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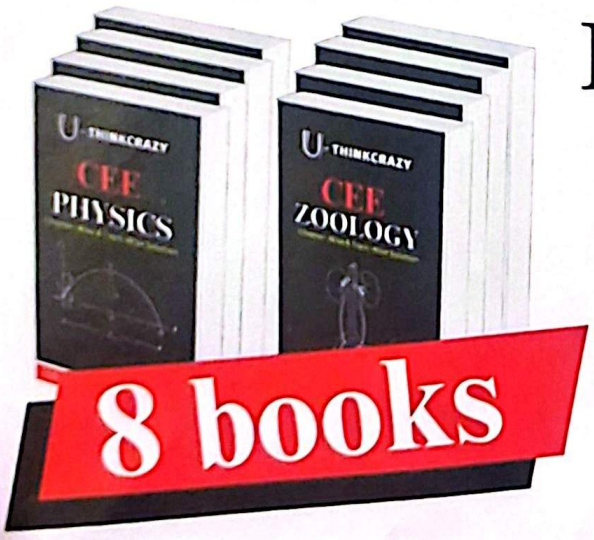

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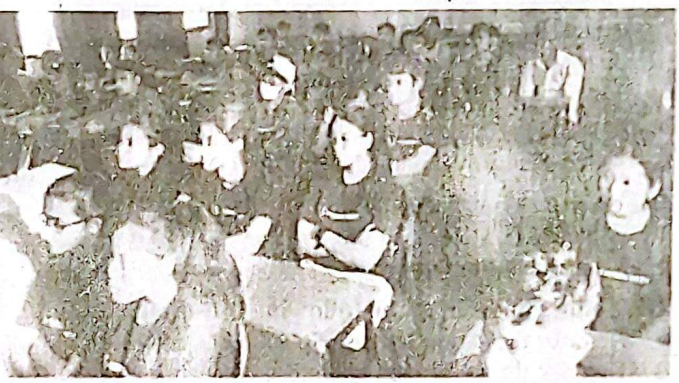

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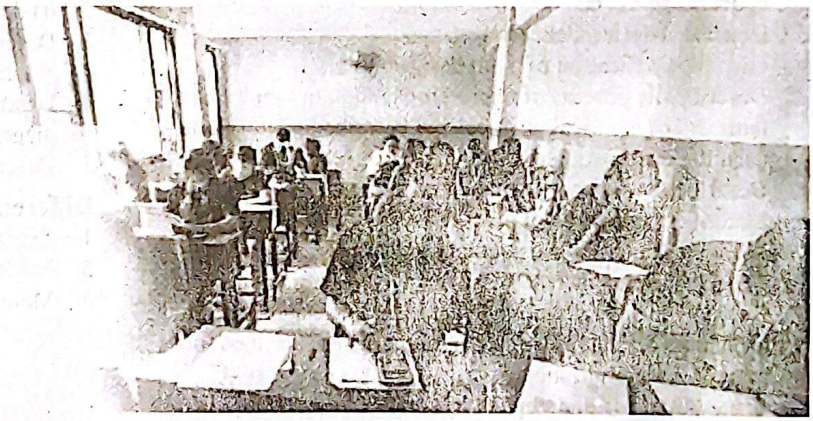


B. Pharma, B.Optometry,BPT,BSc MLT & BSC MIT

Biology | Botany

Biotechnology

The chapter can be break down into following sub topic.

i) Introduction to Biotechnology
ii) Tissue culture
iii) Plant breeding and disease resistant plants
iv) Green manure and biofertilizers
v) Genetic engineering & genetically modified organism
vi) Biopesticides, bioengineering (biological engineering), and food safety & food security

You must remember.

1. Definition
2. Differentiate between
3. Short question

Definitions

1. Biotechnology
2. Antibiotic
3. Vaccine
4. Tissue culture
5. Farmyard manure
6. Genetic engineering
7. Bio fertilizer
8. Green manure
9. Callus
10. Food safety
11. Bio pesticide
12. Insecticide
13. Genetically modified organism (GMO)

Differentiate between

1. Chemical fertilizers and Bio fertilizer
2. Manure and Bio fertilizer

Give short answer to the following questions

1. Describe the various stages of plant tissue culture.
2. Describe the application of biotechnology in the field of agriculture and medicine.
3. Describe the application of fermentation technology in industries.
4. Analyse the benefits and risk of genetic engineering in the field of medicine taking into account the ethical and social concerns involved..
5. Describe about alcoholic fermentation.
6. Give the application of plant tissue culture.
7. Describe the process of micro propagation to rapidly large numbers of identical plantlets and describe how it can be used in conservation efforts for endangered plant species.
8. Describe the process of micro-propagation.
9. Describe the method of plant tissue culture.
10. What are the objectives of plant breeding? Explain.
11. State the advantage and disadvantage of outbreeding.
12. Explain why hybridization is regarded as contemporary breeding techniques for improving crop plant traits. Describe the various steps in the hybridization.
13. Write down various steps of hybridization procedure in plants.
14. Discuss the green manure and its application.
15. Discuss the bio fertilizer and its application.
16. The use of organic fertilizers is more beneficial than chemical fertilizers in the crop fields. Justify the statement with reason.
17. Recombinant DNA technology is used to induce the desired characters of an organism to another organism. Justify the statement describing with various steps.
18. How can GMOs be used to address global food security challenges and what are the potential environmental concerns and health risks associated with their use?
19. Possible danger of genetic engineering.
20. Describe the application of genetic engineering in agriculture.
21. Give the importance of genetic engineering in medicine.
22. DNA recombinant technology is our friend as well as foe's element. Explain upon this statement with reasons.
23. Mention the principles of food safety.
24. Mention the application of bioengineering in the field of medical science.
25. Describe the importance of food security for human beings.
26. Enlist the advantage of use of bio pesticides.
27. What are the 3 main source of bio fertilizer? Explain any one of them.
28. Write down the importance of hybridization.
29. What are the methods of plant breeding?

Biology | Botany | Developmental Biology

Development of Embryo

You must remember..

1. Definition
2. Short question
3. Differentiate between

Definition

1. Suspensor cell
2. Embryo cell
3. Embryogenesis
4. Endosperm
5. Hypobasal cell
6. Epibasal cell

Give short answer to the following questions

1. Draw a well labelled diagram of different stages of monocot embryogeny.
2. Write down salient features of dicot embryo in reference to its development pattern with labelled diagram.
3. Describe development of monocot embryo with labelled diagram.
4. Describe the development of dicot embryo with labelled diagram.
5. Describe the different types of endosperm development.

Differentiate between

1. Zygote and endosperm
2. Nuclear endosperm and cellular endosperm
3. Monocot embryo and dicot embryo

Biology (Botany) | Developmental Biology

Asexual Reproduction

You must remember..

1. Definition
2. Short answer question

Definition

1. Vegetative propagation
2. Grafting
3. Layering
4. Gootee
5. Tuber
6. Stock
7. Scion
8. Asexual reproduction

Give short answer to the following questions

1. Briefly explain the grafting with the examples. Write any two application of this method.
2. Study the given figure carefully and answer the following question carefully:
   a) Identify the given figure.
   b) Name the parts A, B, C and D.
   c) State the function of part D.

3. Explain how pollen grain are formed from microspore mother cell inside the microsporangium.
4. Explain the process of grafting with its importance.
5. What are the importance of vegetative propagation with example.

Biology (Botany) | Genetics

Genetic material

You must remember.

6. Introduction
7. Short Question
8. Differentiate between
9. Long question

Definition

1. Genetics
2. Heredity
3. Variation
4. Gene
5. DNA
6. RNA
7. Replication
8. Genetic code

Give short answer to the following questions

1. Elaborate any four characteristics of genetic code
2. Explain the structure and function of tRNA with diagram
3. Deseribe the double helical structure of Watson and Crick model of DNA
4. Describe the types of RNA
5. Semi-conservative method of DNA replication
6. Process of translation
7. Structure and function of RNA
8. Types of DNA and function

Differentiate between

1. DNA and RNA
2. Conservative and semi-conservative replication

Give long answer to the following questions.

1. Discuss the Watson and Crick model of DNA with the help of neat and labelled diagram. Explain the mechanism of this replication process.
2. Explain the mechanism of semi-conservative method of DNA replication with various enzymes and necessary diagrams.
3. Describe the Griffith bacterial transformation experiment to show that DNA is a genetic material.

Biology (Botany) | Genetics

Mandelian Characters

You must remember.

4. Definition
5. Difference between
6. Short Question
7. Long question

Definition

1. Alleles
2. Homozygous individual
3. Heterozygous individual
4. Test cross
5. Back cross
6. Reciprocal cross
7. Punnet square
8. Hybridization
9. Complete dominance
10. Incomplete dominance
11. Co-dominance

Differentiate between

1. Incomplete dominance and complete dominance
2. Incomplete dominance and co-dominance
3. Phenotype and genotype
4. Homozygous individual and heterozygous individual

Give short answer to the following questions

1. In which cross, the genotype and phenotype ratio are same? Explain it with reference to Mirabilis jalapa plant.
2. Explain the mechanism of incomplete dominance up to F2 generation with suitable example.
3. Explain law of dominance.
4. Illustrate about F1 generation.
5. Explain monohybrid cross with chart.
6. Explain dihybrid cross with chart.
7. Explain the law of segregation.

Give long answer to the following questions

1. Genetics have found that not all traits shows simple dominant-recessive relationship. Justify this statement by describing incomplete dominance and co-dominance with suitable illustration.
2. State the law of independent assortment and explain the essential pattern of inheritance verifying the statement with examples showing cross up to second filial generation.
3. Describe the Mendel's law of inheritance.
4. Why did Mendel choose pea for the experiment? How did he make sure that the plant was true breeding? Briefly describe monohybrid cross between homozygous round and wrinkled seeds in garden pea through two generation using cross chart and draw conclusion.
5. What is dihybrid cross? Mention diagrammatic account of dihybrid cross of Mendel's experiments and discuss.

Biology (Botany) | Genetics

Mutation and Polyploidy

You must remember.

6. Definition
7. Short question
8. Long questions

Definition

1. Gene mutation
2. Muton
3. Polyploidy
4. Transition
5. Transversion
6. Inversion
7. Frame shift mutation
8. Hypoploidy
9. Deletion
10. Aneuploidy
11. Chromosomal mutation
12. Monosomic
13. Hyperploidy
14. Euploidy
15. Autopolyploidy
16. Allopolyploidy

Give short answer to the following questions

1. Explain briefly the significance of polyploidy with examples.
2. Explain gene mutation.
3. Write down the significance of mutation.
4. Write down the differences between euploidy and aneuploidy.
5. What are the causes and roles of mutation?

Give long answer to the following questions

1. Define chromosomal aberration and elaborate its various types. Discuss the significance of mutation in genetics and evolutionary biology.
2. How do chromosomal mutations affect organisms? Elucidate the types of chromosomal mutations. Why do mutations play a significant role in agriculture and evolution?
3. How can chromosomal mutations alter the number and structure of chromosomes? Explain the various types of chromosomal mutations. Write their significance.
4. Explain the process of allopolyploidy with a suitable example. Analyze the benefits and drawbacks of polyploidy in agriculture and plant breeding.

Biology (Botany) | Plant Physiology

Photosynthesis

You must remember.

5. Definition
6. Short question
7. Long question

Definition

1. Phosphorylation
2. Light reaction
3. Cyclic phosphorylation
4. Non-cyclic phosphorylation

Give short answer to the following questions

1. Write down the internal factors of photosynthesis
2. What are the significance of photosynthesis
3. Explain the factors affecting the photosynthesis
4. What are the characteristics of C3 plants
5. What are the characteristics of C4 plants
6. Explain the following
   i) Light reaction
   ii) Cyclic phosphorylation
   iii) Non-cyclic phosphorylation
7. Give the difference between C3 and C4 plants

Give long answer to the following questions

1. The light - independent reactions of photosynthesis involves the conversion of carbon dioxide into glucose. Explain the steps involved in this process and how the products of the light dependent reactions (ATP and NADPH) are utilized.
2. Describe an experiment to demonstrate light is necessary for the process of photosynthesis with clear diagram.
3. Describe the various factors that influence the photosynthesis in plants.
4. Sketch and describe dark reaction of photosynthesis.
5. Describe in brief the mechanism of photosynthesis.

Biology | Botany

Plant Anatomy

The chapter is divided into following content.

Labelled diagrams of T.S. (Transverse Section) of root, stem, and leaf.

1. Differentiate between (comparative questions).
2. Structure and function type questions.
3. Important Questions:

- Short answer questions (1 mark)
- Long answer questions (8 marks)

Draw the labelled diagram of [3 marks]

1. T.S of monocot root & monocot stem
2. T.S of Dicot root and Dicot stem
3. T.S of monocot leaf & Dicot leaf

Differentiate between [2 marks]

1. Collenchyma and sclerenchyma
2. Xylem and Phloem
3. Spongy parenchyma and palisade parenchyma
4. Simple permanent tissue and Complex permanent tissue
5. Monocot root and Dicot Root
6. Monocot stem and Dicot stem
7. Monocot leave and Dicot leaves

Structure and function of :

a) Sclerenchyma
b) Hydathode
c) Collenchyma
d) Aerenchyma
e) Chlorenchymatous tissue
f) Parenchyma
g) Collateral vascular bundle

Important Questions

Give short answer to the following questions

1. What is vascular tissue ? What type of vascular bundle is present in dicot stem.
2. Mention two functions and characteristics of vascular bundle.
3. Elaborate the activities of vascular cambium up to formation

of the cambial ring with necessary diagram.
4. Describe the tunica corpus theory.
5. Write down function of lateral meristem.
6. Write down function of cambium.
7. Meristem is also known as juvenile tissue'. Explain type of the meristem on basis of position .

Give long answer to the following questions

1. Define permanent tissue and discuss the structure and function of complex permanent tissue.
2. Describe the process of secondary growth in dicot stem with necessary diagram.
3. Describe the structure and function of monocot and dicot leaf with suitable diagrams.
4. Describe the anatomical structure of dicot root and compare it with monocot root.

Biology (Botany) | Plant Physiology

Plant Growth and Movement

You must remember.

1. Definition
2. Short question

Definition

1. Chemotropism
2. Geotropism
3. Phototropism
4. Thigmotropism
5. Epigeal germination
6. Hypogeal germination
7. Seed Dormancy
8. Photoperiodism
9. Vernalization
10. Senescence
11. Thermonasty
12. Haptonasty
13. Seismonasty

Give short answer to the following questions

1. Describe four practical importance of seed dormancy in agriculture and horticulture.
2. Describe any four practical applications of vernalization in agriculture and horticulture.
3. What are the types of plant senescence?
4. Write down the importance of senescence.
5. Explain the following:
   i. Long-day plants (LDPs)
   ii. Short-day plants (SDPs)
   iii. Day-neutral plants (DNPs)
   iv. Long-short-day plants (LSDPs)
   v. Short-long-day plants (SLDPs)
6. Write down importance of photoperiodism.

Biology (Botany) | Plant Physiology

Plant Hormones

You must remember.

1. Definition
2. Short Questions

Definition

1. Apical dominance
2. Hormone
3. Plant growth inhibitor
4. Auxin
5. Parthenocarpic fruit

Give short answer to the following questions

1. What are the physiological functions of gibberellins?
2. Discuss any four physiological effects of auxin in agriculture.
3. Write down the functions of ethylene.
4. Mention the role of hormones in plants.
5. Physiological effects of:
   i) Auxin
   ii) Gibberellin
   iii) Cytokinin

Biology (Botany) | Plant Physiology

Water Realtion

You must remember.

1. Definition
2. Difference between
3. Short Question
4. Long Question

Definition

1. Transpiration
2. Guttation
3. Osmosis
4. Ascent of sap
5. Active absorption
6. Passive absorption
7. Plasmolysis
8. Diffusion
9. Turgor pressure
10. Imbibition
11. Hydathode

Difference between

1. Diffusion and osmosis
2. Transpiration and guttation
3. Active absorption and passive absorption

Give short answer to the following questions

1. Briefly describe the transpiration, including its types and advantages.
2. What are the factors that affect the rate of transpiration in plants?
3. Kinds of transpiration.
4. Discuss the various theories involved in transpiration phenomenon.
5. Explain the importance of osmosis.

Give long answer to the following questions

1. Discuss the process of transpiration by bell jar method.
2. Describe the experiment to show the rate of transpiration by Ganong's potometer.
3. Explain the factors affecting the rate of transpiration.
4. Describe the various theories involved in the transpiration phenomenon.

Biology (Botany) | Plant Physiology

Respiration

You must remember.

1. Definition
2. Differentiate between
3. Short Question
4. Long Question

Definition

1. Aerobic respiration
2. Glycolysis
3. Anaerobic respiration
4. Fermentation

Differentiate between

1. Photosynthesis and respiration
2. Aerobic respiration & anaerobic respiration
3. Glycolysis and Krebs cycle

Give short answer to the following questions

1. What are factors affecting respiration?
2. Steps of dark reaction
3. Process of glycolysis
4. What is oxidative phosphorylation? Explain its significance in Krebs cycle
5. Sketch the Krebs cycle (Description not needed)

Give long answer to the following questions

1. Describe the cycle that involves the breakdown of two carbon compound Acetyl CoA in aerobic respiration with necessary chart.
2. What are the chemical changes that occur in pyruvic acid molecules before entering into mitochondria? Describe the process of TCA cycle through the line diagram.
3. Describe the various factors that affect the process of respiration in plants.
4. Describe the aerobic respiration that occurs in the matrix of mitochondria.
5. Discuss the mechanism of anaerobic respiration.

Biology (Zoology) | Animal Tissue & Organ System

Circulatory System

You must remember..

1. Definition
2. Short question
3. Long question
4. Short notes on :
5. Differentiate between

Definition

1. Arteries
2. Veins
3. Capillaries
4. Cardiac cycle
5. Hamburger shift
6. Rh factor
7. Portal vein
8. Antigen
9. Antibody
10. Lymph
11. Valves of the heart

Give short answer to the following questions

1. Describe artificial pacemaker and write down its importance
2. What are the symptoms and causes of anaemia ?
3. What are heart sounds ? How are they produced ?
4. Describe hepatic portal system with its importance.

Give long answer to the following questions

1. Explain the internal structure of human heart and its mechanism with labelled diagram. What would happen when blood supply to the heart is suddenly interrupted.
2. Discuss the origin and conduction of heartbeat. How would it be solved if SA node is damaged.
3. Justify the statement "SA node is natural pacemaker". What would you suggest if the natural pacemaker does not function normally ? How do you test blood grouping in human beings.
4. Give an account of arterial system in human with labelled diagram.
5. Explain the course of blood circulation in human heart with well labelled diagram.

Short notes on

1. Cardiac cycle
2. Blood pressure
3. Natural pacemaker

Differentiate between

1. Open type circulatory and Closed type circulatory system
2. Arteries, Veins and Capillaries
3. SA node and AV node
4. Right atrium and Left atrium

Biology | ZOOLOGY

Developmental Biology

The chapter is break down into following sub topic

1. Gametogenesis
2. Development of frog

The sub-topic is further divided into following content

1. Definition
2. Short answer question (4 marks)

Definition

1. Cleavage
2. Oogenesis
2. Holoblastic cleavage
4. Spermatogenesis
3. Gastrulation
6. Spermiogenesis
4. Blastula
8. Coelom
5. Neurulation
10. Archenteron

Give short answer to the following question

1. Describe the process of Oogenesis in animals with diagram.
2. Describe the process of Spermatogenesis in animals with diagram
3. Discuss the process of gastrulation in frog.
4. Write about neurulation process in development of frog
5. How is blastula formed during development of frog? Why micromeres divides faster then macromeres.
6. How coelom is formed in frog's development
7. How does the cleavage process occurs in zygote of frog
8. Write the event of blastulation in the development of frog.
9. Discuss the process of fertilization in frog
10. Explain morula and blastula stage of frog
11. List the process of segmentation of the egg of frog

Biology (Zoology) | Digestive System

Digestive System

You must remember.

1. Definition
2. Short question
3. Long question

Definition

1. Malnutrition
2. Glycogenolysis
2. Permanent teeth
4. Chyme
5. Chyle
6. Lacteals
7. Rugae
8. Intestinal villi
9. Thecodont
10. Digestion

Give short answer to the following questions

1. Study the given figure and answer the following question
   i) Identify the figure
   ii) Label A, B, C and D
   iii) Mention the role of A

2. What is the role of bile in the fat digestion.
3. Explain the protein digestion in human alimentary canal.
4. How carbohydrate is digested in human digestive tract
5. Draw labelled diagram of T.S of pancreas. Explain the role of the pancreatic lobules or acini in digestion.
6. Name the various types of salivary gland in humans. Explain their nature and role
7. Give a brief account of the action of different proteolytic enzymes.
8. Describe the function of liver.
9. Give long answer to the following questions
10. Draw a labelled diagram of human digestive system and explain the parts of alimentary canal. What would happen if bile duct becomes blocked ?
11. Describe the physiology of digestion in human beings.
12. Give a detail account on structure and function of pancreas and liver with essential diagrams.
13. Which hormone of duodenum induces contraction of gall bladder to release bile ? Describe the structure and role of various digestive gland found in human digestive tract.

Biology | ZOOLOGY

Endocrinology

You must remember.

1. Definition
2. Short answer questions
3. Long answer questions
4. Differentiate between

Definition

1. Hormone
2. Enzymes
3. Glycogenesis
4. Exocrine gland
5. Endocrine gland
6. Collip's hormone
7. Heterocrine gland

Give short answer to the following questions

1. Why pancreas is considered as heterocrine gland
2. What are islets of Langerhans, name the cell involved with them and give their functions.
3. Describe structure and function of adrenal gland.
4. Describe the structure and functions of thyroid gland in brief
5. Explain the antagonistic effect of insulin and glucagon.
6. Describe the role of pituitary gland in Endocrinology.
7. Why adrenal gland is called gland of Emergency ? What are hormones secreted by adrenal gland.
8. Why is pituitary gland called master gland ? Name the hormones of the adenohypophysis and neurohypophysis with their respective functions.

Give long answer to the following questions

1. Describe the structure and function of pituitary gland.
2. Describe the structure and function of an adrenal gland
3. Pituitary gland is called master gland. Justify this Statement. List any 4 tropic hormone released by anterior pituitary and explain briefly their functions. What would be the consequence when beta cells of pancreas fail to function ?

Differentiate between

1. Exocrine gland and Endocrine glands
2. Hypothyroidism and Hyperthyroidism
3. Thyroid gland and Thymus gland

Biology (Zoology) | Animal Tissue & Organ System

Excretory System

You must remember.

1. Definition
2. Long answer question
2. Short answer question
3. Differentiate between

Definition

1. Ultrafiltration
2. Ureotelic Animal
3. Malpighian body
4. Excretion
5. Counter-current system
6. Reabsorption
7. Micturition
8. Homeostasis

Give short answer to the following questions

1. Study the diagram of L.S of human kidney and answer the questions.
   a) Label A, B, C and D

   b) Write any two difference between A and B.
2. Describe the micturition process
3. Explain two common renal disorders in human being.
4. Draw labelled diagram of Nephron.
5. List the function of Human kidney.
6. Describe kidney as a homeostatic organ.
7. Mention three steps of urine formation. How does the process of selective reabsorption takes place ? Explain in brief.

Give long answer to the following questions

8. Explain the process of urine formation. Discuss how kidney

acts as homeostatic organ.

9. Describe the structure and function of Uriniferous tubule with labelled diagram.
10. Discuss how kidney acts as homeostatic organ. Describe human urinary organs with labelled diagram.
11. Draw a well labelled diagram of L.S of kidney. Describe kidney as a principal excretory organ of human body.

Differentiate between

1. Afferent arteriole and Efferent arteriole
2. Renal capsule and Medullary pyramid

Biology / Zoology

Human population and Health Disorder

The chapter is break down into two sub-topic

1. Human population 2. Health disorder

From this topic

1. Defination 2.Short Questions
2. Long Question 3.Short note

Define

1. Malnutrition
2. Carrying capacity
3. Demography
4. Natality rate
5. Population
6. Vasectomy
7. Tubectomy
8. Abortion
9. Family planning
10. Hypertension
11. Hypotension
12. Drug abuse
13. Bronchitis
14. Drug
14. Addiction
16. smoking
15. Alcoholism

Give short answer to the following questions

3. Mention the consequence of Overpopulation.
4. Explain about population growth curve.
5. What are the problems of Over population?
6. Enlist control measures of human population growth
7. Describe the measures of family planning.
8. What is malthus theory of human population ? Write down the causes of population growth.
9. Identify any two risk factors responsible for kidney disorders and suggest any two healthy habits to protect our kidney.
10. Drug abuse in youth is on rise What do you think are the causes behind it ? suggest some preventive measure.
11. Identify some of the health hazards of smoking and suggest some preventive measures of smoking.
12. Highlight the long term effect of tobacco on human health Discuss the ways to overcome it.
13. Why a young people may take drugs ? Write down the points.
14. Mention the health hazards of tobacco smoke.
15. Write down the ill effect of alcohol on health

Write short note on

1. Smoking
2. Cardiovascular disease

Give long answer to the following question [8 marks]

1. Discuss the symptoms, effects and control measures of alcohol addiction in detail.
2. Explain sources and biological effect of different categories of drugs.
3. Write an essay on socially significant diseases.

Nervous System

The Chapter is break down into following content

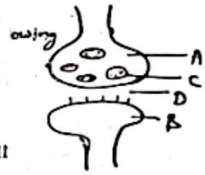
1. Definition
2. Short question
3. Long question
4. Differentiate between

Definition

1. Sensory nerve
2. Motor nerve
3. Neurotransmitter
4. Synapse
5. Nerve impulse
6. Depolarization
7. Parasympathetic Nervous system
8. Repolarization
9. Sympathetic Nervous system
10. Refractory period

Give short answer to the following questions

1. Study the given figure and answer the following questions.



i) Identify the figure

ii) label A, B, C and D

iii) Mention the role of this process

2. Study the given figure and answer the figu

i) Identify the organ.

ii) Label A to D.

iii) Write one difference between C and D.

3. How is impulse transmitted through a nerve fiber ?
4. Explain the function of medulla Oblongata.
5. What is reflex arc ? Draw a diagram of reflex arc. Explain the mechanism of reflex action.

Long answer questions

1. How would you explain various protective layers of human brain ? What do you predict in the body when cerebro-spinal fluid is absent ? Compare cerebrum and cerebellum.
2. Describe the transmission of nerve impulse with labelled diagram.
3. Brain receives all the sensation of the body. With labelled diagram explain how the impulses are carried through a nerve fibre. What would happen if a person suffers from Na+ and K+ imbalance ?
4. Human brain is associated with controlling all metabolic activities of a body. Describe the structure and function of human brain with suitable diagram. What kind of problem would a person face if cerebellum and medulla Oblongata are injured.
5. Name three meninges of brain. Draw a labelled diagram of human brain. Describe various parts of brain with their respective functions.
6. Differentiate between

   i)Sympathetic nervous system and Parasympathetic nervous system

   ii)Cerebrum and Cerebellum

Biology	Reproduction

Reproductive System

The Chapter is break down into following content.

1. Definition
2. Long answer question
3. Short answer question

Definition

1. Menarche
2. Menopause
3. Safe period
4. Uterus
5. Fertilization
6. Fundus
7. Cervix
8. Fimbriae

Give short answer to the following questions

1. What is the role of graffian follicle.
2. Write down the significance of ovarian cycle.
3. List the hormone required for proper functioning of female reproductive organs.
4. Mention the function of male sex hormone.
5. Mention three phases of ovarian cycle.
6. Write short note on about menopause.

Give long answer to the following questions

1. Explain the male reproductive organs with the diagram. Males are reproductively active at older age also. Give reasons.
2. Elaborate the internal organs of female reproductive system with the help of suitable diagram.
3. Elaborate the organs of male Reproductive system with the help of labelled diagram. Why are testes located outside the abdominal cavity in humans ?
4. Draw a labelled diagram of male reproductive organs of human beings. Describe the process of spermatogenesis. Discuss the role of male sex hormone. What would happen if prostate gland is surgically removed ?
5. Describe the fertilization process in human beings.

Biology (Zoology)	Animal Tissue & Organ System

Respiratory System

You must remember.

1. Definition
2. Long answer questions
3. Short answer questions
4. Write short notes on :

Definition

1. Inspiration
2. Expiration
3. Artificial Respiration
4. Vital capacity
5. Internal Respiration
6. Respiratory Quotient
7. Total lung capacity
8. Tidal Volume
9. Residual Volume
10. Dead space Volume
11. Aerobic Respiration
12. Inspiratory Reserve Volume
13. Anaerobic Respiration

Give short answer to the following questions

1. Illustrate the mechanism of breathing in man.
2. What is the role of diaphragm in respiration
3. Write down difference between inspiration and Expiration
4. Name the muscles involved in breathing
5. How does Hamburger's phenomenon help in CO_2 transportation? Explain.
6. What are the functions of lungs?
7. How is oxygen transported in the blood and released in the tissue ?
8. Discuss the artificial respiration and its importance.

Give long answer to the following questions

1. Explain the parts of respiratory system with labelled diagram. What would happen to the respiratory tube when person has asthma attack
2. Discuss the physiology of respiration in human beings.
3. Draw the structures and function of human lungs with labelled diagram. Also explain its working mechanism.
4. Describe physiology of respiration in human with suitable diagram.

Short notes on :

1. Gaseous exchange through lungs
2. Transportation of O_2 through bloods
3. Gaseous exchange between blood and tissue
4. Oxidation of food or cellular Respiration

Biology	Animal Tissue & Organ System

Sense Organs

You must remember.

1. Definition
2. Long answer questions
2. Short answer questions

Definition

1. Ear ossicles
2. Blind spot
3. Eustachian tube
4. Perilymph
5. Grey matter
6. White matter
7. Rhodopsin
8. Auditory ossicles
9. Accommodation
10. Eustachian tube

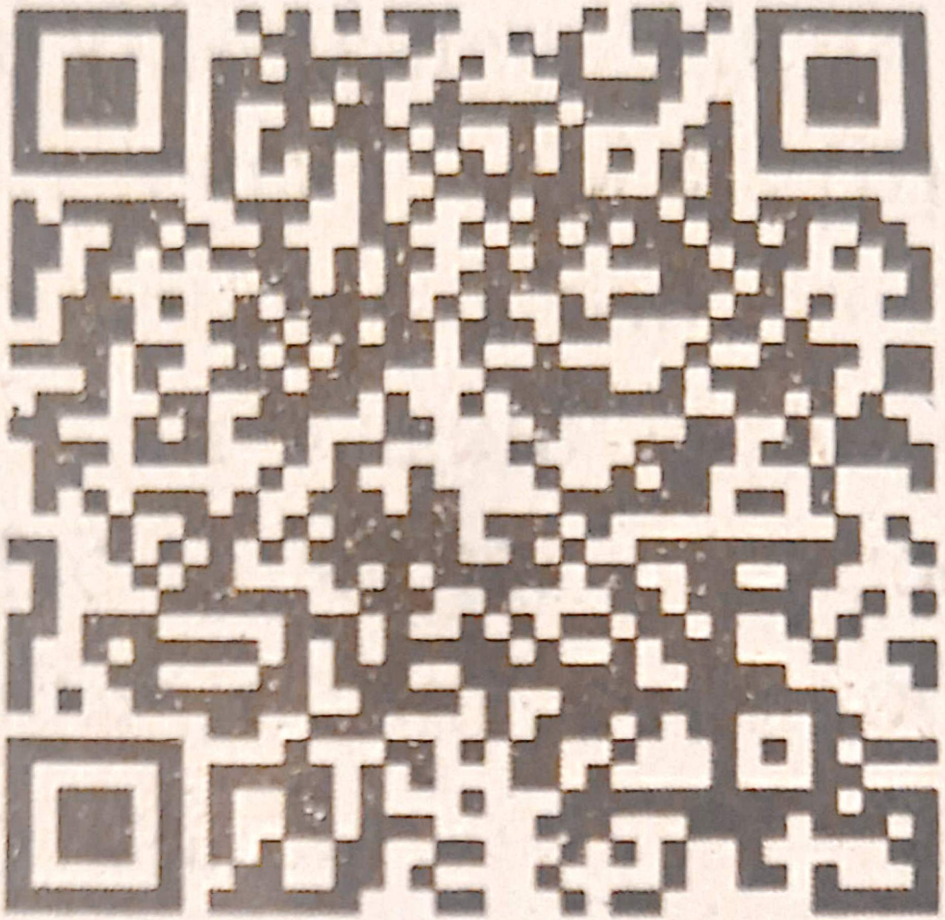
Give short answer to the following questions

1. Draw a neat and labelled diagram of section of eye.
2. Draw a well labelled diagram of human ear.
3. Illustrate the mechanism of hearing
4. Enlist about ear ossicles and their roles.
5. Describe the structure and function of cochlea.
6. What is the role of iris in image formation.
7. Draw a diagram of organ of Corti. Give a brief note on its structure. How does it detect sound ?
8. What are bony labyrinth and membranous labyrinth ? Give a short description on membranous labyrinth with diagram

Give long answer to the following questions

1. Give an account of the structure and function of human ear.
2. State and explain the parts and functions of eye. What would happen to the shape of the lens when an object is placed at far distance or close to the eyes ?
3. Draw a well labelled diagram of human ear. Discuss the mechanism of hearing. What would happen if tympanic membrane is damaged ? Discuss the functional aspects of vestibular apparatus.
4. Draw a labelled diagram of human eye. Also describe its structure and working mechanism in detail.

For extra of Biology



For extra of Biology

Rotational Dynamics

Definition

1. Define Rotational Dynamics.
2. Equation of angular motion.
3. Moment of inertia.
4. Radius of gyration.
5. Torque and angular acceleration of a rigid body.
6. Angular momentum.
7. Principle of conservation of angular momentum.

Derivation

1. Relation between linear and angular kinematics.
2. Kinetic energy of rotation of rigid body.
3. State principle of conservation of angular momentum.
4. Calculation of moment of inertia of rigid body.
5. Relation between torque and moment of inertia.
6. Work and power in rotational motion.
7. Relation between angular momentum and moment of inertia.
8. Relation between angular momentum and torque.

Give reason and short questions

1. A ballet dancer sometimes stretches and sometimes folds her arm during her performance. Why? Justify.
2. Why do we prefer a wrench of longer arm over a wrench of shorter arm?
3. A uniform rod of mass m and length l is rotating about an axis AB passing through one end and perpendicular to the length. Calculate the moment of inertia of the rod about the axis AB.
4. The angular speed is inversely proportional to the moment of inertia. This is given by the principle of conservation of energy.
   a) In a flywheel, most of the mass is concentrated at the rim. Explain why.
   b) The angular velocity of the earth around the sun increases when it comes closer to the sun. Why?
   c) If the earth were to shrink suddenly, what would happen to the length of the day?

Numerical

1. A disc of moment of inertia 10 kg m² about its centre rotates steadily about the centre with angular velocity of 20 rad s^{-1}. Calculate:
   (i) its rotational kinetic energy
   (ii) its angular momentum about the centre
   (iii) the number of revolutions per second of the disc.
2. A constant torque of 200 N m turns a wheel about its centre. The moment of inertia about this axis is 100 kg m². Find:
   (i) the angular velocity gained in 4 s
   (ii) the kinetic energy gained after 20 revs.
3. A flywheel has a kinetic energy of 200 J. Calculate the number of revolutions it makes before coming to rest if a constant opposing torque of 5 N m is applied to the flywheel. If the moment of inertia of the flywheel about the centre is 4 kg m², how long does it take to come to rest?
4. A constant torque of 100 N m turns a wheel about its centre. The moment of inertia of it about the axis is 200 kg m². Find the kinetic energy gained after 20 revs when it starts from rest.
5. A ballet dancer spins with 2.9 rev/sec with her arms outstretched when the moment of inertia about the axis of rotation is 1. With her arms folded, the moment of inertia about the same axis becomes 0.671. Calculate the new rate of spin.
6. The speed of a motor engine decreases from 900 rev/min to 600 rev/min in 10 seconds. Calculate:
   (i) the angular acceleration
   (ii) number of revolutions made by the motor during this interval
   (iii) how many additional seconds are required for motor to come to rest in the same rate.
7. A wheel starts from rest and accelerates with constant angular acceleration to an angular velocity of 8 revolutions per second in 5 seconds. Calculate:
   (i) the kinetic energy of the flywheel
   (ii) the frictional couple opposing the rotation.
8. A playground merry-go-round of radius 2.0 m has a moment of inertia 250 kg m² and is rotating at 10 rev/min. A 25 kg child jumps onto the edge of the merry-go-round. What is the new angular speed of the merry-go-round?
9. Energy is to be stored in a 70.0 kg flywheel in the shape of a uniform solid disk with radius R = 1.20 m. To prevent structural failure of the flywheel, the maximum allowable radial acceleration at a point on its rim is 3500 m/s². What is the maximum kinetic energy that can be stored in the flywheel?

Diagrammatic question

1. 1. In the given fig, the forces A, B, C and D each have magnitude 50 N acting at the same point on the object.
   (a) What torque (magnitude and direction) does each of these forces exert on the object about point P?
   (b) What is the total torque about point P?
2. 2. A typical small rescue helicopter, similar to the one in figure alongside, has four blades, each is 4.00 m long and has mass of 50 kg. The blades can be approximated as thin rods that rotate about one end of an axis perpendicular to their length. The helicopter has a total loaded mass of 100 kg (g = 9.8 m/s²).
   (a) Calculate the rotational kinetic energy in the blades when they rotate at 300 rpm.
   (b) Calculate the translational kinetic energy of the helicopter when it flies at 20.0 ms^{-1} and compare it with the rotational energy in the blades.
   (c) To what height could the helicopter be raised if all of the rotational kinetic energy could be used to lift it?
3. (a) A gymnast rides a unicycle. He applies a constant torque of 200 N m so that the wheel starts rotating from rest. What will be the kinetic energy gained by the wheel after 20 revolutions. Take moment of inertia of wheel about the centre is 100 kg m².
4. (b) If angular momentum of wheel (M.I constant) is increased by 100%, what will be the percentage increase in rotational kinetic energy?
5. (c) Why are the metal spokes provided on the bicycle's wheel? Explain.

PERIODIC MOTION

Definition

1.Periodic motion 2. Simple Harmonic motion and equation
3.Displacement equation 4.Velocity
5.Acceleration 6.Amplitude
7.Time period 8.Frequency
9.Phase 10.Energy in S.H.M
11.Potential Energy 12.Kinetic Energy
13.Simple pendulum 14.Angular simple harmonic motion
15.Oscillatory motion 16.Free oscillation
17.Damped oscillation 18.Forced vibration and Resonant vibration

Derivation

1. Characteristics of simple harmonic motion
2. Graphical representation of displacement, velocity and acceleration in SHM
3. Energy in SHM
4. Application of SHM
5. Vibration of a particle in horizontal spring
6. Vibration of a particle in vertical spring (completion for time period T)

Give Reason and Short Questions

1. If the length of seconds pendulum is increased by 200 percent, will it gain or lose time?
2. What do you understand by a second's pendulum? If it is taken to moon, will it gain or lose time? Why?
3. A simple harmonic motion is represented in wave form by $y = a \sin(\omega t + \varphi)$. Find its acceleration.
4. How does the frequency of vibration of a simple pendulum related with its length? Hence estimate the frequency of a second's pendulum.
5. In wave notation, SHM is given as $y = a \sin(\omega t - \varphi)$. Find its acceleration.
6. A SHM is represented as $y = a \cos(\omega t + \varphi)$ in wave notation. Find the acceleration.
7. Why are bells made of metal and not of wood? Explain.
8. On what factors does the period of a simple pendulum depend?
9. If length of a simple pendulum increases by 4 times its original length, will its time period change? If yes, by how much?
10. If a pendulum clock is taken to a mountain top, does it gain or lose time?
11. A body is moving in a circular path with constant speed. Is the motion simple harmonic? Why?
12. A pendulum clock is taken to moon. Will it gain or lose time?

Numerical:

1. A simple pendulum 2m long swings with an amplitude of 0.1m. Calculate the velocity of the pendulum at its mean point and its acceleration at extreme ends.
2. On an average a human heart is focused to beat 85 times in a minute. Calculate its frequency and time period.
3. One end of a light spring having spring constant 18 N/m is attached to a rigid support. A mass of 0.15 kg is suspended from the other end. The spring is stretched by 4 cm and released. The mass performs SHM.
   (i) Define SHM
   (ii) Calculate the maximum acceleration and time period of SHM
4. A simple pendulum of effective length 4m swings with an amplitude of 0.2m. Compute the velocity of pendulum at its lowest point. ($g = 9.8\ m/s^2$)
5. A bob of mass 0.4 kg performs SHM of amplitude 30 cm. The restoring force is 60 N. Calculate:
   (i) Time period
   (ii) The maximum acceleration
   (iii) Kinetic energy when displacement is 12 cm
6. A particle of mass 0.25 kg oscillates with a period of 2 sec. If its greatest displacement is 0.9m, what is maximum kinetic energy?
7. Calculate the period of oscillation of a simple pendulum of length 1.8m with a bob of mass 2.2kg. The bob is pulled aside a horizontal distance of 20cm and released. What will be the KE when the bob is at the lowest point?
8. An object moving with SHM has an amplitude of 0.02m and a frequency of 20Hz. Calculate:
   (i) the period of oscillation
   (ii) the acceleration at the middle and one end of an oscillation
   (iii) the velocities at the corresponding instants.
9. A body of mass 0.2kg is executing SHM with amplitude of 20mm. The maximum force which acts upon it is 0.064N. Calculate:
   (i) its maximum velocity
   (ii) its period of oscillation
10. A mass of 0.1kg oscillates in simple harmonic motion with an amplitude of 0.2m and a period of 10 sec. Calculate its maximum kinetic energy.

Diagrammatic Questions

(a) Define mass spring system.
(b) Derive an expression for the time period for vertical oscillation of a mass suspended from a coiled spring.
(c) A particle suspended from a vertical spring oscillates 10 times per second as shown in fig. At the highest point of oscillation the spring becomes unstretched. Calculate:
(i) the maximum speed of the block
(ii) speed when the spring is stretched by 0.20m (take $g = 9.8\ m/s^2$)
(a) Define simple pendulum and length of seconds pendulum.
(b) Derive an expression for time period of simple pendulum.
(c) Two identical simple pendulums are connected by an ideal spring of natural length d as shown in fig. Calculate the time periods of pendulums for equal small displacement motion along the same direction.

Fluid Statics

Definition

1. Define center of buoyancy.
2. State Archimedes' principle.
3. State law of floatation.
4. Define surface tension.
5. Define Poiseuille's formula.
6. State Stokes' law.
7. State Bernoulli's Theorem.
8. State Newton's formula for viscosity of liquid.
9. Define coefficient of viscosity.
10. State Pascal's law of pressure.
11. Define upthrust.
12. Define stream-lined flow and turbulent flow.

Derivation

13. Derive expression for the relation between surface tension and surface energy.
14. Derive expression for Poiseuille's formula.
15. Derive expression for coefficient of viscosity of liquid by Stokes' law.
16. Derive expression for law of floatation.
17. Derive expression for Reynold's formula.
18. Derivation of Stokes' law by using Dimensional method.
19. Derive expression for the Bernoulli's Theorem.
20. Show that $\mu = 2T\cos\theta / Drg$, where symbols have usual meaning.

Give reasons and short questions

21. Which give feeling of heaviness in case of a kilogram of cotton or a kilogram of lead? Why?
22. Why is bottom of ship made heavy? Explain.
23. A cork is floating in water. What is the apparent weight of cork?
24. A rigid, lighter than air balloon filled in helium can't continue to rise indefinitely. Why?
25. Why hot soup taste better than cold one?
26. Why is soap solution a better cleaning agent than ordinary water?
27. Explain why liquid drops are spherical in shape?
28. Antiseptics are used for cuts and wounds in human flesh have low surface tension?
29. Why mercury doesn't wet glass tube?
30. An airplane requires a long run-on ground before taking off. Explain.
31. Why is suction experienced by a person standing close to platform at a station when fast train passes?
32. Machines parts are jammed in cold day. Why?
33. The tip of nib of pen is split. Why?
34. The purity of gold can be tested by weighting in air and water. Why?

Numericals

1. An iceberg having volume 2.06 liters floats in sea water of density 1.03 gm/cm^3 with a portion of 224 cc above the surface. Calculate density of ice.
2. The density of ice is 971 kg m^{-3} and the approximate density of seawater in which an iceberg floats is 1025 kg m^{-3}. What fraction of iceberg is beneath the water surface?
3. A boy can lift a maximum load of 250 N of water. How many liters of mercury of density 13600 kg m^{-3} he can lift in an identical vessel?
4. Find work done required to break up a drop of water of radius 5×10^{-3} m into eight drops of water assuming isothermal condition.
5. Calculate the mass of an Aero plane with wings of area 55 m^2 flying horizontally. The velocity of air above and below wings is 155 m/s and 140 m/s respectively.
6. Two drops of same radius are falling through air with steady velocity of 40 m/s. If the two drops coalesce to form a larger spherical drop.
7. An air bubble of radius 1 cm is rising at a steady rate of 5 mm/s through a liquid of density 0.8 g/cm^3. Calculate coefficient of viscosity of liquid.
8. Calculate the work done in breaking a drop of water 2 mm diameter into million droplets of same size. The surface tension of water is 7.2×10^{-3} N/m.
9. A piece of gold–aluminium alloy weights 100 cc in air and 80 g in water. What is the weight of gold in the alloy if relative density of gold is 19.3 and that of aluminium is 2.5.

Diagrammatic Question

10. (a) Describe surface tension and surface energy. (b) Establish the relation between surface energy and surface tension. (c) Find the work done required to break up a drop of water of radius 5×10^{-3} m into eight drops of water, assuming isothermal condition.
11. A collapsible plastic bag (figure) containing a glucose solution of the average gauge pressure in the vein is 1.33×10^3 Pa. What must be the minimum height of the bag in order to infuse glucose into the vein? Assume the specific gravity of the solution is 1.02.
12. (a) Define the term Centre of buoyancy and metacenter. Why should the metacenter lie above the Centre of gravity of a floating body? (b) Explain the equation of continuity and its application. (c) Show a liquid being pushed out of a tube by pressing a piston. The area of cross-section of the piston is 1.0 cm2 and that of the tube at the outlet is 20 mm2. If the piston is pushed at a speed of 2 cm/s, what is the speed of the outgoing liquid?

Thermodynamics

First law of Thermodynamics

Definition:

1. State first law of thermodynamics?
2. Define isothermal process in thermodynamics with example?
3. Define adiabatic process in thermodynamics with example?
4. Define indicator diagram. Also draw indicator diagram.
5. What is mean by entropy. Also write the formula.
6. Define isobaric process?
7. Define isochoric process?
8. Define two specific heat capacity of the gas (Cp and Cv)
9. Define internal energy of the gas in thermodynamics.
10. Define reversible and irreversible process in thermodynamics.
11. State and explain zeroth law.

Derivation:

1. Derive an expression for work done by an ideal gas in an adiabatic process.
2. Derive an expression for work done by one mole of an ideal gas during isothermal expansion from V_1 to V_2.
3. Apply the first law of thermodynamics to relate the two specific heat capacity of a gas i.e. Cp - Cv = R
4. For an adiabatic process, show that PV^{γ} = constant, where symbols have their usual meaning.
5. Explain the work done by the gas by using indicator diagram.
6. Write the first law of thermodynamics in terms of entropy?

Give reasons:

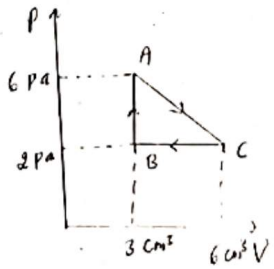
1. Does first law of thermodynamics follow the principle of conservation of energy? Explain.
2. Why is Cp always greater than Cv? Explain.
3. Adiabatic curve is much steeper than an isothermal curve. Why?
4. Can work done by the system without changing its volume?
5. What happens to the energy added to an ideal gas when it is heated at
   (i) constant volume
   (ii) constant pressure
6. Why does the temperature of a gas drop during an adiabatic expansion?
7. When a gas expands adiabatically, it does work on its surroundings. But if there is no heat input to the gas where does the energy come from?
8. Air escaping from a tiny hole of a tube is felt cool. Why?
9. Milk is poured into a cup of tea and is mixed with spoon. Is this an example of reversible process? Explain.
10. Is it possible to increase temperature of body without giving heat to it? Explain.
11. Why does internal energy remains constant in an isothermal system?
12. A cylinder filled with a gas is being carried inside a fast moving train, what change will be there in the internal energy of the gas.
13. Is internal energy of an ideal gas, the sum of kinetic energy and potential energy at a temperature greater than absolute zero? Explain.
14. When the air of the atmosphere rises up it cools. Explain it.
15. Can the temperature of isolated system change?
16. Why are the brake drums of vehicle heated when it moves down a hill at a constant speed?
17. When an electric fan is operated in a closed room, we feel cold. Why? Is there any fall in the temperature of the room?

Numerical:

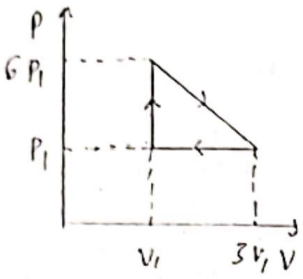
1. Five moles of an ideal gas are kept at constant temperature of 53°C while the pressure of the gas is increased from 1.00 atm to 3.00 atm. Calculate work done by the gas.
2. An ideal gas is slowly compressed at constant temperature of 50°C to one half of its original volume. In this process no heat was given. How much work was done and what was the change in the internal energy of the gas? Assume one mole of an ideal gas.
3. A monatomic ideal gas that is initially at a pressure of 1.50×10^5 Pa and has a volume of 0.08 m^3 compressed adiabatically to a volume of 0.04 m^3.
   (a) What is the final pressure?
   (b) How much work is done by the gas?
   (c) What is the ratio of final temperature of gas to its initial temperature?
4. A quantity of monatomic gas at 30°C is compressed suddenly to $(8/27)^{th}$ part of its initial volume. Find the change in temperature assuming $\gamma = Cp/Cv = 5/3$
5. Air compressed adiabatically to half of its volume. Calculate the change in its temperature.
6. A litre of air, initially at 20°C and at 760 mm of Hg pressure, is heated at constant pressure until its volume is double find
   (i) the temperature
   (ii) external work done by the air in expanding
   (iii) the quantity of heat supplied. Specific heat capacity at constant volume = 714 J/kgK
7. The density of an ideal gas is 1.6 kg/m^3 at 27°C and 10^5 N/m^2 pressure. Its specific heat capacity at constant volume is 312 J/kgK. Find the ratio of the specific heat at constant pressure and constant volume.
8. If the ratio of specific heat capacities of a gas is 1.4 and its density at STP is 0.09 kg/m3 calculate the values of specific heat capacities at constant pressure and constant volume.
9. The density of a gas is 1.775 kg/m^3 at 27°C and 10^5 N/m^2 pressure. If the specific heat capacity at constant pressure is 846 J/kgK find the ratio of specific heat capacity at constant pressure to that at constant volume.

Diagrammatic Question

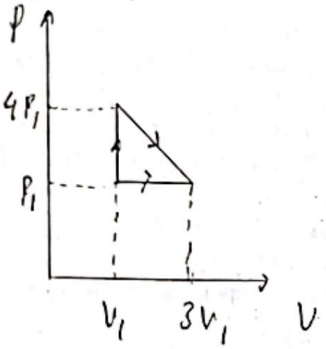
1. An ideal gas is taken through series of changes represented in diagram. The work done by the gas at the end of cycle is



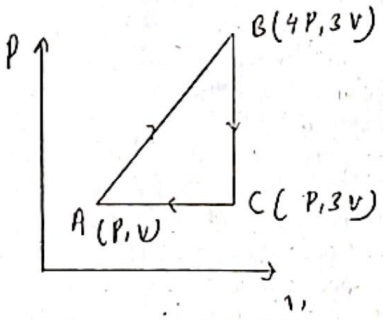
2. An ideal liquid taken through series of changes represented in diagram. The work done by the gas at the end of cycle is



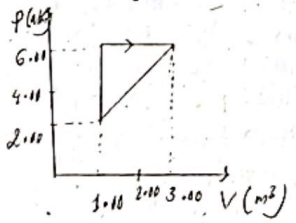
3. An ideal gas is taken through series of changes represented in the diagram below. The net work done by the gas at the end of the cycle is equal to



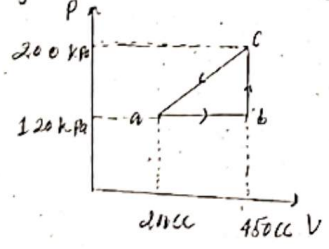
4. An ideal gas is taken through series of changes represented as shown in fig. The net work done by the gas at end of cycle is equal to



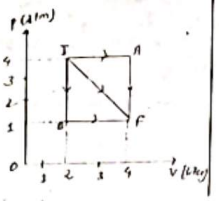
5. A gas increases in pressure from 2.00 atm to 6.00 atm at a constant volume of 1.00 m³ and then expand to a volume 3.00 m³ before returning to its initial state as shown in figure. How much work is done in one cycle.



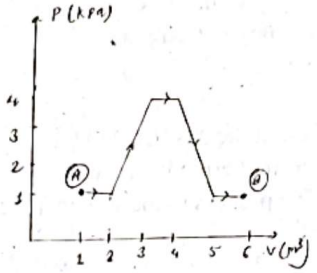
6. Calculate the work done by a gas as it is taken from the state a to b, b to c and c to a as shown in figure.



7. A gas expand from I to F along the three paths indicated in figure. Calculate the work done on the gas along path (a) IAF, (b) IF, (c) IBF

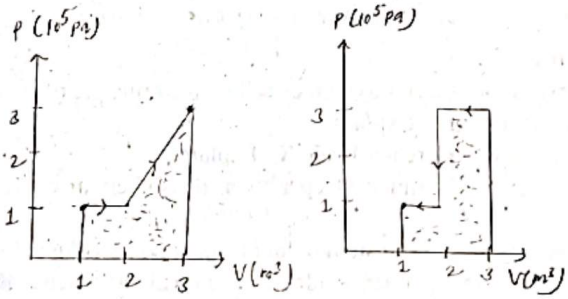


9. A cylinder containing 10.0 moles of a monatomic ideal gas expands from A to B along the path shown in figure.

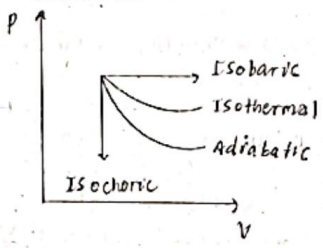


10. (i) Find the temperature of the gas at point A and the temperature at point B.
11. (ii) How much work is done by the gas during this expansion.
12. (iii) what is the change in internal energy of the gas
13. (iv) Find the energy transferred to the gas by heat in this process

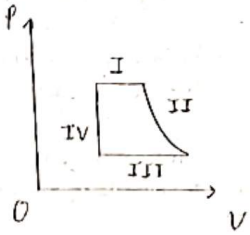
14. Compute the workdone on the system infig (a) and (b)



15. In which of the following process of the gas, work done is maximum.



16. In the given PV-diagram which of the labelled parts of the cycle Identify Isochoric changes and adiabatic changes of state.



Second law of Thermodynamics

Definition:

1. Define second law of thermodynamics according to Kelvin's statement and Clausius statement?
2. Define heat engine and its components.
3. Efficiency of heat engine?
4. Define Carnot engine?
5. Define Carnot cycle with diagram.
6. Define petrol engine with different component.
7. Define diesel engine with different component.
8. Define refrigerator?
9. Define entropy for second law of thermodynamics.
10. Define kelvin scale temperature.

Derivation:

1. Derive and explain the efficiency of heat engine.
2. Derive and explain the working principle of Carnot engine.
3. Derive and explain the PV-diagram of Carnot's cycle.
4. Find the efficiency of Carnot's cycle.
5. Derive and explain the working principle of petrol engine.
6. Derive and explain the PV-diagram of petrol engine.
7. Derive and explain the working principle of diesel engine.
8. Derive and explain the PV-diagram of diesel engine.
9. What is the efficiency of refrigerator.
10. Draw the schematic diagram of refrigerator.
11. Derive and explain entropy in cyclic process.

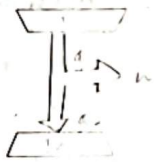
Give reasons:

12. Why not an ideal heat engine is cent percent efficient?
13. Why does a refrigerator consume more power in summer than in winter to cool the same quantity of food by same degree
14. Can a room be cooled by leaving the door of an electric refrigerator open? Justify.
15. Spark plugs not necessary in a diesel engine. Why?
16. Petrol engine is less efficient than diesel engine. Explain why.
17. Can the Carnot engine be realized in practice?
18. On what factors, the efficiency of Carnot engine depends?
19. Why conversion of heat into work not possible without a sink at lower temperature.
20. Is it possible to construct a heat engine that creates no thermal pollution?

Numerical

1. A Carnot's engine has 25% efficiency with a sink at 9°C. By how many degrees should the temperature of the source be increased in order to raise the efficiency to 50%.
2. Two Carnot's engines A and B have their source 400 K and 360 K, and sinks at 350 K and 300 K respectively. Which engine is more efficient and by how much.
3. A Carnot engine working between 300 K and 600 K has a work output of 800 J per cycle. What is the amount of heat energy supplied to the engine from source per cycle.
4. The efficiency of a Carnot cycle is 15%. If on reducing the temperature of sink by 65°C the efficiency becomes double. Find the temperature of source and sink.
5. For a Carnot ideal engine, temperature of sink at temperature 27°C and source is at temperature 127°C. Calculate its efficiency.
6. A diesel engine performs 2500 J of mechanical work and discards 4000 J of heat each cycle.
   (i) How much heat must be supplied to the engine each cycle
   (ii) what is the thermal efficiency of the engine?
7. A Carnot engine takes 10^3 calories of heat from a reservoir at 227°C and rejects heat to a reservoir at 27°C. How much work is done by it?
8. A petrol engine consumes 10 kg petrol in one hour. The calorific value of petrol is 11.4×10^3 cal/kg. The power of the engine is 20 kWatts. Calculate the efficiency of the engine.
9. A Carnot engine works between 800°C and 40°C. If it possible either to increases the source temperature by 50°C or to decrease the sink temperature by 50°C which of these actions will be causing more increase in the efficiency? Justify your answer.

Diagrammatic question



1. (a) A refrigerator transfers heat from a cold body to hot body. Does this not violate the second law of Thermodynamics? Give reason.
   (b) In the given figure, a heat engine absorbs Q_1 amount of heat from a source at temperature T_1 and rejects Q_2 amount of heat to a sink at temperature T_2 doing some external work W.
   (i) Obtain an expression for the efficiency of this heat engine.
   (ii) Under what condition does the efficiency of such engine become zero percentage.
2. Two different adiabatic paths for the same gas intersects two isothermal as T_1 and T_2 as shown in the P-V diagram. How does the ratio (V_a/V_d) compare with the ratio (V_b/V_c) ?
3. An ideal engine works between temperatures T_1 and T_2. It drives an ideal refrigerator that works between temperatures T_3 and T_4 as shown in fig. Find the ratio Q_3/Q_1 in terms of T_1, T_2, T_3 and T_4
4. A thermodynamics system is taken from an original state to an intermediate state by the linear process as shown in figure. Its volume is then reduced to the original value from E to F by an isobaric process. Calculate the total work done by the gas from D to E to F
5. What is the thermal efficiency of an engine that operates by taking n moles of diatomic ideal gas through the cycle 1 → 2 → 3 → 4 → 1 shown in figure.
6. A heat engine contains an ideal monatomic gas confined to a cylinder by a movable piston. The gas starts at A, where $T = 3.00 \times 10^2$ K (fig.) The process B → C is an isothermal expansion.
   (a) Find the number n of moles of gas and the temperature at B.
   (b) Find ΔU, Q, and W for the iso-volumetric process A → B.
   (c) Repeat for the isothermal process B → C

Wave Motion

Definition

1. What is wave?
2. What is mechanical wave?
3. Define:
   (i) Progressive wave
   (ii) Stationary wave standing wave
   (iii) Transverse wave
   (iv) Longitudinal wave
   (v) Nodes & Antinodes
4. Difference between transverse waves and longitudinal wave.
5. Distinguish betweens and stationary waves.
6. Distinguish between light waves and Sound waves.

Long questions:

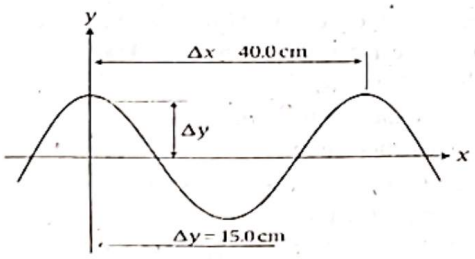
7. Derive an equation for a. .
8. Derive stationary wave equation and show the condition of node and Antinodes.

Give Reason

9. We can't hear echo in a small room. why?
10. If you are walking on the moon surface, can you hear the cracking sound behind you? Explain.
11. Frequency is the most fundamental property of a wave. Why?
12. What types of waves propagate in liquids, explain?
13. Do sound waves undergo reflection, refraction & polarization phenomena? Explain.
14. A wave transmits momentum. Can it transfer angular momentum?
15. Longitudinal waves are also called pressure waves. why?
16. Bells are made of metal and not of wood. why?
17. A radio station broadcast at 800 kHz. what will be the wavelength of the wave?
18. A plane equation is given by Where y is in centimetres, x in meters and t in seconds. What is the speed of the wave?

Numerical Problems

1. A wave has the equation (x in meters and t in seconds) Find
   (i) its frequency, speed and wave length.
   (ii) The equation of wave with double the amplitude but travelling in the opposite direction.
2. Calculate the frequency of Source if the average distance between successive minima is 1.5cm and the speed of the electromagnetic wave in air = 3×108 ms-1?
3. A wave traveling in the positive x-direction is pictured in figure. Find the amplitude, wavelength, speed, and period of the wave if it has a frequency of 8.00Hz. In Figure, $\Delta x = 40.0$ cm and $\Delta y = 15.0$ cm



Mechanical Waves

Long question

1. Velocity of Sound wave in any Medium by dimensional Method.
2. Newton's Formula for velocity of Sound in Gas.
3. laplace Correction and Factors Affecting the velocity of Sound in crases.
   (i) Effect of Temperature.
   (ii) Effect of Pressure.
   (iii) Effect of density of gas.
   (iv) Effect of Moisture or Humidity
   (v) Effect of wind.

Give Reason:

1. Velocity of Sound in Solids is more than that in liquids, why?
2. Discuss the effect of temperature and pressure on velocity of sound in a gas.
3. When sound waves travel through a medium, does the temperature at various points remains constant? Explain.
4. Why does sound travel faster in metals than in air?
5. What is the velocity of Sound in solids, liquid and gases?
6. Velocity of Sound increases on a cloudy day, why?
7. Do sound waves need a medium to travel from one point to other point in space? What properties of the medium are relevant?
8. Explosions on other planets are not heard on the earth. Why?

Numerical Problems

1. Calculate the wavelength of wave in air at 25°C if the frequency of Sound wave is 256 Hz and velocity of Sound at 0°C is 330 ms^{-1}.
2. When a detonator is exploded on a railway line, an observer standing on the rail 2Km away hears two sounds. What is the time interval between them?
   (Young's modulus of steel = 2×10^{11} N m^{-2}).
3. A source of sound produces a note of 512 Hz in air at 17°C with wavelength 66.5 cm. Find the ratio of molar heat capacities 't' constant pressure to constant Volume at NTP. Densities of air and Mercury at NTP are 1.293 kg/m^3 and 13600 kg/m^3 respectively.
4. Calculate the bulk modulus of a liquid in which longitudinal waves with frequency of 250 Hz have the wavelength of 8m and the density of liquid is 900kgm^{-3}.
5. In a resonance air column apparatus, the first and Second resonance positions were observed at 18cm and 56 cm respectively. The frequency of tuning fork used was 480Hz. Calculate the velocity of Sound in air and end correction of the tube.
6. What is the difference between the Speed of longitudinal wave in air at 27° and at -13°C? what is the seed of 0°C?
7. In a stormy day a person observes a lightning flash which is followed a thunder 3s later. How would you estimate the distance of the lightning striking from the person.
   [velocity of sound = 340m/s, velocity of light = 3×10^8 m/s]
8. At what temperature, the velocity of Sound in air is increased by 60% to that at 27°C?
9. The speed of Sound in air at 20°C was found to be 344m/s. What is the change in speed for a 1.0°C Change in air temperature?
10. Find the ratio of velocity of Sound in Oxygen, O_2 to the velocity of Sound in hydrogen, H_2 under Similar Conditions. Given, that 22.4 litre of oxygen weighs 32 gm and that of hydrogen 2gm.
11. A man standing at One end of a closed corridor 57m long blew a short blast on a whistle. He found that the time from the blast to the Sixth echo was two seconds. If the temperature was 17°C, what was the velocity of Sound at 0°C?
12. The velocity of Sound in air Saturated with water vapour at 30°C is 340m/s. If the atmospheric pressure is 65 cm of mercury and Saturated vapour pressure of water at 30°C is 31.7mm of mercury. Calculate the velocity of Sound in dry air at 0°C.

Waves in Pipes and Strings

You Must Remember

Definition

1. what is organ pipe. Example.
2. Define :

(i) closed Organ Pipe

(ii) Open Organ Pipe

3. what do you mean by harmonics and overtones?
4. What is End correction.
5. What are stationary wave.
6. What is Resonance?
7. Differentiate between forced vibration and free vibration
8. State the laws of transverse vibration in a stretched String.
9. State and explain principle of superposition and formation of stationary waves.
10. What is Node and Antinode?
11. Write:
    (a) Law of Length
    (b) Law of Tension
    (c) Law of mass per unit length

Long question

1. Modes of Vibration in Open organ pipe with End correction.
2. Modes of Vibration in closed organ pipe with End Correction.
3. Describe various modes of Vibration in a stretched String.
4. Verification of the laws of vibration of a fixed Stretched String using Sonometer.
5. Resonance Air Column Tube.
6. Using only dimensions show that the speed of propagation of a transverse wave depends only on tension and mass per unit length.

Numerical

1. A steel wire of length 1m long has a mass of 80gm and is stretched with a tension of 1000N . Calculate the fundamental frequency of transverse vibration.
2. A sonometer of density 9gm/cm^3 and length 1m is subjected to an extension of 0.05cm . What is the lowest frequency of transverse vibration in the wire? Assume Young's modulus, Y = 9×10^{10} Nm^{-2}.
3. Guitar string of length 1.5m is made of steel of density 7800kg/m^3 and Young's modulus 2×10^{11} N/m^2. It produces an elastic strain of 1% in the string. Calculate.
4. In a resonance tube experiment, the first and second resonance positions were observed at 17cm and 52.6 cm respectively. The frequency of tuning fork used was 512 Hz and the room temperature was 27°C. Calculate the velocity of sound in air at room temperature and end correction of the pipe. What would be the velocity of sound in air if the temperature drops to 0°C?
5. wheat is the ratio of length of two pipes, an open organ pipe A and a closed organ pipe B both vibrating in third overtones are in resonance? Justify.
6. An organ pipe open at both ends in 0.5m long. what is the fundamental frequency if velocity of sound is 350m/s?
7. A cord of length 1.5m is fixed at both ends. Its mass per unit length is 1.2g/m and the tension is 12N.
   (a) what is the frequency of fundamental oscillation?
   (b) what tension is required if the n=3 mode has frequency of 0.50kHz?
8. One day when speed is 340m/s the fundamental frequency of a closed organ pipe is 220Hz

(a) How long is this pipe?

(b) The second overtone of this pipe has the same wavelength as third harmonic of an open pipe. How long is the open pipe?

9. An Open pipe 30 cm long and a closed pipe 23 cm long, both of the same diameter, each sounds their first overtone. If they are in resonance, find the end correction of these pipes.
10. A uniform tube 60cm long stands vertically with its lower end dipping into water. When the length above the water is 14.8cm and again when it is 48cm, the tube resounds to a vibrating tuning fork of frequency 512Hz. Find the lowest frequency to which the tube will resound when it is open at both ends.
11. A piano string has a length of 2.0m and density of 800kgm^{-3} When tension in the string produces a string of 1% , the fundamental note obtained from the string in transverse vibration is 170Hz. Calculate the Young's modulus value for the material of string.
12. An organ pipe is tuned to a frequency of 440Hz when the temperature is 27°C. Find its frequency when the temperature drops to 0°C. Assume both ends of the pipe open.
13. A wire with mass 40g is stretched so that its end is tied down at points 80 cm apart. The wire vibrates in its fundamental mode with frequency 60Hz. Calculate the speed of propagation of transverse wave in the wire and the tension in the wire.
14. A wire of diameter 0.04 cm and made of steel of density 8000 kgm^{-3} is under constant tension of 80N. A fixed length of 50 cm is set in transverse vibration. How would you cause the vibration of frequency about 840 Hz to predominate in intensity?

Acoustic Phenomena

Definition

1. What is acoustics?
2. Define Doppler's effect' write two uses of it.
3. Define One bel. what is threshold of hearing.
4. What are infrasonic and ultrasonic waves?
5. What is quality of Sound?
6. Define intensity of Sound.
7. What is Musical Sound?
8. What is Noise?
9. Difference between Intensity of Sound and Loudness.
10. Difference between Pitch and frequency.
11. What is Threshold of Hearing?

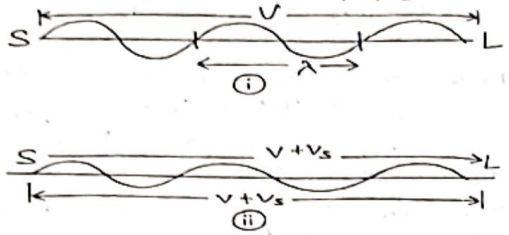
Long question

1. Derive an expression for apparent frequency heard,
   i) when source in motion and observer at rest.
   ii) when Source is moving away from observer.
   iii) when observer in motion and source at rest.
   iv) when observer is moving toward stationary source.
   v) when observer is moving away from stationary source.
   vi) Both source and observer are in motion.
   vii) Both source and observer approaching towards each

other.

viii) Source moving away from the observer and observer toward the source.

2. In the given figure below, figure (i) represents a situation that both Source of Sound (S) and listener (L) are at rest position 'S' and 'L' respectively. Figure (ii) represents relative motion between moving source and stationary listener.
   i) Does the pitch of Sound changes to the listener in Second case? Justify.
   ii) Develop an expression to support our arg ().
3. Write any two properties of medium which is necessary for the propagation of Sound.



4. Define intensity of Sound and show that $I = \frac{1}{2} \rho v r^2 \omega^2$ where symbols have their usual meaning.
5. Describe sound wave as pressure wave and deduce an expression for the pressure amplitude.
6. How are beats formed when two waves are Superimposed? Deduce expression for the frequency of beats so formed.

Give Reason

7. Sound waves are called pressure wave. why?
8. In what condition Doppler effect is not applicable.
9. Calculate the apparent frequency when a source moves towards
10. (a) stationary observer.
11. why does an empty vessel produce louder Sound than the filled one?
12. How is it that one can recognize a friend from his voice without seeing him?
13. write down the factors on which the Speed of Sound in air depends.
14. Can you distinguish two notes, one produced by violin and the other by a sitar, having the same frequency? Explain.
15. How can bats fly around without colliding with objects that come in their way?
16. Why is the voice of a woman more intelligible than that of a man?
17. Explain the difference in characteristics between ultrasonic and supersonic waves.
18. whistle of an approaching train is shriller, why?
19. If the pressure amplitude of a Sound wave is halved, by what factor does the intensity of the wave change?
20. If the pressure amplitude of a Sound wave is halved, by what factor does the intensity of the wave change?
21. A tuning fork has two prongs. why?
22. Bats catch their prey in the dark even when they don't see the prey. How can this happen?
23. Is there a physical difference between intensity and intensity level of a wave? How are these quantities related?
24. How are beats produced? what is beat frequency?
25. Two notes, one produced by violin and other by a Sitar, may have the same frequency, yet we can distinguish between them. why?
26. Why is the roaring of a lion different than the Sound of a mosquito?
27. which has a more direct influence on the loudness of a sound wave: the displacement amplitude or the pressure amplitude? Explain your reasoning.

Numerical

1. The noise from an airplane engine 25.0m from an observer is found to have an intensity of 45.0 db. What will be the intensity in decibel when the plane flies overhead at an altitude of 2.0 km?
2. A note produces 2 beats with a tuning fork of frequency 480Hz and 6 beats/s with a tuning fork of 472Hz. Find the frequency of the note.
3. The intensity level from a loud speaker is 100 dB at a distance of 10m. What is its intensity level at a distance of 200m?
4. when a jet plane is flying on elevation of 1000m the sound level on the ground is 40 db. what could be the intensity level on the ground when its elevation is as low as 100m?
5. A car travelling at $20ms^{-1}$ blows its horn which has a frequency of 600Hz. A stationary Observer notices that the frequency of the horn changes considerably as the car passes by him. Calculate the change in frequency heard by the observer as the car approaches and moves away from the observer. (given velocity of sound = $330ms^{-1}$)
6. A stationary motion detector sends Sound waves of 150Hz towards a truck approaching at a speed of 120Km/hr. what is the frequency of wave reflected back to detector? (velocity of Sound in air = 240m/s)
7. A car travelling at 20m/s sounds its horn which has a frequency of 600Hz. what frequency is heard by a stationary distant observer as the car approaches? velocity of Sound = 340m/s.
8. (i) A sound source producing 1000Hz waves moves toward a stationary listener at one-half the speed of Sound. what frequency will the listener hear?
9. (ii) Suppose instead that the source is now stationary and the listener moves towards the Source at one-half the speed of sound. what frequency will the listener hear?
10. (iii) How does your answers in part (i) and (ii) compare? Explain on physical grounds, why these two answers differ?
11. A car is approaching towards a cliff at a speed of 20m/s. The driver sounds a whistle of frequency 800Hz. Calculate the frequency of echo as heard by the car driver. (velocity of Sound in air 350m/s)
12. A car is sounding its horn has a frequency 400Hz and traveling towards a stationary traffic post. A traffic police at the post detects the change in frequency of 60Hz when the car crosses him. Find the velocity of car if velocity of Sound in air is 340m/s.
13. A Source having frequency 240Hz is moving towards an observer with a speed of 10m/s. when the observer is moving away the source with a velocity of 30m/s, then find the apparent frequency heard by observer if velocity of Sound in air is 340m/s.
14. A Car is Sounding a horn of Frequency 500Hz and travelling towards a stationary observer with Speed 20m/s. what is apparent frequency heard by the observer? (velocity of Sound in air = 340m/s)
15. A train is approaching a cliff at 10m/s. The driver Sounds a whistle of frequency 600Hz. what will be the frequency of echo as heard by the driver? (velocity of Sound in air = 340m/s)

Nature and propagation of light

Definition:

1. Define Huygen's principle?
2. What is mean by wave front and wavelets?
3. What is mean by Quantum Theory in wave?
4. Define Dual nature of light?
5. Define electro magnetic spectrum?
6. Define spherical wave front?
7. Define cylindrical wave front?
8. Define plane wave front?
9. State the laws of reflection on the basis of wave Theory?
10. State the law of refraction on the basis of wave Theory?

Derivation:

1. Apply Huygen's principle to verify the law of reflection of light.
2. Apply Huygen's principle to verify the law of refraction of light.
3. State an explain Huygen's principle.

Reason and short question:

1. If light travels from one medium to another, its velocity changes? Is it dae to change in frequency or wavelength? Explain.
2. A normally incident wavefront does not deviate when it travels from one medium to another. Explain.
3. When monochromatic light incidents on a surface, the reflected and refracted wave will have same frequency, why?
4. Which parameter of light does not change on reflection?
5. How can a plane wavefront be converted into a spherical wave front? Justify
6. How can a spherical wavefront be changed into plane wavefront? Draw a diagram or justify your answer.
7. Differentiate between a plane wave front and a spherical wave front
8. Distinguish between wavefront and wavelets.
9. Does the amplitudes of vibration over a given wavefront remains constant?
10. Can two wavefronts cross one another? Give reasons
11. How is the direction of a ray related with the wave front?
12. What is the geometrical shape of wavefront of light emerging out of a convex lens, when point source is placed at its focus?
13. Write the nature of phenomenon that confirms the wave nature of light
14. Is the speed of light in glass independent of the colour of light? If not which two colours red and violets slower in a glass prism?

Numerical

15. The speed of light in air is 3×10^8 m/s. What will be its speed in diamond whose refractive index is 2.42?
16. The wavelength of yellow light in air is 6.0×10^{-7} m. Calculate its wavelength in water of refractive index 1.33
17. Light travelling through a pool of water in a parallel beam is incident on the horizontal surface. Its speed in water is 2.2×10^8 m/s. Calculate the maximum angle which the beam can make with the vertical if light is to escape in to the air is 3×10^8 m/s

Interference

Definition

1. Define superposition principle?
2. Define coherent sources?
3. Define interference of light?
4. Define constructive interference?
5. Define destructive interference?
6. Define path difference and phase difference?

Derivation

1. Prove that bright and dark fringes are equally spaced in young's double slits experiment

Give reason and short question:

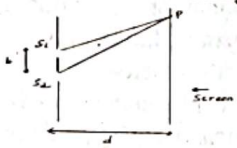
1. Can two independent source of light produce interference?
2. Why have two source of light to be closed to each other for the production of good interference pattern?
3. What are the conditions for constructive and destructive interference of light wave?
4. Can two different bulbs, similar to all respects, act as coherent source?
5. Write suitable conditions for interference?
6. The bright and dark fringes are equally spaced. Justify this statement from young's double slits experiment.
7. Define interference of light? Does it follow the principle of conservation of light energy? Justify your answer.
8. In young's double slits experiment, bright and dark bands are formed on a screen due to interference of light. When the whole apparatus is immersed in a liquid, what will be the effect on the fringe width?
9. In young's double slits experiment, what change will you observe in fringe width for the following operation.
   (i) When experiment is shifted from air to inside water
   (ii) When slits width is increased
10. What changes in the interference pattern observed in young's double slit experiment when light of smaller frequency is used.
11. In young's double slit experiment, how is the fringe width altered if the separation between the slits is double and the distance between the slits and the screen is halved?
12. What happens on the interference fringes in a young's double slit experiment
    (i) When the screen moved away.
    (ii) The source is replaced by another source of shorter wavelength?
13. Distinguish between interference and diffraction
14. What are the factors affecting the fringe width in interference?
15. Explain the statement, light added to light can produce darkness.
16. What is the ratio of the fringe width for bright and dark fringes in young's double slit experiment?
17. Can two coherent sources can be obtained from one incoherent source.
18. Is it true that both diffraction and interference are involved in young's double slit experiment

Numerical

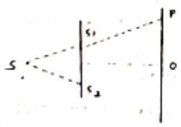
19. In young's slit experiment, the separation of the first to fifth fringes is 2.5 mm when the wave length used is 620 nm. The distance from the slits to the screen is 80 cm. Calculate the separation of two slits
20. In young's double slit experiment the slits are 0.03 cm apart and the screen is placed 1.5 m away. The distance between the central bright fringe and fourth bright fringe is 1 cm. Calculate the wave length of light used.
21. In young's experiment two slits spaced 0.45 mm apart are placed 75 cm from a screen. What is the distance between second and third dark lines in the interference pattern on screen when slits are illuminated with light of 500 nm?
22. Two coherent sources A and B of radio waves are 3 m apart. Each source emits waves with wavelength 6 m; consider points along the line between two sources. At what distances, if any from A is the interference constructive.
23. In a two slits interference experiment, the slits are 0.200 mm apart and the screen is at a distance of 1.00 m. The third bright fringe is found at 9.49 mm from the central fringe; find wavelength of the light used.
24. Two waves are represented in usual notation as $y_1 = a \sin\omega t$ and $y_2 = a \cos\omega t$. The intensities are I_1 and I_2 what would be the ratio of their amplitude when $I_1 = 2I_2$?
25. Two coherent waves. Each of intensity I, are producing an interference pattern, what will be the intensity at a point of.
    (i) Constructive interference?
    (ii) Destructive interference?

Diagrammatic question:

26. White light is used to illuminate two slits in a Young's double slits experiment as shown in fig. At a point on the screen directly in front of one of the slits. Certain wavelengths are missing. Calculate some of these missing wavelengths?



27. An experimental set up similar to young's double slits experiment to observe interference of light is an shown in fig. Such that $SS_2 - SS_1 = \lambda/4$ what are the conditions of
    (i) Constructive interference.



    (ii) Destructive interference at any point b in terms of path difference $(SS_2 - SS_1)$?
    (iii) Does the central fringe observed in the above set up lie above or below point O? Give reason.

Physics	Wave & Optics

Diffraction

Definition

1. What is diffraction of light.
2. Define:
3. (a) Central maxima.
4. (b) Secondary maxima and minima.
5. Define:
6. (a) Interference
7. (b) Diffraction grating
8. Distinguish between interference and diffraction.
9. Difference between the interface and diffraction.
10. Distinguish between Fresnel diffraction and Fraunhofer diffraction.
11. Huygen's principle.

Long question:

1. What is diffraction grating? Discuss the formation of diffraction pattern due to a diffraction grating
2. Discuss the diffraction of light through a single slit.
3. Two narrow slits are illuminated by a single monochromatic source of light.
   (a) Name the pattern obtained on the screen and explain how these patterns are obtained?
   (b) One of these slits is now completely covered. Name the pattern obtained on the screen.
   (c) Write the difference between the patterns obtained in the above two cases on the basis of Huygen's principle.
   (d) Suppose a monochromatic light of wavelength "λ" is incident normally on a narrow slit of width 'd' and focused on a screen. Derive condition for the first minimum of intensity on the screen in terms of wavelength λ and angle of diffraction θ.

Give Reason

1. Radio waves diffract around buildings but not light waves, why?
2. what is the fundamental (physical) between interference and difference diffraction? Explain with figures.
3. Light waves undergo diffraction around an edge. Can sound wave diffract around an edge. Explain:
4. Why is diffraction of sound wave easier to observe than that of light waves?
5. what are the characteristic elements associated with a diffraction grating? How is plan transmission grating constructed?
6. Describe what happens to the single slit diffraction pattern when the width of the slit is less than the wave length of the wave.
7. Diffraction grating is better than a two-slit set up for measuring the wave length of a monochromatic light. Explain.
8. Yellow light is used in a single slit diffraction experiment with slit width of 0.6mm. If yellow light is replaced by X-rays, how will the diffraction pattern be affected?
9. Does the speed of light in vacuum depend on relative motion between Observer, source and Observer.
10. What happens to Fraunhofer single slit diffraction pattern if the whole apparatus is immersed into water?
11. Coloured Spectrum is seen when we look through a muslin cloth. why?

Numerical

1. A parallel beam of Sodium light is incident normally on a diffraction grating. The angle between the two first order spectra on either side of the normal is 27°42'. Assuming that the wavelength of light is 5.893×10^{-7} m, find the number of rulings per mm on the grating?
2. How wide is the central diffraction peak on a screen 3,5m behind a 0.01mm slit illuminated by 500nm light?
3. A plane transmission grating having 500 lines per mm is illuminate normally by light source of 60 nm wavelength. How many diffraction maxima will be observed on a screen behind the grating?
4. For a certain grating a second order green line is found at 41°. At what angle will a first order yellow line be found? wavelength of green light is 546nm and that of yellow light is 589nm.
5. Calculate the width of central diffraction peak on a screen 4m behind a 0.01m slit illuminated by 600nm light source.
6. A monochromatic light of wavelength 5890 Å is incident normally on a diffraction grating which has 6000 lines per centimetre. (i) At what angle will the second order image be seen? (ii) Is third order image possible with this grating?
7. A diffraction grating has 600 lines per mm and is illuminated normally by monochromatic light of wavelength 700nm. Calculate the diffracting angle for the first order spectrum and the maximum number of orders that will be visible.
8. A parallel beam of monochromatic light is incident on diffraction grating having 500 lines/mm to get second order maxima at 30°. Calculate the wavelength of light used.
9. A screen is placed 2m away from the single narrow slit. Calculate the slit widths if the first minimum lies 5mm on either side of the central maximum. Incident plane waves have a wavelength of 5000 Å.
10. Two spectral lines of sodium D_1 and D_2 have wavelengths of approximately 5890 Å and 5896 Å. A Sodium lamp sends incident plane wave on to a slit of width 2 micrometre. A screen is located 2m from the slit. Find the spacing between the first maxima of two Sodium lines as measured on the screen.

Physics | Wave & Optics

Polarization

Definition

1. what is polarization of light?
2. Define:
3. a) polarised light & its representation
4. b) Unpolarised light
5. Define:
6. a) plane of vibration
7. b) plane of polarisation
8. State Brewster's law.
9. State Malus law.
10. Difference between Unpolarized and polarized light.
11. what is polarizing Angle? Does it depend on the wavelength of light used?

Long question

1. Prove that light is a transverse wave.
2. Malus law.
3. Brewster's law.

Give Reason

1. Is there any difference between analyzer and a polarizer? Explain.
2. In which medium is the angle of polarization greater, rarer or denser?
3. Are light wave longitudinal? Justify answer.
4. Can sound wave be polarized? Explain.
5. Is polarization possible for longitudinal waves? Explain.
6. Sun glasses are made of polaroid, not of the coloured glasses. why?
7. Does the value of polarising angle depend upon colour (wavelength) of incident light?
8. Can ultrasonic waves be polarised?
9. How will you verify that light coming from the sky is partially polarized?

Numerical

10. Calculate the polarizing angle for light travelling from water of refractive index 1.33 to glass of refractive index 1.53.
11. The critical angle for light in a certain substance is 45°. what is the polarizing angle?
12. A beam of light is incident at polarizing angle on a piece of transparent material of refractive index 1.62. what is the angle of refraction for the transmitted beam?
13. The critical angle for light in a certain substance is 45°, what is the polarizing angle?
14. The polarizing angle for glass is 57.5°. what is its refractive index? Also find the angle of refraction.
15. The critical angle of water is 48°c. what is the polarizing angle?
16. The refractive index of the material of the polariser is 1.54. what is the polarizing angle?
17. A beam of light is incident at polarizing angle on a piece of transparent material of refractive index 1.62. what is the angle of refraction for the transmitted beam?

Physics | Electricity and Magnetism

Electrical Circuits

Definition

1. State any two Kirchhoff's law of electrical circuit.
2. State Wheatstone bridge principle.
3. State meter bridge principle.
4. Define potentiometer and voltmeter.
5. Define end correction of meter bridge.
6. Define potential gradient.
7. State Joule's law of heating.

Derivation

1. Obtain expression for the balanced condition of Wheatstone bridge using Kirchhoff's laws.
2. Express the potential gradient in terms of specific resistance of potentiometer wire.
3. Convert galvanometer into ammeter.
4. Verify Joule's law of heating.
5. Derive Kirchhoff's law (both based on conservation of charge

and conservation of energy).

6. Obtain the expression for the meter bridge.

Give Reasons

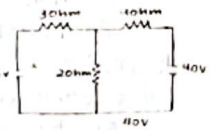
1. Equal length of silver wire and iron wire having same diameter are connected in series to a dry cell. Which wire becomes hotter?
2. How can galvanometer converted into voltmeter? Explain.
3. If the length of wire be doubled, what will be the effect on the position of zero deflection in potentiometer?
4. A voltmeter has high resistance. Why?
5. An ammeter is always connected in series. Why?
6. The resistance of ammeter must essentially be very small. Why?
7. Why voltmeter is always connected in parallel with load resistance?
8. Wheatstone bridge is not suitable for measuring high resistance. Why?
9. Why do we use connecting wires made of copper?
10. It is better to get the null point in middle of wire in a meter bridge. Why?
11. Why are copper strips on meter bridge made thick?
12. Wheatstone bridge is not suitable for measuring very low resistance. Why?
13. Why do we prefer potentiometer of longer length for accurate measurement?
14. Why should the cross section of potentiometer wire be uniform?
15. What is internal resistance of a cell? How can you measure the internal resistance of cell by using potentiometer?
16. What happens when a voltmeter is connected in a series circuit?
17. Why is the potentiometer preferred to a voltmeter to measure the emf of a cell?
18. If the current flowing in the wire of a potentiometer wire be decreased, what will be the effect on the position of zero deflection in potentiometer? Explain.

Numerical

1. Two batteries of 7V and 13V with internal resistance 1Ω and 2Ω respectively are connected in parallel with a resistance of 12Ω. Find the current through each branch and potential difference across 12Ω.
2. What must be the emf E in the circuit so that the current flowing through the 7Ω resistor is 1.80A? Each emf source has negligible internal resistance.
3. A potentiometer is 10m long. It has a resistance of 200Ω. It is connected in series with a battery of 3V and resistance of 20Ω. What is the potential gradient along the wire?
4. An unknown resistance R1 is connected in series with resistance of 10Ω. This combination is connected to one of the gaps of a meter bridge, while another resistance R2 is connected to next gap. The balanced point is obtained at 50cm. Now when 10Ω resistance is removed the balanced point is 40cm. Find the value of R1.
5. A potentiometer is used to measure the internal resistance of a cell. When the cell is short circuited by 50Ω resistor, the null point is at 220cm. Again when the cell is shunted by 200Ω resistor, the null point is at 300cm. What is the internal resistance of cell?
6. A galvanometer has a resistance of 10Ω. It gives maximum deflection for a current of 50mA. Find the shunt resistance to convert it into ammeter of range 2.5A.
7. The emf of a battery is balanced by a length 75cm on a potentiometer wire and emf of a standard cell of 1.02V is balanced by a length 50cm of it. Calculate the emf of battery.
8. A battery of 6V and internal resistance 0.5Ω is joined in parallel with another of 10V and internal resistance 10Ω. The combination sends a current through an external resistance of 12Ω. Find current through each battery.

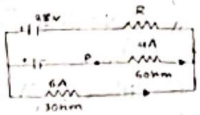
Diagramatic Questions:-

1.Using kirchoff's laws of current and voltage,Find current in 20hm resistor in given circuit.

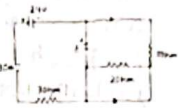


2) In the adjacent circuit find:

1. The current in resistor R
2. Resistance R
3. The unknown emf, ε
4. If the circuit is broken at P, what is current in resistor R?

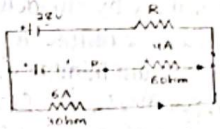


3) What must be the emf ε in the circuit so that the current flowing through the 70Ω resistor is 1.80A?Each emf source has negligible internal resistance.



4) Using Kirchhoff's law find:

1. Current in resistor R
2. The resistance R
3. The unknown emf ε
4. If the circuit is broken at P, what is current in resistor R?



Physics : Electricity and Magnetism

Magnetic Field

Definition

1) What is the principle of moving coil galvanometer?
2) State Ampere's law.
3) What do you mean by current sensitivity and voltage sensitivity?
4) Define one Ampere of current.
5) State Biot-savart's law.
6) What is vector representation of Lorentz force?
7) State Fleming left hand rule.
8) What do you mean by hall effect?
9) Define Tesla.

Derivations

1) Using biot-savart's law obtain an expression for the magnetic field induction at point situated on axis of current carrying circular coil.
2) Derive expression for Hall voltage.
3) Find the magnetic field due to long current carrying solenoid.
4) Using Ampere's law find magnetic field intensity due to long solenoid.
5) Using biot-savart's law find expression for magnetic field at centre of circular coil.
6) Derive an expression for torque produced on the coil when current I passed through it.
7) Derive an expression for the force per unit length between infinitely long parallel straight wires carrying currents.
8) Describe with diagram, the principle, construction and working

of moving coil galvanometer.

9) Derive an expression for magnitude of the magnetic flux density at the centre of narrow circular coil.

Give reasons and short questions

1) Why are pole pieces of magnets cut into cylindrical form in galvanometer?
2) Explain why a current carrying solenoid tends to contract?
3) Why hall effect is more effective in semiconductors?
4) Can a charged particle move through a magnetic field without experiencing any force? Explain.
5) Magnetic field at the centre of a solenoid is double than its end. Why?
6) How can sensitivity of a moving coil galvanometer have increased? Explain.
7) Does a particle moving through a magnetic field always experience a force? Explain.
8) Why is cylindrical core of soft iron used in moving coil galvanometer?
9) A proton moving in a straight line enters a strong magnetic field direction. How will its path and velocity change?

Numerical

1) A wire carrying current of 10A and 2m in length is placed in a field of flux density 0.34 Tesla. What is the force on wire if it is placed at 60° to field?
2) A wire carrying a current of 10A is placed perpendicular to a magnetic field of flux density 5 Tesla. Calculate the force acting on 3m of wire.
3) A copper wire is 28m long is wound into a flat coil 8.0cm in diameter. If the current of 4.50A flows through coil what is magnetic induction at centre of circle. ($\mu 0 = 4\pi \times 10\text{-}7$ Hm-1).
4) A current of 1A is flowing in the sides of an equilateral triangle of side 2m find magnetic field at centroid of triangle.
5) A solenoid is 2m long and 3cm in diameter. It has 5 layers of winding of 1000 turns each and carries a current of 5A. What is magnetic field at centre?

Diagrammatic Questions

1. Calculate the magnetic Field at Centre of coilin the form of square of side 4cm carrying of 5A.

2.A pair of point charges q=+40 μCand q'=-50 μCare moving in a reference frame as shown in fig. At this instant, what are the magnitude and direction of magnetic field produced at origin? Take v=2.0×105 m/sand v'=8.0×105 m/s.

Physics | Electricity and Magnetism

Thermoelectric Effects

Definition

1. What is See beck effect?
2. What is Thermoelectric effect?
3. What do you mean by Peltier's effect?
4. What is Temperature of inversion?
5. What is neutral Temperature?
6. Define ε and θ.
7. What do you mean by Thermo-electronic effect?
8. What is Thermocouple?
9. What is Thermoelectric series?
10. What is Thomson effect?

Derivation

1. Give the relation between neutral temperature and inversion temperature.
2. Give relation between Thermoelectric constants

Give reason and short questions

1. do you mean by Peltier's coefficient? Is Thomson effect reversible?
2. Why do we use potentiometer for measuring thermo emf? See beck effect is a reversible effect. Explain.
3. Why lead is used as a reference metal in thermoelectricity? Thermocouple acts as a heat engine. Why?
4. Why do we generally prefer Sb-Bi thermocouple in all experimental work?
5. What is inversion temperature? On what factor does it depend?
6. Why is lead (Pb) used as a standard reference metal in thermoelectricity?
7. Does the thermo-electric effect obey the law of conversion of energy? Explain.
8. Point difference between Peltier and see beck effect.
9. How does thermo emf change in a thermocouple when temperature of hot junction is changed?

Numerical

1. The cold junction of a thermocouple is maintained at 10°C. No thermo emf is developed when the hot junction is maintained at 530°C. Find the neutral temperature.
2. One junction of a thermocouple is at 0°C and the other is at θ°C. The thermo-emf (in volts) is given by $\varepsilon = 20\times10\text{-}6\ \theta - 0.02\times10\text{-}6\ 02$. Find the neutral temperature and maximum value of emf.
3. A certain thermocouple with one junction at 0°C has an emf given by $\varepsilon = 80t - 15000\times10\text{-}6$Vwhere t is the temperature in degree Celsius. Determine Peltier coefficient at 0°C.
4. In a given thermocouple the temperature of cold junction is 25°C while the neutral temperature is 270°C. What is the value of temperature of inversion?

Physics | Electricity and Magnetism

Magnetic properties of materials

You must remember.

1. Define the term magnetic permeability.
2. what is curie temperature?
3. Define angle of dip.
4. Define angle of declination at a place.
5. Define magnetic susceptibility of a substance.
6. Define term magnetic permeability.
7. Define true and apparent dip.
8. Define magnetic domain.
9. Define magnetic field and inside materials.
10. Define retentivity and coercivity of a ferromagnetic material.

Derivation

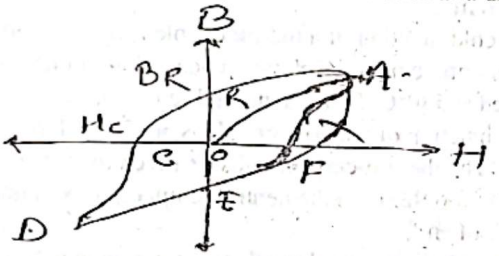
11. obtain the relation between the term magnetic permeability and susceptibility of a substance.
12. obtain the relation between the true and apparent dips.
13. Relate magnetic permeability and susceptibility feature of a magnetic material. Can hysteresis curve be drawn in the case of diamagnetic material? Explain on the basis of above

features.

14. How do you expect about the direction of horizontal and vertical components of earth's magnetic intensity at pole and at equator? Give justification in terms of angle of dip.

Give reason

15. why is soft iron preferred for making the core of a transformer?
16. Permanent magnet are made of steel. why?
17. why does a magnet lose its magnetism when heated to high temp?
18. The angle of dip in Britain is greater than that in ktm why?
19. Permanent magnets are made of steel. why?
20. why should the permeability of a permanent magnet material be expected to decrease with Increase temperature?
21. what is the significant of the area of a hysteresis loop? Draw.
22. Define how is it related with components of earth's magnetic field in term of angle of dip?
23. Above curie temperature a ferromagnetic material becomes paramagnetic. why? Describe with draw and distinguish for the
24. Relation of coercivity and retentivity of a ferromagnetic material and describe the given draw in below.
25. Define magnetic domain. explain with two term and draw.



26. Fig: Hysteresis loop

27. what will be happened, laminated cross is placed in transformer to.

Numerical

28. The needle of a dip circle shows an apparent dip of 45° in a particular position and 53° when the circle is rotated through 90°. calculate the true dip.

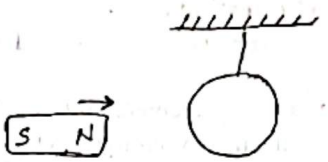
Extra short Questions: -

29. what will be its value at the pole of the earth. on it describe an angle of dip and draw.
30. Distinguish between dia and paramagnetic substance on the basis of susceptibility.
31. write the formula of, (χ) is the magnetic susceptibility of a material then its relative permeability.

Physics | Electricity and Magnetism

Electromagnetic Induction (I)

32. Define Lenz's law.
33. what is magnetic flux?
34. what are eddy current?
35. State faraday's law of electromagnetic induction.
36. Define self inductance.
37. Define coefficient of self Inductance.
38. Define mutual inductance?
39. Define the working principle of transformer and construct it.
40. Define the efficiency of transformer.
41. Define electromagnetic Induction.
42. Short

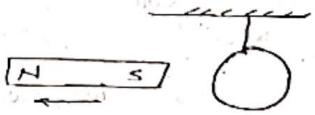


43. A copper ring is suspended by a thread in a vertical plane. one end of a magnetic is brought horizontally toward the ring. How will the position of the ring will be affected ? Justify.
44. plot a graph to show the variation of induced emf in a coil rotating in a uniform field with time.
45. A bar magnet falls through copper ring. will it's acceleration be equal to 'g'? justify with draw.
46. Can a transformer be used with dc? why? why not?
47. Pair of conductor carrying current into or out of the power supply component of electronic equipment are twisted together. why?
48. An induced current has no direction of its own. Explain
49. Explain how this law in accordance with law of conservation of energy..

Give answer in one point.

1. Bird sitting on a high tension line wire fly-off when current is switched on why?
2. write mathematical expression for faraday's law of electromagnetic Induction.
3. why does acceleration of a magnet falling through a long solenoid decrease?
4. A transformer gets heated up while in use. why?
5. can a transformer be used with dc? why not?
6. why the pair of conductor carrying current into or out of the power supply component of electronic equipment are twisted together and explain with draw.
7. A bar magnet fall through copper ring. will it's acceleration be equal to 'g'? give your two opinions points.
8. If the number of turns of a solenoid is doubled, keeping the other factors constant, How does the self inductance of the solenoid change?
9. what are different power losses in a transformer?
10. what measures do you make to minimize these losses?
11. what is the ratio of self inductances of the two coil?
12. How can eddy current reduced on the transformer?
13. Determine the principle and working of a.c generator.
14. A current from A to B increasing in magnitude. A B

what is the direction of induced, if any, in the loops as shown in figure? Justify.



15. A light aluminium ring is suspended from a long thread as shown in figure. when a strong magnet is moved away from it, the ring follows the magnet, why? what would happen if

the magnet were moved toward the ring?

16. write mathematically,

Two closely wound circular coil have the same number of turns, but one has twice the radius of the other. what is the ratio of self inductance of the two coil?

17. why the vertical magnetic field is perpendicular to the vertical plane of a loop, and explain why there are two reversal for one rotation, when the loop rotated about on the same axis in the plane. If the current will be reduced or not justify your opinion.

18. Define transformer. why transformer used in commercially.

19. Transformer can determine, the current of dc to ac, explain your opinion. How can we determine the transformer work and principle, construct it

20. why we study self-inductances. write two point used in commercially at home in our daily life

21. A transformer gets heated up while in use. mention the source of heating.

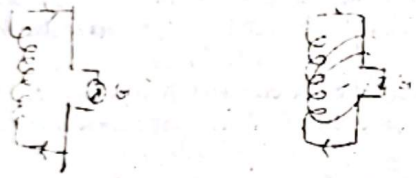
Derivations.

22. Derive an expression for the energy stored in an Inductor.

23. Derive an expression for the induced emf produced in a rectangular coil rotating in uniform magnetic field

24. In figure I a magnet is moving toward one end of a solenoid connected to a sensitive galvanometer. During this movement, a current is induced in the solenoid

Does the direction of induced change if the magnet is moved away from the solenoi d? Explain



25.

26. Derive an expression for the self inductance of a solenoid.

27. explain how the concept of self and mutual inductance are used in the working principle of a transformer

28. Describe the structure and working principle of transformer

29. Describe the principle and working of a.c generator.

30. obtain an expression of emf induced in a moving rod in a magnetic field.

31. The magnetic flux passing perpendicular to the plane of a coil is given by $\phi = 4t^2 - 5t + 2$ where ϕ is in weber and t is in seconds. calculate the magnitude of instantaneous emf induced in the coil when t = 3s.

32. 10. Show the nature of induced emf graphically

Calculation

1. Calculate the self-inductance of a coil of 100 turns if a current of 2A gives rise to magnetic flux of $5 \cdot 10^{-3}$ wb Webber through the coil.

2. A plane circular coil has 200 turns and its radius is 0.10m It is connected to a battery. After switching on the circuit, a current of 2A is set up in the coil. Calculate the energy stored in the coil. ($\mu_0 = 4\pi \times 10^{-7}$ H/m)

3. A rectangular coil of 100 turns has dimension 15 × 10 cm². It is rotated at the rate of 300 rev per min in a uniform magnetic field of flux density 0.6T. Calculate the maximum emf induced in it.

4. A jet plane is flying due west at the speed of 1800 km hr^{-1} what is the voltage difference developed between the end of the wings 25m long of the earth's magnetic field at that location is $5 \cdot 10^{-4}$ T and the angle of dip is 45°.

5. A coil has 500 turns. what is the emf produced in the coil when the magnetic flux cutting the coil changes by 8×10^{-3} wb in 0.1s?

6. A wire of length 0.1m moves with speed of 10 m s perpendicular to a magnet field of induction 1 wb m^{-2} calculate the induced emf.

7. 7. A long solenoid with 15 turns per cm has a small loop of area 0. cm² placed inside normal to the axis of the solenoid. if the current carried by the solenoid change steadily from 2A to 4A in 0.1 sec what is the induced voltage in the loop while the current is changing?

8. 8. An air-cored solenoid having a diameter of 4 cm and a length of 60 cm is wound with 4000 turns. find the inductance of the solenoid. what will be inductance of the solenoid if it has an iron core of relative permeability 400? ($\mu_0 = 4\pi \times 10^{-7}$ H/m)

9. 9. Two plane coil having number of turns 1000 and 2000 and radii 5cm and 10cm respectively are placed co-axially in the same plane. Calculate their mutual Inductance. ($\mu_0 = 4\pi \times 10^{-7}$ H/m)

Alternating Current

1. Define root mean square value of ac
2. what is quality factor of the circuit
3. Define Resonant frequency
4. what is the Resonance in LCR series circuit
5. what do you mean by impedance of ac circuit?
6. Define AC and DC
7. Define power
8. Define choke coil.
9. what is meant by wattless current?
10. Define peak value of an AC
11. define power factor
12. Define capacitance and Inductor

Short answer questions

1. What are the advantage of A.C over D.C?
2. For a capacitor in an circuit explain why there is a phase difference between current and voltage.
3. Draw LCR series circuit and label it
4. under the series LCR circuit is shown in figure what condition electrical resonance occur in above circuit write the required expression
5. what do you mean by "power factor is 1" and power factor is zero?
6. Explain How capacitative reactance of a capacitor change with frequencies.
7. A choke coil is preferable to a resistor in an ac circuit why.
8. Draw graph showing the variation of voltage and current with time over one cycle of alternating current of device is capacitor and the circuit is capacita
9. How does the resonance frequency of an LCR series circuit change if the plates of the capacitor are brought closer together?
10. Alternating current passes through a capacitor while direct current does not. Explain this fact on the basis of capacitative reactance.

11. For a capacitor in an ac circuit, explain why there is a phase difference between current and voltage.
12. An alternating current passes through a circuit containing an inductor and a resistor in series. Describe and label with diagram.
13. At high frequencies, a capacitor becomes a short-circuit and an inductor becomes an open circuit. Explain.
14. How does the resonance frequency of an L.C.R series circuit change if the plate of the capacitor are brought closer together?
15. Sketch the symbol of "capacitor" emf of a cell and "a resistor".
16. write the formula of Resonant frequency.
17. Calculate resonant frequency of series LCR circuit.
18. How peak value of ac is related to vrms.
19. why capacitor is used to fan electrical fan.
20. An alternating emf is applied across a capacitor. show that the current in it lead to the applied emf by 90°.
21. The emf of an ac source is given by the expression,
22. E = 300 sin 314t volts. write the value of peak voltage and frequency of that source. what will be the rms voltage of source?

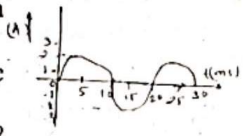
Derivatives

1. Discuss the phase relationship between the current and voltage in A.c circuit containing capacitor and resistor in series and hence derive an expression for the impedance of the circuit.
2. Derive an expression for the impedance of an ac circuit with an inductor L, a capacitor C and a resistor R in series. Draw the phase diagram If the voltage across the capacitor is greater than that across the inductor.
3. Observe the given graph and answer the following question.

(i) what is the value of the current I when time 5 ms?

(ii) what is the period T for the complete cycle?

(iii) what is the frequency of the given ac?



4. Alternating voltage in an circuit is represented by $V = 100\sqrt{(2}\sin)(100\pi t)$ volts. Find it's root mean square value and the frequency.
5. The maximum capacitance of a variable capacitor is 33 pF. what should be the self-inductance to be connected to this capacitor for the natural frequency of the LC circuit to be 810 kHz. corresponding to A.M broadcast and Radio Nepal?
6. A coil of inductance 0.5H and negligible resistance is in series with a resistance of 40Ω. A supply voltage of 40 volts 40 v(rms) is connected across them. If the voltage across the coil is equal to that across resistor, calculate the voltage across each component and frequency of the supply.

Physics | Modern Physics

ELECTRONS

Definition

1. What is the quantization of charge?
2. What is mean by cross field and write one use of cross field?
3. What is the ratio of electric to the magnetic field?
4. What is mean by specific charge of an electron?
5. What are cathode ray?

Derivation

1. Describe with necessary theory, Millikan's oil drop experiment to determine the value of charge associated with an electron.
2. Describe J.J. Thomson's experiment for measuring the specific charge (e/m) of an electron.
3. Discuss the motion of an electric field obtain the expression of vertical deflection when it leaves the electric field.
4. What are the cathode ray? How are they produced? Mention the properties of cathode ray?
5. Describe the motion of electron beam in magnetic field.

6. Give reasons

7. Why are X-rays used in Millikan's oil drop experiment?
8. Why is clock oil used in Millikan's oil drop experiment?
9. How did Millikan's experiments lead to quantum nature of the electric charge? Explain.
10. Can we use water instead of clock oil in Millikan oil drop experiment? Justify your answer.
11. Why discharges not takes place at very low pressure?
12. What is the importance of Millikan's oil drop experiment?
13. Can we perform Millikan's experiment with drops of any size? Explain.
14. Is the Stoke's relation $F = 6\pi\eta rv$ applicable to very minute size oil drops? Explain?
15. What properties of cathode ray indicates that they consists of electrons.
16. Why is metal piece heated up when cathode rays strike it?
17. Cathode rays cannot be regarded as electromagnetic waves. Why?
18. In Thomson's method for determining specific charge of an electron, why is the electric field kept perpendicular to magnetic field? Justify.
19. In Thomson's method for specific charge of an electron is determined:
    (i) What is the ratio of electric to the magnetic fie
20. Compare the specific charge of an electron with that of a proton
21. What are the values of specific charges for electron and proton?
22. Why specific charge for positive rays much smaller than that of cathode rays.
23. Why is a magnetic field used to deflect electron beam but not an electric field in a T.V. picture tube?
24. Beams of protons and electrons with the same initial K.E. enter normally into an electric field, which one will deflect more and why?
25. What path does the electron follow in electric field when the electron is projected normally on the field.
26. An electron passes through a space without deviation. Does it mean, there is no field?
27. Is there any condition that an electron does not experience any force inside the magnetic field?
28. An electron is passing through a field but no force is acting on it. Under what condition is it possible in the motion of the electrons be:
    (i) electric field
    (ii) magnetic field
29. Show that the frequency of an electron moving in a circular

path in a uniform magnetic field is independent of its velocity.

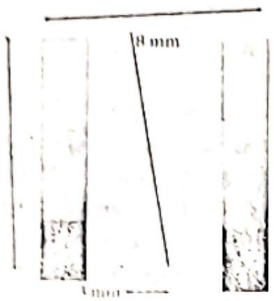
30. Why does electric discharge takes place at low pressure and high potential difference?

Numerical

31. An oil drops of mass 3×10^{-11} g and radius 2×10^{-4} cm carries 10 excess electrons. What is its terminal velocity when:
    (i) falling in a region in which there is no electric field?
    (ii) falling in an electric field of 3×10^{5} V/m directed downward (viscosity of air=1.8×10^{-5} N s/m²)
32. In a Millikan's oil drop experiment, an oil drops of weight 1.5×10^{-14} N is held stationary between two horizontal plates 10 mm apart by applying P.D. of 470 volts between the plates. Calculate the number of electrons attached with the drop.
33. In a Millikan's apparatus the horizontal plates are 1.5 cm apart. With no electric field is switched off, an oil drop is observed to fall with steady velocity 2.5×10^{-2} cm/s. When the field is switched on, the upper plate being positive, the drop just remains stationary when the potential difference between the plates is 1500 V. Calculate the radius of the drop and the number of electronic charges neglecting air density. (Given: density of oil = 900 kg m³ and viscosity of air = 1.8×10^{-5} Ns/m²)
34. (Given: density of oil = 900 kg/m³ and viscosity of air = 1.85 × 10⁻⁵ Ns/m²)
35. In a Millikan's oil drop experiment, a drop is observed to fall with a terminal speed 1.4mm/s in the absence of electric field. When a vertical electrical field of 4.9v/m is applied, the droplet is observed to continue to move downward at a lower terminal speed 1.21 mm/s. Calculate the change on the drop (Density of oil= 750kg/, viscosity of air = 1.81 kg/ms, density of air = 1.29 kg/m3)
36. An ion of specific charge 4.4×10^{7} C/kg is moving in a circular orbit in a magnetic field of flux density 0.4 T with velocity of 5.52×10^{5} m/s. Calculate the radius of this orbit.
37. An electron moves in a circular path of radius 20 cm in a uniform magnetic field of 2×10^{-3} T. Calculate the speed of electron and period of revolution.
    (Mass of electron = 9.1×10^{-31} kg)
38. An electron moving with a speed of 10^{7} m/s is passed into a magnetic field of intensity 0.1 T normally. What is the radius of the path of the electron inside the field? If the strength of the magnetic field is doubled, what is the radius of the new path?
    (e/m = 1.8×10^{11} C/kg)
39. An electron having 500 eV energy enters at right angle to a uniform magnetic field of 10^{-4} T. If its specific charge is 1.75×10^{11} C/kg, calculate the radius of its circular orbit.
40. An electron is accelerated through a potential difference of 2000 V and then it enters a uniform magnetic field of 0.02 T in a direction perpendicular to it. Find the radius of the electron in the magnetic field.
41. (Mass of an electron is 9.1×10^{-31} kg, charge of an electron is 1.6×10^{-19} C)
42. A beam of electrons is under the effect of potential difference 1.36 × 104 volt applied across two parallel plates 4 cm apart and a magnetic field of 2×10^{-3} Wb/m² at right angle to each other.
    (i) Calculate velocity of electrons if two fields produce no deflection in the beam.
    (ii) What will be the radius of the orbit in which the beam will move if the electric field is made zero?
43. In an experiment voltage across two parallel plates is 50 V and distance between them is 30 cm. The magnetic field applied to make the beam undeflected is 5×10^{-4} tesla.
    (i) Why electron beam remains undeflected?
    (ii) Calculate the velocity of electron passing through the fields?
44. Two metal plates are 4 m long are held horizontally 3 cm apart in a vacuum, one being vertical above the other. The upper plate is at a potential of 500 V and the lower plate is earthed. Electrons having a velocity 10^{7} m/s are injected horizontally midway between the plates and in a direction parallel to 4cm edge. Calculate the vertical deflection of the electron beam as it emerges from the plates.
    (e/m for the electron = 1.8×10^{11} C/kg)
45. A beam of electrons moving with a velocity of 1×10^{7} m/s enters midway between two horizontal plates in a direction parallel to the plates. Each plate is 5 cm long which are kept 2 cm apart. Just grazes the edge of the positive plate. (e/m = 1.8×10^{11} C/kg)

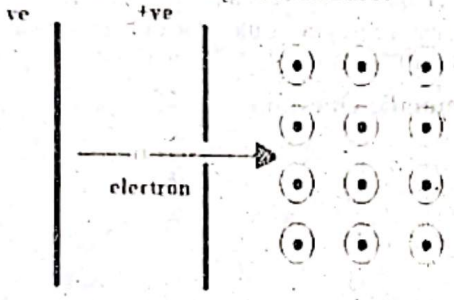
Diagrammatic Question

1. Figure represents the experimental arrangement of Millikan's oil drop experiment.
    (a) For what purpose did Millikan use this apparatus? W1 H.T
    (b) Why atomizer and X-ray are used?
    (c) What would be the effect on Millikan's oil drop experiment of performing it in a vacuum?
    (d) Why water drops cannot be used instead of oil?
    (e) An oil drops of mass 4.95×10^{-15} kg is balanced between two horizontal plates with upper plate positive. The electric field strength between plates is E = 5.1 × 10^{4} N/C.
    (i) Under what condition do the oil drops between plates remain suspended in air?
    (ii) What is the charge on the oil drop?
    (iii) Explain what the same charged oil drop would do if the plates were brought closer together keeping the same charge on the oil drop and voltage across the plate.
2. A charged water drop of weight 6.0×10^{-14} N falls at a terminal speed of 0.15 mm/s in air between two parallel plates 120 mm long and placed 8.0 mm apart. when a p.d. of 45 V is applied between the plates the path of the drop is as shown in the diagram.



(a) Draw a diagram showing the forces acting on the drop. Explain how each of the forces arises. Calculate
(i) the electric force on the drop and
(ii) the charge on the drop in terms of electron charges.
(b) What is the largest p.d. between the plates if the drop is not to hit the right-hand plate?

3. An electron travelling at 8.0×10^6 m/s in a vacuum enters a region of uniform magnetic field of flux density 30 MT as shown in figure.
(i) On the figure mark the direction of the force on the electron when it enters the magnetic field at P.



(ii) Calculate the magnitude of the force on the electron.
(iii) When the electrons moving in the magnetic field it follows a circular path. Why? Explain
(iv) Calculate the radius of circular path.

Physics — Modern Physics

Photons

Definition

1. Define photoelectric emission?
2. Define threshold wavelength?
3. Defined threshold frequency?
4. What is meant by stopping potential?
5. What is mean by work function
6. Define photo-emissive cells?
7. Define photo-voltaic cells?
8. Define photo-conductive cells?
9. Define photon?

Derivation

1. Explain photoelectric effect and write Einstein photoelectric equation.
2. Experimental verification of Einstein photoelectric emission.
3. Derive and explain Millikan's experiment (measurement of planks constant)

Give reason and short question.

1. Is photoelectric equation possible for all wavelengths of light? Explain.
2. Photons comes from three lamps that emits red, green and blue light which of these lamps produces photons with highest energy?
3. Can photoelectric effect be explained on the basis of wave theory of light? Justify your answer.
4. Which has more energy- a photon in the infrared or photon in the ultraviolet? Given reason.
5. If the wavelength of electromagnetic radiation is doubled what will happen to the energy of the photons?
6. What happens to the kinetic energy of photoelectrons when intensity of light is doubled?
7. Human skin is relative insensitive to visible light, but ultra violet radiations can cause serve burns. Does this have anything to do with photon energies? Explain.
8. If we go on increasing the wavelength of light incident on metal surface, what changes takes place in the number of electrons and energy of the electrons?
9. Why does photoelectric emission not take place if the frequency of the incident radiations is less than threshold value.
10. It is harder to remove a free electron from copper than from sodium, which metal has greater work function? which has higher threshold wavelength?
11. Why are alkali metals most suited for photo-electric emission?
12. Light from a bulb falls on the wooden table but no photoelectrons are emitted- why?
13. What is the effect on the velocity of photoelectrons if the wavelength of incident light is increased?
14. Two metals A and B have work functions 4 ev and 10 ev respectively, which metal has higher threshold wavelength?

Numerical

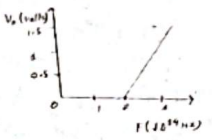
15. A metal has a work function of 2ev, calculate the maximum speed of the emitted photoelectrons when it is illuminated by radiation of wavelength 150 nm, what is the least frequency of the radiation for which electrons are emitted?
16. The minimum energy required to cause an electron to be emitted from a clean zinc surface is 6.9×10-19 J
(i) calculate the maximum wavelength of electromagnetic radiation which will cause an electron to be emitted from the zinc surface?
(ii) what would be the effect of irradiating the zinc surface with radiation of wavelength 4×10-7 m? Justify your answer.
(iii) When light of wavelength λ1 is incident on the cathode of a photoelectric tube, the maximum kinetic energy of the emitted electrons is 2.8ev. If the wavelength is reduced to λ1/2, the maximum kinetic energy of the emitted electron is 5.6ev. Find the work function of the cathode material.
17. Find the change in stopping potential when the wavelength of a radiation is decreased from 400 nm to 300 nm on the same metallic surface, planks constant = 6.62×10-34 Js and velocity of light = 3×108 m/s
18. A clean nickel surface of work function 5.1ev is exposed to light of wavelength 235 nm what is the maximum speed of the photoelectron emitted from its surface?
19. Sodium has a work function of 2ev, calculate the maximum energy and speed of the emitted electrons when sodium is

illuminated by a radiation of 150 nm. what is the threshold frequency of radiation for which electrons are emitted from sodium surface?

20. Ultraviolet light of wavelength 3.5×10-7 m is made to fall on a smooth surface of potassium. the work function of potassium is 2ev. determine maximum energy of emitted photoelectrons and stopping potential.
21. On UV light of 400 nm strikes a caesium surface of work function 1.9ev. Find the velocity of electron emitted from the caesium surface. (me = 9.1×10-31 kg, c = 3×108 m/s, h = 6.62×10-34 Js)

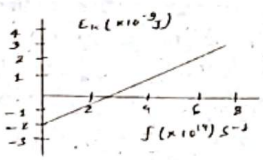
Diagrammatic question

1. The adjacent figure shows a plot of stopping voltage versus frequency of incident radius for photoelectric effect in sodium



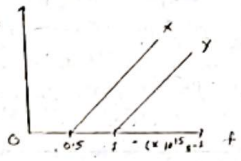
(i) calculate the threshold frequency and work function of sodium
(ii) If the intensity of the incident radiation is increased does the slope of the line change? Justify your answer

2. In an experiment on photoelectric effect, the graph between maximum kinetic energy and frequency of incident radiation on the metal surface is found to be straight line as shown in the figure.Calculate.



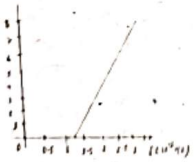
(i) threshold frequency
(ii) planks constant
(iii) work function on metal in ev

3. The following graph shows the vibration of stopping potential Vs with frequency (f) of the incident radiation for two photosensitive metals X and Y



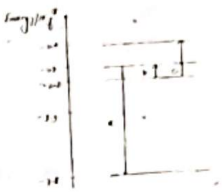
(i) which of the metal have larger threshold wavelength? Give reason
(ii) Explain giving reason which metal gives out electrons having larger KE for the same wavelength of the incident radiation
(iii) If the distance between the light source and metal X is halved what will be the kinetic energy of electron emitted due to this change. Give reason

4. The stopping potential as a function of the frequency of the incident light falling on a metal surface is shown in the graph.



(a) Find the work function for this metal
(b) What value of planks constant does the graph yield?
(c) Why does the graph not extend below x-axis?
(d) If a different metal was used, what characteristics of the graph would you expect to be same and which one to be different?

5. Figure shows part of the energy level diagram of an imaginary atom. the arrows represent three transitions between the energy levels for each of these transitions.



(a) calculate the energy of the photon
(b) calculate the frequency and wavelength of the electromagnetic radiation (emitted or absorbed).
(c) state whether the transition contributes to an emission or an absorption spectrum

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Semiconductor Devices

The chapter is divided into following content

1. conductor
2. Insulator
3. Avalanche effect
4. Intrinsic semiconductor
5. Rectifier
6. Logic Gate
7. Semiconductor diode
8. Full wave Rectifier
10. Zener Breakdown
11. Semi-conductor
12. Zener effect
13. Extrinsic semiconductor
14. PN Junction diode
15. Zener diode
16. Half wave Rectifier
17. Avalanche Breakdown

Short Questions and Give Reason

1. How can Zener diode be used as a Voltage regulator?
2. How is it possible to rectify an AC?
3. When p and N type materials are interfaced, there exists a depletion layer at the interface. Explain
4. When the PN junction diode is forward biased, a large current flow. Why?
5. During forward biasing of P-N junction diode, the width of depletion layer decreases.
6. Why is NOT gate called inverter?
7. How Zener diode differs from ordinary diode?
8. Is an n-type semi-conductor negatively charged?
9. Why are NAND and NOR gates known as digitalbuilding blocks or universal gates?
10. Why does the width of depletion layer of PN junction increases in reverse biasing?

Difference between

a) Ordinary diode and Zener diode
b) Intrinsic semiconductor and Extrinsic semiconductor
c) Half wave Rectifier and Full wave Rectifier

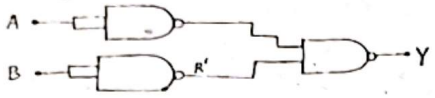
Long Answer questions [†]

1. Describe the working mechanism of half wave rectifier
2. Describe the Zener diode as a Voltage regulator.
3. Explain the full wave rectification using P-N junction diode.
4. Explain the use of P-N junction diode as full wave rectifier.
5. Explain the operation of OR, AND and NAND gate?

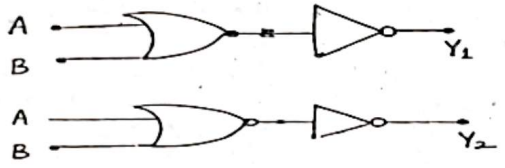
Diagrammatic Question

1. Write truth table related to OR and AND gate
2. Write the truth table of NAND gate
3. Give a truth table for two input NOR gate.
4. Draw the figure of Half wave Rectifier and full wave Rectifier

5. Draw a circuit diagram for P-N junction diode in forward bias. Sketch the
Voltage versus current graph for it
6. For the digital circuit given below write the truth table showing the
output A', B and Y for all possible inputs A and B



7. For the digital circuit given below, write truth table showing the outputs
Y_1, Y_2 for all possible inputs at A and B.
8. Draw circuit diagram for P-N junction diode in forward bias.



Physics | Modern Physics

Quantization of Energy

Definition

9. State Heisenberg's uncertainty principle.
10. State and explain Bohr's postulates of an atomic model.
11. Define ionization potential?
12. State Bragg's law.
13. State and explain Bragg's law of X-ray diffraction.
14. What do you mean by matter wave.
15. What do you mean by uncertainty principle.
16. What is laser?
17. What are X-rays?
18. What do you mean by excitation potential?
19. What is mean by emission spectra?
20. What is mean by absorption spectra?
21. State de-Broglie theory (Quality)?
22. What is optical pumping in the production of lasers.

Derivation

1. Obtain an expression for velocity of an electron in nth orbit of hydrogen atom.
2. State and explain Bragg's law of X-ray diffraction.
3. What is laser? Describe the working of He-Ne laser.
4. Describe Coolidge tube for the production of X-rays. How do you control
5. (i) The intensity production of X-rays by Coolidge tube.
6. What are the X-rays? Confirm with experiment the wave nature of X-rays.

Give reason and short question

7. Why is X-rays radiation process called inverse photoelectric effect?
8. Proton and alpha particle have same kinetic energy, which one has greater de-Broglie wavelength?
9. Why cannot we observe matter wave in our daily life?
10. Which has more energy – a photon in the infrared or photon in the ultraviolet? Give reason.
11. A proton and an electron have the same de-Broglie wavelength, which one has greater K.E.? Explain.
12. The accelerating voltage of a proton is increased two twice. How will its de-Broglie wavelength change? Explain.
13. Can X-ray diffraction experiment be performed by an ordinary grating? Why.
14. Explain the difference between stimulated and spontaneous emissions of radiation.
15. Even if a hydrogen atom contains an electron, its spectrum consists of a large number of lines. Explain how.
16. The total energy of an electron of an atom in an orbit is negative. What does this negative energy indicate?
17. Why is the gravitational force not taken into consideration while evaluating the energy of an electron in an atom?
18. Can X-rays produced from gases? Explain.
19. Define population inversion?
20. When X-rays are produced only about 10% of the initial input energy appears as X-rays energy. Explain what happened to the other 90% of the energy.
21. A stone is dropped from the top of a building. How does its de-Broglie wavelength change?
22. Can Bragg's law of X-ray diffraction be verified with yellow light of wavelength 600 nm? Explain.
23. Differentiate between excitation potential and ionization potential.

Numerical problems

24. A beam of electron accelerating through a potential difference of 40 kV strikes a tungsten target. Calculate the minimum wavelength (or cut-off wavelength) of X-rays produced.
25. X-ray beam of wavelength 2.9 Å is diffracted from the plane of cubic crystal. The first order diffraction is obtained at angle of 35°. Calculate the spacing between the planes.
26. The total energy of an electron in the excited state of hydrogen atom is about 3.4 eV. If the electron in the first excited state jumps to ground state of hydrogen atom find wavelength of the emitted radiation.
(Value of Rydberg constant; $R = 1.097 \times 10^7\ m^{-1}$)
27. Calculate the de-Broglie wavelength of a neutron having kinetic energy 150 eV.
(Give mass of neutron = 1.675×10^{-27} kg, Planck's constant = 6.62×10^{-34} Js)
28. X-rays are incident on the zinc sulphide crystal spacing 3.08×10^{-10} m such that first order reflection takes place at glancing angle 12°. Calculate the wavelength of X-rays and glancing angle for 2nd order maximum.
29. Calculate the wavelength of electromagnetic radiation emitted by a hydrogen atom which undergoes a transition between energy levels of -2.36×10^{-18} J and -5.45×10^{-19} J. (Given Planck's constant = 6.6×10^{-34} Js)
30. Calculate the energy in electron volts of quantum of X-radiation of wavelength 0.15 nm.
(Speed of light $c = 3 \times 10^8$ m/s, Planck's constant = 6.5×10^{-34} Js)
31. A hydrogen atom initially in the ground level absorbs a photon which excites to the n = 4 level. Determine the wavelength and frequency of the photon.
32. An electron initially at rest is accelerated through a potential

difference of 5000 V. Compute
(i) the momentum
(ii) the de-Broglie's wavelength and
(iii) the wave no. of the electron wave.

33. Compute the de-Broglie's wavelength of a proton whose kinetic energy is equal to the rest energy of an electron. Mass of proton is 1835 times that of the electron.
34. If the shortest wavelength in the Lyman series is 918 Å, calculate the longest wavelength in the same series.
35. Calculate the de-Broglie's wavelength of electron when it is accelerated by 500 V.
(Mass of electron = 9.1×10^{-31} kg, h = 6.62×10^{-34} Js, e = 1.6×10^{-19} C)
36. Electrons in an X-ray tube accelerating through a potential difference of 10 kV before striking the target. If the electron produces one photon on impact with the target, what is the minimum wavelength of the resulting X-rays?
(Given h = 6.62×10^{-34} Js and charge of electron = 1.6×10^{-19} C)
37. The largest distance between interatomic planes of crystal is 10 Å. What is the upper limit for wavelength of X-rays which can be used to study the crystal?
38. An α-particle of mass 6.64×10^{-27} kg is emitted in radioactive decay of the $^{92}U^{238}$ with an energy of 4.2 MeV. What is de-Broglie wavelength? (h = 6.6×10^{-34} Js)
39. An X-ray tube works at a dc potential difference of 50 kV. Only 0.4% of the energy of the cathode rays converted into X-rays and heat is generated in the target at rate of 600 W. Estimate the current passed into the tube and the velocity of electrons striking the target.
40. An X-ray tube works at a dc potential difference of 50 kV and the current through the tube is 0.5 mA.
(i) the no. of electrons hitting the target per second
(ii) the energy falling on target per second as K.E. of electrons
(iii) the cut off wavelength of X-ray emitted
41. If an electron position can be measured to an accuracy of 10^{-9} m, how accuracy can its velocity be measured?

Diagrammatic Questions

42. The diagram shows the lowest four discrete energy levels of an atom. An electron is n = 4 state make a transition to n = 2 state emitting a photon of wavelength 122.9 nm.

(i) Calculate the energy level of n = 4 state
(ii) Calculate the momentum of the photon

43. The Balmer series for the hydrogen atom corresponds to electronic transition that terminate in state with quantum number n = 2 as shown in figure.
a) Find the longest wavelength photon emitted in Balmer series and determine its frequency and energy.
b) Find the shortest wavelength photon emitted in same series.

Physics	Modern Physics

. Radioactivity

DEFINITION

1. Define radioactivity?
2. Define laws of radioactive disintegration?
3. What is decay constant?
4. What is natural radioactivity?
5. Define one unit of radioactivity?
6. Define the terms half life and mean life of a radioactive substance.
7. What do you mean by curie?
8. What are the beta and gamma rays? State three properties of each.
9. Explain the term artificial radioisotopes?
10. What do you mean by alpha decay and beta decay?
11. Define Rutherford unit?
12. Define Becquerel (Bq) units?
13. Define radio carbon dating.
14. Define roentgen, rad and rem.

DERIVATIONS

1. Derive the equation $N = N0\ e^{-\lambda t}$ for radioactive process where symbols have their usual meanings.
2. Derive the relation between half-life and decay constant.
3. How will you identify α, β and γ radiation by simple experiment?
4. What are different units of radioactivity? Describe carbon dating.
5. Describe Geiger-Muller (GM) Tube?

GIVE REASONS AND SHORT QUESTIONS

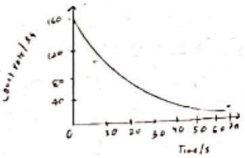
1. Can a single nucleus emit α-particle, β-particle and γ-rays simultaneously? Explain.
2. Compare β-particles and γ-rays in terms of their mass, charge, ionizing power and penetrating power.
3. When does an α-decay occurs?
4. When does a β-decay occurs?
5. What is the physical significance of half-life of a radioactive substance?
6. Differentiate between radioactive decay and nuclear fission.
7. Explain why natural radioactive nuclei are the nuclei of high mass number?
8. Why all radioactive elements are ultimately converted into lead?
9. Beta particles penetrate through a matter easily than that of alpha particle of the same energy.
10. Why do α-rays have the highest ionizing power?
11. What percentage of a given mass of a radioactive substance will be left undecayed after five half-life periods?
12. Mean life of a radioactive sample is 500 seconds then its half-life in minutes is.
13. The half-life of radium is 1600 years. The fraction of a sample of radium that would remain undecayed after 6400 years is.
14. The half-life of a radioactive substance as compared to its mean life.

NUMERICAL

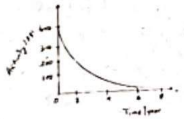
1. If the half-life period of a radioactive substance is 2 days, after how many days will 1/64th part of the substance be left behind?
2. A count rate meter used to measure activity of a radioactive element shows 895 counts per minute and 100 minutes later 327 counts per minute. Find (a) decay constant (b) mean life (c) the half-life.
3. A 120 g sample of carbon from living matter decays at the rate of 1800 decays/min due to radioactive 14C in it. What will be the decay rate of this sample in 100 years?
4. At a certain instant, a piece of radioactive material contains 3×1012 atoms. The half-life of the material is 30 days. Calculate the number of disintegrations in the first second.
5. A GM counter used to measure the activity of a radioactive element shows 895 counts per minute after 10 min, it shows 327 counts per minute. Calculate decay constant and half-life.
6. In a given sample radio isotopes A and B are initially present in the ratio of 1:4. The half-lives of A and B are 100 years and 50 years respectively. Find the time after which the amounts of A and B become equal.
7. The isotope Carbon-14 has life 5700 years. If the sample contains 1022 Carbon-14 nuclei, find its activity.
8. The isotope Ra-226 undergoes decay with a half-life of 1620 years. What is the activity of 1 gram of Ra-226? (Avogadro number = 6.023×1023/mol)
9. The half-life of radium is 1620 years. After how many years 25% of radium block remains undecayed?
10. Calculate the mass in grams of a radioactive sample Pb-214 having an activity of 3.07×109 decays/s and a half-life of 26.8 minutes. Avogadro number = 6.02×1023/mol.
11. A small volume of a solution which contains a radioactive isotope of sodium had an activity of 12000 disintegration per minute when it was injected into the blood stream of a patient. After 30 hours, the activity of 1 cm^3 of the blood was found to be 0.5 disintegration per minute. If the half-life of the sodium isotope is 15 hours, estimate the volume of the blood in the patient.

DIAGRAMMATIC QUESTIONS

1. Figure shows the count rate recorded when a sample of the isotope Indium-116 decays. Use the graph to find the half-life of the isotope and calculate the decay constant.



2. Figure shows the decay of a radioactive isotope of caesium-55^{Cs-134}. Use the graph to determine the half-life of this nuclide in years and hence find the



3. Consider a radioactive nucleus A which decays to a stable nucleus C through the following A → B → C. Here B is an intermediate nucleus which is also radioactive. Considering that there are N0 atoms of A initially, plot the graph showing the variation of number of atoms of A and B versus time.

Physics | Modern Physics

Recent Trends in Physics

DEFINITION

1. Define Seismic wave?
2. Define Internal (Body) wave (P and S wave)?
3. Define gravitational wave?
4. Define Nanotechnology?
5. What is Seismology?
6. What are surface wave? Explain.
7. What is the Higgs boson in simple term?

DERIVATION

1. What types of seismic wave are formed during great earthquake? Explain.
2. What do you mean by shadow zone for seismic phases?

GIVE REASON AND SHORT QUESTION

1. How do gravitational wave forms?
2. Why gravitational waves importance.
3. Differentiate between P- and S- wave.
4. How one can read a seismogram?
5. What causes gravitational wave.
6. Compare the properties of gravitational wave and electromagnetic wave.
7. How does elastic rebound theory describe the earthquake activity in a given region?

Physics | Electricity and Magnetism

Thermodynamics

Definition

1. What is the principle of moving coil galvanometer?
2. State Ampere's law.
3. What do you mean by current sensitivity and voltage sensitivity?
4. Define one Ampere of current.
5. State Biot-savart's law.
6. What is vector representation of Lorentz force?
7. State Fleming left hand rule.
8. What do you mean by hall effect?
9. Define Tesla.

Derivations

1. Using biot-savart's law obtain an expression for the magnetic field induction at point situated on axis of current carrying circular coil.
2. Derive expression for Hall voltage.
3. Find the magnetic field due to long current carrying solenoid.
4. Using Ampere's law find magnetic field intensity due to long solenoid.
5. Using biot-savart's law find expression for magnetic field at centre of circular coil.
6. Derive an expression for torque produced on the coil when current I passed through it.
7. Derive an expression for the force per unit length between infinitely long parallel straight wires carrying currents.

8. Describe with diagram, the principle, construction and working of moving coil galvanometer.
9. Derive an expression for magnitude of the magnetic flux density at the centre of narrow circular coil.

Give reasons and short questions

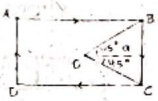
1. Why are pole pieces of magnets cut into cylindrical form in galvanometer?
2. Explain why a current carrying solenoid tends to contract?
3. Why hall effect is more effective in semiconductors?
4. Can a charged particle move through a magnetic field without experiencing any force? Explain.
5. Magnetic field at the centre of a solenoid is double than its end. Why?
6. How can sensitivity of a moving coil galvanometer have increased? Explain.
7. Does a particle moving through a magnetic field always experience a force? Explain.
8. Why is cylindrical core of soft iron used in moving coil galvanometer?
9. A proton moving in a straight line enters a strong magnetic field direction. How will its path and velocity change?

Numerical

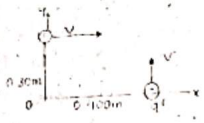
1. A wire carrying current of 10A and 2m in length is placed in a field of flux density 0.34 Tesla. What is the force on wire if it is placed at 60° to field?
2. A wire carrying a current of 10A is placed perpendicular to a magnetic field of flux density 5 Tesla. Calculate the force acting on 3m of wire.
3. A copper wire is 28m long is wound into a flat coil 8.0cm in diameter. If the current of 4.50A flows through coil what is magnetic induction at centre of circle. ($\mu 0 = 4\pi \times 10\text{-}7$ Hm-1).
4. A current of 1A is flowing in the sides of an equilateral triangle of side 2m find magnetic field at centroid of triangle.
5. A solenoid is 2m long and 3cm in diameter. It has 5 layers of winding of 1000 turns each and carries a current of 5A. What is magnetic field at centre?

Diagrammatic Questions

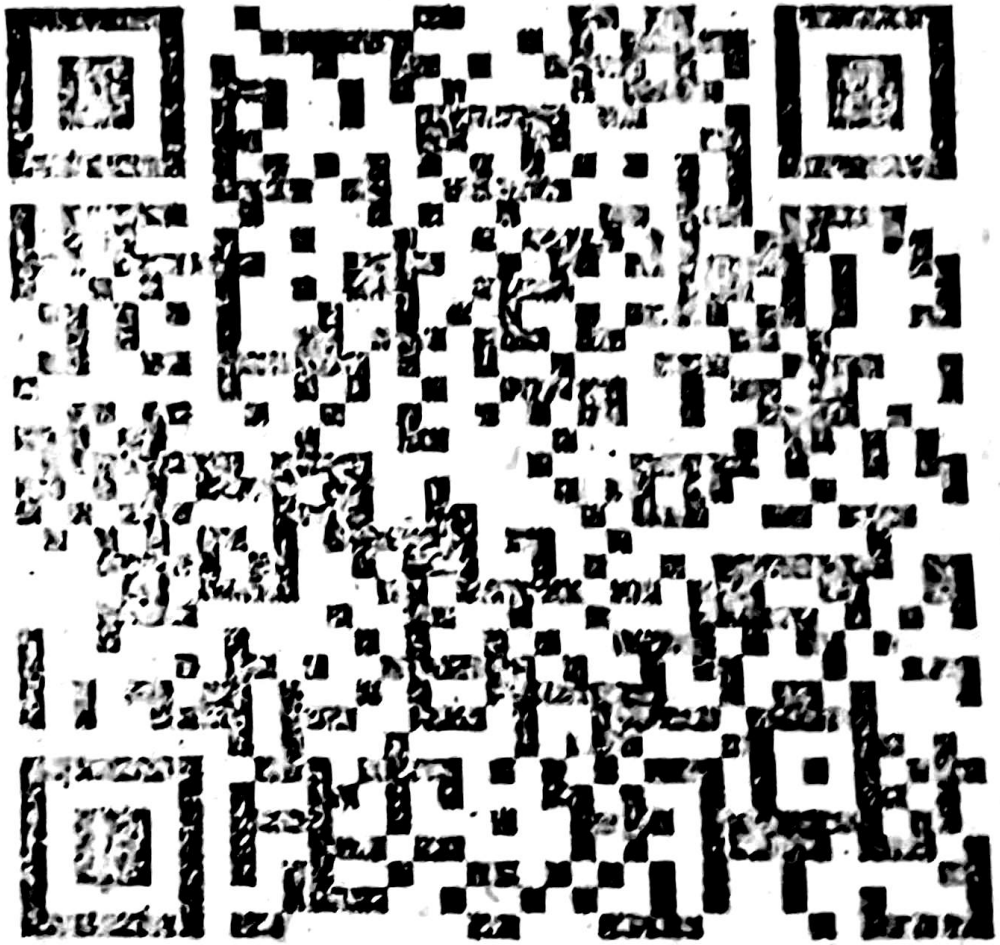
1. Calculate the magnetic Field at Centre of coilin the form of square of side 4cm carrying of 5A.



2. A pair of point charges and are moving in a reference frame as shown in fig. At this instant, what are the magnitude and direction of magnetic field produced at origin? Take and .



For extra of Physics



For extra of Physics

Permutation

1. The permutation of 'n' things taken 'r' at a time when each thing may occur any number of times is
2. How many ways can 'r' letters be posted in 'n' letter box ($n \geq r$)?
3. The value of $P(n, n-1)$ is
4. Write the formula for finding permutation of 'n' different objects taken 'r' at time ($r \leq n$)
5. Write the total number of permutations of set of 'n' objects arranged in circle.
6. Write the total number of permutations of a set having 'n' elements.
7. Write the total number of permutations $P(n, n)$ of a set of 'n' different objects taken 'n' at a time?
8. In how many ways can 5 different coloured beads be strung on a necklace?
9. What is the number of arrangements of 'n' different colored beads that can be strung on a necklace?
10. The number of 4 different digit even number that can be formed by using the digits 0, 1, 2, 3, 4, 5 is
11. How many three-digit numbers can be formed by using the integers 4, 5, 6, 8 with repetition?
12. In how many ways can 5 prizes be distributed among four students when every student can take one or more prize.
13. How many numbers of five digits can be formed from the number 2, 0, 4, 3, 8 when repetition of digits is not allowed?
14. In how many ways the words of **"ASSESSMENT"** are arranged?
15. In how many ways the letters of the word **"CORONA"** can be arranged so that the repeated letters are always together?
16. In how many ways the letters of the word **"EXCELLENT"** can be arranged so that the vowels are always together?
17. In how many ways can the letters of the word **"TUESDAY"** be arranged? How many of these arrangements do not begin with 'T'? How many begin with 'T' and do not end with 'Y'?
18. In how many ways can the letters of the word **"COMPUTER"** be arranged so that
    (i) all vowels are always together?
    (ii) the relative position of vowels and consonants are not changed?
19. Prove that $P(n, r) = \frac{n!}{(n-r)!}$ where the symbols have their usual meaning.
20. In how many ways can eight people be seated in a row of eight seats so that two particular persons are always together.
21. Find the number of ways in which 4 men and 3 women can be seated in a row having seven seats so that the men and women must alternate.
22. Six children are to be seated on a bench. How many

arrangements are possible if the youngest child sits at the left end of the bench.

Mathematics — Permutation & Combination

Combination

1. What is the number of combinations of 'n' object taken 'r' at a time?
2. Which one is the relation between permutation and combination of 'n' things taken 'r' things at a time.
3. If $p(n,r) = C(n,r)$ then $r =$
4. Find the value of r, if ${}^{9}C_{2r} = {}^{9}C_{r+1}$
5. Prove that $C(n,r) + C(n,r-1) = C(n+1,r)$
6. If $C(n,r-1) = 36$, $C(n,r) = 84$ and $C(n,r+1) = 126$. find the value of r and n.
7. Show that the number of combinations of 'n' different objects taken 'r' at time is given by $C(n,r) = \frac{n!}{(n-r)!r!}$
8. Write the relation between $P(n,r)$ and $C(n,r)$.
9. It is given that the permutation $P(n,r) = 240$ and combination $C(n,r) = 120$. Find the value of r.
10. In how many ways can 8 boys and 6 girls be arranged in a straight line so that no two girls are together?
11. There are 6 boys and 5 girls in a class. In how many ways the committee of 5 be made such that there are 2 girls and 3 boys are included.
12. In a group of 12 students 8 are boys and remaining girls. In how many ways can 5 students be selected for quiz competition so as to include at most three girls.
13. From 6 gentlemen and 4 ladies a committee of 5 is to be formed. In how many ways can this be done so as to include at least two gentlemen.
14. A committee is to be chosen from 'a' boy and 6 girls and is to consist 2 boys and 3 girls. If 120 committees are formed what is the number of boys represented by a?
15. A box contain 8 blue socks and 6 red socks. Find the number of ways two socks can be drawn from the box at random if they be of same colour.
16. From 10 person, in how many ways can a selection of 4 be made when two particular persons are always included.
17. From 10 person, in how many ways can a selection of 4 be made when two particular persons are always excluded?
18. In an examination, a candidate has to pass in each of four subjects. In how many ways can the candidate fail?
19. A man has five friends. In how many ways can he invite one or more of them to a dinner?

Mathematics — Binomial Theorem

Binomial Theorem

1. The general term in the expansion of $(2+x)^n$ is
2. Write the number of the total term in the expansion of $\left[(x-\frac{1}{x})^2\right]^{25}$
3. Find the general term of $\left(-x+\frac{8}{n}\right)^8$
4. Find the term independent of x in the binomial expansion of $\left(2x+\frac{1}{2x}\right)^{10}$
5. Find the coefficient of x^6 in the expansion of $\left(x^3+\frac{1}{x}\right)^{10}$
6. If the coefficient of x^{-1} in the expansion of $\left(x+\frac{p}{x^2}\right)^5$ is 90, find the value of p.
7. Find the middle term in the expansion of $\left(x+\frac{1}{x}\right)^{18}$
8. Find the middle term in the expansion of $\left(ax+\frac{1}{ax}\right)^{16}$
9. Prove that the middle term of $(1+x)^{2n}$ is $\frac{1\cdot3\cdot5\cdots(2n-1)}{n!}2^n x^n$
10. Show that the middle term in the expansion of $\left(x-\frac{1}{x}\right)^{2n}$ is $\frac{1\cdot3\cdot5\cdots(2n-1)}{n!}(-2)^n$
11. For what value of r, the coefficients of x^5 and x^{r+1} are equal in the expansion $(1+x)^n$
12. Define Binomial theorem?
13. If the coefficient of x in the expansion of $\left(x^2+\frac{k}{x}\right)^5$ is 270, find k.
14. If the three successive coefficients in the expansion of $(1+x)^n$ are 28, 56 and 70, find n.
15. If $(1+x)^n = C_0 + C_1x + C_2x^2 + \cdots + C_nx^n$ prove that $C_0C_2 + C_1C_3 + C_2C_4 + \cdots + C_{n-2}C_n = \frac{(2n)!}{(n-2)!(n+2)!}$
16. If $(1+x)^n = C_0 + C_1x + C_2x^2 + \cdots + C_nx^n$ prove that $C_0C_n + C_1C_{n-1} + \cdots + C_nC_0 = \frac{(2n)!}{n!n!}$
17. If $C_0, C_1, C_2, \ldots, C_n$ are binomial coefficients in the expansion of $(1+x)^n$, prove that $C_0 + 4C_1 + 7C_2 + 10C_3 + \cdots + (3n-1)C_n = (3n+2)2^{n-1}$
18. Find the sum of binomial coefficient of the expansion of $(1+x)^n$.
19. Find the odd and even binomial coefficient of the expansion of $(1+x)^n$.
20. If $(1+x)^n = C_0 + C_1x + C_2x^2 + \cdots + C_nx^n$, prove that $C_1 - 2C_2 + 3C_3 - 4C_4 + \cdots + n(-1)^{n-1}C_n = 0$ where $C_0, C_1, C_2, \ldots, C_n$ are binomial coefficients.

Mathematics — Exponential & Logarithmic Series

Logarithmic Series

1. Write the expansion of $\log_e(1-x)$, $|x| < 1$
2. Write the series of $\log_e(1+x)$, $|x| < 1$
3. The value of $\log_e(1+x)$ is given by $\log_e(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \cdots + (-1)^{n-1}\frac{x^n}{n} + \cdots$
   (i) What is the name of the above series?
   (ii) Find the value of $\log_e\left(\frac{1+x}{1-x}\right)$
4. For what condition $\log_e\left(x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \cdots\right)$ necessarily exist.
5. Prove that $\frac{1}{1\cdot3} + \frac{1}{2\cdot5} + \frac{1}{3\cdot7} + \frac{1}{4\cdot9} + \cdots = 2(1-\ln 2)$
6. Prove that $\left(\frac{1}{3}-\frac{1}{2}\right) + \frac{1}{2}\left(\frac{1}{3^2}+\frac{1}{2^2}\right) + \frac{1}{3}\left(\frac{1}{3^3}-\frac{1}{2^3}\right) + \cdots = 0$

7. If $x = \frac{y}{1!} + \frac{y^2}{2!} + \frac{y^3}{3!} + \cdots$ show that $y = x - \frac{x^2}{2} + \frac{x^3}{3} - \cdots$

Mathematics — Binomial Theorem

Exponential Series

1. The value of e lies between.
2. Write the series of e^x
3. Write e^{-x} in series form
4. If $y = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots$ to ∞, then e^x equal to.
5. Coefficient of x^{12} in the expansion of e^{3x+2} is
6. Prove that $\frac{1}{2}(e - \frac{1}{e}) = 1 + \frac{1}{3!} + \frac{1}{5!} + \cdots$
7. Show that $\frac{1}{2}(e + \frac{1}{e}) = 1 + \frac{1}{2!} + \frac{1}{4!} + \frac{1}{6!} + \cdots$
8. Show that $\frac{2}{3!} + \frac{4}{5!} + \frac{6}{7!} + \cdots = e^1$
9. Write series representing e^{-1}
10. Show that $\frac{1}{2!} + \frac{2}{3!} + \frac{3}{4!} + \cdots = 1$
11. Prove that $\frac{\frac{1}{1!}+\frac{1}{4!}+\frac{1}{5!}+\cdots}{\frac{1}{2!}+\frac{1}{4!}+\frac{1}{6!}+\cdots} = \frac{e+1}{e-1}$
12. Prove that $\frac{\frac{1}{1!}+\frac{1}{3!}+\frac{1}{5!}+\frac{1}{7!}+\cdots}{1+\frac{1}{2!}+\frac{1}{4!}+\frac{1}{6!}+\cdots} = \frac{e^2-1}{e^2+1}$
13. Show that $\frac{1}{2!} + \frac{1+2}{3!} + \frac{1+2+3}{4!} + \cdots = \frac{e}{2}$
14. Prove that $1 + \frac{1+2}{2!} + \frac{1+2+3}{3!} + \frac{1+2+3+4}{4!} + \cdots \infty = \frac{3e}{2}$
15. Sum to infinity the series: $1 + \frac{3}{1!} + \frac{5}{2!} + \frac{7}{3!} + \cdots$
16. Define exponential and logarithmic series. Also sum to infinity the series: $12 + \frac{2^2}{2!} + \frac{3^2}{3!} + \cdots$
17. Show that $\sum_{n=1}^{\infty} \frac{n^2}{(n+1)!} = e - 1$

Mathematics — Complex Number

A. Most important questions

a. If $\alpha = \frac{1}{2}(-1 + \sqrt{-3})$ & $\beta = \frac{1}{2}(-1 - \sqrt{-3})$ show that $\alpha^4 + \alpha^2\beta^2 + \beta^4 = 0$

OR

b. If $\alpha = \frac{1}{2}(-1 + \sqrt{-3})$ & $\beta = \frac{1}{2}(-1 - \sqrt{-3})$

B. Show that $\alpha^4 + \beta^4 + \alpha^{-1}.\beta^{-1} = 0$

C. Prove that:

a. $(1 + \omega^2)^3 - (1 + \omega)^3 = 0$
b. $(2 + \omega)(2 + \omega^2)(2 - \omega^2)(2 - \omega^4) = 21$
c. $(1 - \omega + \omega^2)^4 \cdot (1 + \omega - \omega^2)^4 = 256$
d. $(1 - \omega)(1 - \omega^2)(1 - \omega^4)(1 - \omega^8) = 9$
e. $(1 - \omega + \omega^2)^4 + (1 + \omega - \omega^2)^4 = -16$

D. Most important questions

a) Show that:- $\frac{a+b\omega+c\omega^2}{b+c\omega+a\omega^2} = \omega$

b) $\frac{a+b\omega+c\omega^2}{a\omega+b\omega^2+c} + \frac{a+b\omega+c\omega^2}{a\omega^2+b+c\omega} = -1$

c) If $x = a + b$ $y = a\omega + b\omega^2$ $z = a\omega^2 + b\omega$ show that:

i) $x + y + z = 0$ ii) $xyz = a^3 + b^3$

iii) $x^3 + y^3 + z^3 = 3(a^3 + b^3)$

iv) $\left(\frac{-1+\sqrt{-3}}{2}\right)^4 + \left(\frac{-1-\sqrt{-3}}{2}\right)^4 = -1$

E. Express the following in x + iy

a) $3(\cos 120° + i \sin 120°)$
b) $2\cos(-45°) + 2i \sin(-45°)$
c) $2(\cos 150° + i \sin 150°)$
d) $(\sin 40° + i \cos 40°)(\cos 40° + i \sin 40°)$
e) $\frac{\cos 30° + i\sin 30°}{\cos 20° + i\sin 20°}$
f) $\frac{(\cos 3\theta + i\sin 3\theta)(\cos\theta - i\sin\theta)}{(\cos\theta + i\sin\theta)^2}$

F. Express the following in polar form & Euler's form

a) $\sqrt{((1 - i)/(1 + i))}$ b) $i/(1 + i)$
c) $(1 + i)/(1 - i)$ d) $1 - i$
e) $i - \sqrt{3}$ f) $2i$
g) $\sqrt{3} + i$ h) $2 + 2i$

G. Most important question (Almost fix)

1. State & prove De-moivre's theorem.
2. Find the cube root of unity using De-moivre's theorem & write its properties.
3. If $z_1 = r_1(\cos\theta_1 + i \sin\theta_1)$ & $z_2 = r_2(\cos\theta_2 + i \sin\theta_2)$, prove that,
   (i) $z_1z_2 = r_1r_2\{\cos(\theta_1 + \theta_2) + i \sin(\theta_1 + \theta_2)\}$
   (ii) $z_1 / z_2 = r_1 / r_2\{\cos(\theta_1 - \theta_2) + i \sin(\theta_1 - \theta_2)\}$
4. **Using De-moivre's theorem find the square root of:**
   a) $4 + 4\sqrt{3}$ b) $-1 + \sqrt{3}\,i$
   c) $-2 - 2\sqrt{3}I$ d) $2i$ e) $-i$
5. **Solve using De-moivre's theorem:**
   a) $z^4 = 1 + 0.i$ b) $z^6 = 1 + 0.i$
   c) $z^4 + 1 = 0$ d) $z^3 = 8i$
6. **Find the fourth root of:**
   a) $-\frac{1}{2} + i\sqrt{3}/2$
7. **Find the value of:**
   a) $(\frac{1}{2} + \sqrt{3}/2\,i)^7$ b) $[3(\cos\pi/4 + i \sin\pi/4)]^{16}$
   c) $(1 + i)^{20}$
8. If $z = \cos\theta + i \sin\theta$, prove that $z^n - 1/z^n = 2i \sin n\theta$
9. If $\bar{z}$ be the conjugate of the complex number z, prove that
   $\text{Arg}(\bar{z}) = 2\pi - \text{Arg}(z)$

H. Very Short Questions

1. Define Complex Number
2. Define Argument of Complex number
3. What does θ represent in complex number
4. What does r represent in complex number
5. State of De-moivre's.

Mathematics — Sequence and Series

A. Some of the Most Important Question:

(i) $2 + 4 + 6 + \ldots\ldots + 2n = n(n + 1)$
(ii) $1^2 + 3^2 + 5^2 + \ldots\ldots + (2n - 1)^2 = [n(2n - 1)(2n + 1)]/3$
(iii) $1^3 + 2^3 + 3^3 + \ldots\ldots + n^3 = (n^2(n + 1)^2)/4$
(iv) $1\cdot2 + 2\cdot3 + 3\cdot4 + \ldots\ldots n(n + 1) = 1/3\, n(n + 1)(n + 2)$
(v) $1/(1\cdot2) + 1/(2\cdot3) + 1/(3\cdot4) + \ldots\ldots + 1/[n(n + 1)] = n/(n + 1)$
(vi) $2 + 2^2 + 2^3 + \ldots\ldots + 2^n = 2(2^n - 1)$

B. This time this may come in exam:

(i) $n^3 + 2n$ is divisible by 3
(ii) $n(n+1)(n+2)$ is a multiple of 6
(iii) $3^{2n} - 1$ is divisible by 8
(iv) $x^n - y^n$ is divisible by $x - y$
(v) $(n+3)^2 \geq 2n + 7$
(vi) $2^n < n!$ for $n \geq 4$
(vii) $3n \geq 2n - 1$

C. Sum of n terms of Series: (Solve)

i. $1 - 4.5 + 7.5^2 + 10.5^3 \ldots$ ii. $1^2.1 - 2^2.3^1 + 3^2.5 - \ldots\ldots$
iii. $1 + 2.2 + 3.2^2 + 4.2^3 + \ldots$ iv. $3.1^2 + 4.2^2 + 5.3^2 + \ldots\ldots$
v. $2.5 - 6.5^2 + 10.5^3 - 14.5^4 + \ldots$
vi. $1.n + 2(n-1) + 3(n-2) + \ldots$
vii. $3.2 + 5.2^2 + 7.2^3 \ldots\ldots$

D. Some Important Question:

(i) Find the n terms : $1 + 5 + 10 + 16 + 23 + \ldots\ldots$
(ii) $1 + 3x + 5x^2 + 7x^3 + \ldots\ldots \quad (-1 < x < 1)$
(iii) $1 + 5a + 9a^2 + 13a + \ldots\ldots$ to n $(-1 < a <$

Mathematics — Matrix based system of linear equation

Row Equivalent Matrix Method

1. Write the augmented matrix of the system of equation $3x + 2y - 1 = 0$ & $4x - y = 3$

2. Solve the following linear equations by using row equivalent matrix method. $2x - 3y = 10$, $3x - 2y = 0$

3. Solve the following system of equations by row equivalent matrix method. $4x - 5y + 2z = 1$, $3x + 4z = 10$, $2y = 3z - 6$

4. Solve the following system of equations by the row equivalent matrix method. $x + y + z = -2$, $2x - 3y + 5z = 5$, $x - 2y - z = 2$

5. Solve by row equivalent matrix method. $9y - 5x = 3$, $x + z = 1$, $2y + z = 2$

Mathematics — Matrix Based System of Linear Equation

Inverse Matrix Method

1. Solve the following linear equations by using matrix method. $x + 2y = 5$, $3x - y = 2$

2. Using inverse matrix method, solve the following system of equation $2x + 5y = 17$, $5x - 2y = -1$

3. Solve the following system of linear equation matrix method. $2x + y = 4$, $3y - z = 3$, $4x - z = 1$

4. Solve the following system by using inverse matrix method. $x - y + 2z = 0$, $x - 2y + 3z = -1$, $2x - 2y + z = -3$

5. A mixture is to be prepared of three foods A, B and C which contain nutrients P, Q and R as shown in table below.
The total quantity of 30 units of P, 36 units of Q and 30 units of R respectively be required.

Foods	P	Q	R
A	2	2	4
B	3	5	0
C	4	3	5

a) Express the information in equation form.
b) Solve the equation using matrix.

Mathematics — Matrix Based System of Linear Equation

Cramer's Rule

1. If the system of equations $p_1x + q_1y = r_1$ and $p_2x + q_2y = r_2$, what is the value of y?

2. If the system of equations is $x + 3y = 4$ and $x - y = 0$ then the value of D =

3. Consider the system of linear equation $9y - 5x = 3$, $x + z = 1$, $z + 2y = 2$ The value of D_2 is

4. Using the Cramer's rule to solve the system of linear equations $x = 2y$ and $3x + 2y = 8$

5. The cost of 2 pen and 3 exercise book is Rs 420 and the cost of 3 pen and 5 exercise book is Rs 680. Find the cost of one book and one exercise book by using Cramer's rule

6. Using the Cramer's rule solve the following system of linear equations $x + y = 5$, $y + z = 8$, $x - z = 7$

7. Use determinant method to solve the equations $2x + y = 4$, $3y - z = 3$, $2x + 3z = 11$

8. A factory produces three articles A, B and C each of which is processed by three machine P, Q and R.
The time (in hours) required for per unit of A, B and C in the machine P, Q and R are given below.

	Machines		
ARTICLES	P	Q	R
A	3	4	2
B	4	2	3
C	2	3	4

If each of the machine is operated for 18 hours, find the number of article A, B and C produced daily by performing the following takes:
(i) Express the above information in form of equation and solve by Cramer's rule

Mathematics — Trigonometry

Properties of Triangle

From this chapter

(1) Sine law (2) Cosine law
(3) Projection law (4) Tangent law
(5) Half angle law (6) The area of triangle

1) State and prove Sine law

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

2) Prove that:

1. $a^3(\sin^3 B - \sin^3 C) + b^3(\sin^3 C - \sin^3 A) + c^3(\sin^3 A - \sin^3 B) = 0$

2. $\frac{a^2 \sin(B-C)}{\sin A} + \frac{b^2 \sin(C-A)}{\sin B} + \frac{c^2 \sin(A-B)}{\sin C} = 0$

3. $\frac{a \sin(B-C)}{b^2 - c^2} = \frac{b \sin(C-A)}{c^2 - a^2} = \frac{c \sin(A-B)}{a^2 - b^2}$

4. $b^2 \sin 2C + c^2 \sin 2B = 2ab \sin C$

5. $a^3\sin(B-C)+b^3\sin(C-A)+c^3\sin(A-B)=0$

6. $\frac{b^2-c^2}{a^2}\sin 2A+\frac{c^2-a^2}{b^2}\sin 2B+\frac{a^2-b^2}{c^2}\sin 2C=0$

7. $\sin(A+B):\sin(A-B)=c^2:(a^2-b^2)$

8. $\frac{b-c}{a}\cos\frac{A}{2}=\sin\frac{B-C}{2}$

3) If $\frac{\sin(A-B)}{\sin(A+B)}=\frac{a^2-b^2}{a^2+b^2}$ prove that the triangle $\triangle ABC$ is either isosceles or Right-angled triangle.

4) If $\frac{\sin A}{\sin C}=\frac{\sin(A-B)}{\sin(B-C)}$ then prove that a^2, b^2 and c^2 are in A.P.

5) $(a\sin A+b\sin B+c\sin C)^2=(a^2+b^2+c^2)(\sin^2 A+\sin^2 B+\sin^2 C)$

Cosine Law

1) State and prove Cosine law;

(i) $b^2=a^2+c^2-2ac\cos B$

(ii) $c^2=a^2+b^2-2ab\cos C$

(iii) $a^2=b^2+c^2-2bc\cos A$

2) Prove that: $a[b\cos C-c\cos B]=b^2-c^2$

3) Prove that: $\frac{\cos A}{a}+\frac{\cos B}{b}+\frac{\cos C}{c}=\frac{a^2+b^2+c^2}{2abc}$

4) Prove that: $\frac{\cos A}{a}+\frac{a}{bc}=\frac{\cos B}{b}+\frac{c}{ca}=\frac{\cos C}{c}+\frac{c}{ab}$

5) Prove that: $\frac{\cos B-\cos C}{\cos A+1}=\frac{c-b}{a}$

6) If $a^4+b^4+c^4=2c^2(a^2+b^2)$ then show that $\angle C=45°, 135°$

7) If $(a+b+c)(b+c-a)=3bc$ then $\angle A$

8) If $\frac{1}{a+c}+\frac{1}{b+c}=\frac{3}{a+b+c}$ then Find the angle $\angle C$

9) If the cosine of two of the angles of a triangle are proportional to the opposite side, prove that the triangle is isosceles.

10) If $\frac{\cos A+2\cos C}{\cos A+2\cos B}=\frac{\sin B}{\sin C}$ then Prove that $\triangle ABC$ is right angle or isosceles.

11) In any $\triangle ABC$, if $2\cos A\cdot\sin C=\sin B$, then prove that the triangle is isosceles

Projection Law

1) State and prove Projection law

(i) $a=b\cos C+c\cos B$ (ii) $b=a\cos C+c\cos A$

(iii) $c=a\cos B+b\cos A$

2) prove: $(b+c)\cos C+(c+a)\cos B+(a+b)\cos C=a+b+c$

3) prove : $\frac{c-b\cos A}{b-c\cos A}=\frac{\cos B}{\cos C}$

Tangent law and Half angle.

1) Prove that

(i) $\tan\left(\frac{B-C}{2}\right)=\frac{b-c}{b+c}\cot\frac{A}{2}$ (ii) $\tan\left(\frac{C-A}{2}\right)=\frac{c-a}{c+a}\cot\frac{B}{2}$

(iii) $\tan\left(\frac{A-B}{2}\right)=\frac{a-b}{a+b}\cot\frac{C}{2}$

2) Prove that:

(i) $\sin\frac{A}{2}=\sqrt{\frac{(s-b)(s-c)}{bc}}$ (ii) $\sin\frac{B}{2}=\sqrt{\frac{(s-a)(s-c)}{ac}}$

(iii) $\sin\frac{C}{2}=\sqrt{\frac{(s-a)(s-b)}{ab}}$

3) Prove that :

(i) $\cos\frac{A}{2}=\sqrt{\frac{s(s-a)}{bc}}$ (ii) $\cos\frac{B}{2}=\sqrt{\frac{s(s-b)}{ac}}$

(iii) $\cos\frac{C}{2}=\sqrt{\frac{s(s-c)}{ab}}$

4) Prove that; $b\cos^2\frac{A}{2}+a\cos^2\frac{B}{2}=\frac{1}{2}(a+b+c)$

5) Prove that: $\frac{b-c}{a}\cos^2\frac{A}{2}+\frac{c-a}{b}\cos^2\frac{B}{2}+\frac{a-b}{c}\cos^2\frac{C}{2}=0$

6) Prove that: $\tan^2\frac{A}{2}\cdot\tan^2\frac{B}{2}\cdot\tan^2\frac{C}{2}=\left(\frac{s-a}{s}\right)\left(\frac{s-b}{s}\right)\left(\frac{s-c}{s}\right)$

7) Prove that: $(a+b-a)\left(\cot\frac{B}{2}+\cot\frac{C}{2}\right)=2a\cot\frac{A}{2}$

Area of triangle.

1) In triangle $\triangle ABC$, if $a=3, b=4$ and $c=3$, find R and $\cos\frac{A}{2}$.

2) In any $\triangle ABC$, if $a=13, b=14, c=15$, find $\sin\frac{A}{2}$, $\cos\frac{A}{2}$, $\tan\frac{A}{2}$, Δ.

Mathematics — Trignomctry

Solution of Triangle.

1) Given $a=\sqrt{6}, b=2, c=\sqrt{3}-1$, solve the triangle.

2) If $a=\sqrt{6}, b=2, c=\sqrt{3}+1$, solve the triangle.

3) If $A=30°, B=45°, a=6\sqrt{2}$, solve the triangle

4) If $A=30°, B=60°, b=10\sqrt{3}$, solve the triangle.

5) If $a=2, b=4, C=60°$, solve the triangle.

6) In $\triangle ABC$, if $b=1, c=\sqrt{3}-1$ and $A=60°$, solve the triangle.

7) Two sides of a triangle are $\sqrt{3}+1$ and $\sqrt{3}-1$ and the angle included is $60°$, solve the triangle

8) If $A=45°, B=60°$, Prove that $a:c=2:\sqrt{3}+1$

9) The angles of a triangle are $105°$ and $15°$, find the ratio of its side.

10) If two angles of a triangle are $75°$ and $60°$, find the ratio of the side.

Mathematics — Conic Sections

Circle

- **Type–1:** Solve the problems related to condition of tangency of a line at a point to the circle.
- **Type–2:** Find the equation of tangent and normal to the circle at a given point.
- **Type–3:** Length of tangent and touches of two circles.

Type–1: Condition of Tangency

1. Find the condition of tangency to a line $y=mx+c$ and circle $x^2+y^2=a^2$.

2. Find the value of k so that the line $4x+3y+k=0$ may touch the circle $x^2+y^2-4x+6y+4=0$.

3. The condition of straight-line $y=mx+c$ to a circle $x^2+y^2=a^2$ is $c^2=a^2(1+m^2)$. Justify with example.

4. Deduce the condition that the line $2x + my + n = 0$ may be a tangent to the circle $x^2 + y^2 + 2gx + 2fy + c = 0$.
5. Find the condition that the circle $x^2 + y^2 + 2gx + 2fy + c = 0$
(i) touches x-axis (ii) touches y-axis.
6. If the line $lx + my = 1$ touches the circle $x^2 + y^2 = a^2$, prove that the point (l, m) lies on a circle whose radius is $1/a$.
7. Prove that the straight-line $y = x + a\sqrt{2}$ touches the circle $x^2 + y^2 = a^2$.

Type–2: Equation of Tangent and Normal to the Circle

1. Find the equation of tangents and normal to the circle $x^2 + y^2 = 36$ at $(-6, 0)$.
2. Find the equation of tangent and normal to a circle $x^2 + y^2 = 40$ at the point whose
(a) abscissa is 2 (b) ordinate is -6.
3. Find the equation of tangent to the circle $2x^2 + 2y^2 = 9$ which makes an angle 45° with x-axis.
4. Find the equation of tangent to the circle $x^2 + y^2 = 5$ which is perpendicular to $x + 2y = 0$.
5. Show that the tangents to the circle $x^2 + y^2 = 100$ at the points (6, 8) and (8, −6) are perpendicular to each other.
6. Find the equation of tangent and normal to the circle $x^2 + y^2 - 6x - 8y - 4 = 0$ at (8, 6).
7. Find the equation of tangent to the circle $x^2 + y^2 - 2x - 4y - 4 = 0$ which are perpendicular to the line $3x - 4y - 1 = 0$.

Type–3: Length of Tangent and Touches of Two Circles

1. Prove that the circles $x^2 + y^2 + 2ax + c^2 = 0$ and $x^2 + y^2 + 2by + c^2 = 0$ will touch each other, if $1/a^2 + 1/b^2 = 1/c^2$.
2. Find the condition for two circles $x^2 + y^2 = a^2$ and $(x - h)^2 + y^2 = b^2$ to touch
(i) externally (ii) internally.
3. Find the length of tangent to the circle
(a) $x^2 + y^2 - 2x - 10y + 7 = 0$ from the point $(-2, -3)$.
4. Find the value of k so that the length of the tangent from (5, 4) to the circle $x^2 + y^2 + 2ky = 0$ is 1.

Mathematics — Conic Sections

Parabola

Type–1: Standard Equation of Parabola
Type–2: Equation of Tangent and Normal to the Parabola

Type–1: Standard Equation of Parabola

1. Deduce the standard equation of parabola $y^2 = 4ax$.
2. Find the equation of parabola with vertex $(-1, 3)$ & focus (5, 3).
3. Find the equation of parabola with vertex (2, 3) and focus (2, 5).
4. Find the equation of parabola with vertex $(-5, -3)$ & ends of latus rectum $(-1, 5)$ and $(-1, -11)$.
5. Find the equation of parabola with vertex $(-1, 2)$ and equation of directrix $x = 4$.
6. Find the equation of parabola with focus $(-3, 4)$ and equation of directrix $2x - y + 5 = 0$.
7. Find the equation of the parabola whose length of latus rectum is 6, axis along the line parallel to x-axis and passes through the points (3, 3) and $(3, -2)$.
8. Prove that the equation of parabola whose vertex and focus are on x-axis at distances a and b from origin respectively is $y^2 = 4b(x - a)$.
9. Find the co-ordinates of vertex, focus, equation of directrix, length of latus rectum and axis of equation:
(a) $y^2 = 6y - 12x + 45$ (b) $x^2 - 4x - 8y + 12 = 0$
(c) $x^2 = 12y$ (d) $y^2 = 24x$

Type–2: Equation of Tangent and Normal to the Parabola

1. Find the equation of tangent to the parabola $y^2 = 4ax$ at (x_1, y_1).
2. Find the equation of normal to the parabola $y^2 = 4ax$ at (x_1, y_1).
3. Obtain the equations to the tangent and the normal to the parabola $y^2 = 8x$ at $(2, -4)$.
4. Obtain the equation to the tangent and the normal to the parabola $x^2 = 4y$ at the point whose abscissa is 6.
5. Obtain the equation to the tangent and the normal to the parabola $y^2 = 12x$ at each end of its latus rectum.
6. Prove that the line $3x + 4y + 6 = 0$ is tangent to the parabola $2y^2 = 9x$ and find its point of contact.
7. For what value of a will the straight-line $y = 2x + 3$ touch the parabola $y^2 = 4ax$?
8. If the line $2x + y = 3$ touches the parabola $y^2 = 4ax$, find the length of latus rectum.
9. Find the equation of tangent to the parabola $y^2 = 4x$ perpendicular to the line $2x - y = 4$. Also find the point of contact.
10. Find the equation of the tangent and normal to the parabola $y^2 = 6x$ making angle 45° with x-axis.
11. Establish the condition that the line $ax + by + c = 0$ may be normal to the parabola $x^2 = 4ay$.
12. Find the condition that a line $ax + by + c = 0$ may be normal to the parabola $y^2 = 4ax$.
13. If the chord joining the points $(at_1^2, 2at_1)$ and $(at_2^2, 2at_2)$ on the parabola $y^2 = 4ax$ passes through the focus S(a, 0), show that $t_1t_2 = -1$.
14. Show that the tangents to the parabola as $y^2 = 4x$ and $x^2 = 4y$ at (1, 2) and $(-2, 1)$ respectively are at right angle.

Mathematics — Conic Sections

Ellipse

1. Find the centre, vertex, eccentricity, focus, length of latus rectum, length of major axis and minor axis and equation of directrix:
(a) $x^2/9 + y^2/16 = 1$ (b) $3x^2 + 4y^2 = 36$
(c) $9x^2 + 4y^2 - 18x - 16y - 11 = 0$
(d) $(x + 2)^2/16 + (y - 5)^2/9 = 1$
2. Find the eccentricity of the ellipse whose major axis is four times its minor axis and passes through the point (4, 0).
3. Find the equation of the ellipse in standard form with

its length of the major axis 12 and eccentricity 2/3.
4. Find the equation of ellipse whose foci are (±2, 0) and length of latus rectum is 6 units.
5. Find the equation of the ellipse in the standard form with a vertex at (0, 8) and passing through (3, 32/5).
6. Find the equation of the ellipse whose distance between two foci is 8 and the semi-latus rectum is 6.
7. Find the condition that for the conic $x^2/2 + y^2/5 = 1$ to represent an ellipse.
8. Find the eccentricity of an ellipse if its latus rectum is eual to one-half of its major axis.

Mathematics — Conic Sections

Hyperbola

1. Find the centre, vertex, focus, eccentricity, length of latus rectum, length of transverse and conjugate axis and equation of directrix:
(a) $x^2/36 - y^2/25 = 1$ (b) $3x^2 - 4y^2 - 6x = 0$
(c) $9x^2 - 16y^2 + 18x + 32y - 151 = 0$
2. Determine the equation of the hyperbola with a focus at (5, 0) and a vertex at (3, 0).
3. Find the equation of hyperbola in standard position such that its transverse and conjugate axes are respectively 4 and 5.
4. Find the equation of hyperbola with focus at (−7, 0) and eccentricity 7/4.
5. Find the equation of the hyperbola with vertex (8, 0) and passing through the point $(8\sqrt{2}, 4)$.
6. Find the equation of the hyperbola in which the distance between foci is 16 and eccentricity is $\sqrt{2}$.

Mathematics — Derivatives & it's Application

Hyperbola Function

1 Find the derivative of the following:
(a) $y = \sinh(3x)$ (b) $y = \tanh(x/2)$
(c) $y = 2\sinh(x/2)$ (d) $y = \text{cosech } x$
(e) $y = \sinh x$ (f) $y = \tanh(5x) - \text{sech}(2x)$

2 Find the derivative of the following:
(a) $y = \coth^2 x$ (b) $y = \text{sech}^2(3x)$
(c) $y = \cosh^3(2x/3)$ (d) $y = \sinh^2 x + \cosh^2 x$
(e) $y = \coth x - \coth^3 x$
(f) $y = \sqrt{(\sinh x)} + 1/\sqrt{(\cosh x)}$

3 Find the derivative of following:
(a) $y = e^{(\tanh(x/2))}$ (b) $y = \log(\tanh x)$
(c) $y = \log(\sinh(x/a))$ (d) $y = \log(\cosh x^2)$
(e) $y = \log(\log x)$

4 Find the derivative of following:
(a) $y = \coth^{-1} x$ (b) $y = \text{cosech}^{-1} x$
(c) $y = \tanh^{-1} x$ (d) $y = \cosh^{-1} x$
(e) $y = \text{sech}^{-1} x$ (f) $y = \sinh^{-1} x$
(g) $y = \sec(\tan^{-1} x)$ (h) $y = \text{sech}^{-1} x - \cosh^{-1} x$
(i) $y = \text{Arc tan}(\sinh x)$ (j) $y = 2\tanh^{-1}(\tan 1/2x)$
(k) $y = \sinh^{-1}(\cos 2x)$ (l) $y = \coth(\text{Arc sin } x)$

5 Find the derivative of the following:
(a) $y = \tanh x \cdot \coth x$ (b) $y = (\ln x)^{(\sinh x)}$
(c) $y = x^{(\sinh x)}$ (d) $y = (\tan x)^{(\log x)}$
(e) $y = (\sec x)^{(\tan x)}$ (f) $y = x^{\cosh^2\left(\frac{x}{2}\right)}$
(g) $y = x^{(\tanh^{-1}(x/3))}$ (h) $y = \left(\sinh\left(\frac{x}{a}\right)\right)^{x^2}$
(i) $y = (\cosh(x/a))^{(\log x)}$ (j) $y = (\cosh^{-1} x)^{(\sinh x)}$

Mathematics — Derivatives & it's Application

L' Hospital Rule

1 Define L'Hospital rule? with example.
2 $\lim_{x\to 0} \frac{\sin x}{x}$ 3 $\lim_{x\to 0} \frac{1-\cos x}{6x^2}$
4 Find the value of $\lim_{x\to 0} \frac{\tan x - x}{x - \sin x}$ is
5 Apply L-Hospital rules evaluate: $\lim_{x\to 1} \frac{x^3-2x^2+1}{3x^3-3x}$
6 What is the value of $\lim_{\theta\to 0} \frac{\tan\theta}{\theta}$
7 Solve by using L'Hospital rules
1. $\lim_{x\to 4} \frac{x^3-64}{x^2-16}$ 2. $\lim_{x\to 0} \frac{e^x - x - 1}{x^2}$
3. $\lim_{x\to 0} \frac{e^x + e^{-x} - 2\cos x}{\sin^2 x}$ 4. $\lim_{x\to 0} \frac{x^2 - \sin^2 x}{x^2}$
5. $\lim_{x\to 0} \frac{(e^x - 1)\tan x}{x^2}$ 6. $\lim_{x\to 0} \frac{x - \sin x.\cos x}{x^3}$
7. $\lim_{x\to 0} \frac{\ln(\tan x)}{\ln x}$ 8. $\frac{xe^x - \log(1+x)}{x^2}$
9. $\lim_{x\to\infty} \frac{\ln x}{x}$ 10. $\lim_{x\to\infty} \frac{\ln(2x^2+5)}{\ln(3x^2+4)}$

8. Give an example of the function which is continuous but not derivable with justification.
9. A residential student of a school is putting the following Questions
(a) What is the relation between continuity and differentiability of a function at a point?
(b) What is the principle of Differentiation.
(c) write any one condition where we use the derivative to find the limit of a function.
(d) write one difference between differentiation and integration of a function
(e) In the expression $\int f(x)\,dx = F(x) + C$, what is the relation between $f(x)$ and $F(x)$ from differentiation point of view?

Mathematics — Derivatives & it's Application

Rate Measure

1. The velocity of a rectilinear motion given by the equation $S = 3t^2 - 2t + 1$ at $t = 4$ is
2. The radius of a spherical ball is increasing at the rate of 1.5 cm/sec. At what rate is the surface area of the ball increasing when the radius is 2cm.
3. If a radius of a circular plate on heating increases at the rate of 1.2 cm/s. then the rate of increase of it's Circumference is
4. The side of square sheet is increasing at the rate of 5

cm min. At what rate is the area increasing when the sides are 12cm long.

5. Find the rate of change of the Volume of a cylinder of radius r and height h will respect to a change in radius.

6. A circular plate of metal expands by heat so that it's radius increases at the rate of 0.25 cm/sec. Find the rate at which the surface is increasing when the radius is 7cm

7. Two concentric circle are expanding in such a way that the radius of the inner circle is increasing at the rate of 6cm sec and that of the outer circle at the rate of 2.5 cm sec. At a certain time, the radius of the inner and outer circle is respectively 20cm & 32cm. At that time how fast is the area between the circle increasing or decreasing.

8. A spherical balloon is inflated at the rate of 10 cubic cm/sec. At what rate is the radius increasing when the radius is 10cm.

9. A spherical ball of salt is dissolved in water in such a manner that the rate of decreases in volume at any instant is proportional to the surface- prove that radius is decreasing of a Constant rate.

10. water flows into an inverted conical vessel at the rate of 24 m^3/min. When the depth of water is 4m how fast is the level rising, assuming that the height of the vessel is 8m and the radius at the top is 2m?

11. What flows into an inverted conical tank at the rate of 27 ft^3/min. when the depth of water is 2ft, how fast is the level rising? Assume that the height of the tank is 4ft. and the radius of the top is 1ft

12. If the volume of the expanding cube is increasing at the rate of 24 cm^3/min. How fast is its surface area is increasing when the surface area is 216cm^2?

13. If the volume of an expanding cube is increasing at the rate of 5 cm^3/min. How fast is it surface area increasing when the surface area is 24 sq.cm?

14. A kite is 24 m Height & there are 25m of Cord out If the kite moves horizontally at the rate of 36km/hr directly away from the person who is flying it, how fast is the Cord out.

15. A point is moving along the curve $y = 2x^3 - 3x^2$ is such a way that it's x - coordinate is increasing at the rate of 2cm/sec. find the rate at which the distance of the point from the origin is increasing when the point is at (2,4).

16. A man of height 1.5m walk away from a lamp post of height 4.5m at the rate of 20cm/sec How fast is the shadow lengthing when the man is 42cm from the post.

17. A ladder 5 meters long reached against vertical wall if its top slides downwards at the rate of 10cm/sec. find the rate at which the foot of the ladder is sliding where the fast of the ladder is 4 meters away from the wall.

Mathematics — Derivatives & it's Application

Differential Tangent and Normal

1. Find the slope and the inclined with x-axis of the tangent of $x^2 + y^2 = 25$ at $(-3,4)$.
2. What is the slope of the curve of the function $F(x) = x^2 - 2x$ at $x = 5$?
3. What is the slope of normal to the curve $y = 2x^2 + 3x + 5$ at $(-2,7)$.
4. If $\frac{dy}{dx} = \frac{2}{5}$, what is the slope of normal at $(1,1)$for $y = F(x)$?
5. The angle of intersection of the curve $y = x^2$and $x = y^2$at $(1,1)$is.
6. What is the angle between the tangents to the curve $x^2 = 6y - 15$ at the points $(1,9)$ and $(-9,0)$.
7. Tangent to the curve $y = x^3$at $x = 2$ and $x = -2$ are.
8. Write the condition where the curve $y = F(x)$has tangent parallel to y-axis.
9. Write the slope of tangent to the curve $y = F(x)$at (x_1, y_1).
10. Find the equation of tangent to $y = x^2 - 4x + 1$at $(2,-3)$.
11. Find the equations of the tangent to $y = x^3 - 2x^2 + 4$at $(2,4)$.
12. Find the points on the curve $y = x^3 - 3x^2 + 1$where the tangents are parallel to the x-axis.
13. Find the point on the curve $4y = x^2$when the tangent draw make angle 45°with the x-axis.
14. What is the point on the curve $y = 2x^2 - 4x - 3$at which the tangent to the curve is parallel to the line $4x - y + 2 = 0$.
15. Find the angle if intersection of the curve $y = 6 - x^2$of $x^2 = 2y$.

Mathematics — Antiderivatives

Integration

A. Find the inegral of

1. $\int \frac{1}{4+x^2}\,dx$?
2. $\int \frac{dx}{5x^2+1}$?
3. $\int \frac{1}{4x^2+9}\,dx$?
4. $\int \frac{1}{x^2+7}\,dx$?
5. $\int \frac{dx}{x^2-36}$
6. $\int \frac{dx}{2x^2-5}$
7. $\int \frac{dx}{a^2-x^2}$
8. $\int \frac{dx}{5-4x^2}$
9. $\int \frac{dx}{\sqrt{x^2+a^2}}\,dx$
10. $\int \frac{dx}{\sqrt{4x^2-9}}$
11. $\int \frac{dx}{\sqrt{a^2-x^2}}$
12. $\int \frac{dx}{\sqrt{1-x^2}}$
13. $\int \frac{dx}{x^2+x+1}$
14. $\int \frac{dx}{\sqrt{x^2-2x+2}}$
15. $\int \frac{dx}{\sqrt{5-4x-x^2}}$
16. $\int \frac{dx}{\sqrt{x^2+3x+1}}$
17. $\int \frac{dx}{7-2x-x^2}$
18. $\int \frac{dx}{\sqrt{2ax-x^2}}$
19. $\int \sqrt{2ax - x^2}$
20. $\int \sqrt{x^2 + 7x - 9}\,dx$.

B. Find the inegral of

1. $\int \frac{2x-11}{x^2+x-2}\,dx$
2. $\int \frac{6x+1}{x^2+9}\,dx$
3. $\int \frac{2x+3}{4x^2+1}\,dx$

4 $\int (2x+3)\sqrt{x^2-2x-3}\,dx$

5 $\int \frac{dx}{x+\sqrt{x^2-1}}$ 6 $\int \frac{dx}{\sqrt{(x-\alpha)(x-\beta)}}\ (\beta > \alpha)$

7 $\int \frac{x^2-1}{x^4+x^2+1}\,dx$ 8 $\int \frac{\sqrt{1+e^x}}{1-x}\,dx$

9 $\int (2x-5)\sqrt{x^2-5x+1}\,dx$

10 $\int \frac{dx}{e^x+e^{-x}}$ 11 $\int \frac{dx}{\sqrt{1+e^{-2x}}}$

C. Evaluate:

1. $\int \frac{dx}{1-2\cos x}$ 2 $\int \frac{dx}{a+b\cos x}$

3 $\int \frac{dx}{2+3\cos x}$ 4 $\int \frac{dx}{1-3\sin x}$

5 $\int \frac{dx}{1+2\sin x}$ 6 $\int \frac{dx}{3\sin x+4\cos x}$

7 $\int \frac{dx}{1+\sin x+\cos x}$ 8 $\int \frac{dx}{4+3\cos hx}$

9 $\int \frac{dx}{3+5\cos hx}$ 10 $\int \frac{\cos x-\sin x}{\sqrt{\sin 2x}}\,dx$

11 $\int \frac{\cot hx\,dx}{\sin hx-9\operatorname{cosec} hx}$ 12 $\int \frac{\sin 2x}{(\sin x+\cos x)^2}\,dx$

D. **Using partial fraction method:**

1. $\int \frac{8}{(2x-1)(2x+1)}\,dx$ 2 $\int \frac{x}{(x-a)(x-b)}\,dx$

3 $\int \frac{dx}{x(x-1)}$ 4 $\int \frac{1}{(4+x^2)(9+x^2)}\,dx$

5 $\int \frac{x^2}{(x+2)^2(x+3)}\,dx$ 6 $\int \frac{1}{x(x-1)(x-2)}\,dx$

7 Define proper rational fraction with an example

• integrate $\int \frac{2x^2+3}{x^3+3x^2+2x}\,dx$ using concept of partial fractions

8 $\int \frac{2x^2-x+4}{x^3+4x}\,dx$ 9 $\int \frac{5}{(x+5)(x^2+5)}\,dx$

10 $\int \frac{x}{(x-1)(x^2+1)}\,dx$ 11 $\int \frac{dx}{(x-2)^2(x-3)^3}$

12 $\int \frac{x^2}{x^4-2x^2-15}\,dx$

Mathematics — Differential equation

1. What is the order of the differential equation $\left(\frac{d^5y}{dx^5}\right)^2 + \left(\frac{d^4y}{dx^4}\right)^3 + \left(\frac{d^3y}{dx^3}\right)^2 + y = 0$

2. The order and degree of the differential equation $x\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^2 + y^2 = 0$ are respectively.

3. If the degree of the differential equation is $x\frac{dy}{dx} + 3\left(\frac{d^2y}{dx^2}\right)^3 + 4\left(\frac{dy}{dx}\right)^4 + 5 = 0$ is 1, what is its **order**?

4. Write the degree and order of the differential equation $\left[1+\left(\frac{dy}{dx}\right)^2\right]^3 = \left(\frac{d^3y}{dx^3}\right)^2$

5. Define order and degree of differential equation?

6. Write the order of differential equation $\frac{d^2y}{dx^2} + \frac{dy}{dx} + 5 = 0$

7. What is the degree of ordinary differential equation $\frac{d^3s}{dt^3} = \left(4+\left(\frac{d^2s}{dt^2}\right)^2\right)^{1/2}$

Variable separable differential equation

1. Solve the differential equation:

a. $\frac{dy}{dx} = \frac{1+y^2}{1+x^2}$ b. $\sqrt{1-x^2}\,dy + \sqrt{1-y^2}\,dx = 0$

2. Solve: $y\,dx - x\,dy = 0$ 3. Solve: $\frac{dy}{dx} = \frac{1-y}{2x+1}$

4. The solution of differential equation $\frac{dy}{dx} + y = 1$ is

5. Solve: $\frac{dy}{dx} = \frac{e^x}{e^y} + \frac{x^3}{e^y}$ 6. Solve: $(1+x^2)\frac{dy}{dx} = 1$

7. Solve $\frac{dy}{dx} + \frac{1+\cos 2y}{1-\cos 2y} = 0$ 8. Solve $\frac{dy}{dx} + \sqrt{\frac{1-y^2}{1-x^2}} = 0$

9. Solve the differential equation: $\frac{dy}{dx} = \frac{2x+1}{5y+1}$

Homogeneous differential equation

1. Solve: $\frac{dy}{dx} + \frac{x^2-y^2}{3xy} = 0$

2. Solve: $(x^2+y^2)\,dx - 2xy\,dy = 0$

3. Identify the homogeneous differential equation and solve it $(2xy+y^2)\,dy + (y^2+x)\,dx = 0, (1-x^2)\frac{dy}{dx} - xy = 1$ and $\frac{dy}{dx} + \frac{x^2-y^2}{3xy} = 0$

4. Give an example of homogeneous differential equation with integral.

5. **Solve**

a. $x^2y\,dx = (x^3+y^3)\,dy$ b. $\frac{dy}{dx} = \frac{y}{x} - \sin^2\frac{y}{x}$

c. $\frac{dy}{dx} = \frac{(y-x)(y+x)}{2xy}$

Exact differential equation

1. Write an example of exact differential equation

2. An exact differential equation have always the mathematical form like $M(x,y)\,dx + N(x,y)\,dy = 0$ Take a simple example to justify the statement with characteristics of $M(x,y)$and $N(x,y)$.

3. If the differential equation $y\,dx - x\,dy = 0$ is not exact differential equation, then how can you make differential equation?

4. Solve the differential equation: $(x+y+1)\,dy = dx(x-y+1)$.

5. Solve the differential equation $x\,dy + y\,dx = 0$.

6. Solve the differential equation $2xy\,dx + x^2dy = 0$

7. Solve: $y\,dx - x\,dy = xy\,dy$

Linear differential equation

1. Write the standard form of first order linear differential equation

2. If the integrating factor of the differential equation $\frac{dy}{dx} + P(x)y = Q(x)$ is x, then $P(x)$is

3. What is the integrating factor of $\frac{dy}{dx} + \frac{1}{x}y = x^2$?

4. Which is the integrating factor of differential linear equation $\cos^2 x\frac{dy}{dx} = 1 - y$?

5. The integrating factor of differential equation $x\frac{dy}{dx} + y\cos x = x\sin x$ is

6. $\frac{dy}{dx} + P(x)y = Q(x)$ is general form of a first degree linear equation. Take suitable function $P(x)$ and $Q(x)$ and solve it.

7. Which type of differential equation $\sin x\frac{dy}{dx} + y\cos x = x\sin x$ represents? Also solve it

8. Find the solution of differential equation $x\frac{dy}{dx} + y - x\log x = 0$

9. Solve:

a. $\frac{dy}{dx} + \frac{y}{x} = 1$ b. $(1 + x^2)\frac{dy}{dx} + y = \tan^{-1} x$

c. $\frac{dy}{dx} + 2y\tan x = \sin x$ d. $\cos^2 x\frac{dy}{dx} + y = 1$

e. $\frac{dy}{dx} + \frac{2xy}{1+x^2} = \frac{1}{(1+x^2)^2}$ f. $(1 + x^2)\frac{dy}{dx} + y = e^{\tan^{-1} x}$

Mathematics Vectors

DOT (Scalar) Product

1. Define scalar (dot) product of two vectors with example.
2. For what value of m are the vectors $\vec{i} - \vec{2j} + \vec{4k}$ *and* $\vec{2i} - \vec{7j} + \vec{mk}$ orthogonal?
3. Find the cosine of the angle between the vectors $\vec{2i} - \vec{j} + \vec{k}$ and $\vec{4i} + \vec{3j} + \vec{5k}$
4. If $\vec{a}$ and $\vec{b}$ are perpendicular vectors and $\vec{a} = (4, 5)$, $\vec{b} = (2, k)$, find the value of k.
5. If $\vec{a} = \vec{4i} - \vec{3j} + \vec{2k}$ and $\vec{b} = \vec{3i} - \vec{2j} + \vec{4k}$ are two vectors, find the projection of $\vec{b}$ on $\vec{a}$.
6. If $\vec{a} = (1, 2)$ and $\vec{b} = (-3, 1)$, find the projection of $\vec{a}$ on $\vec{b}$.
7. Find the dot product of the vectors $\vec{2i} - \vec{j} + \vec{2k}$ and $\vec{3i} - \vec{2j} + \vec{6k}$
8. Is the angle between the lines represented by $\vec{2i} - \vec{j} + \vec{k}$ and $\vec{i} - \vec{j}$ acute? Explain it.
9. The position vectors of the vertices of ΔABC are $\vec{7j} + \vec{10k}$, $\vec{-i} + \vec{6j} + \vec{6k}$ and $\vec{-4i} + \vec{9j} + \vec{6k}$. Prove that the triangle is an isosceles right-angled triangle.
10. The dot product of two non-zero vectors gives a positive real number. Justify it with example.

PROVE THAT:

1. If θ is the angle between two unit vectors $\vec{a}$ and $\vec{b}$, show that $\frac{1}{2}|\vec{a} - \vec{b}| = \sin(\theta/2)$
2. If $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$, prove that $\vec{a}$ is perpendicular to $\vec{b}$.
3. If $|\vec{a}| = 3$, $|\vec{b}| = 4$ and $|\vec{a} + \vec{b}| = 5$, then find value of $|\vec{a} - \vec{b}|$.
4. Prove by vector method:
(i) $\cos(A + B) = \cos A\cos B - \sin A\sin B$
(ii) $\cos(A - B) = \cos A\cos B + \sin A\sin B$
5. Use vector method, prove in any triangle ΔABC:
(i) $b^2 = c^2 + a^2 - 2ca\cos B$ (ii) $c^2 = b^2 + a^2 - 2ab\cos C$
(iii) $a^2 = b^2 + c^2 - 2bc\cos A$
6. Use vector method, prove that in any triangle that:
(i) $a = b\cos C + c\cos B$ (ii) $b = a\cos C + c\cos A$
(iii) $c = a\cos B + b\cos A$
7. Prove by vector method that the angle in a semicircle is a right angle.
8. If A, B, C and D are any four points, show that: $\vec{AB}\cdot\vec{CD} + \vec{BC}\cdot\vec{AD} + \vec{CA}\cdot\vec{BD} = 0$
9. The scalar product of two vectors and cross product of two vectors are interrelated. Explain.
10. In a rhombus, two of the diagonals are perpendicular to each other. Verify it by vector dot product of two vectors.

Vectors

Cross Vector Product

1. Define vector product (cross product) of two vectors and interpret geometrically, with example.
2. Find the area of parallelogram determined by the vectors $\vec{-i} + \vec{j} + \vec{k}$ and $\vec{3i} - \vec{j} + \vec{2k}$.
3. Find the area of parallelogram whose diagonals are represented by the vectors $\vec{i} + \vec{j} - \vec{3k}$ and $\vec{3i} - \vec{3j} + \vec{k}$.
4. Find the unit vector perpendicular to each of the vectors $\vec{3i} + \vec{j} + \vec{2k}$ and $\vec{2i} - \vec{2j} + \vec{4k}$.
5. Find the sine of the angle between the two vectors $\vec{2i} - \vec{j} + \vec{k}$ and $\vec{3i} + \vec{4j} - \vec{k}$.
6. If $\vec{a} = \vec{6i} + \vec{3j} - \vec{5k}$ and $\vec{b} = \vec{i} - \vec{4j} + \vec{2k}$, show that $\vec{a} \times \vec{b}$ is perpendicular to $\vec{a}$.
7. Find the area of triangle determined by the vectors $\vec{3i} + \vec{4j}$ & $\vec{-5i} + \vec{7j}$
8. Find the area of triangle formed by the points whose position vectors are $\vec{2i} - \vec{j} + \vec{3k}$, $\vec{i} - \vec{j} - \vec{2k}$ and $\vec{i} + \vec{2j} + \vec{3k}$.
9. Find the unit vector perpendicular to each of the vectors $\vec{a} = (1, 0, -2)$ and $\vec{b} = (2, 0, -1)$.

10. Show that the area of triangle PR whose vertices are P(1, 2, 3), (3, 4, 5) and R(1, 4, 7) is **$2\sqrt{6}$ square units.**

PROVE THAT:

1. State and prove the sine law by vector method.

OR

(i) $\sin(A - B) = \sin A \cos B - \cos A \sin B$

(ii) $\sin(A + B) = \sin A \cos B + \cos A \sin B$

2. Prove by vector method that in any triangle ABC:

$a / \sin A = b / \sin B = c / \sin C$

OR

$\sin A / a = \sin B / b = \sin C / c$

3. Prove that the area of plane uadrilateral ABCD is $\frac{1}{2}|\overrightarrow{AC} \times \overrightarrow{BD}|$, where AC and BD are its diagonals.

4. Show that: $|\frac{1}{2}[(\vec{a} - \vec{b}) \times (\vec{a} + \vec{b})]| = |\vec{a}||\vec{b}| \sin\theta$

5. Let $\vec{a}$ and $\vec{b}$ be two non-zero vectors and θ be the angle between them. Prove that: $(\vec{a} \times \vec{b})^2 + (\vec{a} \cdot \vec{b})^2 = a^2 b^2$

6. If $|\vec{a} \cdot \vec{b}| = |\vec{a} \times \vec{b}|$, then find the angle between $\vec{a}$ and $\vec{b}$.

7. Prove that: $(\vec{a} - \vec{b}) \times (\vec{a} + \vec{b}) = \vec{2a} \times \vec{b}$

Mathematics — Correlation & Regression

1. The Pearson's correlation coefficient can be expressed in terms of:
(a) original units of the data (b) without any unit
(c) change of the given unit of measurement
(d) none of the above

2. Karl's Pearson coefficient ranges from:
(a) $-\infty$ to ∞ (b) 0 to 1 (c) 0 to ∞ (d) -1 to 1

3. Karl's Pearson correlation coefficient measures:
(a) the strength of relationship between two quantitative variables
(b) the direction of relationship between two quantitative variables
(c) both strength and direction of relationship between two quantitative variables (d) none of these

4. In correlation analysis, the plot of the scatter diagram helps to:
(a) understand the nature of the relationship between the variables
(b) quantify the strength of the relationship between the variables
(c) quantify the effect of one variable on another variable
(d) none of the above

5. If the covariance between two variables x and y is 9; the variance of x and variance of y each is 9 for 10 pairs of observations, then the Pearson's correlation coefficient is:
(a) perfect positive (b) perfect negative
(c) no relationship (d) cannot be recognized

6. If the correlation coefficient is positive, then:
(a) both the regression coefficients are positive
(b) both the regression coefficients are negative
(c) exactly one regression coefficient is negative
(d) none of these

7. The correlation between x and y is positive, then the coefficient of correlation between $-x$ and $-y$ is:
(a) negative (b) positive
(c) undetermined (d) unity

8. Two regression lines pass through their:
(a) median values (b) mode values
(c) standard deviation values (d) mean values

9. If both the regression coefficients are 1, then what would be the value of correlation coefficient?
(a) 2 (b) 1 (c) 1/2 (d) 1/4

10. The sign of both the regression coefficients must be:
(a) same (b) opposite in direction
(c) positive (d) negative

11. If two regression coefficients bxy and byx are negative, what would be the sign of correlation coefficient between x and y?
(a) positive (b) negative
(c) it may be with any sign either positive or negative
(d) none of the above

12. Which of the following statement is best suitable to explain the regression analysis?
(a) It explains the relationship between two variables
(b) It explains the strength and direction of relationship between the variables
(c) It explains the cause-and-effect relationship between the variables
(d) none of the above able to explain suitably

13. If Cov (x, y) = 0, then rxy euals:
(a) 0 (b) 1 (c) -1 (d) $\pm 1/2$

14. If x and y are independent variables, then:
(a) Cov (x, y) = 0 (b) Cov (x, y) = 1
(c) Cov (x, y) = -1 (d) Cov (x, y) = $\pm 1/2$

15. If the correlation coefficient between x and y is zero, then the correlation coefficient between x^2 and y^2 is:
(a) 1 (b) 0 (c) 0.5 (d) none of these

16. Which of the following case is not wrong statement in Spearman's rank correlation?
(a) when ranks are given (b) when ranks are not given
(c) when ranks are repeated (d) all of these

17. The method of studying correlation between variables

is:

(a) graphical method (b) diagramatical method

(c) mathematical method (d) all of the above

18. Coefficient of correlation between two variables is independent of:

(a) change of origin only (b) change of scale only

(c) change of both origin and scale (d) none of these

19. Which one of the following is not appropriate for studying the relationship between two quantitative variables?

(a) scatter plot (b) bar chart

(c) correlation (d) regression

20. Given $n = 10$, $\Sigma x = 4$, $\Sigma y = 3$, $\Sigma x^2 = 8$, $\Sigma y^2 = 9$ and $\Sigma xy = 3$, then the coefficient of correlation is:

(a) ¼ (b) 7/12 (c) 15/4 (d) 14/3

21. If two lines of regression are $9x - 10y + 66 = 0$ and $40x - 18y = 214$, then $(\bar{x}, \bar{y})$ is:

(a) (17, 10) (b) (13,

(c) (−17, 13) (d) (−13, −17)

22. If $2x + y = 8$ and $x + 2y = 7$ are two regression lines respectively, then the correlation coefficient between x and y is:

(a) +1 (b) −1 (c) +1/2 (d) −1/2

Mathematics — Statistics

1. Determine the degree of relationship between the ages of sisters and their brothers from the following data by using Karl's Pearson's method:

Ages of sisters (yrs):	25	44	60	80	90	77
Ages of brothers (yrs):	30	22	55	70	100	82

2. Height and weight of six persons is given below:

Height in inches (x):	62	72	70	60	67	70
Weight in kg (y):	50	65	65	63	56	60

Write the equation for the regression of weight for a given height. Find the correlation coefficient between x and y.

3. The following table shows hours of time spent by five students of grade 12:

Hours of grade-12 study book (x):	5	7	9	10	11
Hours spending on playing games (y):	5	4	3	2	1

(a) Estimate the hours spending on playing games who spend 6 hours in study book.

(b) Find the coefficient of correlation between x and y.

4. The city council of Bhaktapur has gathered data on number of minor traffic accidents and the number of youth football games that occurred in town over weekends as:

Football games:	10	12	13	12	16	15
Minor accidents:	40	43	43	45	37	43

(a) Calculate the Pearson's coefficient of correlation.

(b) Predict the number of minor traffic accidents that will occur at weekend during where number of football game is 40.

5. Calculate the coefficient of correlation between x and y series from the following data:

	Series x	Series y
Number of observations	15	15
S.D.	3.01	3.03

$\Sigma(x - \bar{x})(y - \bar{y}) = 122$

6. If $\Sigma(x - \bar{x})^2 = 40$, $\Sigma(y - \bar{y})^2 = 63$ and $\Sigma(x - \bar{x})(y - \bar{y}) = 35$, find the correlation coefficient between two variables.

7. A researcher while calculating the correlation between x and y got the following data: $\Sigma x = 120$, $\Sigma x^2 = 600$, $\Sigma y = 90$, $\Sigma y^2 = 250$, $\Sigma xy = 1365$ and $n = 30$. On final checking however it was found that two pairs of observations (8, 10) and (12, 14) were wrongly entered and the correct pairs were (8, 12) and (10, 8). Obtain the correct correlation coefficient.

8. Calculate the coefficient of rank correlation between age (in years) and weight (in kg) of the following observations:

Age in years (x):	12	14	16	18	20
Weight in kg (y):	25	32	40	50	56

9. From the marks obtained by 10 students in Biology and Chemistry, compute the rank coefficient of correlation:

Roll No.:	1	2	3	4	5	6	7	8	9	10
Marks in Biology:	55	50	55	50	60	70	72	78	80	63
Marks in Chem:	20	25	60	45	80	95	55	65	85	75

10. **The equations of regression lines are:**

$3x + y = 65$, & $3x + y = 32$. Find:

(a) the mean of x and mean of y

(b) the regression coefficient between x and y

(c) the correlation coefficient between x and y

(d) the ratio of standard deviations of x and y

11. In a partially destroyed laboratory record of an analysis of a data the following results only are eligible:
Variance of x = 9
Regression equations: $4x - 5y + 33 = 0$ and $20x - 5y = 107$. Find:
(a) mean value of x and y
(b) the coefficient of correlation between x and y
(c) the standard deviation of y

Mathematics — Probability

1. If A and B be events such that P(A) = 0.48, P(B) = 0.4 then $P(A \cap B)$ is:
(a) 0.74 (b) 0.75 (c) 0.192 (d) 0.088

2. If P(A) = 0.5, P(B) = p, $P(A \cup B) = 0.8$ such that A and B are independent events, then p is:
(a) 4/5 (b) 6/7 (c) 5/7 (d) 3/5

3. If P(A) = 1/5, P(B) = 2/3 and $P(A \cap B) = 1/5$, which one of the following is $P(B \mid A)$?
(a) 3/5 (b) 2/5 (c) 2/15 (d) 1/15

4. For two events A and B, P(B) = 0.032, $P(A \cap B) = 0.2$ and $P(B \mid A) = 0.5$, then what is the probability of P(A)?
(a) 0.40 (b) 0.020 (c) 0.15 (d) 0.01

5. Two independent events A and B are given in such a way that $P(A \cap B) = 0.78$ and P(A) = 0.82. What is the value of $P(B \mid A)$?
(a) 0.49 (b) 0.78 (c) 0.82 (d) 0.95

6. Let A and B be two dependent events. If P(A) = 0.5, P(B) = 0.75 and $P(A \cap B) = 0.4$, what is the value of $P(A \mid B)$?
(a) equal to P(B) (b) less than $P(A \cap B)$
(c) less than $P(B \mid A)$ (d) equal to $P(B \mid A)$

7. Let A and B be two dependent events. If $P(A \cap B) = 1/15$, P(B) = 1/18 and aP(A) = 5P(B), what is the value of $P(B \mid A)$?
(a) 1/324 (b) 1/18 (c) 5/36 (d) 2/5

8. Consider A and B be two dependent events. If P(A) = 1/2, P(B) = 1/13 and $P(A \cap B) = 1/26$, what is $P(B \mid A)$?
(a) 1/52 (b) 1/26 (c) 1/18 (d) 1/2

9. A and B are events with P(A) = 0.5, P(B) = 0.7 and $P(A \mid B) = 0.4$. What is $P(A \cap B)$?
(a) 0.2 (b) 0.28 (c) 0.35 (d) 0.4

10. The range of the probability of any event P is:
(a) $P \leq 1$ (b) $0 \leq P(A) \leq 1$ (c) $-1 \leq P(A) \leq 1$ (d) $0 < P(A) < 1$

11. What is the probability of getting 53 Saturdays in a leap year?
(a) 1/7 (b) 2/7 (c) 1/365 (d) 53/365

12. The probability of getting 53 Sundays in a randomly selected leap year is:
(a) 3/7 (b) 2/7 (c) 5/7 (d) 1

13. A die is rolled once. What is the conditional probability that face turned up is a prime number given that the outcome is an even number?
(a) 1/2 (b) 1/3 (c) 2/3 (d) 1/6

14. A bag contains some tickets numbered from 1 to 15. Two tickets are drawn one by one without replacement. The probability that the first ticket has even number and second ticket the odd number is:
(a) 1/5 (b) 4/15 (c) 3/14 (d) 7/15

15. In a family there are 2 males and 3 females. If two persons are chosen at random, what will be the probability that both are female?
(a) 6/25 (b) 4/25 (c) 9/25 (d) 3/10

16. Two students are selected from a class of 20 boys and 30 girls. Find the probability that the first student is boy and second is girl:
(a) 6/25 (b) 12/49 (c) 58/245 (d) 49/500

17. Four unbiased coins are tossed successively. The mean and variance of the distribution differ by:
(a) 1 (b) 2 (c) 3 (d) 4

18. From a well shuffled pack of 52 cards, two cards are drawn at random successively without replacement. What is the probability of getting both ace cards?
(a) 1/221 (b) 1/169 (c) 2/221 (d) 2/13

19. A bag contains 5 brown and 4 white socks. A man pulls out two socks. The probability that these are of the same colour is:
(a) 5/108 (b) 18/108 (c) 30/108 (d) 48/108

20. A card is drawn from a well shuffled pack of cards. The probability of getting a ueen of club or king of heart is:
(a) 1/52 (b) 1/26 (c) 1/18 (d) none of these

21. A bag contains 5 red, 7 white and 8 blue balls. If we draw 4 balls one by one without replacement, what is the probability that all balls are red?
(a) 1/380 (b) ¼ (c) 1/969 (d) 2/969

22. The probability that 13th day of a randomly selected month is a Sunday is:
(a) 1/12 (b) 1/84 (c) 13/84 (d) 1/12

23. The probability of solving a uestion of three students are respectively 1/4, 1/6, 1/3. Then the probability that the question is solved if all of them try is:
(a) 1/48 (b) 23/48 (c) 11/12 (d) 1/24

24. If P(A) = 0.68, P(B) = 0.4 then $P(\bar{A}) + P(\bar{B})$ is:
(a) 0.98 (b) 0.33 (c) 0.92 (d) 0.9

25. The probability of a sure event is:
(a) 0 (b) 1 (c) 1/2 (d) 3/2

Short Questions

1. Suppose three people are selected at random from a group of 7 men and 6 women. What is the probability that:

(a) all are men (b) all are women

(c) at least one is a woman

2. An urn contains 9 red, 7 white and 4 black balls. If two balls are drawn at random, find the probability that:

(a) both the balls are red (b) one ball is white

(c) the balls are of the same color

3. Five men in a group of 20 are graduates. If 3 men are selected from them, what is the probability that:

(a) all are graduates (b) none are graduates

(c) at least one is graduate (d) exactly one is graduate

4. A bag contains 6 red and 9 blue balls. Four balls are drawn at a time. Find the probability for 4 red balls in the first draw and 4 blue balls in the second draw if the draws are made:

(a) with replacement (b) without replacement

5. A box of 100 mobile sets contains 10 mobile sets with type A defects, 5 mobile sets with type B defects and 2 mobile sets with both types of defects.

Find the probability that:

(a) A mobile set to be drawn has a type B defect under the condition that it has a type A defect.

(b) A mobile set to be drawn has a type B defect under the condition that it has no defect of type A.

Mathematics: System Linear Equations

Gauss Elimination Method

1. Which of the following equation is not a linear equation?

(a) $2x + y = 1$ (b) $x_1 + 2x_2 = 5$

(c) $3x + 4y = 6$ (d) $x^2 + 3x + 2 = 0$

2. The system $x - y = 1$ and $x - y = 5$ has:

(a) one solution (b) infinitely many solutions

(c) no solution (d) none of the above

3. In Gauss elimination method, the coefficients of the variables of the equation a_{ij} where $i \neq j$ is known as:

(a) basic elements (b) non-basic elements

(c) pivot elements (d) common elements

4. In Gauss elimination method, the coefficient of the first variable in first equation must be:

(a) non-zero (b) zero (c) negative (d) positive

5. Using Gauss elimination method, find the value of x, y, z from the given equations:

$x + y - z = 1$, $-x + y + z = 1$, $x + y + z = 3$

(a) (1, 0, 0) (b) (1, 1, 2) (c) (1, 1, 1) (d) None

6. Use backward substitution for:

$[\,1\ -2\ 3 \mid 23\,]$ $[\,0\ 5\ -8 \mid -139\,]$ $[\,0\ 0\ 3780 \mid 11340\,]$

(a) $x = 1, y = 2, z = 3$ (b) $x = 1, y = -2, z = 3$

(c) $x = 2, y = 3, z = 4$ (d) $x = 1, y = 3, z = 4$

7. Test for consistency and solve:

$x + y + z = 6$, $x - y + 2z = 5$, $3x + y + z = 8$

(a) $x = 1, y = 2, z = 3$ (b) $x = 2, y = 1, z = 3$

(c) $x = 3, y = 2, z = 1$ (d) $x = 4, y = 2, z = 3$

8. Gauss elimination method system is:

(a) Upper triangular (b) Lower triangular

(c) Upper rectangular (d) Lower rectangular

9. Operation of Gauss elimination method is:

(a) Column (b) Row

(c) Both (a) and (b) (d) None of these

10. The Gauss elimination method to reduce the linear equation to an equivalent upper triangular system which can be solved by:

(a) Exact method (b) Back substitution method

(c) Both (a) and (b) (d) None of these

Short Questions (2 Marks)

1. Solve using Gauss elimination method:

$x + 2y + z = 3$, $2x + 3y + 3z = 10$, $3x - y + 2z = 13$

2. Solve the following system of equations using Gauss elimination method:

$3x + 4y + 5z = 40$, $2x - 3y + 4z = 13$, $x + y + z = 9$

3. By Gauss elimination method, solve:

$4x - 3y = 11$, $3x + 2y = 4$

4. Solve by Gauss elimination method:

$2x + 3y + z = 13$, $x - y - 2z = 0$, $3x + y + 4z = 15$

1. In a Gauss Seidel method, solving the linear equations, which system is diagonally dominant?

(a) $12x + 3y - 5z = 1, x + 5y + 3z = 28, 3x + 7y + 13z = 5$

(b) $x + 5y + 3z = 28, 3x + 7y + 13z = 5, 2x + 3y - 5z = 1$

(c) $9x - 3y - 5z = 1, 3x + 8y + 13z = 1, x + 5y + 3z = -28$

(d) $2x + y + z = 5, 2x + y + z = 8, 3x + 5y + 2z = 15$

2. The system of equations $ax + by = c_1$ and $a_2x + b_2y = c_2$ can be solved by Gauss Seidel method if:

(a) $|a_1| > |b_1|$ (b) $|a_1| < |b_1|$

(c) $|a_1| > |b_1|$ and $|b_2| > |a_2|$

(d) $|a_1| < |b_1|$ and $|b_2| > |a_2|$

3. In Gauss Seidel method for solving $3x + y = 5$ and $x + 5y = 11$, $(x_0, y_0) = (0, 0)$. What is (x_1, y_1)?

(a) (5, 11) (b) (1, 5)

(c) (5/3, 28/15) (d) (3/5, 5/3)

4. Which one of the following is the system of linear

equations in two variables?
(a) $x + y = 3, y + z = 5, z + x = 4$
(b) $x = 4, 2z = 8$
(c) $x + y = 5, x - y = 1$ (d) $x = y, y = z, z = x$

5. The solution of the system of equations $2x_1 - x_2 = 8$, $3x_1 + 7x_2 = -5$ by taking initially $x_1 = 0, x_2 = 0$ after first iteration is:
(a) $-2.428, -1.908$ (b) $2.428, 1.908$
(c) $3, -2$ (d) $2.786, -1.908$

6. Gauss Seidel method is also termed as a method of:
(a) Iterations (b) False positions
(c) Successive displacement (d) Eliminations

Short Questions (2 Marks)

1. Examine whether the system of equations $2x + 3z = 7$, $3x - y + 2z = 1$ and $2x + 3y - 3z = 5$ is diagonally dominant.

2. Examine whether the system of equations $2x - 3y + z = 1$ and $4x - 3y + z = 3$ is diagonally dominant or not.

3. Are the following system of equations diagonally dominant?
$12x_1 + 3x_2 - 5x_3 = 1$, $x_1 + 5x_2 + 3x_3 = 28$, $3x_1 + 7x_2 + 13x_3 = 1$

4. Define well-conditioned and ill-conditioned system of equations.

5. Interpret geometrically that a system of equations in two variables is ill-conditioned.

6. Examine whether the following system of equations are ill-conditioned: $x_1 + x_2 = 25$, $0.001x_1 + x_2 = 25$

7. Is the system $[1\ 2;\ 3\ 8][x\ y]^T = [4\ 7]^T$ well-conditioned? Justify your answer.

8. Use the Gauss Seidel method in second iteration:
$3x_1 + x_2 + 2x_3 = -1$, $2x_1 + 3x_2 + x_3 = 5$, $x_1 + 2x_2 - x_3 = 8$

Mathematics — Linear Programming Problems

Simplex Method

1. In less than or eual to constraints, the non-negative variable that is used to balance both sides is:
(a) condition variable (b) surplus variable
(c) slack variable (d) solving variable

2. In simplex method, the basic feasible solution must satisfy:
(a) negative constraints (b) non-negativity constraint
(c) basic constraint (d) non-basic constraint

3. The simplex method was developed by:
(a) George Dantzig (b) Pythagoras
(c) Isaac Newton (d) Abel

4. The entry in the simplex tableau in the entering variable column and departing variable row is:
(a) departing element (b) entering element
(c) pivot element (d) basic element

5. In the simplex method, the slack and surplus variables are restricted to be:
(a) multiplied (b) divided
(c) negative (d) non-negative

6. The optimal value of the objective function is obtained when all entries in the last row of the simplex tableau is:
(a) negative (b) positive
(c) non-positive (d) non-negative

7. What does it mean if the objective function coefficient of non-basic variable is zero?
(a) The variable is non-negative constrained
(b) The variable is at its upper bound
(c) The variable is redundant
(d) The variable is at its lower bound

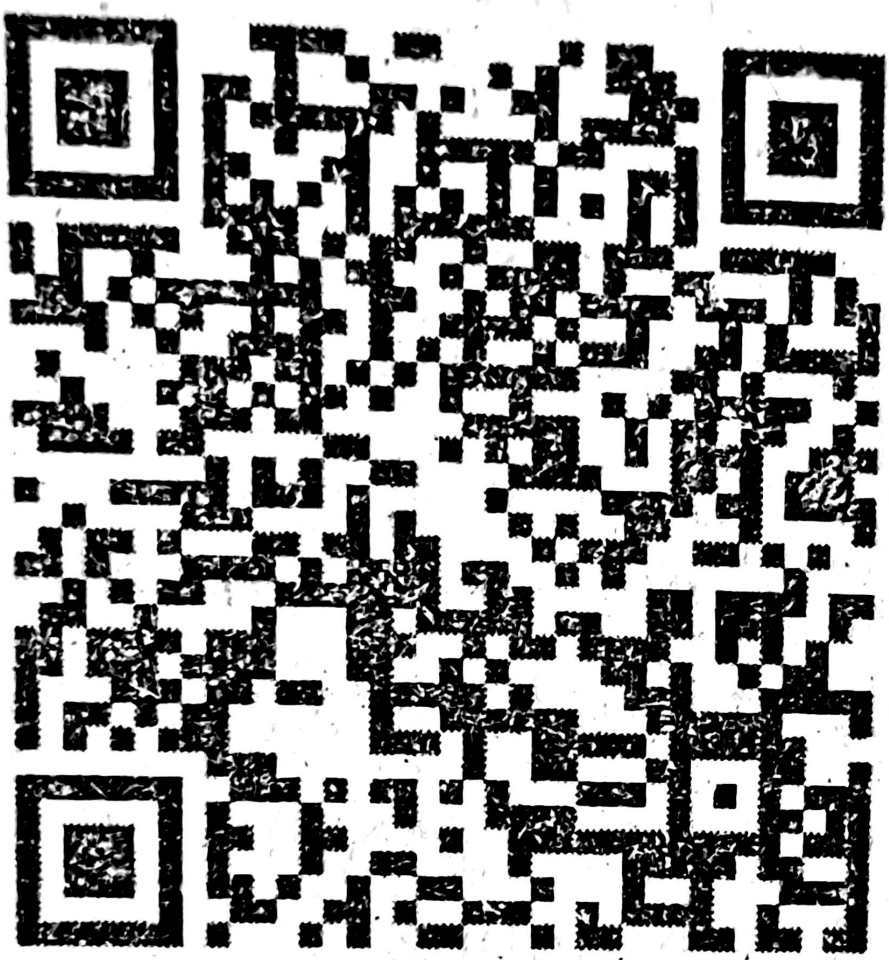
8. Use simplex method and maximize $Z = 20x + 50y$ subject to the constraints $x + y \leq 30$ and $x + y \leq 40$, x and y are positive numbers.

9. Use simplex method to maximize $Z = 2x + 3y$ subject to $5x + 2y \leq 2$, $-y - 2x \geq -1$ and $x, y \geq 0$.

10. Using simplex method, maximize profit $P(x, y) = 10x + 5y$ subject to constraints $6x + 7y \leq 42$, $2x + 3y \leq 42$, $x + 3y \leq 9$, $x \geq 0$, $y \geq 0$.

11. Reformulate the following LP problem into standard form: Maximize $Z = 4x + 6y$
Subject to constraints $2x - 2y \leq 8$, $x + y \leq 24$, $x, y \geq 0$.
Also find the optimal solution of the above LPP by simplex method.

For extra of Math



For extra of Math

Volumetric Analysis

You must remember

a) Important formulas before solving the question
b) Defination
c) Numerical problems
d) Important Question

Important formulas

A) Percentage conc^n in mass/volume or %(w/V)

- $\%\ (w/V) = \frac{\text{Mass of solute in gm}}{\text{Volume of solution in ml}} \times 100$
- $\%\ (w/W) = \frac{\text{Mass of solute in gm}}{\text{Wt of solution in gm}} \times 100$
- $\%\ (v/V) = \frac{\text{Volume of solute in ml}}{\text{Volume of solution in ml}} \times 100$
- Gram litre (g/L)
- conc^n in g/L $= \frac{\text{Weight of solute in gm}}{\text{Volume of solution in ml}} \times 1000$
  - $= (W/V)\% \times 10$
- Molarity (M) $= \frac{\text{Number of moles of solute}}{\text{Volume of solution in liter}}$
  $= \frac{\text{Gram/Liter}}{\text{Molecular wt}}$
  $= \frac{\left(\frac{w}{w}\right)\% \times \text{specific gravity} \times 10}{\text{Molecular wt}}$
- Normality $= \frac{\text{No of gm eq wt of solute}}{\text{Volume of soln in litre}}$
  $= \frac{\text{Gram/litre}}{\text{Equivalent wt}}$
  $= \frac{\left(\frac{w}{w}\right)\% \times \text{specific gravity} \times 10}{\text{Equivalent wt}}$
- Molality $= \frac{\text{NO of moles of solute}}{\text{Wt of solvent in kg}}$
- Mole fraction of solvent (Xsolvent) $= \frac{n\text{solvent}}{n\text{solute} + n\text{solvent}}$
  [Where n=no. of moles]
- Mole fraction of solute (Xsolute) $= \frac{n\text{solvent}}{n\text{solute} + n\text{solvent}}$

Xsolute + Xsolvent = 1

- parts per million (ppm) $= \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 10^6$
- parts per billion (ppb) $= \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 10^9$

Some important defination

1. Normality
2. Molarity
3. End point
4. Equivalence point
5. Titration Error
6. Titrant
7. Secondary standard solution
8. Redox titration
9. Normal solution
10. Acidity of Base
11. Basicity of Acid
12. Semi - normal solution
13. Molality of solution
14. Primary standard Solution
15. Titrand
16. Neutral point
17. Indicator
18. Formality
19. Parts per million
20. Parts per billion
21. Percentage of solution

Some Important Numerical Problem

Master concept

- $\left(\frac{W}{E}\right)_{acid} = \left(\frac{W}{E}\right)_{base}$
- $\left(\frac{NV}{1000}\right)_{acid} = \left(\frac{NV}{1000}\right)_{base}$
- $\left(\frac{W}{E}\right)_{metal} = \left(\frac{W \rightarrow \text{excess}}{E}\right)_{acid} - \left(\frac{W}{E}\right)_{base}$

Numerical problem

1) x gm of $CaCO_3$ required 40ml of $\frac{N}{2}$ HCl for complete neutralization. Calculate x.
2) 1.5 gm of calcium carbonate sample required 40 ml of $\frac{N}{2}$ HCl for complete neutralization. Calculate percentage purity of calcium carbonate in the sample.
3) 0.6 gm of divalent metal was dissolved in 100 cc of 1.28 N HCl and the solution was diluted to 200 cc. 50 cc of the dilute solution required 54.6 cc of 0.22 N NaOH for complete neutralization. find the atomic weight of the metal.
4) 4 gm of divalent metal was dissolved in 100 cc of 2M H_2SO_4 (f = 1.01). The excess of acid required 30 cc of 1N NaOH for neutralization. Find the atomic mass of metal.
5) 1gm of divalent metal was dissolved in 25ml of 1M H_2SO_4. The unreacted acid further required 15cc of 4N NaOH (f=0.8) for complete neutralization
   i) calculate the gram equivalent of unreacted acid
   ii) Find the atomic weight of metal
6) 0.715 gm of $Na_2CO_3 . xH_2O$ required 20ml of seminormal hydrochloric acid solution for complete reaction. find the value of x.
7) 7.35gm of dibasic acid was dissolved in water and diluted to 250ml. 25ml of this solution was neutralized by 15ml of N NaOH sol', what is the Equivalent mass and molecular mass of the acid?
8) How many ml of conc. HNO_3 of specific gravity 1.41 containing 69% by mass are required to prepare 500ml of 0.5N HNO_3?
9) A solution of conc. HCl contains 38%. HCl by mass. What is the molarity of this solution if the desity of the solution is 1.19 gm/cc.
10) What Volume of 95% sulphuric acid (density = 1.85g/cc) and what mass of water must be taken to prepare 200 cc of 15%. solution of sulphuric acid (density = 1.19gm/cc).
11) What Volume of N/2 and N/10 HCl must be mixed to gives 2 litres of N/5 HCl
12) What Volume of water should be added to 500ml of 2N (f=0.98) Na2CO3 to make it exactly N/10?
13) What mass of 80%. pure $CaCO_3$ is required to neutralize 2 litre decinormal solution of HCl?
14) 10gm of NaOH was added to 200 cc of N/2 (f=1.5) H_2SO_4. The volume was diluted to two litres. Predict whether the dilute solution is acidic, basic or neutral and also calculate resulting molarity of the solution.
15) Ram weighed 1.31gm of Na_2CO_3 to prepare 250 ml of its decinormal solution.
   a) calculate the actual strength of the soln' indicating normality Factor

b) Find the Volume of water required to be evaporated to make it exactly normal solution
c) Calculate the mass of Oxalic crystal required to neutralize the solution completely?

16) x gm of metal (equivalents weight = 12) was completely dissolved in 200cc of $\frac{N}{2}$ HCl solution. The Volume was then made upto 500cc. It is found that 25cc of diluted acid solution required 17.5cc of $\frac{N}{2}$ NaOH for complete neutralization. Find the value of x.

17) Calculate the normality and molarity of 5% NaOH solutions.

18) Convert the following
a) 2.5M H_3PO_4 into Normality
b) 4.9M H_2SO_4 into gm/L
c) 4.9N H_2SO_4 into gram/litre

19) Find the equivalent mass of H_2SO_4 in the following r^{xn}
$NaOH + H_2SO_4 \rightarrow NaHSO_4 + H_2O$

20) Which one has higher concentration
a) 80gm/L NaOH solution and 3M NaOH solution
b) 5.3g/L Na_2CO_3 solution and $\frac{N}{10}$ Na_2CO_3

21) What mass of Na_2CO_3 are required to neutralize 50ml of its semi-normal solution.

22) 100 ml of 0.1N HCL and 50 ml of 0.2N NaOH are mixed
a) will the solution be acidic, basic or neutral
b) what is the normality of resulting acid or basic or salt?
c) Calculate the mass of NaCl formed

23) Calculate the equivalent wt of KMno4 and $(COOH)_2.2H_2O$ for the reaction.

24) 50 cc of deci-normal solution of HCl solution required 80 cc of a solution of Na_2CO_3 for complete neutralization. Calculate the strength of Na_2CO_3 in terms of
i) Normality ii) Molarity
iii) Gram/litre iv) % by Volume

Important question and derivation

1) All standard solution is not primary standard solution. Comment the statement.
2) Oxalic acid is taken as primary standard solution. Why?
3) Name the indicator used in the titration of $KMnO_4$ and standard oxalic acid solution. Why?
4) Concentration of sulphuric acid solution can be determined with titrating primary standard sodium Carbonate solution.
5) Derive the normality equation
6) Relation betⁿ Normality and Molarity

Differentiate between

→ Normality and Molarity
→ End point and Equivalence point
→ Normality Factor and Titration error
→ Titrants and Titrand
→ primary standard solution and Secondary standard solution

Chemistry	Physical Chemistry

Ionic Equillibrium

You must remember

- Defination
- Important question
  a) Reason based Question
  b) Important Derivation
  c) Difference betⁿ
- Important Formula
- Numerical problem

Defination

1. P^H of solution
2. Solubility product
3. Common ion effect
4. Ionic product of water
5. Degree of Ionization
6. Ostwald dilution law
7. Lewis acid
8. Lewis base
9. Bronsted lowry acid
10. Bronsted lowry base
11. Ionization constant
12. Strong electrolyte
13. Weak Electrolyte
14. Buffer Solution
15. Acid buffer Solution
16. Basic buffer Solution

Important Question and Derivation

1. Ostwald dilution law
2. Limitation of Ostwald dilution law
3. Why Ostwald dilution law is not applicable for strong electrolyte?
4. Relation betⁿ p^H and p^{OH}
5. Explain the fact that the aqueous solution of sodium carbonate is basic while the aqueous solution of Sodium chloride is neutral
6. Write the conjugate acid and base of NH_3
7. Application of solubility product principle and common ion effect
8. Give proper reason
   a. NH_3 act as Bronsted base but not bronsted acid
   b. NaCl can't undergo hydrolysis
   c. Group II metal ions get precipitated as their Sulphide when H_2S is passed through their acidified salts.
9. Deduce the relation: $K_w=[H^+][OH^-]$
10. What is the effect of temperature on ionic product of water?
11. Short note on selection of Indicator in acid base titration
12. What happens when HCl gas is passed through saturated solⁿ of NaCl and why?
13. Write suitable example to show water act as Bronsted-lowry acid and base

Some important formula

1. $P^H = -\log [H^+]$
2. $P^{OH} = -\log [OH^-]$
3. $P^H + p^{OH} = 14$
4. $pH < 7$ → Acidic
5. $pH > 7$ → Basic

Solubility

- Concentration of ion = Solubility of ion
- Solubility product (Ksp) = $[A^+]^x [B^-]^y$
- Ionic product of water (K_w) = $[H3O^+][OH^-]$
- $\alpha = \sqrt{\frac{Ka}{C}}$ where α = degree of ionization, C = concentration
- Molarity = conc of solution = $\frac{\frac{g}{l}}{Mol.wt}$

For type AB Salt:

- Solubility (S) = $\sqrt{Ksp}$
- For type A_2B or AB_2 salt:
- Solubility (S) = $\sqrt[3]{\frac{Ksp}{4}}$

 # Problems related to pH calculation

1) Find the pH of 1×10^{-6} N H_2SO_4

2) Calculate the pH of 0.04 N H_2SO_4 solution.

3) Calculate the pH of solution obtained by mixing equal volume of two HCl solutions having pH = 3 and pH = 5.

4) Calculate the pH of 1×10^{-5} N H_2SO_4 solution.

5) Calculate the pH of 10^{-9}M HCl.

6) Calculate the pH of solution by dissolving 1g of NaOH in 1 L solution.

7)10cc of $\frac{N}{2}$ HCl, 30cc of $\frac{N}{10}$ HNO_3 and 60cc of $\frac{N}{5}$ H_2SO_4 are mixes together. Find the p^H of the mixture.

8) 49gm of H_2SO_4 present in 1000ml of its solution. What is the p^H of solution.

9) Calculate the pH of an aqueous solution containing 10^{-7} moles of NaOH per litre.

10) Calculate the pH of 1 g/L NaOH solution.

Problems Related to Solubility and Solubility Product

1) The solubility product of CaF_2 in water at 18°C is 2.05×10^{-4}mole/litre. Calculate its solubility.

2) The solubility of AgCl in water at 298K is 1.43×10^{-3}. Calculate the solubility in 0.5M KCl sol^n.

Questions related to K_a, K_w and K_{sp}

1) If the volume of 25 cm^3 of 0.05 M $Ba(NO_3)_2$ is mixed with 25 cm^3 of 0.02 M NaF, will any BaF_2 precipitate?

2) If 80 ml of 0.01M $AgNO_3$ are mixed with 20 ml of 0.001 M NaCl solution, will any AgCl precipitate?

3) The solubility product constant (Ksp) of $Ca(OH)_2$ at 25°C is 4.42×10^{-5}. A 500 ml of saturated solution of $Ca(OH)_2$ is mixed with equal volume of 0.4 M NaOH. What mass of $Ca(OH)_2$ is precipitated out?

4) The pH of 0.1 M HCN solution is 5.2. What is the value of the ionization constant (Ka) for the acid?

5) The solubility product of $BaSO_4$ is 1×10^{-11}. Will precipitate occur or not, if equal volume of 2×10^{-3} M $BaCl_2$ solution and 2×10^{-4} M Na_2SO_4 are mixed?

6) The solubility product of AgCl is 1.8×10^{-10}. How much of AgCl (molecular mass = 143.5) will be precipitated if 0.2 moles of HCl solution is added to the saturated solution of AgCl?

7) 500 ml of $Ca(OH)_2$ is mixed with equal volume of 0.4 M NaOH. What mass is precipitate to be formed if Ksp of $Ca(OH)_2 = 4.42 \times 10^{-5}$? How much metal ion is precipitated?

8) What amount of $Zn(OH)_2$ will be precipitated at 25°C if 100 ml of 0.22 gm NaOH is added to 1 liter of saturated solution of $Zn(OH)_2$. precipitate is obtained in this reaction, Why? (Solubility product of $Zn(OH)_2$ at 25°C is 1.8×10^{-14}.)

Chemistry	Physical Chemistry

Electrochemistry

You must remember

1. Definition
2. Some important question
3. Some important numerical problems
   - Type-I → EMF of cell calculation problem
   - Type-II → Cell notation
   - Type-III → cathode and anode indicating problem

All types are mixed in one question

Definition

1. Electrolytic cell
2. Electrochemical cell
3. Electrode potential or Standard Electrode potential
4. Oxidation potential or standard Oxidation potential
5. Reduction potential or standard Reduction potential
6. Standard hydrogen electrode
7. Electrochemical series
8. Salt Bridge
9. Primary cell
10. Secondary cell
11. Fuel cells

Some important Questions Give reason (2 marks)

1) Why does blue colour of CuSO4 soln get discharged when iron is dipped into it.

2) Why does silver nitrate soln becomes bluish when copper rod is dipped in it?

(Standard reduction potential of Cu and Ag are +0.34V and +0.80V respectively.

3) Two metallic element X and Y have following standard electrode potential, X = +0.40V Y = -0.80V

a) What would you expect to occur if X is added to an aqueous soln of salt of Y? Give reasons

4) Standard hydrogen electrode acts as both an anode and cathode. Give reason.

5) Can CuSO4 solution be stored in zinc vessel?
E° Cu2+/Cu = +0.34V E° Zn2+/Zn = -0.76V

6). Predict whether the following reaction will occur spontaneously or not. Why?

7). Single electrode potential cannot be measured.

Some important questions

1) Explain the standard hydrogen electrode

2) Will the r^{xn} occur: $Zn^{++} + 2Fe^{++} \rightarrow Zn + Fe^{2+}$
Given standard potential is
E° Zn^{2+}/Zn = -0.76V E° Fe^{2+}/Fe = +0.80V

3) Name any two factors that affect the magnitude of single electrode potential

4) What product would you expect at cathode and anode when aqueous NaCl is electrolysed using platinum electrode

5) An electrochemical cell (galvanic cell) is designed by coupling Zn electrode with standard hydrogen electrode (SHE) given by E° Zn^{2+}/Zn = -0.76
i) Draw the galvanic cell
ii) Write down complete cell rxn

Some important numerical

1) For a cell Mg(s) | Mg^{2+} (1M) || Cu^{2+} (1M) | Cu(s)
E° Mg^{2+}/Mg = -2.37V and E° Cu^{2+}/Cu = +0.34V
a) Indicate cathode and anode
b) Write the rxn taking place at electrode
c) Calculate the EMF of 1M solution of its ions

2) The standard electrode potential of copper and silver are (E° Cu^{2+}/Cu = +0.34V and E° Ag^{+}/Ag = +0.80V)
i) Construct cell notation for an electrochemical cell

ii) Calculate the emf of 1M solution of its ion
iii) Will the rxn occur $Cu + 2Ag^+ \rightarrow Cu^{2+} + 2Ag$? Give reason

3) The standard electrode potential is given as
$E^\circ Mg^{2+}/Mg = -2.37V$, $E^\circ Cu^{2+}/Cu = +0.34V$
a) Construct cell notation for an electrochemical cell
b) Write the rxn taking place at anode and cathode
c) Calculate the EMF of cell

4) You are given standard reduction potential of Cu2+/Cu and Fe2+/Fe as +0.34V and -0.44V respectively
a) Construct a galvanic cell indicating cathode and anode with cell notation
b) Calculate the standard EMF of cell
c) Above given condition, why does blue colour of CuSO4 solution get discharged when iron rod is dipped into it?

5). The standard reduction potential of X and Y are -0.76V, +0.34V respectively
a) Write the cell notation for construction
b) Write the anode half r^{xn}, cathode half r^{xn} and overall r^{xn}
c) Why is cell reaction spontaneous?

Chemistry	Physical Chemistry

Chemical Kinetics

You must remember

1. Definitions
2. Important Questions
   - Reason based Question
   - Important derivation
   - Difference between
3. Some important formulas
4. Some important Numerical
   - Rate constant calculation
   - Order of Reaction calculation

Definitions

1. Rate of Reaction
2. Average rate of reaction
3. Instantaneous rate of reaction
4. Activation Energy
5. Threshold Energy
6. Rate law equation
7. Order of Reaction
8. Molecularity of Reaction
9. Rate constant
10. Zero order Reaction
11. First order Reaction
12. Effective collision
13. Proper orientation
14. Half life period of Reaction
15. Pseudo 1st order Reaction

Important Questions

Reason based Question & other questions

1. In the following reaction $SO_2 + 3H_2S \rightarrow 3H_2O + S$
Why is rate of formation of water is not equal to rate of disappearance of SO_2 ?
2. Why does temperature increase the rate of Reaction?
3. What is the essential condition for effective collision of the reacting species?
4. Factors affecting the rate of Rx^n
5. Draw the Energy profile diagram showing endothermic and exothermic reaction.

Important derivation

Deduce the relation that the half life for a reaction is directly proportional to initial concn of reactant
Deduce the relation $K_t = 2.303/t \log_{10} (a/(a-x))$
Difference bet^n
- Order of R^{xn} and Molecularity of R^{xn}
- First order R^{xn} and Pseudo first order Rx$_n$

Important Formula's for solving Numerical

- $k = (\text{mol } L^{-1})^{1-n} \text{ time}^{-1}$ where n = order of R^{xn}

For zero R^{xn}
$k_0 = x/t$ $T_1/2 = a/2k_0$ $T_1/2 \propto a$

For first order R^{xn}
$k = \frac{2.303}{t} \log_{10} (\frac{a}{a-x})$
$T_1/2 = 0.693/k$

Some important Numerical

(Short numerical) [2 marks]

Type-1

a) For a R^{xn} $3O_3(g) \rightarrow 3O_2(g)$The rate of decomposition of Ozone is 1.2 x 10-4mol L-1 sec-2.What will be the rate of formation of oxygen ?

b) For a R^{xn} $2N_2O5(g) \rightarrow 4NO2(g) + O2(g)$If the rate of formation of oxygen is 2 x 10-1 mol L-1 sec-1. What will be the rate of disappearance of N2O5 ?

c) For a R^{xn} $2N_2O_5(g) \rightarrow 4NO_2 + O2$.The rate of disappearance of N_2O_5 is 4 x 10^{-6} mol L-1 sec-1. What will be rate of formation of NO_2 ?

d) For R^{x}n $2HI \rightarrow H_2 + I_2$. If the rate of formation of I2 is 9.1 x 10^{-6} mol L^{-1} sec^{-1}.What will be the rate of disappearance of HI ?

Type-2

a) A first order Rxn is 90% complete in 30 minutes. How long would it take to be 99% complete.

b) In a first order Rxn 40% of reactant gets converted into product in 30 minutes.What time would it require to convert 75% into product.

c) A first order Rxn will take 100 minutes to complete 60% of the reactant into product.What time will it take to complete 75% of the reactant into product.

d) What will be initial rate of reaction if its rate constant is 1 x 10-3 min-1 and conc^n of reactant is 0.2 mol L-1. How much reactant will be converting into the product in 500 minutes.

e) 99% of first order Rxn is completed in 32 minutes.What time will it take to complete 99.9% of Rxn.

f) For a first order Rxn it takes 4 minute for initial concn 0.8 mol /1 to become 0.2 mol L-1. What time will it take to become concentration to 0.04 mol L-1.

g) If 75% of first order Rxn is completed in 32 minutes, when will be 50% of R^{xn} completed.

Type-3

a) The rate of first order reaction is 1.5 x 10^2 mol L-1 min-1 at 0.5 M concn of the Rxn. What is the half life of the Rxn.

b) A first order Rxn has half life period of 69.3 seconds. What will be the rate of Rxn when the concn of reactant is 0.1 mol /L.

c) Calculate the half life period of first order Rxn when the rate constant is 5 year-1.

d) The half life period of 1st order Rxn is 3 hours. Find the time required to complete 87.5% of the reaction.

Type-4 (Finding order of reaction and unit)

a) The rate constant of Rxn is 2.4 x 10-4 mol L-1 s-1. What is the order of reaction.

b) Rate of Rxn is doubled when concn of A is doubled but there is no effect in rate with change in conc of B, find out unit of Rxn.

c) Identify reaction orders if the unit of rate constant are:
i) min^{-1} ii) mol L^{-1} min^{-1}

Type-5

a) The R^{xn} P + Q → Z is first order with respect to P and zero order with respect to Q. Fill in the blanks in following

Exp	[P]M	[Q]M	Rate of formation
I	0.1	0.1	2×10^{-2}
II	-	0.2	4×10^{-2}
III	0.4	0.4	-
IV	-	0.2	2×10^{-2}

b) For hypothetical R^{xn} 2M + N → products
The following data are given

Exp No	Initial conc^n of (mol L^{-1}) [M] mol L^{-1}	Initial conc^n of [N] mol L^{-1}	Initial rate (mol L^{-1} s^{-1})
I	0.20	0.20	$3 * 10^2$
II	0.30	0.40	$3.6 * 10^3$
III	0.30	0.80	$1.44 * 10^4$
IV	0.30	1.60	A
V	0.60	0.80	B
VI	0.10	0.40	C

c) From the following data, for the R^n bet' A and B
$2A + B_2 \rightarrow 2AB$

Experiment	[A] mol L^{-1}	[B] mol L^{-1}	Initial Rate
1	0.50	0.50	1.6×10^{-4}
2	0.50	1.00	3.2×10^{-4}
3	1.00	1.00	3.2×10^{-4}

Calculate the rate of formation of AB when [A] = 2 mol L^{-1} and [B] = 4 mol L^{-1}

d) The following data were obtained from hypothetical R^{xn} X + Y → Z

Exp	[X] mol L^{-1}	[Y] mol L^{-1}	Formation of Z (mol L^{-1} s^{-1})
1	0.20	0.20	$3 * 10^{-3}$
2	0.40	0.20	$1.2*10^{-2}$
3	0.40	0.40	$6*10^{-3}$
4	0.60	0.20	$9*10^{-3}$

Calculate the rate constant and find out rate of disappearance of Y when [X] = 0.2 mol $L^{-1}$and [Y] = 0.7 mol L^{-1}

e) The following data are given for the R^{xn} 2X + Y → Products

Exp No	[X] mol L^{-1}	[Y] mol L^{-1}	Initial rate(mol L^{-1} s^{-1})
1	0.1	0.1	$7 * 10^{-3}$
2	0.3	0.2	$8.4*10^{-2}$
3	0.3	0.4	$3.36*10^{-1}$
4	0.4	0.1	$2.8*10^{-2}$

Calculate:

a. the order with respect to X and Y
b. Half life of Rxn with respect to X
c. Rate of formation of products when [X] = 0.6 mol L-1and Y = 0.3 mol L^{-1}

Chemistry — Physical Chemistry

Chemical Thermodynamics

You must remember

→ Definition
→ Some important question
→ Reasoning Based Question
→ Important Derivation
→ Difference between
→ Some important numerical

Definition

→ Open system → Closed system
→ Isolated system → State function
→ Path function → Extensive property
→ Intensive property → Isothermal process
→ Adiabatic process → Isobaric process
→ Isochoric process → Cyclic process
→ Internal energy → Enthalpy or standard enthalpy
→ Exothermic R^n → Endothermic R^n
→ First law of thermodynamics

Enthalpy of formation

→Heat of combustion → Bond dissociation energy
→ Hess law of constant heat summation
→ Entropy → Gibbs free energy
→ First law of thermodynamics
→ Second law of thermodynamics

Some Important Questions Reasoning based Question

a) Gases having the highest absolute entropy among three states of matter.

b) Decrease of enthalpy is the sole criterion for feasibility of process

c) State the effect of increased temperature on the entropy of a substance

Other important Questions

a) Calculate entropy change (ΔS) and free energy change (ΔG) for conversion of ice into water at equilibrium condition when the enthalpy change (ΔH) is 9 kJ mol^{-1}

b) How would you apply the relation $-\Delta G = T\Delta S\_total.$ Predict whether the process is spontaneous or non-spontaneous.

c) Under what condition the R^n is expected to occur
i) Spontaneous
ii) non-spontaneous, if ΔH and ΔS are positive for the R^n

d) How would you predict the spontaneity of a reaction in terms of free-energy change

Important Relations

Relation of Gibbs free energy with enthalpy change and entropy change.

Prove that $\Delta G = -W$ useful

or, prove that Gibbs free energy is equal to the negative of useful work done.

Difference between

1. Spontaneous and non-spontaneous process
2. Enthalpy and Entropy
3. Reversible and Irreversible process

Important Numerical

Type–1

a) Calculate the heat of formation of ethanol from following data

$H_2(g) + 1/2\ O_2(g) \rightarrow H_2O(l)$, $\Delta H = -286.2$ kJ/mol

$C(s) + O_2(g) \rightarrow CO_2(g)$, $\Delta H = -393.2$ kJ/mol

$C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$, $\Delta H = -1368$ kJ/mol

b) Heat of combustion of carbon(s), sulphur(s) and carbon disulphide (CS_2) are −395 kJ/mol, −295 kJ/mol and −1110 kJ/mol respectively.

Calculate the heat of formation of $CS_2(l)$

c) Calculate the heat of formation of acetic acid from following data

$C(s) + O_2(g) \rightarrow CO_2(g)$, $\Delta H = -95$ kcal/mole

$H_2(g) + 1/2\ O_2(g) \rightarrow H_2O(l)$, $\Delta H = -68$ kcal/mole

$CH_3COOH(l) + 2O_2(g) \rightarrow CO_2(g) + H_2O(l)$, $\Delta H = -208$ kcal/mole

d) Calculate heat of formation of CS_2 from following data

$C(s) + O_2(g) \rightarrow CO_2(g)$ $\quad \Delta H = -395$ kJ

$S(s) + O_2(g) \rightarrow SO_2(g)$ $\quad \Delta H = -295$ kJ

$CS_2(l) + 3O_2(g) \rightarrow CO_2 + SO_2(g)$ $\quad \Delta H = -1110$ kJ

e) If heat change for the following reaction is 1648 kJ, what is the standard enthalpy of formation of Fe_2O_3

$4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$

f) Heat of combustion of benzene (C_6H_6) is −3280 kJ. Heat of formation of CO_2 and water are −395 kJ and −286 kJ respectively. Calculate heat of formation of benzene.

g) The bond enthalpies of gases H_2, Cl_2 and HCl are 104 kcal mol^{-1}, 58 kcal mol^{-1} and 103 kcal mol^{-1} respectively. Calculate the enthalpy of formation of HCl

Type–2

1. Enthalpy of formation of benzene is 55 kJ; enthalpy of formation of water and carbon-dioxide are −395 kJ and −285 kJ respectively. Calculate enthalpy of combustion of benzene.
2. Heat of formation of ethyl alcohol, water and carbon-dioxide are −64.1 kcal, −68.6 kcal and −95 kcal. Calculate the heat of the combustion of ethyl alcohol.
3. If the heat of formation of CO_2, H_2O and $C_6H_{12}O_6$ are −395 kJ mol^{-1}, −269.4 kJ mol^{-1} and −1169 kJ mol^{-1} respectively. Calculate the heat of combustion of glucose.

Type–3

1. Calculate the ΔS and ΔG for the conversion of ice into water when they are at equilibrium at 0°C (ΔH : 4 kJ/mole)
2. The latent heat of fusion of ice is 336 J g^{-1}. Calculate the molar entropy of fusion of ice at its normal melting point.
3. Calculate entropy change (ΔS) and free energy change (ΔG) for conversion of ice into water at equilibrium condition when enthalpy change (ΔH) is 9 kJ mol^{-1}.
4. Calculate the enthalpy of formation of NH_3 from equation $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ $\quad \Delta H = -93$ kJ

Chemistry — Organic Chemistry

Haloalkane

You must remember

1. Naming reaction

1. Markonikov's rule
2. Dehydrohalogenation
3. Chlorination
4. Sand meyer reaction
5. Hell - volhard - zelinsky reaction
6. Corey - house Synthesis reaction
7. Reimer - Tiemann reaction
8. Darzen's method
9. Anti-Markonikov's rule
10. Wurtz reaction
11. Fitting reaction
12. Gattermann reaction
13. Hunsdiecker
14. Carbylamine reaction
15. Hydrolysis Reaction

2. Conversion

1. Ethyl magnesium bromide → ethanoic acid
2. Ethanal → trichloromethane
3. Chloroform → acetylene.
4. Bromoethane → ethane
5. ethyne → trichloromethane
6. iodoethane → butane
7. trichloromethane → chloropicrin (Tear gas)
8. trichloromethane → carbonyl chloride
9. trichloromethane → chloretone
10. 1 - halopropane → 2,3 dimethyl butane
11. ethane → bromoethane
12. Phosgene gas → diethyl carbonate
13. bromoethane → ethyne
14. 1 - chloropropane → 2 - chloropropane
15. 1 - bromopropane → 2 - bromopropane
16. Bromomethane → N - methyl methane amine
17. propan - 2 - ol → propane
18. 1 - halopropane → 2 - halo propane

3. Identification

1. $(A) aq.NaOH \rightarrow$ (B) $\xrightarrow[H]{k_2Cr_2O7}$ → propanone.

(i) Identify the compound (A) and (B).

2. An organic compound (A) when heated with Ag powder gives C_2H_2 and form carbonyl chloride when it exposes to air
   (i) Identify the compound (A)
3. An unsaturated hydrocarbon (C3H6) undergoes Markoni kov's rule to give (A). Compound (A) is hydrolysed with aqueous alkali to yield (B), when (B) is treated with PBr_3, compound (C) is produced (C) react with AgCN (alc) to give another compound (D). The compound (D) if reduced with LiAlH4 produce (E)
   (i) identify (A), (B), (C), (D) and (E) with chemical reaction.

4. An alkene (A) undergoes addition with HBr to give (B), when (B) is heated with sodium in presence of dry ether give 2,3-dimethyl butane. Identify (A) and (B)
5. Identify the major products (A) and (B) and give their IUPAC name

$CH_3CH_2I \xrightarrow{AlC.AgCN} (A) \xrightarrow{LiAlH_4} (B)$

6. Identify (A) and (B) in the following reaction

$CH_3CH_2Br \xrightarrow[\Delta]{alc.KOH} (A) \xrightarrow[ii.Zn/H_2O]{i.O3} (B)$

7. Identify (X) and (Y) in the following reaction

(X) $\xrightarrow{Mg/ether}$ (Y)) $\xrightarrow[ii\ H_2O/Ht]{i.O2}$ propanoic acid.

8. An aliphatic haloalkane (A) is heated with aq. KOH to give (B). The compound (B) react with $SOCl_2$ to produce (C). The compound (C) further reacts with AgCN to yield (D). on reduction of compound (D) with $LiAlH_4$ produces (E). The compound (A) undergoes wurtz reaction to give an alkane of molecular formula C4H10. Identify (A), (B), (C), (D) and (E) → also write reaction involved.
9. A haloalkane (P) react with aq.KOH to give Q. The compound (Q) on oxidation with $k_2Cr_2O_7$/Ht gives (R) and (R) undergoes clemmensen reduction to produce (S). The compound (P) react with sodium in presence of dry ether to form 2,3 - dimethyl butane, write chemical reaction involved and identify (P), (Q), (R) and (S).
10. A secondary haloalkane (A) gives compound (B) when heated with alc.KOH (B) on ozonolysis produces ethanal and methanal as major product. Identify (A) and (B). also write chemical reaction what product would you expect when (A) is heated with sodium in presence of dry ether
11. An aliphatic haloalkane (A) gives compound (B) when heated with alc.NaOH. The compound (B) reacts with HBr to give major product (C). on heating compound (C) with sodium in presence of dry ether yields 2,3-dimethyl butane. what product will you expect when the compound is (B) subjected to ozonolysis.

4. Important question

1. Why is trichloromethane stored in dark-brown bottle?
2. Laboratory preparation of chloroform
3. what happens when chloroform exposed in air
4. Why does trichloromethane not give white ppt with silver nitrate solution
5. How does chloroform (trichloromethane) react with i) Phenol ii) Silver powder iii) Conc nitric acid
6. **Give the action of chloroform upon heated silver.**

Chemistry	Organic Chemistry
Haloarenes	

You must remember

1. Naming reaction

1. Wurtz - fitting reaction
2. Carbonylation reaction
3. Friedal craft acylation
4. DDT Formation R^{xn}
5. Sand meyer reaction
6. Friedal craft alkylation
7. Benzoin condensation
8. Deacons process

2. Conversion

1. Chlorobenzene → phenol
2. Benzyl chloride → benzoic acid.
3. 1 - chloro - 2 - methyl benzene → chlorobenzene
4. chlorobenzene → benzene.
5. Aniline → chlorobenzene.

3. Identification

1. An aromatic compound (A) undergoes Sand meyer's reaction to give (B). The compound (B) is reduced with Ni - Al in presence of alkali to give compound (C). The compound (C) further reacts with CH_3Cl in presence of anhydrous $AlCl_3$. The compound (D) when heated with chloral in acidic medium gives a common insecticide. Identify (A), (B), (C) and (D) giving complete reaction.

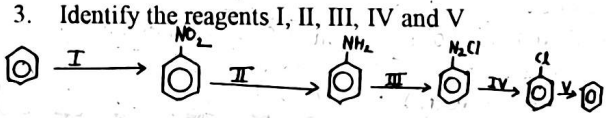
2. i) Give correct chemical reaction for the preparation of chlorobenzene from
   (a) benzene
   (b) benzene diazonium chloride

(ii) why is haloarene less reactive than haloalkane towards nucleophilic substitution reaction

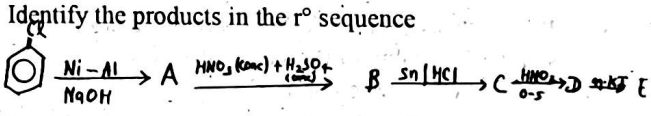
(iii) A reaction sequence is given below:

$C_6H_5Cl \xrightarrow{P} C_6H_6 \xrightarrow{Q} C_6H_5NO_2$

3. Identify the reagents I, II, III, IV and V



4. Identify the products in the r° sequence



Some important question

1. Why haloarenes are less reactive towards nucleophilic substitution R^{xn}?
2. What happens when chlorobenzene is heated with chloral?
3. How would you obtain benzene from chlorobenzene?

Chemistry	Organic Chemistry
Alcohol	

You must remember

1) Naming reaction:

1.Oxo-process
2. Iodoform Test
3. Esterification reaction (Laboratory test of ethanol)
4. Dehydration of alcohol
5. Catalytic dehydrogenation Reaction
6. Grignard reagent
7. Fermentation
8. Darzen's method
9. Lucas test
10. Victor's Mayer's test

2) Conversion

1. propan-1-ol → propan-2-ol
2. propan-2-ol → propan-1-ol

3. Ethanal → propanone
4. propan-2-ol → Ethanoic acid
5. Ethanol → ethyl magnesium chloride
6. propan-1-ol → nitrolic acid
7. Ethanol → propanone
8. 1,1-dichloroethane → ethanol
9. Methyl magnesium bromide → propan-2-ol
10. Ethyl magnesium bromide → propan-1-ol
11. propan-1-ol → methyl magnesium bromide
12. Methyl magnesium bromide → 2-methylpropan-2-ol
13. 2-methylpropan-2-ol → Methanoic acid
14. Isopropyl alcohol → Formic acid
15. propan-1-ol → propanone
16. propanoic acid → Ethanoic acid

3) Identification

1. A dihydric alcohol $C_2H_6O_2$ (A) undergoes step wise oxidation with $K_2Cr_2O_7$ / H+ to give dicarboxylic acid $C_2H_2O_4$ (B) as final product. Identify (A) and (B) with reactions and give their IUPAC name.
2. An organic compound give H_2 gas with sodium metal on treatment with alkaline iodine gives yellow ppt and on oxidation with CeO_2 / H+ form an aldehyde (C_2H_4O). Name the compound and write the reaction involved.
3. An organic compound (M) gives H_2 gas with sodium metal on treatment with alkaline iodine gives yellow ppt and on oxidation with CeO_2 / H+ forms an aldehyde (C_2H_4O). Name the compound (M) and write reactions involved. What happens when (M) is heated with P_2O_5?
4. A monohydric alcohol reacts with PBr_3 to give B. The compound B if heated with alc. KOH gives C. 'C' on ozonolysis produces ethanal and methanal as the major product.
   i. The compound A responds iodoform test.
   ii. Identify A, B and C with reaction involved.
   iii. What happens when B is heated with sodium in presence of dry ether.
5. Consider a reaction:

$$(A)\xrightarrow[\Delta]{P_2O_5}(B)\xrightarrow{KCN}(C)\xrightarrow[\Delta]{H_2O/H^+}(D)\xrightarrow[\Delta]{P_2O_5}(E)$$

The compound (A) is primary alcohol which gives positive iodoform test. Identify the organic compound A, B, C, D and E.

6. Identify the product A, B, C and D

$$(A)\xrightarrow[\Delta]{PBr_3}(B)\xrightarrow{KCN}(C)\xrightarrow[\Delta]{H_2O/H^+}(D)\xrightarrow[\Delta]{P_2O_5}(E)$$

7. $(CH_3)_2\,CHOH \xrightarrow{PCl5} (A) \xrightarrow{alc.KOH} (B) \xrightarrow{Ozonolysis} C + D$

Identify the compound A, B, C and D.

8. $A \xrightarrow[ice\ cold]{NqNO_2+HCL} B \xrightarrow[[O]]{KMnO_4/H^+} CH_3CHO \xrightarrow[[O]]{KMnO_4/H^+} CH_3COOH$

Identify the compound (A) and (B)

Important Question

1. Write an example of primary, secondary and tertiary alcohol. What are the oxidation products of primary, secondary and tertiary alcohol.
2. What happens when Ethanol is heated with conc. H_2SO_4 at 160–170°C.
3. Alcohols of low molecular weight are soluble in water, whereas ethers of about the same molecular weight are not. Explain.
4. Define fermentation and molasses. Write down function of yeast in fermentation of ethyl alcohol.
5. Isopropyl alcohol has lower boiling point than propyl alcohol. Explain.

Chemistry	Organic Chemistry

Phenol

You must remember.

1. Coupling reaction
2. Reimer–Tiemann reaction
3. Friedel Craft alkylation
4. Laboratory Test of phenol
5. Bromination of phenol
6. Diazotization reaction
7. Nitration of phenol
8. Gattermann Koch reaction
9. Phenol phthalein synthesis
10. Dow's process
11. Kolbe's Reaction
12. Libermann's test
13. Lederer Manasse reaction

2) Conversion

1. Phenol → Benzaldehyde
2. Benzene → Benzenediazonium chloride
3. Phenol → Cyclohexane
4. Chlorobenzene → Phenol
5. Phenol → Methoxybenzene
6. Phenol → Methyl benzene
7. Phenol → Benzene
8. Phenol → Aniline
9. Phenol → m-nitrobenzoic acid
10. Phenol → DDT

3) Identification (5 marks Question)

1. Identify A, B, C, D and E in the following reaction sequence

$$(A)\xrightarrow[H_2SO_4]{Con.HNO_3l}(B)\xrightarrow[\Delta]{Sn/HCl}(C)\xrightarrow[alc]{CH_3Cl_3/KOH}(D)\xrightarrow[\Delta]{LiAlH_4}(E)$$

Compound (A) can be obtained by heating phenol in presence of Zn-dust.

2. Identify the major product A, B, C and D in the following reaction sequences

$$(A)\xrightarrow[\Delta]{Zn\ Dust}(B)\xrightarrow[\Delta]{CHCl_3/ALCL_3}(C)\xrightarrow[\Delta]{CeO_2/H^+}(D)$$

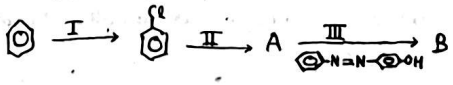
Compound (D) gives methylbenzene when heated with alc. KOH and hydrazine.

3. An organic compound A reacts with caustic soda at about 350°C under high pressure which on acidification gives B. B reacts with aq. bromine to give C. C on heating with Zn dust produces 1,3,5 tribromobenzene. Identify A, B and C with necessary chemical reaction.
4. Identify the reagent A, B and C from the following

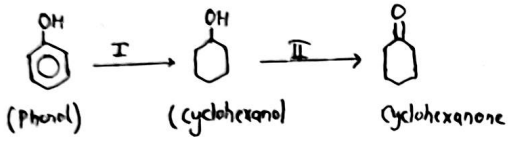
$$C_6H_5OH \xrightarrow{A} C_6H_6 \xrightarrow{B} C_6H_5CH_3 \xrightarrow{C} C_6H_5CHO$$

Suggest the structure A and B

5. Identify the reagent I, II and III



6. Identify the reagent I and II.



Some important question (2 marks)

1. Why is phenol more acidic than aliphatic alcohol.
2. The –OH bond in phenol is easily broken, but difficult in alcohols. Explain.
3. What happens when a piece of moist blue litmus is dipped into phenol.

Chemistry – Organic Chemistry

Aldehyde and Ketone

You must remember

1) Naming reaction

1. Carbonylation reaction
2. Aldol condensation
3. Fehling solution test
4. Clemmensen's reduction
5. Hydroboration oxidation
6. Rosenmund's reduction
7. Carboxylation reaction
8. Wolf - kishner reduction
9. Dehydrohalogenation
10. Perkin's Condensation reaction
11. Nitration of benzaldehyde
12. Benzoin condensation
13. Gattermann Koch Reaction
14. 2,4,- DNP Test
15. Cannizzaro's reaction
16. williamsen synthesis
17. coupling reaction
18. Tollen's Test
19. Iodoform Test
20. Decarbonylation reaction
21. Ozonolysis
22. Wurtz reaction
23. Benzoin condensation
24. stephen reduction
25. Benedict solution test

2) Conversion

1. Acetone → 2, hydroxy 2-methyl propanoic acid
2. 2,2, dichloropropane → Acetone
3. Acetone → 2-methyl propan-2-ol
4. propan-2-ol → Iodoform
5. propanone → ethanal
6. Ethanal → propan-2-ol
7. ethanoic acid → propanone
8. 2,2-dichloropropane → propanone
9. propan-2-ol → methanal
10. 2,3-dimethyl but-2-ene → propanone
11. Ethanal → 2-hydroxy propanol
12. propyne → propanone
13. Aniline → Benzaldehyde
14. benzaldehyde → Aniline
15. Benzaldehyde → toulene
16. Benzaldehyde → Cinnamic acid
17. Ethyne → Benzaldehyde
18. Benzaldehyde → Benzyl chloride
19. Benzaldehyde → Benzoic acid
20. Benzaldehyde → Phenol

3) Identification

1. A Carbonyl compound (M) is used as nail polish remover. The compound (M) contains three carbon atoms and it undergoes iodoform Test.
   (i) Identify the compound (M)
   (ii) write down a chemical reaction for the preparation of M
   (iii) Give the laboratory test reaction for Carbonyl compound.
2. A Carbonyl compound (x) gives iodoform test and can be obtained by oxidation of a mono hydric alcohol containing three carbon atom.
   (i) write down the structural formula of (x)
   (ii) Give the functional isomers of (x).
3. Alkene (A) undergoes ozonolysis to give an aldehyde and a ketone as the major product. The aldehyde gives positive iodoform Test reaction and the ketone undergoes clemmensen reduction to yield propane. Identify A,B,C and gives their IUPAC name. Also write their reaction involved.
4. Alkene (A) undergoes ozonolysis to give aldehyde and ketone as the major products. The aldehyde and the ketone further undergoes clemmensen reduction to yield ethane and propane respectively. Identify (A). and give its IUPAC name. what product you expect when (A) is treated with HBr.
5. An aliphatic compound (A) react with aq. NaOH to give (B). (B) on oxidation with $K_2Cr_2O_7/H^+$ produce (C). The compound (C) undergoes clemmensen reduction to give propane. If compound (C) responses positive iodoform test. Identify (A), (B) and (C) also what product would you expect when (A) is treated with alc. KOH.
6. An organic compound (A) react with HCN to give (B). On hydrolysis of (B) in acidic medium give (C). Compound (A) also produces propane when treated with zinc amalgam and HCL. Identify (A), (B), (C). With reaction and give their IUPAC names. What product would you expect when (A) is treated with trichloromethane in alkaline medium
7. An organic compound (A) reacts with sodium metal to give hydrogen gas. The compound (B) on treated with alkaline iodine forms a yellow crystalline substance and on oxidation with acidified dichromate forms an aldehyde with molecular formula C_2H_4O. Identify the compound and write equation for these reaction.
8. An organic compound 'P' which reduces tollens reagent. on oxidation with potassium permanganate formed a compound 'Q' having same number of carbon atoms as 'P'. Q reacts with Na_2Co_3(aq) to give carbon dioxide. 'Q' on reaction with ethanol in the presence of sulphuric acid formed as ester having molecular formula $C_4H_8O_2$ 'R'. Identify P,Q,R and write their IUPAC name.
9. An alcohol (A) react with thionyl chloride to produce (B) which on dehydrohalogenation yield a compound (C). The compound (C) on ozonolysis gave the mixture of ethanal and methanal. If the alcohol (A) responses positive iodoform Test. Identify A,B and C.

10. A carbonyl compound 'A' gives both tollen's and iodoform tests positively.
(i) identify the compound 'A'
(ii) How does the compound 'A' react with dil. NaOH. Give chemical reaction involved
(iii) Write the chemical equation when compound 'A' reacts with dil.NaOH followed by hydrolysis

11. A carbonyl compound with molecular formula C_3H_6O (it does not give silver mirror test) is heated with a compound Y which gives Z. Z on hydrolysis in acidic medium gives 2-hydroxy-2-methyl propanoic acid. Identify the carbonyl compound Y and Z with proper reaction

12. An organic compound (A) reacts with PBr_3 to give (B). compound (B) produces (C) when heated with alc. KOH. The compound (C) undergoes ozonolysis to yield ethanal and methanal as major product. The compound (A) responses iodoform test. Identify A,B,C and write reaction involved. How is 'A' obtained from CH_3MgBr

13. Identify x and Y in following reaction
$CH_3CHO \xrightarrow[\Delta]{I_2/NaOH} X \xrightarrow[\Delta]{Ag} (Y)$

14. Identify the product X in the reaction.
$HCHO + CH_3MgI \xrightarrow{Dry\ ether} Intermediate \xrightarrow{H^+/H_2O} X$
Identify the product X in the reaction

15. Consider the following reaction sequence
$C_6H_5CH_3 \xrightarrow{X} C_6H_5CHO \xrightarrow{alc.\ KCN} B$
Identify the compound B
   i. Identify the compound B
   ii. Write down reagent and condition in place of X

16. An alkene A undergoes ozonolysis to give two carbonyl compound (B) and (C). The compound (B) reacts with Zn-Hg/H+ gives propane. The compound C reacts with HCN followed by hydrolysis to produce 2-hydroxypropanoic acid as major product. Write chemical r^{xn} and IUPAC names of (A), (B) and (C)

Some important Question (2 marks)

1. Write the action of Methanal with Ammonia ?
2. How is sodium benzoate converted into acetophenone
3. What happens when the product obtained by dehydrogenation of the ethanol is allowed to react with tollens reagent
4. suggest suitable chemical r^{xn} to distinguish ethanol from propanone. Give chemical Reaction.

Chemistry	Organic Chemistry

Carboxylic Acid

You must remember

Naming Reaction

1. Carboxylation Reaction
2. Decarboxylation Reaction
3. Esterification Reaction
4. HVZ Reaction
5. Soda lime decarboxylation Reaction
6. Rosenmund's Reduction Reaction
7. Claisen condensation Reaction
8. Schotten Baumann Reaction

Conversion

1. Methanol into Methanal
2. Ethanoic acid into methanoic acid
3. Ethanoic acid into Ethanamine
4. Ethanoic acid into methanol
5. Ethanenitrile into Ethanoic acid
6. Tribromomethane into Ethanoic acid
7. Ethanoic acid into Methane
8. Ethanoic acid into methylethanoate
9. Ethanoic acid into Ethanoic anhydride

Identification R^{xn}.

1. A sequence of R^{xn} in general form is expressed as
$A \xrightarrow{PCl3} B \xrightarrow[\Delta]{NH_3} C \xrightarrow{Br2/NaOH} D \xrightarrow[(0-5^0)]{NaNO_2+HCL} E$
Identify A, B, C, D and E with reaction involved

2. Consider the following Reaction
Sodium benzoate $\xrightarrow[\Delta]{NaOH/CaO} A \xrightarrow[AlCl_3]{CHCl_3/\Delta} B \xrightarrow{CeO2/H+} C \xrightarrow[Sodium\ acetate]{Acetic\ anhydride} D$

3. $A \xrightarrow[pyridine]{PCl_5} B \xrightarrow[anh.AlCl_3]{C_6H_6} C$, Identify A, B and C

4. Identify A and B writing the related R^n
$(A) \xrightarrow[\Delta]{Zn} (B) \xrightarrow[AlCl_3]{CH_3Cl} (C) \xrightarrow{CeO2/H+} (D)$
Compound D on reduction with Zn amalgam in the presence of acid gives toluene. Identify A, B, C and D writing the related Reaction.

5. Arrange the given compound according to this ascending order of acidic strength and justify your order.
CH_3CH_2COOH , C_6H_5COOH , Cl CH_2CH_2COOH

6. Represent a regular sequence of chemical reaction of following sets of organic compound using suitable reagents, catalyst or condition with proper reason.
CH_3COOH , CH_3Br , $CH_3COOMgBr$, CH_3MgBr

7. $CH_3CH_2CHO \xrightarrow[Reduction]{LiAlH_4} B \xrightarrow[conc.H_2SO_4]{CH_3COOH} C \xrightarrow{H2O/H+} D + E$
Identify B, C, D and E

8. Identify the product A and B and give their IUPAC name
$CH_3COOH \xrightarrow[\Delta]{P_2O_5} A \xrightarrow[\Delta]{LiAlH_4} B$

9. An aliphatic compound A reacts with $SOCl_2$ to give B.The compound B is heated with ammonia to produce C.The compound C is heated with Br_2/KOH to yield D.The compound D gives E when treated with $NaNO_2$/HCl at low temp.The compound E is primary alcohol which gives positive iodoform test.Identify A, B, C, D and E. Write the R^{xn} involved

10. An aliphatic compound A reacts with $SOCl_2$ to give B.B on reduction with H_2 in the presence of $Pd/BaSO_4$ gives C.When HCN is added to C produces D.On hydrolysis of D in acidic medium forms E.Compound C can be obtained by heating mixture of sodium formate and sodium acetate.Identify A, B, C, D and E. Write the R^{xn} involved.

11. Identify A, B, C, D and E in following R^{xn} sequence and write R^{xn} involved

$$A \xrightarrow{NH_3} B \xrightarrow{Br_2/aq.KOH} C \xrightarrow{HNO_2} D \xrightarrow[\Delta]{NaOH/I_2} E$$

Some important Question

1. What happens when Methanoic acid is warmed with ammonical silver nitrate?
2. Acetic acid is weaker acid than chloroacetic acid ?
3. Methanoic acid gives Tollens test but ethanoic acid doesn't. Give reason.
4. The boiling point of methanoic acid is higher than ethanol although they have same molecular mass. Explain.

Chemistry	Organic Chemistry

Nitro Compound

You must remember

Naming R^{xn}

1. Hoffman's Reaction's:
2. Baker Mulliken test

Conversion R^{xn}

1. Aniline into phenylisocyanide
2. Aniline into Azo dye
3. Nitroethane into N-ethyl hydroxylamine
4. Nitrobenzene into picric acid
5. Nitrobenzene into Azobenzene
6. Nitrobenzene to p-aminoazobenzene
7. Benzoic acid p-aminoazobenzene
8. Nitrobenzene to p-hydroxyazobenzene
9. Nitrobenzene to Hydrazobenzene
10. Nitrobenzene to Phenol

1) Identify (A), (B) and (C) in r^{xn} sequence

$$\text{Nitrobenzene} \xrightarrow[\Delta]{Sn/HCl} (A) \xrightarrow[0-5^\circ C]{NaNO_2+HCl} (B) \xrightarrow{Aniline} (C)$$

2) Identify A, B, C and D in following r^{xn}

$$\text{Nitrobenzene} \xrightarrow[\Delta]{Sn/HCl} A \xrightarrow{NaNO_2/HCl} B \xrightarrow[\Delta]{H_2O} C \xrightarrow[\Delta]{CHCl_3/KOH} D$$

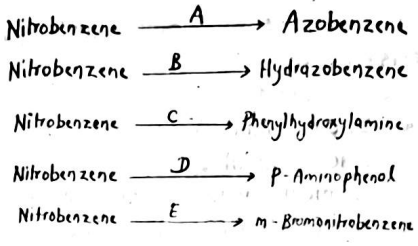
3). Make a correct sequence of reactions using suitable condition from the following compounds

Benzoin , Toluene , Benzaldehyde , Phenol , Benzoic diazonium chloride and Benzene

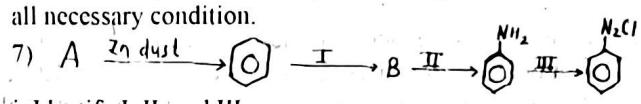
4). Identify A, B, C and D in the given R^{xn}

$$\text{Benzene} \xrightarrow[conc.H_2SO_4]{conc.HNO_3} A \xrightarrow{Fe/HCl} B \xrightarrow{CHCl_3/KOH} C \xrightarrow{LiAlH_4} D$$

5)

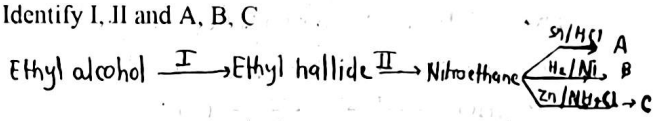


6). A pale-yellow oily liquid (A) gives compound (B) on catalytic reduction. (B) reacts with nitrous acid in cold to give C when couples with phenol to give D . (A) is reduced to azobenzene in alkaline condition. Identify A,B,C and D with all necessary condition.

7) 

i. Identify I, II, and III
ii. Identify the product (A) and (B)

8) Identify I, II and A, B, C



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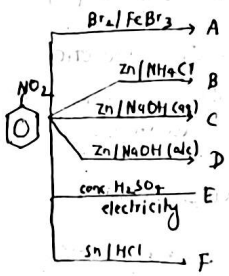


Identify the products A, B, C, D, E and F in the R^{xn}

Important Question

1. Why is electrophillic substitution occurs at meta-position
2. What happens when nitrobenzene is reduced with electrolytic medium ?
3. What happens when nitrobenzene is reduced in acidic, neutral, alkaline and electrolytic conditions.

Chemistry	Organic Chemistry

Amine

You must remember

1. Naming Reaction
2. Conversion
3. Identification

Naming Reaction

1. Hoffman's Ammonolysis Reaction
2. Mendius Reduction Reaction
3. Hoffman's Bromamide Reaction
4. Carbylamine Reaction
5. Diazotization Reaction

6. Acylation Reaction
7. Schotten Baumann Reaction
8. Coupling Reaction

Important Identification Reaction

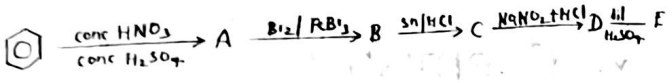
1) A $\xrightarrow{SOCl_2}$ B $\xrightarrow{NH_3}$ C $\xrightarrow{Br_2/KOH}$ D $\xrightarrow{NaNO_2+HCl}$ E

The compound E is primary alcohol which gives positive iodoform test. Identify (A), (B), (C), (D) and (E)

2) $CH_3CH_2NH_2 \xrightarrow{I} CH_3CH_2OH \xrightarrow{II} CH_3CH_2I \xrightarrow{III} CH_3CH_2CN \xrightarrow{IV} CH_3CH_2CH_2NH_2$

Identify the reagent (I to IV) in following R^{VII}

3) suggest suitable Reagent with proper condition



4) Identify A, B, C and D in following R^{XII}

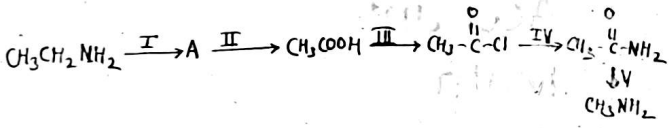
5) Represent a regular sequence of reaction of following sets of organic compound using suitable catalyst, reagent or conditions.

$CH_3CH_2CH_2{-}Cl$, $CH_3CH_2NH_2$, $CH_3CH_2CH_2{-}OH$, CH_3CH_2COOH, $CH_3CH_2CONH_2$

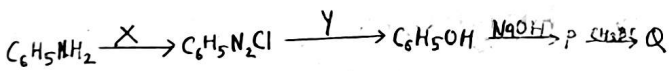
6) Represent regular sequence of chemical reaction of following sets of organic compound using suitable catalyst, reagent giving proper names

CH_3CH_2NC , CH_3CH_2Br , $CH_3CH_2{-}NH{-}CH_3$, $CH_3CH_2NH_2$

7) Suggest suitable reagent with proper condition.



8) Identify reagent X, Y and product P and Q



Conversion Reaction

1. Chlorobenzene into Aniline
2. Methanamine into Ethanamine
3. Ethanamine into Methanamine
4. Propanamide into Ethanamine
5. Ethanenitrile into Ethanamine
6. Chlorobenzene into N-methylaniline
7. Chlorobenzene into N-Nitroso-N-methylaniline

Some important Question

Short question

1. Give a chemical test to distinguish Ethanamine from N-methylmethanamine
2. Write down structure of secondary amine and tertiary amine from C_3H_9N and give their IUPAC name
3. Write a chemical reaction to distinguish alliphatic amine from aromatic amine
4. Why is amine more basic than ammonia?
5. Why is methanamine more basic than aniline?
6. What is amine? How do different classes of amine react with diethyl oxalate?
7. Write down possible isomeric amines of C_3H_9N and give their IUPAC name.

Long Questions

1. How do you separate of C_3H_9N by Hoffman's method? Explain with suitable chemical equation
2. Write down structural formula of primary, secondary and tertiary amine of each from C_3H_9N. How is Hoffman's method applied to separate them from their mixture.
3. Write down chemical reaction to distinguish Ethanamine from N-methylmethanamine? How is Ethanamine prepared from i) Propanamide ii) Ethanenitrile

Chemistry — Heavy Metals

Organometallic Compound

You must remember

Short Questions

1) How can you prepare Grignard reagent from aryl halide?

2) What type of bond is present between carbon and metal in organometallic compound?

3) Why only magnesium is used in Grignard reagent?

4) What is the final product when Grignard is treated with ester?

5) Ethanal forms a class of alcohol with Grignard reagent? Write the name of alcohol. What happens when this class of alcohol is heated with conc. H_2SO_4 at 170°C?

6) Why Grignard reagent is stored in dry ether?

Long Questions

1) Grignard reagent is an organometallic compound which is used to synthesize various organic compound. Starting from CH_3MgBr, how would you prepare:
   i) Methane ii) Ethanoic acid
   iii) Ethanol iv) Propan-2-ol

2) An organic compound (A) having molecular formula C_2H_5Br is heated with magnesium metal in the presence of dry ether to form compound B.
   a) How can you prepare tertiary alcohol from the compound (B)?
   b) What product is formed when compound (B) is heated with CO_2 followed by hydrolysis?
   c) What is the role of ether for the preparation of Grignard reagent?

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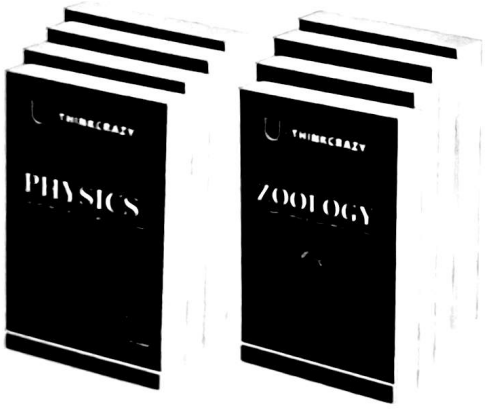

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