



ஸ்ரீ-ல-ஸ்ரீ காசிவாசி சுவாமிநாத சுவாமிகள் கலைக் கல்லூரி
தீருப்பன்தாள் - 612504

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



QUESTION BANK

Title of the Paper

Analytical Chemistry

Course: III B.Sc. (Chemistry)

Prepared by

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ANALYTICAL CHEMISTRY**OBJECTIVES**

1. To know the storage and handling of various chemicals and first aid procedures.
2. To learn data analysis, various separation techniques.
3. To learn gravimetric analysis and various thermo analytical methods.
4. To learn visible spectrophotometry and colorimetry.
5. To know the various electroanalytical techniques.

UNIT I**LABORATORY HYGIENE AND SAFETY**

- 1.1. Storage and handling of chemicals-corrosion, flammable, explosive, toxic, carcinogenic and poisonous chemicals.
- 1.2. Simple first aid procedures for accidents involving acids, alkalis, bromine, burns and cut by glass.
- 1.3. Precautions to avoid poisoning-treatment for specific poisons, threshold vapour concentrations-safe limits-laboratory safety measures.
- 1.4. Waste disposal-fume disposal-precautions for avoiding accidents.

UNIT II**DATA ANALYSIS**

- 2.1. The Mean-significant numbers, the median-precision, accuracy- confidence limits, standard deviation.
- 2.2. Errors-method for improving accuracy-rejection of data-presentation of tabulated data- Scatter diagram –method of least squares- S.I.units.
- 2.3. Separation techniques: Precipitation-solvent extraction-chromatography – types, column chromatography-thin layer chromatography.
- 2.4. Paper chromatography – paper electrophoresis – Ion exchange chromatography – Gas liquid chromatography.

UNIT III**GRAVIMETRIC ANALYSIS AND THERMOANALYTICAL METHODS**

- 3.1. Gravimetric analysis - principles-methods of gravimetric analysis - requirement of gravimetric analysis-precipitation-theories of precipitation.
- 3.2. Types of precipitation – co-precipitation, post precipitation – and precipitation from homogeneous solution-digestion, filtration and washing, drying and ignition. Inorganic and organic precipitating agents.
- 3.2. Thermo analytical techniques – types-TGA principle-Instrumentation – TGA analysis of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$.

3.3. Differential thermal analysis-principle-DTA of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$.-factors affecting TGA &DTA



UNIT IV VISIBLE SPECTROPHOTOMETRY AND COLORIMETRY

- 4.1. Theory of spectrophotometry and colorimetry, Beer-Lambert's law (statement only), Molar absorptivity and absorbance.
- 4.2. Visual comparators-multiple standard methods, duplication and dilution method, balance method, photoelectric colorimeter, spectrophotometer.
- 4.3. Criteria for satisfactory colorimetric estimation-advantages of colorimetric estimation, determination of composition of complexes, colorimetric estimation of iron.

UNIT V ELECTROANALYTICAL TECHNIQUES

- 5.1. Electro gravimetry –theory - electro gravimetric analysis of Fe and Cu.
- 5.2. Electrolytic separation of metals: principle –separation of copper and nickel, Electro deposition- principle–overvoltage.
- 5.3. Coulometry -Principle of coulometric analysis –coulometry at controlled potential- apparatus and technique-separation of nickel and cobalt. Amperometry titrations-principle – Instruments–types-applications.

REFERENCES


1. Gopalan R, Subramanian PS and Rengarajan K (1993) ``Elements of analytical chemistry'' second revised edition, Sultan Chand.
2. Gurdeep R Chatwal, Sham K. Anand (2005) ``Instrumental methods of chemical analysis'', Himalaya publishing house.
3. Vogel A.I. Text Book of Quantitative Inorganic analysis, The English Language Book Society, Fourth edition.
4. Douglas A. Skoog, Donald M. West and F. J. Holler, Fundamentals of Analytical chemistry, 7th edition, Harcourt College Publishers.
5. Mendham J., Denny R. C., Barnes J.D., Thomas M., Vogel's Test book of Quantitative Chemical analysis 6th edition, Pearson education.
6. Sharma, B. K., Instrumental methods of chemical analysis, Goel Publishing House, Merrut (1997).

EDUCATION IS WEALTH

Analytical Chemistry

Unit – I

Choose the correct answer:

- 1) Flammable materials like alcohol, should never be
 - a) an open door
 - b) an open flame
 - c) another student
 - d) as ink
 - 2) If an acid is splashed on your skin, wash at once with
 - a) soap
 - b) oils
 - c) weak base
 - d) plenty of water
 - 3) you are heating a piece of glass and now want to pick it up, you should
 - a) use a rag or paper towels
 - b) pick up the end that looks cooler
 - c) use tongs
 - d) pour cold water on it
 - 4) You have been injured in the laboratory (cut, burn etc.) first you should
 - a) visit the school nurse after class
 - b) see a doctor afterschool
 - c) tell the science instructor at once
 - d) apply first aid yourself
 - 5) When you finish working with chemicals, biological specimens, and other lab substances, always
 - a) treat your hands with skin lotion
 - b) wash your hands thoroughly with soap and water
 - c) wipe your hands on a towel
 - d) wipe your hands on your clothes
 - 6) The chemical which cause _____ are called carcinogen
 - a) Kidney problem
 - b) vomiting
 - c) cancer
 - d) skin problem
- 

- 7) If bromine falls on the skin _____
- wash
 - bromine water
 - alcohol
 - HCl
- 8) If the poison enters the mouth is washed _____
- ethanol
 - water
 - HCl
 - Sulphuric acid
- 9) A poisonous chemicals absorbed by a living organism causes _____
- death
 - skin problem
 - liver problem
 - kidney problem
- 10) You are heating a substance in a test tube. Always point the open end of the tube
- toward yourself
 - toward you lab partner
 - toward another classmate
 - away from all people

Answer:

- 1) b 2) d 3) c 4) c 5) b 6) c 7) a 8) d 9) a 10) d

Short Question (2 Marks)

- How will you handle the carcinogenic chemicals?
- What is the first aid procedure for burns in the eyes?
- Give two examples corrosive chemicals.
- Name any two toxic chemicals.
- How are explosive chemicals stored?
- How are flammable chemicals stored?
- Mention an example for a flammable chemical.
- Name two poisonous inorganic chemicals used in laboratory.
- How will you handle flammable chemicals?
- How will you handle poisonous chemicals?

Paragraph Question (5 Marks)

- 21) Explain the methods used of the storage and handling of corrosive reagents.
- 22) How is whether handled before proceeding with experiment?
- 23) Elaborate the first aid procedure for the accidents involving cut by glass and burns.
- 24) What is the procedure to be followed when a volatile, inflammable liquids is spilled on the floor?
- 25) Give a brief account on the usage and storage of inflammable.
- 26) Name mention an examples for an explosive chemicals.
- 27) Name five poisonous inorganic chemicals used in the laboratory.
- 28) Discuss the storage and handling of explosive chemicals.
- 29) List the precautions that you will take while handling toxic substances.
- 30) Write short notes on storage of poisonous chemicals.

Essay Question (10 Marks)

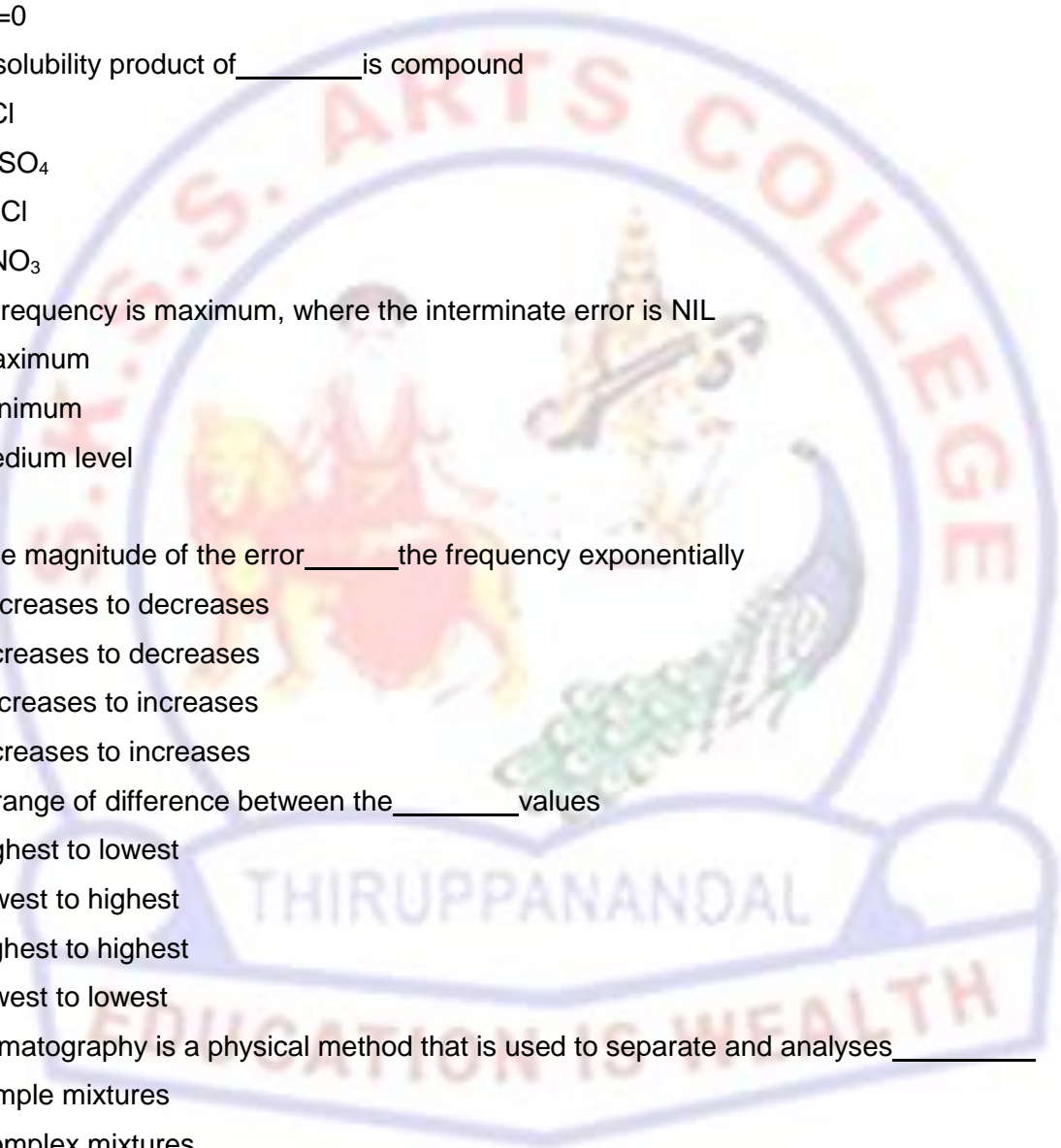
- 31) Give a detailed account on general precautions for avoiding accidents in laboratory.
- 32) What are carcinogenic chemicals? Give an example.
- 33) Describe the storage and handling of carcinogenic chemicals.
- 34) Name five poisonous inorganic chemicals used in the laboratory.
- 35) Write short notes on storage of poisonous chemicals.
- 36) Bring out the differences between poisonous chemicals and toxic chemicals.
- 37) Write any five rules to be followed in the storage of chemicals.
- 38) Explain the methods used of the storage and handling of corrosive reagents.
- 39) How will you handle explosive chemicals in laboratory?
- 40) Extreme care is exercised while opening bottles contain ammonia or ether –why?

THIRUPPANANDAL

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Unit – II

Choose the correct answer:

- 1) A deviation of the absolute error(E)_____
 - a) $E = x$
 - b) $E = x_i - x_t$
 - c) x
 - d) $E = 0$
 - 2) The solubility product of _____ is compound
 - a) HCl
 - b) H_2SO_4
 - c) AgCl
 - d) HNO_3
 - 3) The frequency is maximum, where the interminate error is NIL
 - a) maximum
 - b) minimum
 - c) medium level
 - d) 0
 - 4) As the magnitude of the error _____ the frequency exponentially
 - a) decreases to decreases
 - b) increases to decreases
 - c) decreases to increases
 - d) increases to increases
 - 5) The range of difference between the _____ values
 - a) highest to lowest
 - b) lowest to highest
 - c) highest to highest
 - d) lowest to lowest
 - 6) Chromatography is a physical method that is used to separate and analyses _____
 - a) Simple mixtures
 - b) Complex mixtures
 - c) Viscous mixtures
 - d) Metals
- 

- 7) In which type of chromatography, the stationary phase held in a narrow tube and the mobile phase is forced through it under pressure?
- Column chromatography
 - Paper chromatography
 - Liquid chromatography
 - Gas chromatography
- 8) In chromatography, which of the following can the mobile phase be made of?
- Solid or liquid
 - Liquid or gas
 - Gas only
 - Liquid only
- 9) Which of the following cannot be used as adsorbent in Column adsorption chromatography?
- Magnesium oxide
 - Silica gel
 - Activated alumina
 - Potassium permanganate
- 10) Gas chromatography can be performed in which of the following ways?
- Only in columns
 - Only on plane surfaces
 - Either in columns or on plane surfaces
 - Neither in columns nor on plane surfaces

Answer:

- 1) b 2) c 3) a 4) a 5) a 6) b 7) c 8) b 9) d 10) c

Short Question (2 Marks)

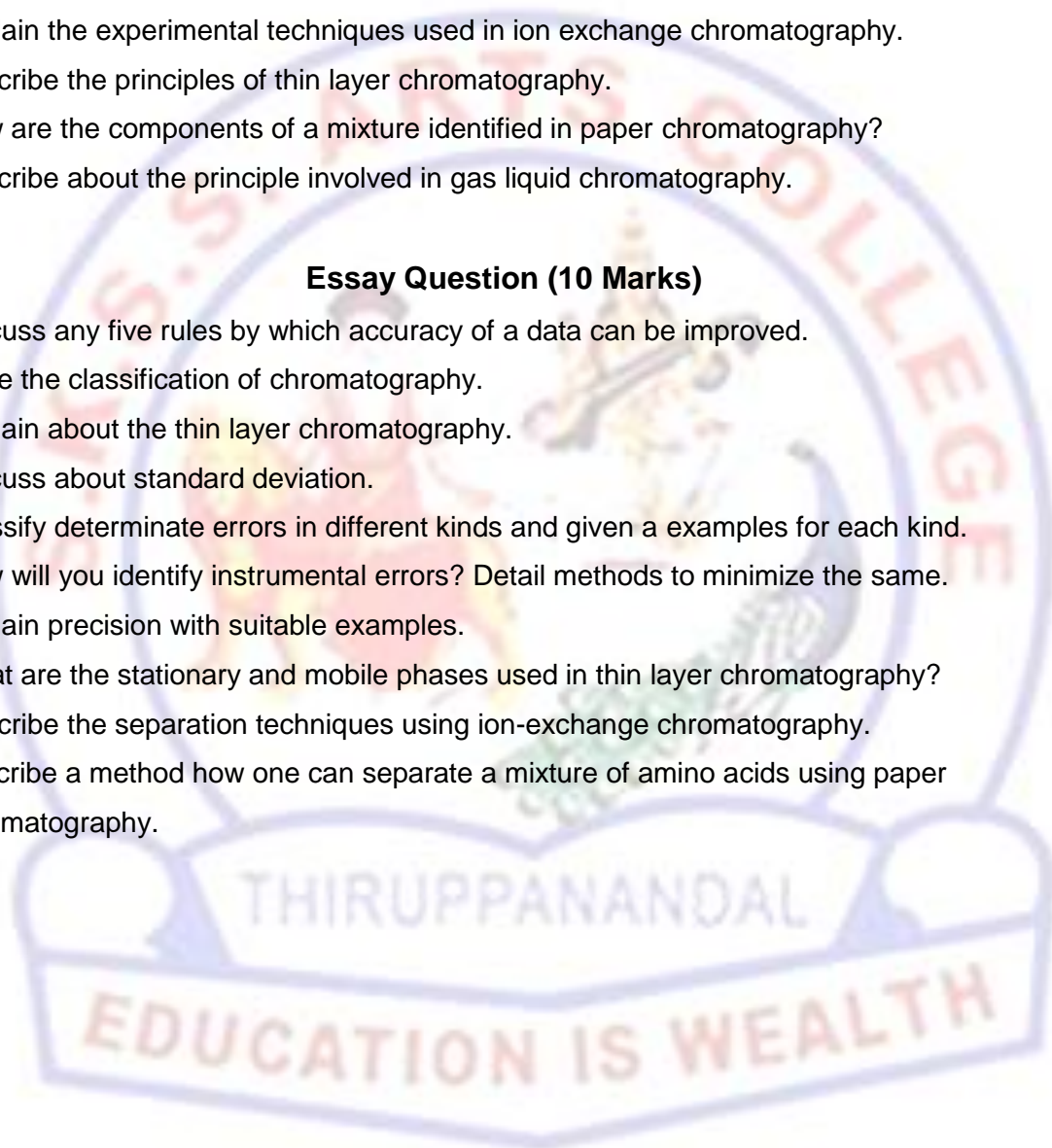
- What is precision?
- What do you mean by confidence limit?
- Define error.
- Define the term accuracy.
- Define mean.
- Define mean deviation.
- What are the applications of R_f value?
- What is the principle of thin layer chromatography?
- How is paper chromatography obtained?
- What are the stationary and mobile phases in paper chromatography?

Paragraph Question (5 Marks)

- 21) How will you identify personal errors? Detail methods to minimize the same.
- 22) Explain accuracy with suitable examples.
- 23) How is mean deviation useful in chemical data?
- 24) Explain precision with suitable examples.
- 25) How is standard deviation useful in analyzing chemical data?
- 26) Discuss the principle, procedure and applications of paper chromatography.
- 27) Explain the experimental techniques used in ion exchange chromatography.
- 28) Describe the principles of thin layer chromatography.
- 29) How are the components of a mixture identified in paper chromatography?
- 30) Describe about the principle involved in gas liquid chromatography.

Essay Question (10 Marks)

- 31) Discuss any five rules by which accuracy of a data can be improved.
- 32) Write the classification of chromatography.
- 33) Explain about the thin layer chromatography.
- 34) Discuss about standard deviation.
- 35) Classify determinate errors in different kinds and given a examples for each kind.
- 36) How will you identify instrumental errors? Detail methods to minimize the same.
- 37) Explain precision with suitable examples.
- 38) What are the stationary and mobile phases used in thin layer chromatography?
- 39) Describe the separation techniques using ion-exchange chromatography.
- 40) Describe a method how one can separate a mixture of amino acids using paper chromatography.



Unit – III

Choose the correct answer:

- 1) Gravimetric analysis relies heavily on the principle of
 - a) Conservation of energy
 - b) Conservation of mass
 - c) Constant composition
 - d) Define proportions
- 2) DTA can be used for which of the following process
 - a) Line positions of the crystals
 - b) Mechanical properties of the crystals
 - c) Phase diagrams
 - d) Catalytic properties of enzymes
- 3) A rapid TGA method is used for which of the following process
 - a) Decomposition of polymers exothermally
 - b) Decomposition of enzymes exothermally
 - c) Decomposition of crystals endothermally
 - d) Decomposition of reactions isothermally
- 4) On studying the reversible process during DTA which of the following is observed on both heating and cooling
 - a) Esterification
 - b) Hysteresis
 - c) Methylation
 - d) Carboxylation
- 5) Thermal analysis is defined as
 - a) Measurement of concentration of materials as a function of temperature
 - b) Measurement of solubility of materials as a function of temperature
 - c) Measurement of physical properties as a function of temperature
 - d) Measurement of line positions of crystal as a function of temperature
- 6) Which of the following method can be used for the measurement of change in weight of the oxysalt
 - a) Thermoelectric analysis
 - b) Wagner analysis
 - c) Stockbarger analysis
 - d) Thermal analysis

- 7) What are the two main techniques for thermal analysis
- FTG and DGG
 - MSP and FCT
 - TGA and DTA
 - TSA and DGF
- 8) In thermogravimetric analysis the results obtained appear as
- Continuous chart
 - Continuous parabola
 - Continuous circular
 - Discontinuous chart
- 9) Under conditions of _____ heating decomposition usually take place in thermogravimetry
- First order
 - Second order
 - Third order
 - Dynamic
- 10) What is the range of the rate " C_{mix}^{-1} " required during process in TGA?
- 1 -20
 - 25 – 50
 - 100 – 200
 - 150 – 1000

Answer:

- 1) d 2) c 3) d 4) b 5) c 6) d 7) c 8) a 9) d 10) a

Short Question (2 Marks)

- What is meant by co-precipitation?
- What is the principle behind the TGA?
- What is meant by thermal analysis?
- What is DTA?
- What are the two types of organic precipitants?
- Name of apparatus used in TGA.
- How does post-precipitation affect a gravimetric estimation?
- Explain the DTA curve of $CaC_2O_4 \cdot H_2O$.
- What is the application of DTA?
- Differential thermal analysis of substances.

Paragraph Question (5 Marks)

- 21) What are the requirements of gravimetric analysis? Explain.
- 22) Draw and analyze the DTA thermogram of calcium oxalate monohydrate.
- 23) Write the help of TGA thermogram. Explain the various thermal changes occurring in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
- 24) How is DTA useful in gravimetry?
- 25) Write a note on the choice of precipitants.
- 26) Describe the principle of gravimetric analysis with an example.
- 27) Detail with examples various techniques of precipitation in gravimetry.
- 28) Discuss the theory of post precipitation. How is it caused?
- 29) Draw the block diagram of the instrument for differential thermoanalysis.
- 30) Name any four factors that affect differential thermal analysis curves.

Essay Question (10 Marks)

- 31) With neat sketch explain the TGA instrumentation.
- 32) Explain the theories of precipitation.
- 33) Write notes on co-precipitation example? How can it decreased minimized?
- 34) How is the precipitation from homogeneous solution superior? Explain with an example.
- 35) Describe the applications of solubility product principle gravimetric analysis.
- 36) Explain the DTA curve of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$.
- 37) Discuss the factor which affecting the thermogravimetric.
- 38) Draw the TGA curves. Explain the features.
- 39) Write short notes on detectors in DTA.
- 40) Differential thermal analysis of substances.



Unit – IV

Choose the correct answer:

- 1) Which of the following principle are used in silica analyzer?
 - a) Amperometric principle
 - b) Colorimetric principle
 - c) Coulometric principle
 - d) Magnetic principle
- 2) Which of the following is not an application of calorimeter?
 - a) Paints
 - b) Inks
 - c) Cosmetics
 - d) Composition detection
- 3) Which of the following is a source used in spectroscopy?
 - a) Laser
 - b) Tune light
 - c) Sodium vapor lamp
 - d) Tungsten lamp
- 4) Beer lampert's law gives the relation between which of the following?
 - a) Reflected radiation and concentration
 - b) Scattered radiation and concentration
 - c) Energy absorption and concentration
 - d) Energy absorption and repeated radiation
- 5) Beer's law states that the intensity of light decreases with respect to _____
 - a) Concentration
 - b) Distance
 - c) Composition
 - d) Volume
- 6) What is the unit of absorbance which can be derived from Beer Lamber'slaw?
 - a) $Lmo^{-1}cm^{-1}$
 - b) $Lgm^{-1}cm^{-1}$
 - c) Cm
 - d) No unit

- 7) Spectroscopy deals with interaction of electromagnetic radiation with matter. What is the speed of this radiation in vacuum in m/s?
- a) 6×10^8
 - b) 5×10^8
 - c) 7×10^8
 - d) 3×10^8
- 8) Which of the following is not a source used in mid infrared photospectrometer
- a) Nernst glower
 - b) High pressure mercury arc lamp
 - c) Glodar
 - d) Nichrone wire
- 9) What is the name of an instrument used to measure that absorbance of coloured compound in solution?
- a) Colorimeter
 - b) Colourmeter
 - c) Calorimeter
 - d) Coulometer
- 10) Grating is a device used in the spectroscopic to function as
- a) a light source
 - b) amonochromator
 - c) adetector
 - d) anebulizer

Answer:

- 1) b 2) d 3) d 4) c 5) a 6) d 7) d 8) b 9) a 10) b

Short Question (2 Marks)

- 11) What is molar absorbance?
- 12) State Beer-Lamberts law.
- 13) What is the principle involved in colorimettry?
- 14) State the law of photochemical equivalence.
- 15) What are applications of colorimetric analysis?
- 16) What is monochromator?
- 17) Draw the block diagram of a spectrophotometer
- 18) Define colorimetric estimation of iron.
- 19) Write any two advantages of colorimetric analysis.

20) Write the principle of photoelectric colorimeter.

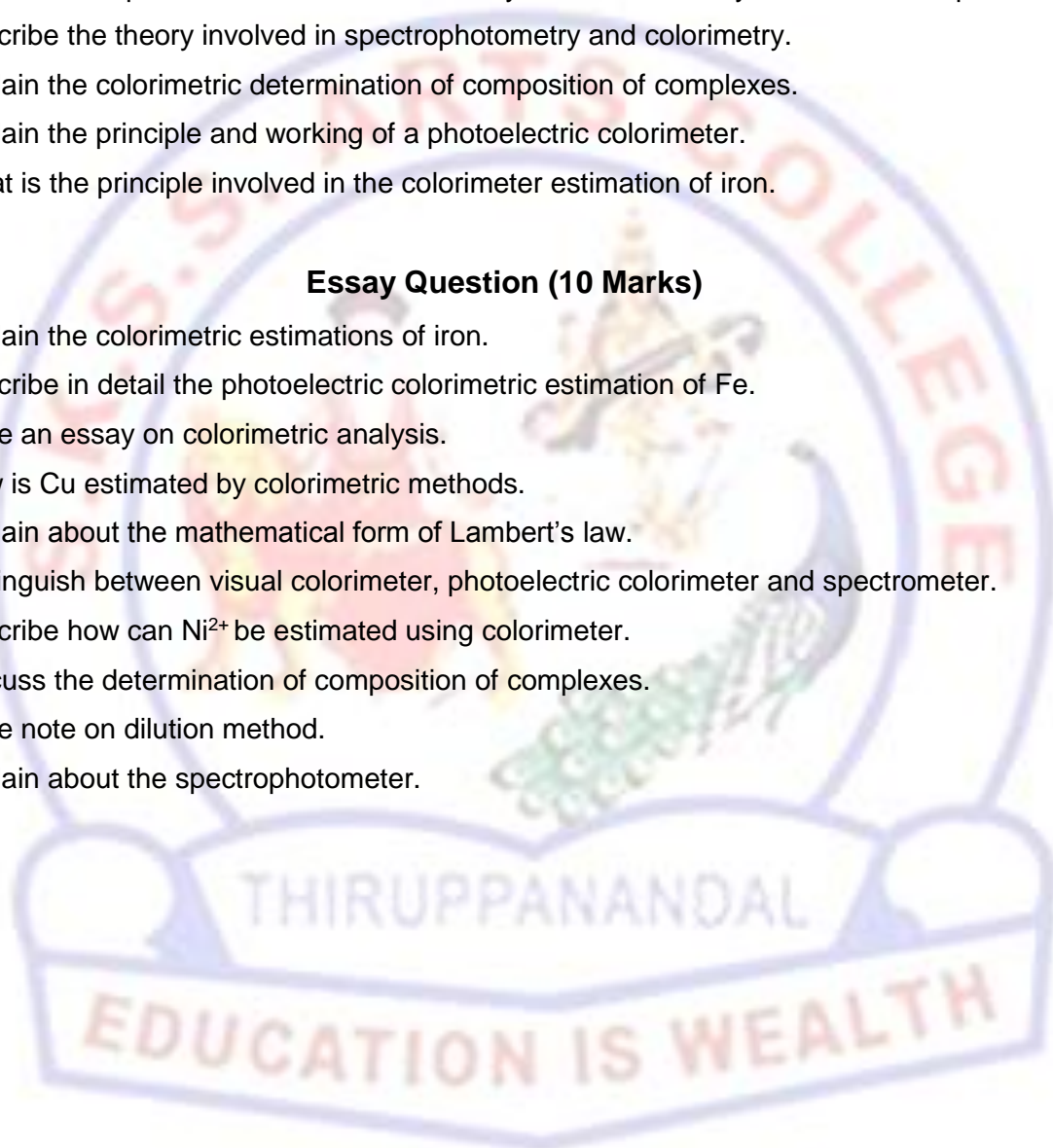


Paragraph Question (5 Marks)

- 21) Explain the colorimetric estimation of iron.
- 22) Explain the principle and working of colorimetry.
- 23) Draw the block diagram of a spectrophotometer and explain.
- 24) How is Cu estimated by colorimetric methods?
- 25) Explain various deviation of Beer's Law.
- 26) Explain the separation of nickel and cobalt by colorimetric analysis at controlled potential.
- 27) Describe the theory involved in spectrophotometry and colorimetry.
- 28) Explain the colorimetric determination of composition of complexes.
- 29) Explain the principle and working of a photoelectric colorimeter.
- 30) What is the principle involved in the colorimeter estimation of iron.

Essay Question (10 Marks)

- 31) Explain the colorimetric estimations of iron.
- 32) Describe in detail the photoelectric colorimetric estimation of Fe.
- 33) Write an essay on colorimetric analysis.
- 34) How is Cu estimated by colorimetric methods.
- 35) Explain about the mathematical form of Lambert's law.
- 36) Distinguish between visual colorimeter, photoelectric colorimeter and spectrometer.
- 37) Describe how can Ni^{2+} be estimated using colorimeter.
- 38) Discuss the determination of composition of complexes.
- 39) Write note on dilution method.
- 40) Explain about the spectrophotometer.



Unit – V

Choose the correct answer :

- 1) Which of the following measurement involves electrolysis
 - a) The measurement of pH with pH electrode
 - b) A redox titration using a redox indicator
 - c) A stripping analysis of uranium in water
 - d) All of the above
- 2) Which of the following electrochemical methods requires the formation of an insoluble from the analysis?
 - a) electrogravimetry
 - b) coulometry
 - c) Voltametry
 - d) Potentiometry
- 3) Which of the following analytical methods is it possible to have the greatest precision?
 - a) volumetric titration
 - b) linear Calibration
 - c) gravimetric
 - d) spectrophotometric
- 4) Which of the following is a static ($i=0$) electrochemical technique?
 - a) Potentiometry
 - b) Cyclic voltammetry
 - c) Controlled current coulometry
 - d) Amperometry
- 5) Secondary coulometry titration involve
 - a) Addition of titrant
 - b) Titrant precursor
 - c) Use of secondary standards
 - d) Constant potential
- 6) The electroanalytical technique that involves the measurement of electricity consumed in a redox reaction of the analysis is
 - a) Potentiometry
 - b) Conductometry
 - c) Polarography
 - d) Coulometry

- 7) In potentiostatic coulometry, the current
- Increases exponentially
 - Decreases exponentially
 - Constant
 - Zero
- 8) The end point in the coulometric titrations is determinedly
- Spectroscopy
 - Biamperometry
 - Potentiometry
 - All of the above
- 9) In an amperometric titration the following type of plot was observed. Select the correct statement regarding this plot
- The sample is electro active
 - Titrant is electro active
 - Both sample and titrant are electro active
 - Both sample and titrant are electro inactive
- 10) Coulometric technique result in a plot of _____
- Current versus time
 - Electrochemical potential time
 - Current versus electrochemical potential
 - Potential only

Answer :

- 1) c 2) a 3) c 4) a 5) b 6) d 7) b 8) d 9) a 10) c

Short Question (2 Marks)

- What is the principle of coulometry?
- What are amperometric titrations?
- Write the principle of electrogravimetry.
- How is redox potential measured?
- How is pH determined using redox potential measurements.
- What is over voltage?
- Write the principle of coulometry.
- Write the applications of amperometry.
- Define electrolytic separation of metals.
- Name the factors affect overvoltage.

Paragraph Question (5 Marks)

- 21) Explain the redox potentials.
- 22) Elaborate the principle involved in electrogravimetry.
- 23) Explain the separation of nickel and cobalt by coulometric analysis at controlled potential.
- 24) Discuss the separation of Cu and Fe.
- 25) Write the applications of amperometry.
- 26) Describe the electro gravimetric analysis of Cu^{2+} and Ag^+ mixture.
- 27) When does simultaneous deposition of metals occur.
- 28) What is meant by over voltage? Explain its significance in the electrode position of metals.
- 29) Write short notes on the principle of electro deposition.
- 30) Describe any one use of redox potential.

Essay Question (10 Marks)

- 31) Elaborate the basic principle involved in coulometric analysis.
- 32) Explain the coulometric analysis with controlled potential technique.
- 33) Give an account of electrolytic separation.
- 34) Discuss the separation of Ni and Co.
- 35) Write a note on simultaneous electro deposition of metals
- 36) Describe the principles and instrumentation of electrogravimetry.
- 37) Explain how copper is estimated using electrogravimetry.
- 38) What is meant by over voltage? Explain its significance in electrode position of metals.
- 39) Write short notes on the principle of electro deposition.
- 40) Explain about the amperometry titrations.

