ஸ்ரீ-ல-ஸ்ரீ காசிவாசி சுவாமிநாத சுவாமிகள் கலைக் கல்லூரி

திருப்பனந்தாள் – 612504

S.K.S.S ARTS COLLEGE, THIRUPPANANDAL - 612504

QUESTION BANK

Title of the Paper

ATOMIC AND MOLECULAR PHYSICS

Course: III B.sc Physics

Prepared by

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CORE COURSE VI
ATOMIC AND MOLECULAR PHYSICS

Objective:
The purpose is to understand the outgrowth of the structure ,extra nuclear part of the atom and origin of the spectra.

UNIT I Cathode and Positive Ray - Analysis
Production and Properties of Cathode rays - Electronic charge - Millikan's oil- drop method - Production and properties of positive rays - Thomson's parabola method - Aston's, Dempster's and Bainbridge's mass - spectrographs (e/m) – Mass defect and Packing Fraction.

UNIT II Atom model
Bohr atom model – Critical Potentials - Experimental determination of critical potentials - Franck and Hertz's experiment -Sommerfield's Relativistic atom model - Vector atom model - Quantum numbers associated with vector atom model - Pauli's exclusion principle – Electronic configuration of elements and periodic table - Magnetic dipole moment due to orbital motion and spin of the electron - The Stern and Gerlach experiment - Zeeman effect - Experimental arrangement for the normal Zeeman effect - Larmor's theorem - Quantum mechanical explanation of the normal Zeeman effect - Anomalous Zeeman effect- Paschen Back Effect – Stark effect.

UNIT III X-Rays
X-rays - production - detection and properties -Bragg's law - Bragg's X-ray spectrometer - Laue's experiment - The Powder crystal method –Rotating crystal method -X-ray spectra - Characteristics of X-ray spectrum - Moseley's law - Compton effect - Determination of wavelength – Symmetry operations and elements of Symmetry.

UNIT IV Photoelectric Effect and Free Electron theory of metals
Free electron theory of metals - Properties of metals - Drude and Lorentz theory - Electrical and thermal conductivities - Wiedemann and Franz law. Photoelectric effect - Lenard's experiment - Richardson and Compton experiment - Experimental investigations on the photoelectric effect – Laws of photoelectric emission - Einstein's photoelectric equation – Experimental verification - Millikan's experiment - Photoelectric cells - Photoemissive cell - Photovoltaic cell - Photoconductive cell - Applications of Photoelectric cells.
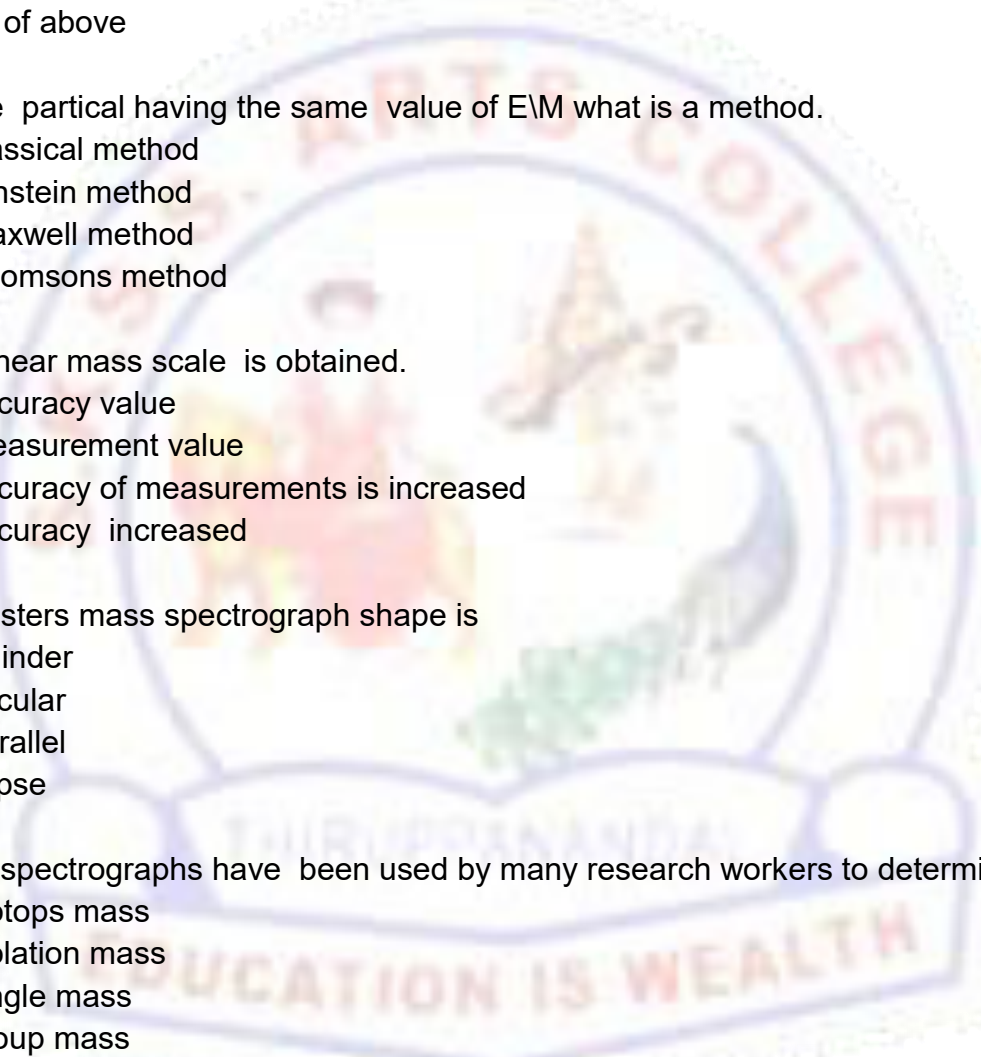
UNIT V Molecular Physics
Induced absorption - Spontaneous emission - Stimulated emission – Ruby laser - He laser - Semiconductor laser - Properties of laser beam – Applications of LASER in Medicine and Industry - Theory of the pure rotational spectrum of a molecule - Theory of the origin of the vibration - rotation spectrum of a molecule - Electronic spectra of molecules - Molecular orbital theory of Hydrogen molecule ion - Heitler-London theory of Hydrogen molecule - Theory of ESR .

ATOMIC AND MOLECULAR PHYSICS

UNIT - I
Choose the correct answer

1. Thomson determine the charge to mass ratio of
   a. positive ions
   b. Negative ions
   c. Positive or negative ions
   d. all of above

2. All the partical having the same value of E\M what is a method.
   a. classical method
   b. Einstein method
   c. Maxwell method
   d. Thomsons method

3. The linear mass scale is obtained.
   a. accuracy value
   b. measurement value
   c. accuracy of measurements is increased
   d. accuracy increased

4. Dempsters mass spectrograph shape is
   a. cylinder
   b. circular
   c. parallel
   d. elipse

5. Mass spectrographs have been used by many research workers to determine the.
   a. isotops mass
   b. isolation mass
   c. single mass
   d. group mass

6. What is the mass defect formula
   a. $\Delta = M-A$
   b. $\Delta = A-M$
   c. $\Delta = m-a$

7. What is the packing fraction formula
   a. M-A\A
   b. A-M\A
   c. A\A-M
   d. M\A-M

8. What is a binding energy
   a. $E=(\Delta m)c^2$
   b. $\Delta E=(\Delta m)c^2$
   c. $E=mc^2$

9. The cathode in a discharge tube is perforated is
   a. luminous rays
   b. positive rays
   c. canal rays

10. What is the cathode rays
    a. fast moving electrons
    b. slow moving electron
    c. group of electron

Answers :
1. a   2. d   3. c   4. a   5. a   6. a   7. a   8. b   9. a   10. a

Short Questions (2 Marks)
11. what are cathode rays?
12. What is positive rays?
13. Two properties of positive rays?
14. What is a parabola method?
15. Astons mass spectrograph advantages?
16. Write the detection of isotops?
17. What is bainbridges mass spectrograph?
18. Uses of mass spectrographs?
19. What is mass defect?
20. Write the packing fraction?

Paragraph Questions (5 Marks)
21. What are positive rays? Give their properties?
22. Describe in detail about thomsons parabola method?
23. Production and properties of cathode rays?
24. Explain the electron charge?
25. Write the production and properties of positive rays?
26. Explain the Astons mass spectrograph?

27. Explain the dempsters mass spectrograph?
28. Bain bridges mass spectrographs e\m method?
29. Write short notes on millikans oil drop method?
30. Write the mass defect and packing fraction?

Essay Questions (10 Marks)

31. Explain in detailabout millikans oil drop method?
32. Explain the production of cathode rays?
33. Explain the electron charge?
34. Explain thomsons parabola method?
35. Explain:
       a.cathod rays properties
       b.positive rays properties
36. Explain the production of positive rays?
37. Explain Astons mass spectrograph?
38. Explain dempsters mass spectrograph?
39. Explain bain bridges mass spectrograph?
40. Write mass defect and packing fraction?

UNIT- II
Choose the correct answer

1. To distinguish two kinds of critical potential?
    a. Frank potential
    b. Hertzs potential
    c. Excitation&ionization potential

2. Experimental determination of critical potentials?
    a. Frank&hertzs method
    b. Maxwell method
    c. Bohr method

3. What is called the angular (or)azimuthal quantum number
    a. nr
    b. nφ
    c. nϴ

4. Arnold sommerfeld birth of year
    a. 1870
    b. 1860
    c. 1868

5. The concept of spinning electron was introduced by
    a. uhlenbeck and goudsmit
    b. maxwell
    c. bhor

6. The principal of quantum number identical
    a. l
    b. s
    c. n

7. The magnetic total angular momentum quantum number identical
    a. mj
    b. ms
    c. ml

8. No two electrons in an isolated atom may have the same four quantum numbers is
    a. pauli exclusion principle
    b. stern and gerlach
    c. bhor principle

9. Larmors theorem statement formula
    a. $w=e\backslash 2m$
    b. $w=Be\backslash 2m$
    c. $w=2m\backslash B$

10. The original angular momentum formula
    a. $L=mr^2w0$
    b. $L=mrwo$
    c. $L=mr^2$

Answers :
1. c   2. a   3. b   4. c   5. a   6. c   7. a   8. a   9. b   10. A

Short Questions (2 Marks)
11. What is j-j coupling?
12. Write paulis exclusion principle?
13. What is meant by critical potential?
14. What is magnetic dipole moment?

15. What is magnetic orbital motion?
16. Write Zeeman effect?
17. State larmors theorem?
18. Write vector atom model?
19. What is anomalous Zeeman effect?
20. What is paschen back effect?

Paragraph Questions (5 Marks)

21. Write an essay on various quantum number?
22. Explain L-S coupling?
23. Write an vector atom model?
24. Experimental arrangement of critical potential?
25. Explain stern and gerlach experiment?
26. Explain Zeeman effect?
27. Write an essay on larmors theorem?
28. Explain quantum mechanical explanation of the normal Zeeman effect?
29. Explain paschen back effect?
30. Explain in detail about stark effect?

Essay Questions (10 Marks)

31. Explain bhor magnet ion stern and gerlach experiment setup in detail?
32. Explain in detail about bhor atom model?
33. Explain about frank and hertzs experiment?
34. Explain sommerfields relativistic atom model?
35. Explain electronic configuration of elements and periodic table?
36. Magnetic dipole moment due to orbital motion and spin of the electron?
37. Explain zeemaneffect?
38. Explain in detail about larmors theorem?
39. Brifly explain quantum mechanical explanation of the normal Zeeman effect?
40. Explain the stark effect?

UNIT- III
CHOOSE THE CORRECT ANSWER

1. X-rays were discovered by
   a. moseiey
   b. roentgen
   c. braggs

2. X-rays are electromagnetic waves of short wavelengths in the range of
   a. 15 Å to 5Å
   b. 10Å to 5Å
   c. 10 Å to 0.5Å

3. The longer wavelength end of the spectrum is known as the
   a. hard x-rays
   b. soft x-rays
   c. hard&soft x-rays

4. The minimum wavelength produced by an x-rays tube formula
   a. λ min=hc\ev
   b. λ min=h\ev
   c. λ min=h\e

5. The braggs law formula
   a. 2dcos Θ=nλ
   b. 2dsinΘ =nλ
   c. dsinΘ =nλ

6. The superimpose lines on the continuous back grount constitute the
   a. characteristics radiation
   b. continuous spectrum
   c. characteristics spectrum

7. The laues and braggs techniques for the investigation of crystal
   a. size
   b. structures
   c. colour

8. The moseleys law formula may be written as
   a. $\sqrt{v}$ =a(Z-b)
   b. $\sqrt{v}$ =b(Z-a)
   c. $\sqrt{v}$ =Z(b-a)

9. The regular repetition of atomic ionic (or) molecular units in three dimensions is called the
   a. structures
   b. size
   c. lattice

10. A single crystal is ratated about a fixed axis usually
    a. vertical
    b. horizondal
    c. parallel

Answers :
1. b   2. c   3. b   4. a   5. b   6. c   7. b   8. a   9. c   10. a

Short Answers (2 Marks)

11. What is a x-rays?
12. Given an account of the production of x-rays?
13. The properties of x-rays?
14. What is Bragg's law?
15. What is Moseley's law?
16. What is a Compton effect?
17. Characteristics of x-rays spectrum ?
18. What is a x-ray spectra?
19. What is a power crystal methods?
20. What is symmetry operations?

Paragraph Questions (5 Marks)

]21. Given an account of the production of x-rays?
22. Describe the Laue's experiment?
23. Given the theory of Compton effect ?
24. Describe the moseley's work on x-rays?
25. Explain x-rays spectrometer may be used to stydying crystal structure?
26. Explain the power crystal method?
27. Explain bragg's x-rays spectrometer?
28. Describe the bragg's law and their properties?
29. Describe rotating crystal method?
30. Write the notes on determination of wavelength?

Essay Questions (10 Marks)

31. Describe laue's experiments and point outits significance?
32. Derive bragg's law for x-ray diffraction in crystals.how is it verified?
33. Describe the powder crystal method of studying crystal structure?
34. Describe moseley's work on x-ray .what is Moseley's law ?
35. Given the theory of Compton effect and experimental verification?

36. The production of x-rays write a short notes?
37. Explain characteristics of x-ray spectrum?
38. Describe the rotating crystal method?
39. Explain the notes on x-rays spectra?
40. Explain symmetry operations and elements of symmetry?

UNIT - IV
CHOOSE THE CORRECT ANSWER

1. Emission of electrons from a metal plate, when illuminated by light of suitable wavelength is called.
   a. photoelectric effect
   b. compton effect
   c. einstein's effect

2. The electrons emitted are known as the photoelectrons in the case of
   a. solid metals
   b. alkali metals
   c. liquid metals

3. e\m is calculated formula is
   a. $4e\backslash m = 2v\backslash B^2 R^2$
   b. $e\backslash m = 2\backslash B^2 R^2$
   c. $e\backslash m = 2v\backslash B\ R$

4. This minimum frequency which can cause photoelectric emission is called
   a. breakdown frequency
   b. threshold frequency
   c. avalanche frequency

5. Photoelectric emission is an instantaneous process time lag is
   a. 5×10^{-10} sec
   b. 2×10^{-19} sec
   c. 3×10^{-9} sec

6. The photoelectron from sodium by exposure to violet light of wave length is
   a. 4000Å
   b. 6000Å
   c. 3000Å

7. Thus the energy of a single photon of frequency v is
   a. E=hv
   b. e=h
   c. e=hve

8. What is einstein's photoelectric equation is
   a. hv=hv0
   b. hv=ø+1\2
   c. hv=ø+1\2mv^2

9. Robert Andrews millikan born in year
   a. 1953
   b. 1963
   c. 1868

10. The first direct photoelectric determination of plank's constant h is
   a. 1912-1915
   b. 1913-1914
   c. 1916-1915

Answers :
1. a   2. b   3. a   4. b   5. c   6. a   7. a   8. c   9. c   10. a

Short Answers (2 Marks)
11. What is free electron theory?
12. Properties of metals?
13. What is thermal conductivities?
14. What is electrical conductivities?
15. What is photoelectric effect?
16. state the frank law?
17. Define law of photoelectric emission?
18. What is photoelectric cells?
19. What is photoelectric equation?
20. What is photovoltaic cell?

Paragraph Question (5 Marks)
21. Describe the drude and lorantz theory?
22. Explain the widemann and frank law?
23. Explain properties of metals?
24. Explain the electrical and thermal conductivities?
25. Describe the details above free electron theory of metals?
26. Explain the the lenard's experiment and their details?
27. Write the experimental investegations on thephotoelectric effect?

28. Explain experimental verification of millikan method?
29. Explain applications of photoelectric cells?
30. Describe the einstein's photoelectric equation?

Essay Question (10 Marks)

31. Explain different type of photo electric cells and explain their action?
32. Describe the wiedemann and franz law?
33. Explain the free electron theory of metals?
34. Describe the free electron theory of metals?
35. Explain the lenard's experiment method?
36. Explain details above drude and Lorentz theory?
37. Explain Richardson and Compton experiment?
38. Experimental investigations on the photoelectric effect?
39. Experimental verification of millkan's experiments?
40. Application of photoelectric cells?

UNIT- V
CHOOSE THE CORRECT ANSWER

1. Three kinds of transition involving electromagnetic radiation are possible between two energy lerels is
   a. E2andE3
   b. E1andE2
   c. E1andE3

2. Induced absorption process is
   a. upper
   b. lower
   c. same

3. The Einstein coefficient for stimulated emission identified is
   a. B21
   b. B20
   c. A21

4. Holography is a method of producing optical image is
   a. three dimensional
   b. two dimensional
   c. one dimensional

5. The selection rule for rotational transitions is
    a. $\Delta J = \pm 1$
    b. $\Delta j = \pm 0$
    c. $\Delta J = \pm 1,2$

6. The selection rule for transitions detween vibrational state
    a. $\Delta v = \pm 0$
    b. $\Delta v = \pm 1$
    c. $\Delta v = \pm 2$

7. The magnitude of electron nuclear coupling depent on the electron dencity at the nuclear
    a. A=rp
    b. A=Rp
    c. A=rb

8. Which of the following is not a trace element in the human body
    a. iodine
    b. zinc
    c. fluorine

9. Which of the following atomic number would describe the element that is least reactive
    a. 1
    b. 2
    c. 18

10. An atom of argon three electron shells all of which are full its atomic mass is 40 how many neutron
    a. 8
    b. 20
    c. 16

Answers:
1. b   2. a   3. a   4. a   5. a   6. c   7. b   8. c   9. a   10. a

Short Questions (2 Marks)
11. What is induced absorption?
12. What is a spontaneous emission?
13. What is stimulated emission
14. What is semiconductor laser?
15. Write the properties of laser beam?
16. Application of laser inmedicion?

17. Application of laser in industry?
18. What is principle of laser?
19. What is a holography?
20. Introduction of molecular spectra?

Paragraph Questions (5 Marks)

21. Describe the He laser and their application?
22. Describe the ruby laser and applications?
23. Explain the brifly notes on semiconductor laser?
24. Theory of the pure rotational spectrum of a molecule?
25. Application of laser in medicine and industry?
26. Explain theory of the origin of the vibration?
27. Explain rotation spectrum of a molecules?
28. Describe the electronic spectra of molecule?
29. Describe the molecular orbital theory?
30. Explain theory of ESR?

Essay Questions (10 Marks)

31. Describe the principle ,construction and working of a ruby laser?
32. Describe the working of the helium –neon gas laser?
33. Describe the general features of molecular spectra?
34. Give the elementary theory of the origin of pure rotation spectrum molecule?
35. Explain the laser application?
36. Give an elementary theory of the origin of the vibration-rotation spectrum of a molecule?
37. Describe the electronic spectra of molecule?
38. Explain molecular orbital theory of hydrogen molecule ion?
39. Explain the heitler-london theoryof hydrogen molecule?
40. Explain the theory of ESR and absorption fine structure of ESR?