ u}$.
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 = $1.67 \times 10^{-27} \text{ Kg}$
Charge of proton = $1.60 \times 10^{-19} \text{ C}$.
15. Calculate the radius of He atom if its electronic polarizability is $1.85 \times 10^{-41} \text{ Fm}^2$.
Given $\epsilon_0 = 8.85 \times 10^{-12} \text{ Fm}^{-1}$.
16. The dielectric constant of sulphur is 3.4. If a sample of sulphur contains 3.76×10^{28} sulphur atoms per m^3 , find the polarizability of sulphur atom. Given $\epsilon_0 = 8.85 \times 10^{-12} \text{ Fm}^{-1}$.

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.
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VI Semester B.Sc. Examination, May 2017
(Fresh + Repeaters)
(CBCS – Fresh – 2016 – 17 & Onwards/NS – Repeaters – 2013 – 14
& Onwards)

PHYSICS – VIII
Atmospheric Physics, Electronics and Computational Physics

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 “Relative humidity and Absolute humidity”.
b) What is hydrostatic balance ? Derive hydrostatic equation. (4+4)
2. a) Define :
i) Absorptivity and
ii) Emissivity of earth’s atmosphere.
b) Derive Beer’s law. (2+6)
3. a) What is green house effect ?
b) Derive an expression for pressure gradient force per unit mass in the atmosphere. (2+6)
4. a) What is an operational amplifier ? Mention any two characteristics of an ideal op-amp.
b) Derive an expression for voltage gain of a non-inverting amplifier using op-amp. (4+4)
5. a) What is feedback ? State Barkhausen’s conditions for sustained oscillations.
b) Describe the working of Wien bridge oscillator with a diagram using op-amp and write it’s frequency of oscillation. (3+5)

P.T.O.



6. a) Explain :
 i) NAND gate and
 ii) X OR gate, with their symbols and truth tables. (4+4)
 b) What is half subtracter ? Give it's logic circuit and truth table.
7. a) What is algorithm ?
 b) Define :
 i) Round-off error and
 ii) True error. (1+2+5)
 c) Write a C-program to solve linear equation $ax + b = c$.
8. a) Derive Newton backward difference formula using Taylor's series expansion.
 b) Write the algorithm to evaluate $I = \int_a^b f(x)dx$ using Simpson's $\frac{3}{8}$ rule. (3+5)

PART – B

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

9. The saturation vapour pressure at -20°C is 4.6 mb at a place with atmospheric pressure of 1500 mb. The vapour pressure was measured to be 1.2 mb. Calculate the relative humidity at that place.
10. A rocket of mass 5000 kg is fired vertically upwards from a place at the equator with a velocity of 1300 ms^{-1} . If the angular velocity of the earth is $7.3 \times 10^{-5} \text{ rad s}^{-1}$, calculate the Coriolis force acting on it.
11. Add the following numbers and verify the results by doing addition in decimal number system.
 $(1010)_2$, $(1011)_2$ and $(1111)_2$
12. Calculate the output voltage of a Summer circuit for the following values :
 $R_1 = 250 \text{ K}\Omega$, $R_2 = 500 \text{ K}\Omega$, $R_3 = 1\text{M}\Omega$, $R_f = 1\text{M}\Omega$, $V_1 = -3\text{V}$, $V_2 = 3\text{V}$ and $V_3 = 2\text{V}$
13. In an RC phase shift oscillator $R = 5000 \Omega$ and $C = 0.1 \mu\text{F}$. Calculate the frequency of oscillation.

$$\frac{3}{250000} + \frac{3}{500000} + \frac{2}{500000}$$

$$28000$$



14. Using Newton-Raphson method, find the real root of $f(x) = x^3 - x - 1$ correct to 9 decimal places.
15. Use the forward, central and backward difference formula to complete the last row of the table.

x	0.4	0.5	0.6
f(x)	0.393	0.612	0.851
f'(x)			

16. Using Euler's method, obtain the solution of $y' = x - y$ with $y(0) = 1$ at $x = 0 (0.2) 0.6$.

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks.

(5×2=10)

17. a) Is water vapour a green house gas ? Explain.
- b) Name the sources of radiation in the atmosphere.
- c) Why ICs are better compared to discrete circuit technology ?
- d) Name the types of ICs. ✓
- e) Is 8 an octal number ? Explain. ✓
- f) What type of feedback is preferred for amplifiers ? Explain. ✓
- g) Is convergence of the bisection method fast ? Explain.
- h) While applying Simpson's $\frac{1}{3}$ rule, how many intervals must be selected ? Explain.
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