Rekha V.V.I. Questions for 2022 Examination

Answer of below mentioned V.V.I. questions are present in your Rekha Guess Paper Part-III Physics-5

SHORT ANSWER TYPE QUESTIONS

1. What do you mean by holonomic and non-holonomic constraints ? Give example. **V. V. I.** 7
2. Discuss the generalised co-ordinates. **V. V. I.** 7
3. State and explain D' Alembert's principle. **V. V. I.** 8
4. Explain generalised momentum. 9
5. Show that generalised momentum conjugate to a cyclic co-ordinate is conserved. 11
6. What is Hamiltonian ? Give its physical significance. **V. V. I.** 12
7. Explain Inertial and Non-inertial frame of references. **V. V. I.** 13
8. State and explain Galelian invariance. 14
9. What is principle of virtual work ? Explain. 15
10. What is photoelectric emission effect ? What are the laws of photoelectric emission effect ? How did Einstein explain these laws ? 16
11. On the basis of uncertainty principle show that electrons can not exist inside the nucleus. **V. V. I.** 17
12. Explain the inadequacies of classical mechanics. 17
13. Give postulates of quantum mechanics. 18
14. What is zero point energy of a harmonic oscillator ? 19
15. Write about the different properties of wave function. 19
16. Mention the physical significance of the wave function ψ. 20
17. Explain and obtain expression for probability density. 22
18. Find the relation between Probability & Entropy.
    Or, Write a note on Entropy and Probability. 23
19. Give postulates of statistical mechanics. **V. V. I.**
    Or, What are the fundamental assumptions of statistical mechanics ? 25
20. Write down the probability theory of statistical thermodynamics.
    Or, Explain thermodynamical probability. **V. V. I.** 25
21. Discuss the law of equipartition of energy. 26
22. Obtain Stefan Boltzmann law of black body radiation. 28
23. Differentiate between FD, BE and classical statistics. **V. V. I.** 29

Group–A
Classical and Quantum Mechanics

1. Derive Lagrange's equation of motion for particle under the action of conservative forces. 30
2. Explain one application of Lagrange's equation. 35
3. Deduce conservation theorem for generalised momentum and linear momentum. 38
4. Derive Hamilton's equations of motion for a system of particles. Use it to obtain the equation of motion for a simple pendulum. **V. V. I.** 40
5. Explain Hamilton's principle and use it to deduce Hamilton's equation for a holonomic conservative system. **V. V. I.** 43
6. State three Kepler's law of planetary motion and obtain them theoretically.
   Or, What is central force ? State and deduce Kepler's law of planetary motion.
   Or, State and prove Kepler's law of planetary motion. How does the weight of a body change in the route from the earth to the moon ? 46
7. Explain coriolis and centrifugal forces. Mention their simple applications and obtain an explicit expression for each of them. **V. V. I.** 49
8. Explain Frank-Hertz experiment. Show how critical potentials are determined. 52
9. What do you understand by wave-particle duality ? Derive the de-Broglie relation and give its experimental verification. **V. V. I.** 54
10. What do you mean by group and phase velocities ? Establish relation between them. 59
11. State and prove Heisenberg's uncertainty principle and give one of its application. 61
12. Derive expression for wave function and energy for a particle in three dimensional box.
    Or, Give steady-state form of the Schrodinger's equation for a particle in a three-dimensional rigid box. Solve this equation to obtain the energy eigenvalues and eigenfunctions of the particle. 65

13. Deduce Schrodinger's time independent and time dependent equation for matter wave. Explain the physical significance of wave function (ψ). **V. V. I.** 67

14. Establish Schrodinger's equation for a linear harmonic oscillator and solve it to obtain eigen values and eigen functions. 72

15. Write down Schrodinger's equation for hydrogen atom and solve its radial part only. 76

16. The potential function for a particle moving along positive x-axis is represented as

$$V(x) = 0, \text{ for } x < 0$$
$$= V, \text{ for } x > 0$$

Calculate the transmittance and reflectance at the potential discontinuity.

Or, Explain the theory of potential step for a potential function which is discontinuous at a point on x-axis. 79

Group–B
Statistical Physics

1. What are the fundamental assumptions of statistical mechanics ? State and prove Boltzmann's theorem connecting entropy and probability. **V. V. I.** 87

2. Derive Maxwell-Boltzmann's law of distribution and discuss briefly its experimental verification. 88

3. What do you mean by partition function ? Express entropy and Helmholtz free energy in terms of partition function.

Or, Express entropy, total energy, Gibbs free energy, Helmholtz free energy, enthalpy, pressure, specific heat at constant volume in terms of partition function. 94

4. Define micro-canonical ensemble. Use it to obtain the entropy and internal energy of a perfect gas. **V. V. I.**

Or, Discuss entropy of a perfect gas using classical microcanonical ensemble. What is Sackur-Tetrode equation ? 98

5. What do you mean by Gibb's paradox in connection with the entropy of a perfect gas ? How was it resolved ?

Or, Write a note on Gibb's paradox. 102

6. Derive Rayleigh-Jeans law of radiation and point out its limitations. 104

7. State and prove Stefan-Boltzmann's law of black-body radiation. How can the law be experimentally verified ?
Or, On the basis of thermodynamic considerations explain Stefan- Boltzmann law of radiation. **V. V. I.** **108**

8. What is black body radiation ? Obtain Planck's radiation formula for black body radiation.
Or, Derive Planck's radiation formula using Bose-Einstein Statistics. Differentiate between Bose-Einstein and Fermi-Dirac Statistics. **111**

9. Give an account of Bose-Einstein distribution law and discuss its application to liquid helium II. **115**

10. Derive Fermi-Dirac distribution formula. Discuss one application for its distribution.
Or, Derive Fermi-Dirac distribution law (statistics) for indistinguishable particles. **V. V. I.** **119**

11. Show the essential requirements of Fermi-Dirac statistics. Considering a Fermi gas, deduce an expression for energy distribution function for the electron gas. **123**

12. Write short notes on the following :
(a) Partition Function **125**
(b) Differentiate various types of ensembles **125**
(c) Wien's Distribution Law **126**
(d) Fermi Energy **127**
(e) Planck's Quantum Postulates **127**
(f) Negative Temperatures **128**

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PHYSICS - 5 (Hons.) (2021)

1. Answer any four questions of the following.
   (a) Discuss the principle of virtual work. 15
   (b) Explain Fictitious or Pseudo force.
   (c) Define group and phase velocity. Obtain the relation between them. 59
   (d) Define Eigen values and Eigen functions.
   (e) Find the relation between entropy and probability. 23
   (f) Obtain Stefan- Boltzmann law of black body radiation. 28

GROUP – A

2. State and prove Heisenberg's uncertainty principle and give one of its application. 61
3. Establish Schrodinger's equation for a linear harmonic oscillator and solve it to obtain Eigen values and Eigen functions. 72
4. What are generalized co-ordinates ? Obtain Lagrange's equations of motion for a conservative system in a generalised co-ordinates.
5. State three Kepler's laws of planetary motion and obtain them theoretically. 46

GROUP – B

6. What is black body radiation? Obtain Planck's radiation formula for black body radiation. 111
7. What do you mean by partition function ? Express entropy and Helmholtz free energy in terms of partition function. 94
8. Derive Fermi Dirac distribution law and obtain the expression for the specific heat of a degenerate and electron gas. ..119,123
9. Deduce B-E- distribution law and give one of its application. 115

PHYSICS - 5 (Hons.) (2020)

Answer five questions, selecting at least two questions from each Group, in which Q. No. 1 is compulsory.

1. Answer any four questions of the following:
   (a) What do you mean by holonomic and non-holonomic constraints? 7
   (b) Explain Inertial and Non-Inertial frame of references. 13
   (c) State and explain D'Alembert's principle. 8
   (d) Write down the probability theorems of statistical thermodynamics. 25
   (e) What do you mean by wave particle duality ? 54
   (f) What is principle of virtual work? Explain. 15

Group–A

2. Deduce Schrodinger's time independent and time dependent equations for matter wave. Explain the physical significance of wave function? 67
3. Explain coriolis and centrifugal forces. Mention their simple applications and obtain an explicit expression for each of them. 49
4. Explain Hamilton's principle and use it to deduce Hamilton's equation for a holonomic conservative system. 43
5. What do you mean by Group and Phase velocities ? Establish relation between them. 59

Group- B

6. What are the fundamental assumptions of statistical mechanics? State and prove Boltzmann's theorem connecting entropy and probability. 87
7. Show the essential requirements of Fermi Dirac Statistics. Considering the free electron in a metal to form a Fermi gas, deduce an expression for energy distribution function for the electron gas. 123
8. Give an account of B. E. distribution law and discuss its application to liquid Helium II. 115
9. State and prove Stefan-Boltzmann law. Describe how the law can be verified experimentally. 108

PHYSICS - 5 (Hons.) (2019)

Answer five questions, selecting two questions from each Group, in which Q. No. 1 is compulsory.

1. Answer any four questions of the following
   (a) Discuss the generalised co-ordinates. 7
   (b) What is Hamiltonian? Give its physical significance. 12
   (c) Mention the physical significance of the wave function. 20
   (d) What are.the fundamental postulates of statistical mechanics? 25
   (e) On the basis of uncertainty principle show that electrons can not exist inside the nucleus. 17
   (f) Distinguish between BE, FD and classical statistics. 29

Group-A

2. What do you understand by wave-particle duality ? Derive the de-Broglie relation and give its experimental verification. 54
3. Derive Lagrange's equation of motion for particle under the action of conservative forces. 30

4. Deduce Mosley's law and show how it has been utilized in removing some of the defects of periodic table.
5. Write short notes on any two of the following :
   (a) Spin orbit interaction (b) Characteristic X-ray spectra
   (c) Zeeman effect (d) Lande's g-factor

Group - B

6. Define micro-canonical ensemble. Use it to obtain the entropy and internal energy of a perfect gas. 98
7. Discuss with suitable schematic diagrams, the construction and the working of a Ruby laser.
8. What is black body radiation? Obtain Planck's radiation formula for black body radiation. 111
9. Write notes on any two of the following:
   (a) Application of Raman Effect (b) Entropy and Probability
   (c) Stefan-Boltzmann Law (d) Gibb's Paradox

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Rekha V.V.I. Questions for 2022 Examination

Answer of below mentioned V.V.I. questions are present in your Rekha Guess Paper Part-III Physics-6

Short Questions with Answers

1. Give the basic properties of nucleus. 7
2. Explain the term packing fraction and binding energy of a nucleus. 8
3. Write a short note on Electric Quadrupole Moment. 8
4. What radiation do we get from radioactive substances ? Mention their nature and properties. **V. V. I.** 9
5. Define average life of radioactive nuclei. Derive relation between mean life and radioactive constant. 10
6. Discuss the Q-value of nuclear reaction. **V. V. I.** 11
7. Explain fission and fusion reaction. **V. V. I.** 12
8. Distinguish between cyclotron and synchrocyclotron. 13
9. What do you mean by primary and secondary cosmic rays ? **V. V. I.** 14
10. Distinguish between amorphous and crystalline solids. **V. V. I.** 14
11. What are miller indices ? How orientation of a plane is specified by miller indices ? **V. V. I.** 15
12. What is a reciprocal lattice ? Mention some of its important properties. 16
13. What do you mean by Brillouin zones ? **V. V. I.** 17
14. State and prove Bragg's law of X-ray diffraction. 18
15. Give an outline of the free electron theory of metals. 18
16. Distinguish between metals, insulators & semiconductors. **V. V. I.** 19
17. Distinguish between Dia, Para, Ferro and Ferri magnetic materials. 20
18. Discuss the B–H curve of steel and soft iron. **V. V. I.** 20

Group–A
Nuclear Physics and Cosmic Ray

1. Explain the term 'Mass defect' and 'Packing Fraction'. Obtain Weizsacker's semi empirical formula. **V. V. I.**
Or, State Weizsacker semi-empirical mass formula. Discuss the physical meaning of each term involved in this formula. 22

2. Describe the construction, theory and working of Aston's mass spectrograph. How it has been used to detect isotopes ? 25
3. What is radioactivity ? State the laws of radioactive disintegration and deduce them. Define half life and mean life in radioactivity. 28
4. Describe the range of α-particles. 31
5. Explain Geiger-Nuttall law. 34
6. Describe the Gamow's theory of α-decay. 36
7. Describe the construction, principle and working of an ionization chamber. Explain the difference between the ionization chamber and G.M. counter. 39
8. Describe a G.M. counter and explain its working. Draw a typical characteristic curve for a G.M. tube and discuss its shape. **V. V. I.** 40
9. Describe the principle, construction and working of a cloud chamber. Also explain its uses and limitations. 42
10. What is a nuclear reaction ? Define Q-value of nuclear reaction. Derive an expression for the Q-value of reaction in terms of kinetic energy of incident and product particles. **V. V. I.** 45
11. Describe the principle, construction and working of a cyclotron. Discuss its limitations. 46
12. What is a Betatron ? Describe the principle, construction and working of it. **V. V. I.**
Or, Explain the principle of working and the construction of a Betatron. Derive the condition for its operation. How is it achieved ? 50
13. What are primary and secondary cosmic rays ? Explain the latitude effect and East-West asymmetry in cosmic ray intensity. **V. V. I.** 54
14. What are cosmic ray showers ? Explain the cascade theory of origin of cosmic rays. **V. V. I.** 56
15. Write short notes on the following :
(a) Electric Quadrupole Moment 58
(b) Semi-empirical Mass Formula 59
(c) α-decay 60
(d) α-particle spectra 61
(e) Nuclear Fission 61
(f) Nuclear Cross Section 61

(g) Photographic Emulsions 62
(h) Theory of formation of Compound Nucleus 62
(i) Direct Nuclear Reaction 63
(j) Cosmic Rays 64
(k) Classification of Elementary Particles 64
(l) Conservation Laws 65

Group–B
Condensed Matter Physics

1. What are ionic crystals ? Derive an expression for lattice energy of ionic crystals from Born's theory. **V. V. I.** 67
2. What are Bravais Lattice or Crystal Lattice ? Explain all crystal lattice with suitable diagram.
Or, What is a Lattice ? Describe various types of lattices and mention their distinguishing features. 70
3. What is a Reciprocal Lattice ? Show that the bcc lattice is the reciprocal of the fcc lattice. **V. V. I.** 73
4. Give an account of different types of bonding in a crystal.
Or, Discuss ionic, metallic, covalent, hydrogen and vander waal bonding in brief. 76
5. Derive de-Broglie relation between particle moment p and wavelength λ of the de-Broglie waves. Also give the experimental verification of this relation. 78
6. Derive Laue's equation of diffraction of X-rays and obtain Bragg's diffraction condition from them.
Or, What is Bragg's law ? Deduce the Laue's equation of diffraction of X-rays by a crystal. Show how Bragg's law follows from that equation. 80
7. State and explain the terms electrical and thermal conductivities of metal and establish Wiedemann-Franz relation between them. **V. V. I.** 85
8. Define electrical conductivity. Develop Sommerfeld theory of electrical conductivity through metals. 86
9. Distinguish between intrinsic and extrinsic semiconductor. Derive expression for electron concentration in an intrinsic semiconductor. **V. V. I.** 91

10. State and prove Bloch theorem in reference to periodicity character of potential in a crystal.
Or, What is Bloch theorem ? Deduce Bloch theorem and discuss its results. 95

11. What is Hall Effect ? Obtain an expression for Hall co-efficient and its experimental determination.
Or, What is Hall Effect ? Derive different parameters associated with it. **V. V. I.** 96

12. Mention main features of ferromagnetic substances. Discuss the Weiss theory of ferromagnetism. **V. V. I.** 99

13. Explain the three magnetic vectors and establish a relation between them. 103

14. Write short notes on the following :
(a) Unit Cell 105
(b) Reciprocal Lattice 105
(c) Miller Indices 106
(d) Brillouin Zones 106
(e) Wiedemann-Franz Law 107
(f) Rigid Rotor 107
(g) Hermitian Operators 108
(h) Hall Effect 108
(i) Langevin's Theory of Paramagnetism
Or, Classical Theory of Paramagnetism 108
(j) Magnetic Hysteresis 109
(k) Energy Loss due to Hysteresis 110

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PHYSICS - 6 (Hons.) (2021)

1. Answer any four of the following questions :
   (a) Give the basic properties of the nucleus. 7
   (b) Distinguish between Para, Dia and Ferromagnetic materials. 20
   (c) Give the outline of free electron theory of metal. 18
   (d) What is reciprocal lattice? Mention some of its important properties. 16
   (e) Explain the term Packing Fraction and Binding energy of a nucleus. 8
   (f) Write short notes on Electric quadrupole moment. 8

GROUP – A

2. Describe the Gamow's theory of α-decay. 36
3. What is radioactivity? State the lame of radioactive disintegration and deduce them. Define half life and mean life in radioactivity. 28
4. Describe the construction, theory and working of Aston's mass Spectrograph. How it has been used to detect isotopes. 25
5. Describe the principle, construction and working of a cyclotron. Discuss its limitations. 46

GROUP – B

6. Derive Laue's equation of diffraction of X-rays and obtain Bragg's diffraction condition from them. 80
7. State and prove Bloch theorem in reference to periodicity character of potential in crystal. 95
8. Define electrical conductivity. Develop Sommerfield theory of electrical conductivity through metals. 86
9. Write notes on any two of the following :
   (a) Miller Indices. 116
   (b) Brillouin zones. 106
   (c) Magnetic Hysteresis. 109
   (d) Classical theory of paramagnetism. 108

PHYSICS - 6 (Hons.) (2020)

Answer five questions, selecting at least two questions from each Group, in which Q. No. 1 is compulsory.

1. Answer any four questions of the following:
   (a) What do you mean by Primary and Secondary Cosmic rays? 14
   (b) Explain Fission and Fusion reaction. 12
   (c) Distinguish between Metal, Insulator and Semiconductor. 19
   (d) Discuss the B-H curve of Steel and Soft Iron. 20
   (e) Distinguish between Amorphous and Crystalline Materials. 14
   (f) What do you mean by Brillouin Zones? 17

Group-A

2. State Weizsacker Semi-empirical mass formula. Discuss the physical meaning of each term involved in this formula. 22
3. What is a Betatron? Describe the principle, construction and working of it. 50
4. Describe a G. M. counter and explain its working. Draw a typical characteristic curve for a G. M. tube and discuss its shape. 40
5. What are cosmic ray showers? Explain the Cascade theory of origin of cosmic rays. 56

Group - B

6. State and explain the terms thermal and electrical conductivities of metal and establish Wiedmann - Franz relation between them. 85
7. What is Hall effect? Obtain an expression for Hall Co-efficient and its experimental determination. 96
8. What is a reciprocal lattice? Show that the bcc lattice is the reciprocal of the fcc lattice. 73
9. Mention main features of ferro-magnetic substances. Discuss the Weiss theory of Ferromagnetism. 99

PHYSICS - 6 (Hons.) (2019)

1. Answer any four of the following questions:
   (a) Discuss the Q-value of nuclear reaction. 11
   (b) Explain the term Packing Fraction and Binding Energy of nucleus. 8
   (c) What radiations do we get from radioactive substance ? Mention their nature and properties. 9
   (d) Distinguish between Para, Dia and Ferromagnetic materials. 20
   (e) Give the outlines of free electron theory of metal. 18
   (f) What are Miller Indices ? How orientation of a plane is specified by Miller Indices ? 15

Group-A

2. Describe the Gramow's theory of α-decay. 36
3. What is radioactivity ? State the laws of radioactive disintegration and deduce them. Define half life and mean life in radioactivity. 28
4. Describe the construction, principle and working of an ionization chamber. Explain the difference between the ionization chamber and G M. Counter. 39
5. Write short notes on any two of the following:
   (a) Semi-empirical mass formula 59
   (b) Nuclear fussion 12
   (c) Electric quadrupole moment 58
   (d) Cosmic rays 64

Group - B

6. Define electrical conductivity. Develop Sommerfield theory of electrical conductivity through metals. **86**
7. State and prove Bloch theorem in reference to periodicity character of potential in crystal. **95**
8. Derive de-Broglie relation between particle moment p and wavelength λ of the de-Broglie waves. Also give the experimental verification of this relation. **78**
9. Write short notes on any two of the following:
   (a) Hermitian operators **108**
   (b) Rigid rotator **107**
   (c) Reciprocal lattice **105**
   (d) Hall effect **108**

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Rekha V.V.I. Questions for 2022 Examination

Answer of below mentioned V.V.I. questions are present in your Rekha Guess Paper Part-III Physics-7

Short Questions with Answers

1. Distinguish the term Isotope and Isobar. **V. V. I.** 7
2. Give the outline of vector atom model. **V. V. I.** 7
3. Show that the ratio of orbital magnetic moment to angular momentum is $-e/2m$. 9
4. Explain the term Bohr Magneton and Gyromagnetic ratio. **Or,** Explain spin magnetic moment of an electron. **V. V. I.** 10
5. What is Zeeman effect ? Distinguish between normal and anomalous Zeeman effect. **V. V. I.** 11
6. What is Stark effect ? Show that Ist order Stark effect for hydrogen is zero. 11
7. How symmetric and anti-symmetric wave functions lead to Pauli's exclusion principle ? **V. V. I.** 12
8. Compare L-S and J-J coupling schemes. 13
9. State Bohr's postulates of hydrogen spectra. What are the shortcomings of Bohr's model ? **V. V. I.** 14
10. What are the selection rules for *j* for observing doublet spectra in single electron system ? 15
11. Discuss, in brief, the different types of molecular spectra. 15
12. Mention the different series of alkali spectra. **V. V. I.** 16
13. Determine the intermolecular distance (bond length) of CO molecule. 16
14. What is Raman effect ? Explain its importance. 17
15. Explain the characteristics of Raman lines. 18
16. Explain Stoke and Anti-Stoke's line. 18
17. Explain metastable state and its importance. 18
18. Discuss the spontaneous and stimulated emission. 19
19. Explain the phenomena of population inversion and optical pumping. **V. V. I.** 20
20. Mention some important application of Laser. **V. V. I.** 21

Group–A
Atomic Spectroscopy

1. Describe, with theory J. J. Thomson method for measuring the ratio of charge (e/m) of an electron. 22

2. What is meant by thermionic emission ? Derive Richardson-Dushman equation. **V. V. I.** 25
3. State and explain Larmor's Theorem.
Or, Explain the determination of spin magnetic moment. 27
4. Describe Stern-Gerlach Experiment. Show how it verifies the principle features of vector atom model. 28
5. What is Zeeman effect ? Give the theory of anomalous Zeeman effect.
Or, What is Zeeman effect ? Discuss briefly about its different types. 32
6. Outline the theory of Paschen-Back effect and discuss the Paschen-Back pattern of 2P–2S transition. 33
7. What is Paschen-Back Effect ? Give the theory of this effect and illustrate it by taking the example of energy level associated with D-transition sodium. **V. V. I.** 36
8. Deduce Pauli's Exclusion Principle and explain its physical significance. 39
9. What do you mean by L-S and J-J coupling ? Explain comparison between them. **V. V. I.** 41
10. Give an account of Bohr's theory of Hydrogen spectra and deduce the expression for energy of an electron. What are the shortcomings of this theory ? 43
11. Discuss Bohr's theory of hydrogen spectra. On what basis does the Sommerfeld theory of elliptical orbit differs from Bohr's theory of circular orbit ? **V. V. I.**
Or, Describe Bohr-Sommerfeld theory of hydrogen spectra. Discuss briefly the fine structure of H_α line in hydrogen spectrum. What are the shortcoming of this model ? 47
12. Describe the main features of alkali spectra. How are they explained ? **V. V. I.** 52
13. Write short notes on the following :
(a) Thermionic Emission 55
(b) Space Quantisation 56
(c) Electron spin and Angular Momentum
Or, Spin Angular Momentum 57
(d) Stern-Gerlach Experiment 57
(e) Bohr Magneton 58
(f) Spin Orbit Coupling 58
(g) L-S Coupling 59
(h) Hund's Rule 60

(i) Pure Rotational Spectra
Or, Infrared Spectra 60

Group–B
Molecular Spectroscopy and Laser

1. Obtain expression for the rotational energy levels of diatomic molecule, considering it as a rigid rotator. Discuss the relevant selection rule. **V. V. I.** 62
2. Give the theory of vibrational spectra of diatomic molecules and show that the energy levels are equi-spaced. **V. V. I.** 66
3. Outline the theory of rotational-vibrational spectra of diatomic molecules. Discuss the effect of presence of isotopes on the spectra. 68
4. Discuss the quantum theory of Raman effect. What light does it throw on the structure of molecules ? What are Stokes and Anti-Stokes line ?
Or, What is Raman effect ? How is Raman effect explained on the basis of quantum theory ? 70
5. What are Einstein coefficients ? How are they related with each other ?
Or, What are Einstein's A and B coefficients ? Establish relation between them. **V. V. I.** 72
6. What do you mean by Laser rate equation ? Using laser rate equation, deduce condition of population inversion in three laser system. **V. V. I.** 74
7. Discuss with suitable diagram the principle, construction and working of Ruby Laser. 77
8. What is the threshold condition of Ruby Laser ? Deduce an expression of flux density in Ruby Laser.
Or, Explain Pumping Power in Ruby Laser. 79
9. Describe a He-Ne gas laser. How is population inversion achieved in this type of laser ? Mention advantages of gas laser over a solid state laser. **V. V. I.** 82
10. Write short notes on the following :
(a) Selection Rules 84
(b) Population Inversion 84
(c) Three Level Laser System 85
(d) Four Level Laser System 86
(e) He-Ne Laser 87

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PHYSICS - 7 (Hons.) (2021)

1. Answer any four of the following questions.
   (a) What is stark effect? Show that 1st order stark effect for Hydrogen is zero. 11
   (b) Show that ratio of orbital magnetic moment to angular momentum is –e/2m 9
   (c) What are the selection rules for j for observing doublet spectra in single electron system ? 15
   (d) compare L-S and J-J coupling schemes. 13
   (e) Discuss spontaneous emission and stimulated emission. 19
   (f) Explain Metastable states. 18

GROUP – A

2. What is Zeeman effect ? Give the theory of anomalous Zeeman effect. 32
3. Describe with theory J.J. Thomson's method of measuring the ratio of charge to mass (e/m) of electron. 22
4. Describe Stern-Garlach experiment. Show how it verifies the principle features of vector atom model. 28
5. Give an account of Bohr's theory of Hydrogen spectra and deduce the expression for energy of an electron. What is the significance of energy of an electron ? 43

GROUP – B

6. Discuss the quantum theory of Raman effect. What light does it throw on the structure of molecule ? What are stokes and anti stokes line ? 70
7. What is the threshold condition of Ruby laser ? Deduce an expression of flux density in Ruby laser. 79
8. Discuss the rotational - vibrational spectra of a diatomic molecules. Discuss the effect of presence of isotopes on the spectra. 68
9. Write notes on any two of the following : 84
   (a) Optical pumping
   (b) Three-level laser system.
   (c) Selection rules.
   (d) Pure rotational spectra.

PHYSICS - 7 (Hons.) (2020)

Answer five questions, selecting at least two questions from each Group, in which Q. No. 1 is compulsory.

1. Answer any four of the following questions :
   (a) Explain Bohr magneton and Gyromagnetic ratio. 10

(b) Distinguish between Normal and Anomalous Zeeman effect. 11
(c) Explain how symmetric and antisymmetric wave functions lead to Pauli's exclusion principle. 12
(d) Explain the phenomenon of population inversion and optical pumping. 20
(e) Mention some important application of Laser. 21
(f) Distinguish the terms Isotope and Isobar. 7

Group – A

2. What is meant by thermionic emission? Derive Richardson Dushman equation and give its experimental support. 25
3. Describe the main features of alkali spectra. How they are explained? 52
4. What is Paschen Back effect? Give the theory of this effect and illustrate it taking the example of energy level associated with D-transition Sodium. 36
5. What do you mean by L. S. and J. J coupling? Explain comparison between them. 41

Group – B

6. Obtain expression for the rotational energy levels of diatomic molecule considering it as a rigid rotator. 62
7. Give the theory of vibrational spectra of diatomic molecule and show that the energy levels are equispaced. 66
8. What are Einstein's A and B Co-efficients? Establish relation between them. 72
9. Describe a He–Ne gas laser. How is population inversion acheived in this type of laser? Mention advantages of gas laser over a solid state laser. 82

PHYSICS - 7 (Hons.) (2019)

1. Answer any four of the following questions:
(a) Discuss, in brief, the different types of molecular spectra. 15
(b) State Bohr's postulates of Hydrogen spectra.What are the shortcomings of Bohr's model? 14
(c) Give the outlines of vector atom model. 7
(d) Discuss spontaneous emission and stimulated emission. 19
(e) Explain Stoke and Anti-Stoke's line. 18
(f) Mention the different series of alkali spectra. 16

Group-A

2. Describe, with theory J. J. Thomson's method of measuring the ratio of charge to mass (e/m) of electron. 22
3. Deduce Pauli exclusion principle and explain its physical significance. 39

4. Describe Stem-Gerlach experiment. Show how it verifies the principal features of vector atom model. 28
5. Write notes on any two of the following:
(a) Normal and anomalous Zeeman effect
(b) Bohr magneton 58
(c) Thermionic emission 55
(d) Spin-orbit coupling 58

Group - B

6. Outline the theory of rotation-vibration spectra of diatomic molecules. What will be the effect of the presence of isotopes on the spectra ? 68
7. What is Raman effect ? How is Raman effect explained on the basis of quantum theory? 70
8. What is the threshold condition of Ruby laser ? Deduce an expression of flux density in Ruby laser. 79
9 Write notes on any two of the following :
(a) Selection rules 84
(b) Infra red spectra
(c) Population inversion 87
(d) He-Ne laser 84

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