HSC BOARD

IMPORTANT QUESTIONS

PHYSICS

HSC 2027

Chapter-wise Question Collection

For study and revision

Rotational Dynamics

Marks without option: 5 | Marks with option: 7

1. **Define:**
   - Radius of Gyration
   - Moment of Inertia
   - Conical Pendulum
   - Uniform Circular Motion
2. State and prove the principal of parallel axes in rotational motion.
3. State and prove theorem of perpendicular axes about moment of inertia.
4. Obtain an expression for torque acting on a body rotating with uniform angular acceleration.
5. State and prove principle of conservation of angular momentum.
6. Derive an expression for kinetic energy of a rotating body.
7. **Distinguish between:**
   - Centripetal force & Centrifugal force
   - Uniform circular motion and non-uniform circular motion
8. Obtain an expression for total kinetic energy of a rolling body in the form

   $\frac{1}{2}Mv^2\left[1+\frac{K^2}{R^2}\right]$.
9. A particle of mass just completes the vertical circular motion. Derive the expression for the difference in tension at the highest and lowest point.
10. Explain the physical significance of radius of gyration.
11. Derive an expression for maximum possible speed for a vehicle to move on a horizontal unbanked road.
12. Derive an expression for angle of banking when a vehicle (considered to be a point) moves along a curved banked road neglecting friction.
13. Derive an expression for time period of a conical pendulum.
14. Obtain an expression relating the torque with angular acceleration for a rigid body.

Mechanical Properties of Fluids

Marks without option: 5 | Marks with option: 7

1. **Define:**
   - Surface tension
   - Surface energy
   - Capillarity
   - Terminal velocity
   - Angle of contact
   - Viscosity
   - Force of cohesion
   - Force of adhesion
   - Sphere of influence
   - Pascal's law
2. Derive the relation between surface tension and surface energy.
3. Define angle of contact & state its characteristics.
4. What is capillarity? Give its applications.
5. Derive an expression for excess pressure inside a liquid drop.
6. Distinguish between streamline flow and turbulent flow.
7. State and explain Newton's law of viscosity.
8. Obtain an expression for terminal velocity of a small sphere falling under gravity through a viscous fluid.
9. State Bernoulli's principle & derive Bernoulli's equation.
10. State properties of an ideal fluid.
11. Explain the effect of presence of impurities on the surface tension of a liquid.
12. Draw a neat labelled diagram for the rise of liquid in a capillary tube showing different components of tension (Force).
13. Derive an expression for pressure exerted by a liquid column. On which factors does pressure due to liquid column depend?
14. On the basis of molecular theory, explain the phenomenon of surface tension.
15. Obtain an expression for the rise or fall of liquid in a capillary tube using the force method.

Kinetic Theory of Gases & Radiation

Marks without option: 5 | Marks with option: 7

1. **Define:**
   - Mean free path
   - Degree of freedom
   - Athermanous substance
   - Diathermanous substance
   - Emissive power
   - Coefficient of emission
   - Law of equipartition of energy
   - Coefficient of absorption
   - Coefficient of reflection
   - Coefficient of transmission
2. Derive an expression for pressure exerted by a gas on the basis of kinetic theory of gases.
3. Show that RMS velocity of a gas molecule is directly proportional to the square root of absolute temperature of gas.
4. With a neat labelled diagram, explain Ferry's perfectly blackbody.
5. On the basis of kinetic theory of gases, obtain an expression for kinetic energy per unit volume of gas.
6. State and prove Kirchhoff's law of radiation.
7. Explain Blackbody radiation spectrum in terms of wavelength.
8. State Wien's displacement law.
9. Derive Mayer's relation for molar as well as principal specific heats.
10. State Stefan-Boltzmann law.
11. State and explain law of equipartition of energy.
12. State Prevost's theory of exchange of heat.
13. Explain Maxwell's distribution of molecular speeds.

Thermodynamics

Marks without option: 5 | Marks with option: 7

1. **Define / Laws:**
   - Zeroth law of thermodynamics
   - Internal energy
   - Refrigerator
   - First law of thermodynamics
   - First form of second law of thermodynamics (Kelvin-Planck statement)
   - Second form of second law of thermodynamics (Clausius statement)
2. What is a thermodynamic system? How are systems classified on the basis of transfer of heat and matter?
3. Explain flow of energy between the system and environment with the help of neat diagrams for the following conditions:
   - Temperature of the system is less than that of environment.
   - Temperature of the system is more than that of environment.
   - Both are in thermal equilibrium.
4. Explain cyclic process with a neat labelled p-V diagram.
5. **Distinguish between:**
   - Isothermal process & adiabatic process
   - Reversible process & irreversible process
6. What is an isothermal process? Determine the expression of work done for an isothermal process.
7. What is an isobaric process? Derive the expression for heat exchange in an isobaric process.
8. Derive an expression for work done in an adiabatic process.
9. Explain the schematic energy flow diagram for a heat engine.
10. Explain Carnot cycle in brief.
11. Describe processes in Stirling cycle in brief using p-V diagram.
12. Write a short note on Refrigerator.

Oscillations

Marks without option: 4 | Marks with option: 5

1. **Define:**
   - Periodic Motion
   - Linear S.H.M.
   - Angular S.H.M.
   - Damped Oscillations
   - Amplitude of S.H.M.
   - Period of S.H.M.
   - Frequency of S.H.M.
2. Obtain differential equations of linear S.H.M.
3. Obtain an expression for acceleration, velocity & displacement of a particle performing S.H.M.
4. Show that S.H.M. is a projection of U.C.M. on any diameter.
5. Discuss analytically the composition of two S.H.M.s of same period and parallel to each other. Find the resultant amplitude when phase difference is:
   - O rad
   - $\frac{\pi}{2}$ rad
   - π rad
6. Derive expressions for K.E., P.E. & T.E. of a particle performing linear S.H.M. and represent them graphically.
7. Define ideal simple pendulum. Derive an expression for its time period.
8. Draw graphs of displacement, velocity, and acceleration against phase angle for a particle performing linear S.H.M. from:
   - The mean position
   - The positive extreme position
   - Deduce your conclusions from the graph.
9. Distinguish between conical pendulum and simple pendulum.
10. Obtain the expression for the period of a magnet vibrating in a uniform magnetic field and performing S.H.M.

Superposition of Waves

Marks without option: 4 | Marks with option: 6

1. **Define:**
   - Beat
   - Harmonic
   - Overtone
   - Waxing
   - Waning
   - Progressive waves
2. State principle of superposition of waves. Derive expression for amplitude of resultant wave produced due to superposition of waves, and explain conditions for maximum and minimum amplitude.
3. Define stationary wave. Derive expression for equation of wave on a stretched string.
4. Show that only odd harmonics are present in vibrations of air column in a pipe closed at one end.
5. Show that all harmonics are present in vibrations of air column in a pipe open at both ends.
6. State and explain laws of vibrating string.
7. Deduce analytically the expression for beat frequency of two sound waves having same amplitude and slightly different frequencies.
8. **Distinguish between:**
   - Free vibrations & forced vibrations
   - Progressive wave & stationary wave
9. Show that all harmonics are present on a stretched string between two rigid supports.

Wave Optics

Marks without option: 5 | Marks with option: 7

1. **Define:**
   - Polarization
   - Plane polarized light
   - Polarizers
   - Wavefront
2. Explain Huygens' construction of spherical wavefront.
3. Derive laws of reflection of light using Huygens' principle.
4. Explain refraction of a plane wavefront at a plane surface on the basis of Huygens' wave theory of light.
5. State and explain Brewster's law.
6. Using the geometry of the double slit experiment, derive the expression for fringe width of interference bands.
7. Explain Rayleigh's criterion for resolution of two close point objects when images are:
   - Just resolved
   - Well resolved
   - Unresolved
8. **Distinguish between:**
   - Interference & Diffraction
   - Constructive & Destructive interference
9. Explain the construction of plane wavefront using Huygens' principle.
10. Derive the laws of refraction of light using Huygens' principle.

Electrostatics

Marks without option: 4 | Marks with option: 6

1. **Define:**
   - Electrostatic potential energy
   - Equipotential surfaces
   - Displacement Current
   - Capacitance
   - Dielectrics
   - Electric potential
2. Obtain expression for electric field intensity due to a uniformly charged spherical shell or hollow sphere.
3. Obtain an expression for electric field due to an infinite charged plane sheet.
4. Distinguish between Polar & Non-Polar dielectrics.
5. Obtain an expression for capacitance of a parallel plate capacitor with a dielectric.
6. Obtain an expression for capacitance of a parallel plate capacitor without a dielectric.
7. Obtain an expression for energy of a charged capacitor & express it in different forms.
8. With the help of a neat diagram, explain construction and working of Van de Graaff generator.
9. Derive an expression for electric field intensity due to an infinitely long straight charged wire.
10. Derive an expression for electrostatic potential energy.
11. Obtain an expression for potential energy of an electric dipole in an external field. Discuss potential energy if dipole is (i) perpendicular and (ii) parallel to electric field.

Current Electricity

Marks without option: 4 | Marks with option: 6

1. **Define & Laws:**
   - Kirchhoff's current law
   - Kirchhoff's voltage law
   - Potential Gradient
2. Obtain balancing condition in case of Wheatstone's network.
3. Explain with a neat circuit diagram how you will determine unknown resistance using a meter bridge.
4. Describe Kelvin's method to determine resistance of a Galvanometer.
5. State and explain principle of potentiometer.
6. State advantages of potentiometer over voltmeter.
7. With the help of a neat circuit diagram, explain how you will determine internal resistance of a cell using potentiometer.
8. Distinguish between potentiometer and voltmeter.
9. Explain how moving coil galvanometer is converted into a voltmeter.
10. How will you convert a moving coil galvanometer into an ammeter?
11. Describe how a potentiometer is used to compare the EMFs of two cells by combination method.
12. State any two sources of errors in meter bridge experiment. Explain how they can be minimized.
13. Describe how a potentiometer is used to compare the EMFs of two cells by connecting the cells individually.
14. State the uses of a potentiometer.
15. Write a short note on Galvanometer.
16. Explain thermocouple with the help of examples.

Magnetic Field Due to Electric Current

Marks without option: 4 | Marks with option: 6

1. **Define / Laws:**
   - Lorentz force
   - Biot-Savart's law
   - Ampere's law
2. What is a cyclotron accelerator? Explain construction and working of a cyclotron.
3. With the help of a neat labelled diagram, explain construction & working of MCG.
4. State and explain Ampere's circuital law.
5. Apply Biot-Savart's law to an infinitely long current-carrying conductor.
6. Obtain an expression for magnetic induction along the axis of a toroid on the basis of Ampere's circuital law.
7. Using Ampere's law, obtain an expression for magnetic field due to axis of an ideal long straight solenoid.
8. State Ampere's circuital law, obtain an expression for magnetic induction at any point due to a straight conductor carrying current.
9. Derive expression for force per unit length between two long current-carrying parallel wires separated by small distance.
10. Derive the relation for magnetic force acting on a straight wire carrying current.
11. Write expression of torque acting on rotating current-carrying coil in terms of its magnetic dipole moment.
12. Write a note on magnetic potential energy of a dipole.
13. Derive an expression for a magnetic field produced at the center of a current-carrying arc of wire. What will be the value of field if arc were a complete circle?

Magnetic Materials

Marks without option: 4 | Marks with option: 5

1. **Define with SI unit and formula:**
   - Magnetization
   - Magnetic intensity
   - Magnetic susceptibility
   - Magnetic permeability
   - Relative permeability
   - Gyromagnetic ratio
2. Obtain an expression for orbital magnetic moment of an electron rotating about nucleus in an atom.
3. Explain ferromagnetism on the basis of domain theory.
4. Distinguish between Diamagnetic, Paramagnetic, and Ferromagnetic substances.
5. Derive relation between magnetic field intensity (H) and magnetization (M).
6. Establish the relation between permeability and susceptibility of a substance.
7. Discuss Curie's law of paramagnetic material.
8. Explain behavior of ferromagnetic material with the help of Hysteresis Cycle (Coercivity and Retentivity).
9. What happens to a ferromagnetic material when its temperature increases above Curie temperature?
10. What is soft magnetic material and hard magnetic material?
11. Explain magnetic shielding and state its uses.
12. Derive an expression for the potential energy of a bar magnet placed in a uniform magnetic field.

Electromagnetic Induction

Marks without option: 5 | Marks with option: 7

1. **Define / Laws:**
   - Faraday's laws
   - Lenz's law
   - Eddy current
   - Self-inductance
   - Mutual inductance
2. Derive an expression for EMF (e) generated in a conductor of length (l) moving in uniform magnetic field (B) with uniform velocity (v) along X-axis.
3. Explain self-inductance and mutual inductance.
4. Derive an expression for energy density stored at any point in a magnetic field.
5. Explain coefficient of coupling between two circuits.
6. State principle of working of transformer. Explain construction & working of a transformer.
7. Distinguish between step-up & step-down transformer.
8. For a magnet-coil system, show that the peak induced EMF e_0 is directly proportional to angular amplitude and inversely proportional to time period (T).
9. Derive an expression for the total EMF induced in a conducting rotating rod.
10. Explain the working of an electric generator and also derive an expression for the induced EMF.
11. Show that the work done in pulling a loop through the magnetic field appears as heat energy in the loop.
12. Derive an expression for energy stored in a magnetic field in terms of induced current.

AC Circuits

Marks without option: 4 | Marks with option: 6

1. **Define:**
   - Inductive reactance
   - Capacitive reactance
   - Admittance
   - Impedance
   - Phasor Diagram
2. Show that in an AC circuit containing a pure inductor, the voltage is ahead of current by $\frac{\pi}{2}$ in phase.
3. Derive an expression for impedance of an LCR circuit connected to an AC power supply.
4. Obtain an expression for power consumed in an LCR series circuit.
5. What is a series LCR circuit? State conditions for series resonance. Obtain an expression for resonant frequency.
6. Distinguish between Resistance and Reactance.
7. With the help of diagram, write a note on sharpness of resonance (Q factor).
8. Assuming expression for impedance in a parallel resonant circuit, state the conditions for parallel resonance. Define resonant frequency and obtain an expression for it.
9. Explain the theory of an AC circuit with a resistor. Draw phasor diagram of voltage and current in the circuit.
10. An AC source generating a voltage $e=e_0 \sin(\omega t)$ is connected to a capacitor of capacitance C. Find the expression for the current I flowing through it. Plot a graph of e and I versus ωt.
11. Obtain an expression for average power dissipated in a purely resistive AC circuit.
12. Obtain an expression for average power dissipated in a purely capacitive AC circuit.

Dual Nature of Radiation & Matter

Marks without option: 4 | Marks with option: 6

1. **Define:**
    - Stopping potential
    - Photoelectric work function
    - Threshold frequency and wavelength
    - Photoelectric effect
2. With the help of circuit diagram, describe experimental study of photoelectric effect with any two characteristics of photoelectric effect.
3. Describe construction and working of photoelectric cell with the help of neat schematic diagram along with its applications.
4. On the basis of de Broglie hypothesis, obtain the relation for wavelength of an electron accelerated by potential difference V volts.
5. Describe Davisson and Germer Experiment.
6. What do you understand by the term wave-particle duality? Where does it apply?

Structure of Atom and Nuclei

Marks without option: 4 | Marks with option: 6

1. **Define:**
   - Excitation Energy
   - Binding Energy
   - Ionization Energy
   - Nuclear Binding Energy
   - Binding Energy per Nucleon
2. State the postulates of Bohr's theory of Hydrogen atom.
3. Derive an expression for total energy of electron in n^{th} orbit. Show that energy is inversely proportional to square of principal quantum number.
4. Obtain an expression for radius of Bohr orbit for H-atom.
5. Using expression for energy of electron, obtain Rydberg's formula for spectral lines of an atom.
6. Draw a neat, labelled energy level diagram for H-atom showing transitions.
7. State law of radioactive decay. Hence derive expression $N = N_0\, e^{-\lambda t}$.
8. Distinguish between Nuclear fission and Nuclear fusion.
9. What is mass defect? State its formula.
10. Draw a binding energy curve to show the variation of binding energy per nucleon with mass number. What inferences can be drawn from the B.E. curve?
11. Define radioactive decay. State types of radioactive decay.
12. Define half-life period. Derive expression for it.

Semiconductor Devices

Marks without option: 4 | Marks with option: 5

1. **Define:**
   - Ripple factor
   - Rectifier
   - Amplifier
   - Dark Resistance
2. Draw a neat diagram of full wave rectifier and explain its working with advantages.
3. Draw a neat diagram of half wave rectifier and explain its working.
4. Describe construction, working, advantages, disadvantages, and V-I characteristics of:
   - LED
   - Photodiode
   - Solar Cell
5. What is a Zener diode? How is it used as a voltage regulator? Explain with V-I characteristics.
6. Explain working of a transistor as an amplifier in detail with the help of a proper diagram.
7. What are $\propto$ and β parameters? Obtain a relation between them.
8. Write Boolean expression, truth table, and draw symbol of all logic gates:
   - NOT, OR, NOR, AND, NAND, and EX-OR Gate
9. Explain NPN and PNP transistor.
10. Describe the waveforms obtained in a rectifier using a block diagram.

HSC BOARD

IMPORTANT QUESTIONS

CHEMISTRY

HSC 2027

Chapter-wise Question Collection

For study and revision

12th Chemistry

Question Bank

1. Solid State

1. Define the terms — i) Unit cell
   ii) Isomorphism
2. Distinguish between crystalline solid and amorphous solid.
3. Classify the following solids — i) Diamond ii) NaCl iii) P_4 iv) HCl v) SO_2 vi) CO_2 vii) Ag
4. Calculate the number of atoms in a unit cell of — SCC, BCC & FCC.
5. Distinguish between schottky and Frenkel defect
6. Explain metal deficiency defect with example.
7. Explain — a) Substitutional impurity defect
   b) Interstitial impurity defect.
8. Explain Formation of tetrahedral and octahedral voids.
9. Write the consequences of Frenkel defect.
10. Derive the relationship between molar mass, density of the substance and unit cell edge length.
11. Write conditions for the formation of schottky defect.
12. Write names of seven crystal system.

2. Solutions

1. Define — i) Isotonic solution ii) Hypertonic soln
   iii) Hypotonic solution iv) Osmotic pressure.
   v) Boiling point vi) Semipermeable membrane
2. State and explain Henry's law.
3. Define cryoscopic constant. Derive the relation between elevation of boiling point and molar mass of solute.
4. Define Ebullioscopic constant. Derive the relation between freezing point depression and molar mass of solute.
5. Distinguish between ideal and nonideal solutions.
6. Define osmosis. Explain reverse osmosis.

7. State Raoult's law for a solution containing non volatile solute.
8. Derive the relationship between relative lowering of vapour pressure and molar mass of solute.
9. What is van't Hoff factor?
10. How is van't Hoff factor related to degree of ionization.
11. Derive an expression to calculate molar mass of nonvolatile solute by osmotic pressure measurement.

3. Ionic Equilibria

1. Define acids and bases according to —
   i) Bronsted-Lowry theory
   ii) Lewis acid base theory
2. Identify the Bronsted-Lowry conjugate acid-base pairs in the following reactions
   i) $CH_3COOH_{(aq)} + NH_{3(aq)} \rightleftharpoons NH_4^+{}_{(aq)} + CH_3COO^-_{(aq)}$
   ii) $CN^-_{(aq)} + H_2O_{(l)} \rightleftharpoons OH^-_{(aq)} + HCN_{(aq)}$
   iii) $HCl_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + Cl^-_{(aq)}$
3. Derive an expression of Ostwald's dilution law for weak acid/weak base.
4. Derive the relationship between pH and pOH
5. Define solubility product. Derive the relationship bet solubility and solubility product for PbI_2
6. What is basic buffer? Give Henderson Hasselbalch eqn. to calculate pOH of basic buffer solution.
7. Define buffer solution. Write applications of buffer solution.
8. What is hydrolysis of salt? Why an aqueous solution of NH_4Cl is acidic while that of HCOOK basic?
9. What is an acidic buffer solution? Give Henderson Hasselbalch equation to calculate pH of acidic buffer soln.
10. Write relation between ionic product and solubility product.
11. Write a note on common ion effect.
12. Define — i) Solubility ii) Molar solubility

4. Chemical Thermodynamics

1. Define — i) Intensive property ii) Extensive property iii) Enthalpy iv) Entropy
2. State first law of thermodynamics. Write its mathematical equation for isothermal process and adiabatic process.
3. Derive the relationship between ΔH and ΔU for gas phase reaction.
4. State and explain Hess's law of constant heat summation.
5. Derive an expression for maximum work obtainable during isothermal reversible expansion of an ideal gas.
6. State second law of thermodynamics in terms of entropy. Write its mathematic equation.
7. Obtain the relation between ΔG and ΔS_{total} Comment on spontaneity of the reaction.
8. What is standard enthalpy of combustion? Write the correct condition of spontaneity in terms of Gibb's energy.
9. Define — i) Enthalpy of fusion ii) Enthalpy of atomization.
10. Derive relation between Gibb's standard energy change of the reaction and equilibrium constant.
11. Write the sign convention of work done during expansion of gas.

5. Electrochemistry

1. State Kohlrausch law of independent migration of ions. Write application of Kohlrausch law.
2. What is cell constant? Write its unit.
3. Distinguish between electrolytic and galvanic cell.
4. How is a salt bridge prepared? What are the functions of salt bridge in galvanic cell?

5. Define reference electrode. Draw neat labelled diagram of standard hydrogen electrode (SHE)
6. sketch and explain the operation and working of dry cell (Leclanche cell)
7. Define electrochemical series. Write its applications.
8. Draw labelled diagram of H_2-O_2 fuel cell. Write two applications of fuel cell.
9. What is molar conductivity & write SI unit of molar conductivity.
10. Draw a neat and labelled diagram of lead storage battery.
11. Write the cell reactions during discharging of lead accumulator.
12. Write : notation of SHE.
13. Define — i) Electrode potential ii) Molar conductivity iii) Conductivity.

6. Chemical kinetics

1. Define elementary reaction.
2. Distinguish between molecularity and order of the reaction.
3. Define instantaneous rate of reaction.
4. Derive integrated rate law for first order reaction.
5. Define half life of first order reaction. Obtain the expression for half life and rate constant of the first order reaction.
6. What is Pseudo first order reaction explain with suitable example.
7. Derive integrated rate law for zero order reacn
8. Write Arrhenius equation. Derive an expression to determine activation energy for two different temperatures T_1 and T_2
9. What is the rate determining step.
10. How will you represent first order reactions graphically.

7. Elements of Group 16, 17 and 18

1. Explain the trends in the following atomic properties of group 16 elements.
   i) Atomic radii ii) Ionisation enthalpy
   iii) Electronegativity iv) Electron gain enthalpy
2. What is charring? What is the action of conc^{n}. H_2SO_4 on — i) CaF_2 ii) Canesugar
   iii) HBr iv) HI
3. What is the action of chlorine on the following
   i) NH_3 (excess) ii) Phosphorous
   Write uses of chlorine.
4. What happens when
   i) Ethene reacts with iodine monochloride.
   ii) Sulphur dioxide is oxidised inpresence of V_2O_5
   iii) Moist SO_2 reacts with $KMnO_4$
5. What are interhalogen compounds? Write two uses of Argon.
6. Write chemical composition of —
   i) Cryolite ii) Gypsum salt iii) Fluorapatite.
7. Give reason — Group 16th elements have lower ionization enthalpy compared to group 15th elements.
8. Draw structures of following compounds —
   a) Chlorous acid b) Chloric acid c) perchloric acid.
9. Write structural formula of
   a) Peroxy monosulphuric acid b) Thiosulphuric acid
   c) Peroxysulphuric acid.
10. Explain anomalous behaviour of oxygen in group 16
11. Give reason for anomalous behaviour of fluorine.
12. Arrange the following in the increasing order of the property mentioned.
    i) HOCl, $HClO_2$, $HClO_3$, $HClO_4$ (acidic strength)
    ii) HF, HCl, HBr, HI (bond dissociation enthalpy)
    iii) H_2S, H_2Te, H_2Se (reducing property)
13. Distinguish between rhombic sulfur and monoclinic sulfur.

14. How are XeO_3 and $XeOF_4$ prepared ?

8. Transition and Inner transition elements

1. Define — i) Hydrometallurgy ii) Electrometallurgy iii) Gangue. iv) Ore
2. Write factors related to colour of transition metal ion.
3. Write preparation of $KMnO_4$ from MnO_2. Write any two uses of $KMnO_4$.
4. Explain preparation of $K_2Cr_2O_7$ from chromite ore.
5. Write chemical formula of following ore —
   i) Haematite ii) Chalcopyrites
   iii) Chalcocite iv) Zinc blende.
6. What is the action of $K_2Cr_2O_7$ on
   i) KI ii) H_2S
7. What is lanthanoid contraction. & Give electronic configuration of Gd (Z = 64)
8. Distinguish between lanthanides and actinides.
9. Calculate spin only magnetic moment of divalent cation of transition metal with atomic number 24.
10. Why is Sc^{3+} colourless while Ti^{3+} coloured.
11. Write the reaction in the zone of combustion in blast furnace during extraction of iron.
12. Mention the names of various steps involved in the extraction of pure metals from their ores.
13. Write balanced chemical eqn.
    i) When acidified $K_2Cr_2O_7$ reacts with H_2S
    ii) When acidified $K_2Cr_2O_7$ reacts with KI

14. What is the action of $KMnO_4$ on
i) Fe^{2+} ii) Oxalic acid iii) Thiosulphate ion.

9. Coordination Compounds

1. Define ligand. Explain types of ligands with example.
2. Write postulates of Werner theory of coordination complexes.
3. What is effective atomic number (EAN)? Calculate EAN of the central metal ion atom in following compound — i) $K_4[Fe(CN)_6]$, Fe (Z=26) ii) $Cr(CO)_6$, Cr (Z=24) iii) $[Co(NH_3)_6]^{3+}$, Co (Z=27) iv) $[Zn(NH_3)_4]SO_4$, Zn (Z=30)
4. Illustrate with example, the difference between a double salt and a co-ordination compound.
5. Explain cationic, anionic and neutral sphere complexes with example.
6. Explain formation of $[CoF_6]^{3-}$ complex with respect to — i) Hybridisation ii) Magnetic properties iii) Inner / outer complex iv) Geometry.
7. Explain Formation of $[NiCl_4]^{2-}$ complex on the basis of VBT
8. Explain ionisation isomers & coordination isomers with suitable example.
9. Write IUPAC name of following complexes -
i) $Na_3[Co(NO_2)_6]$ ii) $[Fe(H_2O)(CNCS)]^{2+}$
iii) $[Fe(CN)_6]^{4-}$ iv) $[Co(NO_2)_3(NH_3)_3]$
10. Explain types of coordination complexes classified on the bases of types of ligands.
11. Explain any two applications of coordination compounds.
12. Draw cis-trans isomers in each of the following
i) $Pt(NH_3)_2ClNO_2$ ii) $Ru(NH_3)_4Cl_2$
iii) $[Pt(en)_3]^{4+}$ iv) $[Pt(en)_2ClBr]^{2+}$

10. Halogen Derivatives

1. Define — i) Chiral carbon atom ii) optical activity iii) Racemic mixture iv) Enantiomers.
2. Explain S_N2 reaction mechanism for alkaline hydrolysis of bromomethane.
3. Explain optical activity of 2-chlorobutane.
4. What is Grignards reagent? How it is prepared?
5. Write four salient features of S_N1 mechanism.
6. Explain — i) Finkelstein reaction
   ii) Swartz reaction
7. What is the action of following on ethyl bromide?
   a) alc. AgCN b) sodium methoxide c) alc. NH_3
   d) potassium nitrite.
8. Write the chemical reactions for the following
   a) Chlorobenzene is heated with fuming H_2SO_4
   b) Ethyl bromide is heated with silver acetate.
   c) Chlorobenzene is reacts with methyl chloride
   d) Chlorobenzene to biphenyl
9. Write the use and environmental effect of
   — i) DDT ii) Freons iii) Chloroform
10. Explain Wurtz-fittig reaction
11. Explain dehydrohalogenation of 2-chlorobutane.
12. Give reason — alkyl halides ..... are more reactive than aryl halides.

11. Alcohols, Phenols and Ethers

1. What happens when vapours of 1° and 2° alcohols are passed over hot Cu metal?
2. Write chemical reactions for the following conversion — i) Acetic acid into ethyl alcohol
   ii) Ethyl alcohol into ethyl acetate
   iii) Diethyl ether into ethyl chloride.
   iv) Phenol into benzene.
3. Write a preparation of phenol from cumene.
4. Write a note on ~~Kolbe~~ Reimer-Tiemann Reaction.

5. Write chemical reactions of the following reagents on carbolic acid —
i) Br_2 water ii) conc^n HNO_3

6. Write chemical reactions of following reagents on methoxymethane —
i) HOt HI ii) PCl_5 iii) dil. H_2SO_4

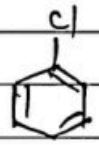
7. Write the preparation of phenol from aniline. Give two uses of ethanol.

8. Prepare the following by using methyl magnesium iodide —
i) Ethanal ii) Propan-2-ol iii) 2-Methylpropan-2-ol

9. Write chemical reaction of following reagent on anisole — i) HI ii) CH_3COCl iii) conc^n HNO_3

10. Identify A, B and C in following chain reaction and rewrite the chemical reactions.

i) $CH_3\text{-}CHO \xrightarrow{H_2/Ni} A \xrightarrow{\text{conc. } H_2SO_4} B$

ii)  $\xrightarrow[623\,K,\ 10\ atm]{NaOH} A \xrightarrow{H_3O^+} B \xrightarrow[dust]{Zn} C$

iii) $CH_3\text{-}CH_2\text{-}OH \xrightarrow[Br_2]{\text{red 'P'}} A \xrightarrow[alc.]{KCN} B \xrightarrow[Ether]{LiAlH_4} C$

11. Write chemical reaction for preparat^n of phenol form benzene sulphonic acid.

12 What is the action of following reagent of phenol
i) H_2/Ni ii) Zn iii) $Na_2Cr_2O_7 / H_2SO_4$

13. Write note on kolbe reac^n.

12. Aldehydes, Ketones and Carboxylic Acids

1. What is the action of the following reagents on propanone ?
a) Phenyl hydrazine b) Zn-Hg/conc. HCl c) sodium bisulphite d) semicarbazide.

2. Write a note on self oxidation-reduction reaction of aldehyde with suitable example. (Cannizaro reac^n)

3. Write chemical equation for the following —
   i) Gattermann - Koch formylation.
   ii) Rosenmund reduction.
   iii) Esterification.

4. What is the action of following reagents on ethanoic acid ?
   a) $LiAlH_4 / H_3O^+$ b) PCl_3, heat c) P_2O_5, heat.
   d) $SOCl_2$

5. Explain Aldol condensation.

6. Write a note on Haloform reaction

7. Write IUPAC name of — i) α-methylpropionic acid
   ii) isobutyraldehyde iii) Adipic acid.

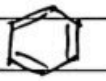
8. Explain Wolf-Kishner reduction reaction.

9. Convert the following —
   i) Acetic acid to Acetamide.
   ii) Acetyl chloride to acetic anhydride
   iii) Sodium acetate to methane.

10. Write preparation of acetic acid from
    i) Dry ice ii) Acetyl chloride.

11. Write a note on Rosenmund reduction.

12. Identify 'A' & 'B' in the following reaction.

i)  $+ CH_3COCl \xrightarrow[-HCl]{AlCl_3} A \xrightarrow[\text{conc. HCl}]{Zn\cdot Hg} B + H_2O$

ii) $C_6H_5MgBr + CO_2 \xrightarrow[\text{ether}]{\text{dry}} A \xrightarrow{PCl_5} B$
H^+/H_2O

iii) $2\ CH_3-\overset{CH_3}{\underset{|}{C}}=O \xrightarrow{Ba(OH)_2} A \xrightarrow{\Delta} B + H_2O$

13. How is benzophenone prepared from benzonitrile

14. Explain the following tests of aldehydes —
    i) Tollen's test ii) Fehling test.

15. How will convert cyclohexene to adipic acid.

16. Write a note on Stephen reaction.

13. Amines

1. Explain Hoffmann bromamide degradation reaction.
2. Write a note on Gabriel phthalimide synthesis.
3. What is the action of benzene diazonium chloride on
   i) phenol in alkaline medium
   ii) Aniline.
4. What is the action of benzene sulphonyl chloride on ethylamine and diethylamine.
5. Write the formula of Hinsberg's reagent.
6. Write a short note on Hoffmann elimination.
7. Write reactions to prepare ethanamine from
   i) Acetonitrile ii) Nitroethane iii) Propionamide.
8. Write chemical reaction for carbylamine test.
9. Complete the following reaction and identify A and B

   i) Isopropyl alcohol $\xrightarrow{PBr_3}$ A $\xrightarrow[excess]{NH_3}$ B

   ii) $C_2H_5-\overset{+}{N}(CH_3)_3I^- \xrightarrow[\Delta]{Ag_2O/H_2O}$ A $\xrightarrow{H^+}$ B + $(CH_3)_3N$ + H_2O

10. Write the name of the product formed by the action of $LiAlH_4$ / ether on acetamide.
11. What is the action of the following reagent on ethyl amine — i) chloroform and caustic potash
    ii) Nitrous acid.
12. Explain basic nature of amines.
    Write IUPAC name of
    i) Benzylamine ii) Diphenylamine.
13. Write balanced chemical reaction of following —
    i) Bromine water reacts with aniline.
    ii) Benzene sulphonyl chloride reacts with ethyl amine & diethylamine.
    iii) Conc^n. sulfuric acid reacts with aniline.
14. Complete the following reac^{ns}

    i) $C_6H_5-\overset{+}{N}_2Cl^- \xrightarrow{CuCl/HCl}$?

    ii) $C_6H_5\overset{+}{N}_2Cl^- \xrightarrow{H_3PO_2}$?

    iii) $C_6H_5\overset{+}{N}_2Cl^- \xrightarrow{KI}$?

14. Biomolecules

1. Distinguish between globular and fibrous proteins
2. Draw a neat diagram for the zwitter ion.
3. What are carbohydrates ? How is glucose prepared from sucrose ?
4. Define — Oligosaccharides. Write the name of monosaccharides obtain on hydrolysis of
   i) Maltose ii) Lactose iii) Raffinose iv) Stachyose.
5. What is the action of following reagent on glucose —
   i) HI, heat ii) Br_2 water iii) dil. HNO_3
   iv) acetic anhydride.
6. Explain formation of peptide linkage in protein with an example.
7. What is denaturation of protein ?
8. Draw the Haworth projection formula of α-D (+)-glucose.
9. Draw structure of Thymine ~~and~~, Adenine, Cytosine.
10. How are nucleotide formed ? Draw structure of nucleotide.
11. State industrial application of enzyme catalysis.
12. Give reason — Hydrolysis of sucrose is called inversion.
13. Draw — i) Haworth formula of maltose
    ii) Haworth formula of lactose.

15. Introduction To polymer chemistry

1. Define — i) Elastomer ii) Vulcanization.
2. Write the chemical reaction for the preparation of — i) Nylon-6 ii) Teflon iii) Nylon-6,6
   iv) Terylene.
3. Write chemical composition of Ziegler-Natta catalyst.

4. What are biodegradable polymers and non-biodegradable polymers? Write one example of each.
5. What are elastomers? Distinguish between thermoplastic polymers and thermosetting polymers.
6. Define — i) Condensation polymer ii) Homopolymer.
7. Write the structure and name of monomer of — i) Natural rubber ii) Teflon iii) Orlon
8. Write classification of polymers on the basis of structure.

16. Green Chemistry And Nanochemistry

1. Define — i) Nanochemistry ii) Nanotechnology iii) Greenchemistry. iv) Nanoscience.
2. Explain three principles of green chemistry.
3. Write two advantages of nanoparticle and nanotechnology.
4. What information are obtained about nanomaterials using XRD and FTIR?
5. Name two compounds used in photocatalysis.
6. Write the name of nano structured materials used in car tyres to increase the life of tyres.
7. Write one example of zero, one and two dimensional nanostructures.
8. Describe any two characteristic features of nanoparticles.

HSC BOARD

IMPORTANT QUESTIONS

MATHEMATICS

HSC 2027

Chapter-wise Question Collection

For study and revision

IMPORTANT THEOREMS

TRIGONOMETRIC FUNCTIONS

Theorem 1) The Sine Rule :

In ΔABC, $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = 2R$ where R is the circumradius of ΔABC.

- sine rule can be used in different forms.
  - i] $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c} = K$
  - ii] $\sin A = ak$, $\sin B = bk$, $\sin C = ck$

Theorem 2) The Cosine Rule :

In ΔABC,

i] $a^2 = b^2 + c^2 - 2bc \cos A$

ii] $b^2 = c^2 + a^2 - 2ac \cos B$

iii] $c^2 = a^2 + b^2 - 2ab \cos C$

Theorem 3) The Projection Rule :

In ΔABC,

i] $a = b\cos C + c\cos B$

ii] $b = c\cos A + a\cos C$

iii] $c = a\cos B + b\cos A$

Theorem 4) Half angle formula :

In ΔABC, if $2s = a+b+c$ then

i] $\sin\frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{bc}}$

ii] $\cos\frac{A}{2} = \sqrt{\frac{s(s-a)}{bc}}$

iii] $\tan\frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}}$

Theorem 5) Napier's Analogy (tangent law) :-

In ΔABC,

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

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

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

Theorem 6) Using the sine rule, prove the cosine rule.

PAIR OF STRAIGHT LINES

Theorem 1) Prove that every homogeneous equation of second degree in x and y, i.e. $ax^2+2hxy+by^2=0$ represents a pair of lines through the origin, if $h^2-ab \geq 0$.

Theorem 2) If θ is the acute angle between the lines given by $ax^2+2hxy+by^2=0$, then prove that

$$\tan\theta = \left|\frac{2\sqrt{h^2-ab}}{a+b}\right|, \quad \text{if } a+b \neq 0.$$

VECTORS

Theorem 1) If $\bar{a}$ and $\bar{b}$ any two non-zero, non-collinear vectors lying in the same plane, then prove that any vector $\bar{r}$ is coplanar with them if and only if there exist unique scalars t_1, t_2 such that $\bar{r} = t_1\bar{a} + t_2\bar{b}$.

Theorem 2) Three non-zero vectors $\bar{a}, \bar{b}, \bar{c}$ are coplanar if and only if there exist scalars x, y, z not all zero simultaneously such that $x\bar{a} + y\bar{b} + z\bar{c} = \bar{0}$.

Theorem 3) If $\bar{a}, \bar{b}, \bar{r}$ are position vectors of the points A, B and R respectively and R divides the line segment AB externally in the ratio m:n, then prove that,

$$\bar{r} = \frac{m\bar{b} - n\bar{a}}{m-n}$$ (Section formula for external division)

Theorem 4) Section formula for Internal division :

$$\bar{r} = \frac{m\bar{b} + n\bar{a}}{m+n}$$

Theorem 5) If l, m, n are the direction cosines of a line, then $l^2 + m^2 + n^2 = 1$

DIFFERENTIATION

Theorem 1) If $y = f(u)$ is a differentiable function of u and $u = g(x)$ is a differentiable function of x, then y is a differentiable function of x and $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$

Theorem 2) Suppose $y = f(x)$ is differentiable function of x and y is one-one onto, $\frac{dy}{dx} \neq 0$. Also, if $x = f^{-1}(y)$ is differentiable then $\frac{d}{dy}[f^{-1}(y)] = \frac{1}{f'(x)}$ or $\frac{dx}{dy} = \frac{1}{(dy/dx)}$, where $\frac{dy}{dx} \neq 0$.

Theorem 3) If $x = f(t)$ & $y = g(t)$ are differentiable functions of t, then $\frac{dy}{dx} = \frac{dy/dt}{dx/dt}$, if $\frac{dx}{dt} \neq 0$.

INDEFINITE INTEGRATION

Theorem 1) If $x = \phi(t)$ is a differentiable function of t, then $\int f(x) \cdot dx = \int f[\phi(t)] \cdot \phi'(t) \cdot dt$.

Theorem 2) Prove that : $\int \frac{1}{x^2+a^2} dx = \frac{1}{a} \tan^{-1}\left(\frac{x}{a}\right) + c$

Theorem 3) Prove that : $\int \frac{1}{x^2-a^2} \cdot dx = \frac{1}{2a} \log\left|\frac{x-a}{x+a}\right| + c$

Theorem 4) Prove that : $\int \frac{1}{a^2-x^2} dx = \frac{1}{2a} \log\left|\frac{a+x}{a-x}\right| + c$

Theorem 5) Prove that : $\int \frac{1}{\sqrt{a^2-x^2}} \cdot dx = \sin^{-1}\left(\frac{x}{a}\right) + c$

Theorem 6) Prove that : $\int \frac{1}{\sqrt{x^2-a^2}} \cdot dx = \log\left|x+\sqrt{x^2-a^2}\right| + c$

Theorem 7) Prove that : $\int \frac{1}{\sqrt{a^2+x^2}} \cdot dx = \log\left|x+\sqrt{a^2+x^2}\right| + c$

Theorem 8) Prove that : $\int \frac{1}{x\sqrt{x^2-a^2}} = \frac{1}{a} \sec^{-1}\left(\frac{x}{a}\right) + c$

Theorem 9) If u and v are functions of x, then $\int u \cdot v \cdot dx = u\int v \cdot dx - \int\left(\frac{du}{dx} \cdot \int v \cdot dx\right) \cdot dx$

Theorem 10) $$\int \sqrt{a^2-x^2}\,dx = \frac{x}{2}\sqrt{a^2-x^2} + \frac{a^2}{2}\sin^{-1}\left(\frac{x}{a}\right) + c$$

Theorem 11) $$\int \sqrt{x^2+a^2}\,dx = \frac{x}{2}\sqrt{x^2+a^2} + \frac{a^2}{2}\log\left|x+\sqrt{x^2+a^2}\right| + c$$

Theorem 12) $$\int \sqrt{x^2-a^2}\,dx = \frac{x}{2}\sqrt{x^2-a^2} - \frac{a^2}{2}\log\left|x+\sqrt{x^2-a^2}\right| + c$$

Theorem 13) If $f(x)$ is derivable function of x, then
$$\int e^x [f(x) + f'(x)]\,dx = e^x f(x) + c$$

DEFINITE INTEGRATION

Theorem 1) $$\int_0^a f(x)\,dx = \int_0^a f(a-x)\,dx$$

Theorem 2) $$\int_a^b f(x)\,dx = \int_a^b f(a+b-x)\,dx$$

Theorem 3) $$\int_0^{2a} f(x)\,dx = \int_0^a f(x) + f(2a-x)\,dx$$

Theorem 4) $$\int_{-a}^{a} f(x)\,dx = 2\int_0^a f(x)\,dx$$ If f is an even function.

$$= 0$$ If f is an odd function.

MATHEMATICAL LOGIC

Que 1) Write the following compound statements symbolically without examining the truth value.

i] Nagpur is in Maharashtra and Chennai is in Tamilnadu.

ii] If ΔABC is right angled at B then $m\angle A + m\angle C = 90°$.

Que 2) If the statement p and q are true statements and r, s are false statements then determine the truth values of the following.

i] $(p \to q) \vee (r \to s)$

ii] $[\sim p \wedge (\sim q \wedge r)] \vee [(q \wedge r) \vee (p \wedge r)]$

iii] $[(\sim p \wedge q) \wedge \sim r] \vee [(q \to p) \to (\sim s \vee r)]$

Que 3) Construct the truth table for each of the following statement patterns.

i] $(\sim p \to \sim q) \wedge (\sim q \to \sim p)$

ii] $[p \to (q \to r)] \leftrightarrow [(p \wedge q) \to r]$

iii] $(p \vee \sim q) \to (r \wedge p)$

Que 4) Using truth table, prove the following logical equivalences.

i] $p \leftrightarrow q \equiv \sim[(p \vee q) \wedge \sim(p \wedge q)]$

ii] $(p \vee q) \to r \equiv (p \to r) \wedge (q \to r)$

iii] $[p \wedge (q \vee r)] \equiv (p \wedge q) \vee (p \wedge r)$

Que 5) Examine whether each of the following statement pattern is a tautology or a contradiction or a contigency.

i] $(p \to q) \leftrightarrow (\sim p \vee q)$

ii) $(p \wedge \sim q) \leftrightarrow (p \rightarrow q)$

iii) $(\sim p \rightarrow q) \wedge (p \wedge r)$

Que 6) Write the duals of each of following.

i) $p \wedge \sim q$

ii) $[\sim(p \vee q)] \wedge [p \vee \sim(q \wedge \sim s)]$

iii) $c \vee \{p \wedge (q \vee r)\}$

Que 7) Write the negations of the following.

i) $11 < 15$ and $25 > 20$

ii) Quadrilateral is a square if and only if it is a rhombus.

iii) $\forall\, n \in N$, $n^2 + n + 2$ is divisible by 4.

iv) $\exists\, x \in N$ such that $x - 17 < 20$.

Que 8) Write converse, inverse and contrapositive of the following statements.

i) If $x < y$ then $x^2 < y^2$ $(x, y \in R)$

ii) If Surface area decreases then pressure increases.

iii) If Voltage increases then Current decreases.

Que 9) Using rules of negation, write the negations of the following with justification.

i) $(p \vee \sim q) \wedge r$

ii) $\sim(p \wedge q) \vee (p \vee \sim q)$

iii) $(p \vee \sim q) \rightarrow (p \wedge \sim q)$

Que 10) Without using truth table prove that :

i) $p \leftrightarrow q \equiv (p \wedge q) \vee (\sim p \wedge \sim q)$

ii) $(p \wedge q) \vee (\sim p \wedge q) \vee (p \wedge \sim q) \equiv p \vee q$

iii) $\sim[(p \vee \sim q) \rightarrow (p \wedge \sim q)] \equiv (p \vee \sim q) \wedge (\sim p \vee q)$

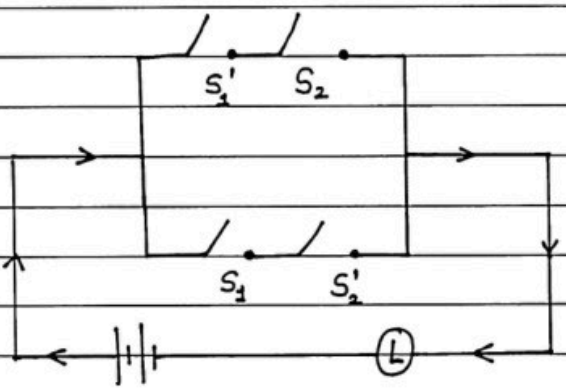
Que 11) Using rules in logic, prove the following.

i] $p \leftrightarrow q \equiv \sim(p \wedge \sim q) \vee \sim(q \wedge \sim p)$ Corrected as $p \leftrightarrow q \equiv \sim(p \wedge \sim q) \wedge \sim(q \wedge \sim p)$

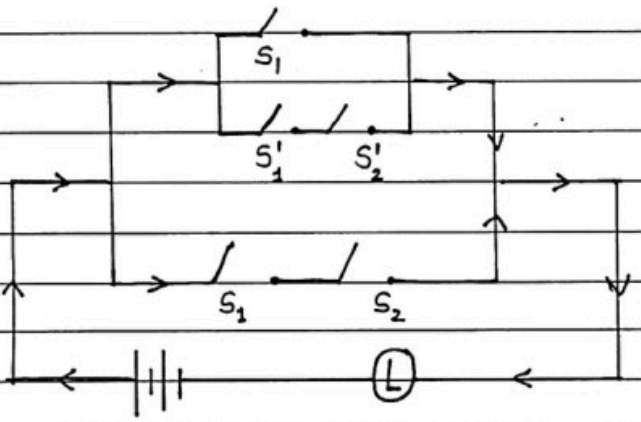
ii] $\sim(p \vee q) \vee (\sim p \wedge q) \equiv \sim p$

Que 12) Express the following circuits in the symbolic form of logic and write the input-output table.

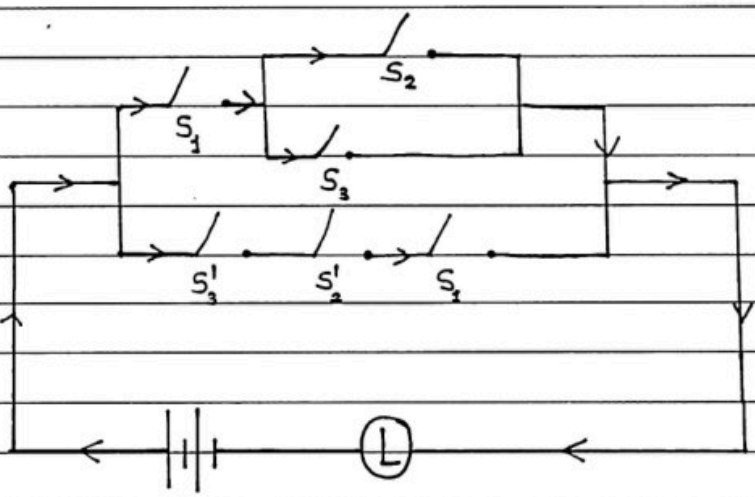
i]



ii]



Que 13) Give an alternative equivalent simple circuits for the following circuits, so that the new circuit has minimum switches.

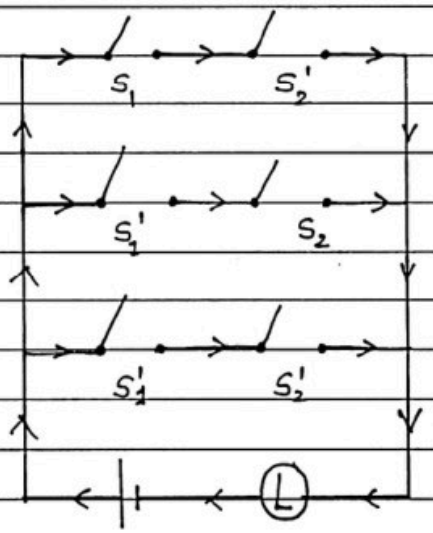


Que 14) Obtain the simple logical expression of the following. Draw the corresponding switching circuit.

i) $(\sim p \wedge q) \vee (\sim p \wedge \sim q) \vee (p \wedge \sim q)$

ii) $[p \vee (\sim q) \vee (\sim r)] \wedge [p \vee (q \wedge r)]$

Que 15) Give an alternative arrangement for the following circuit so that new circuit has minimum switches.



MATRICES

Que 1) Transform $\begin{bmatrix} 1 & -1 & 2 \\ 2 & 1 & 3 \\ 3 & 2 & 4 \end{bmatrix}$ into an upper triangular matrix by suitable row transformations.

Que 2) Find the matrix of cofactors for the following matrices :

$$\begin{bmatrix} 1 & 0 & 2 \\ -2 & 1 & 3 \\ 0 & 3 & -5 \end{bmatrix}$$

Que 3) If $A = \begin{bmatrix} 1 & -1 & 2 \\ 3 & 0 & -2 \\ 1 & 0 & 3 \end{bmatrix}$ verify that $A(\text{adj}A) = (\text{adj}\,A)\,A = |A| \cdot I$.

Que 4) Check whether the following matrices are invertible or not :

i] $\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$ ii] $\begin{bmatrix} 3 & 4 & 3 \\ 1 & 1 & 0 \\ 1 & 4 & 5 \end{bmatrix}$

Que 5) If $A = \begin{bmatrix} x & 0 & 0 \\ 0 & y & 0 \\ 0 & 0 & z \end{bmatrix}$ is a non-singular matrix, then find A^{-1} by using elementary row transformations. Hence, find the inverse of $\begin{bmatrix} 2 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$

Que 6) Find the inverse of $A = \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$ by

i] elementary row transformation
ii] elementary column transformation.

Que 7) Find the matrix X such that $AX = B$, where $A = \begin{bmatrix} 1 & 2 \\ -1 & 3 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & 1 \\ 2 & 4 \end{bmatrix}$

Que 8) Find X, if $AX = B$ where $A = \begin{bmatrix} 1 & 2 & 3 \\ -1 & 1 & 2 \\ 1 & 2 & 4 \end{bmatrix}$ and

$B = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$

Que 9) Find the inverse of $\begin{bmatrix} 1 & 2 & 3 \\ 1 & 1 & 5 \\ 2 & 4 & 7 \end{bmatrix}$ by the adjoint method.

Que 10) Find A^{-1} by adjoint method and by elementary transformations, if $A = \begin{bmatrix} 1 & 2 & 3 \\ -1 & 1 & 2 \\ 1 & 2 & 4 \end{bmatrix}$

Que 11) Find the inverse of matrix A by elementary row transformations, where $A = \begin{bmatrix} 2 & -3 \\ -1 & 2 \end{bmatrix}$

Que 12) If $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -2 \\ 1 & -1 & 2 \end{bmatrix}$ then find A^{-1} by Adjoint method.

Que 13) If $A = \begin{bmatrix} 2 & 1 & 3 \\ 1 & 0 & 1 \\ 1 & 1 & 1 \end{bmatrix}$, then reduce it to I_3 by using row or column transformations.

TRIGONOMETRIC FUNCTIONS

Que 1) Find the principal solutions of the following equations:

i] $\cos\theta = \frac{1}{2}$ ii] $\cot\theta = \sqrt{3}$

iii] $\tan\theta = -1$ iv] $\sqrt{3}\operatorname{cosec}\theta + 2 = 0$

Que 2) Find the general solutions of the following equations:

i] $\cos\theta = \frac{\sqrt{3}}{2}$ ii] $\tan\theta = \frac{1}{\sqrt{3}}$ iii] $\operatorname{cosec}\theta = -\sqrt{2}$

iv] $\cot 4\theta = -1$ v] $4\cos^2\theta = 3$ vi] $\cos 4\theta = \cos 2\theta$

vii] $\cos\theta + \sin\theta = 1$

Que 3) Find the general solution of $4\sin x \cdot \cos x + 2\sin x + 2\cos x + 1 = 0$

Que 4) Find the general solution of $\sin 2x + \sin 4x + \sin 6x = 0$

Que 5) Find the general solution of $\cot x + \tan x = 2\operatorname{cosec} x$.

Que 6) Find the cartesian coordinates of the points whose polar coordinates are

i] $\left(\sqrt{2}, \frac{\pi}{4}\right)$ ii] $\left(\frac{3}{4}, \frac{3\pi}{4}\right)$

Que 7) Find the polar coordinates of the points whose cartesian coordinates are

i] $\left(0, \frac{1}{2}\right)$ ii] $\left(1, -\sqrt{3}\right)$

Que 8) In ΔABC, prove that

$$\sin\left(\frac{B-C}{2}\right) = \left(\frac{b-c}{a}\right)\cos\frac{A}{2}$$

Que	9)	With the usual notations, prove that $2\left\{a\sin^2\frac{C}{2} + c\sin^2\frac{A}{2}\right\} = a-b+c$.
Que	10)	In ΔABC if $\cot A, \cot B, \cot C$ are in A.P., then show that a^2, b^2, c^2 are also in A.P.
Que	11)	In ΔABC if $a\cos A = b\cos B$, then prove that the triangle is either a right-angled or an isosceles triangle.
Que	12)	Find the principle values of the following :
		i] $\tan^{-1}(-\sqrt{3})$ ii] $\cos^{-1}\left(\frac{-1}{2}\right)$
Que	13)	Evaluate the following :
		i] $\tan^{-1}(1) + \cos^{-1}\left(\frac{1}{2}\right) + \sin^{-1}\left(\frac{1}{2}\right)$
		ii] $\operatorname{cosec}^{-1}(-\sqrt{2}) + \cot^{-1}(\sqrt{3})$.
Que	14)	Prove the following.
		i] $\sin^{-1}\left(\frac{1}{\sqrt{2}}\right) - 3\sin^{-1}\left(\frac{\sqrt{3}}{2}\right) = \frac{-3\pi}{4}$
		ii] $\sin^{-1}\left(\frac{-1}{2}\right) + \cos^{-1}\left(\frac{-\sqrt{3}}{2}\right) = \cos^{-1}\left(\frac{-1}{2}\right)$
		iii] $\sin^{-1}\left(\frac{3}{5}\right) + \cos^{-1}\left(\frac{12}{13}\right) = \sin^{-1}\left(\frac{56}{65}\right)$
		iv] $\cos^{-1}\left(\frac{3}{5}\right) + \cos^{-1}\left(\frac{4}{5}\right) = \frac{\pi}{2}$

v] $\tan^{-1}\left(\frac{1}{2}\right) + \tan^{-1}\left(\frac{1}{3}\right) = \frac{\pi}{4}$

Que 15) In ΔABC, prove that $\cos\left(\frac{A-B}{2}\right) = \left(\frac{a+b}{c}\right)\sin\frac{C}{2}$

Que 16) In ΔABC, if $\cos A = \sin B - \cos C$, then show that it is a right-angled triangle.

Que 17) In any ΔABC, prove the following :

i] $\frac{c - b\cos A}{b - c\cos A} = \frac{\cos B}{\cos C}$

ii] $\frac{\cos A}{a} + \frac{\cos B}{b} + \frac{\cos C}{c} = \frac{a^2+b^2+c^2}{2abc}$

Que 18) In ΔABC, if $\sin 2A + \sin 2B = \sin 2C$, then show that the triangle is a right angled triangle.

Que 19) Show that
$\tan^{-1}\left(\frac{1}{5}\right) + \tan^{-1}\left(\frac{1}{7}\right) + \tan^{-1}\left(\frac{1}{3}\right) + \tan^{-1}\left(\frac{1}{8}\right) = \frac{\pi}{4}$

Que 20) If $\sin\left(\sin^{-1}\frac{1}{5} + \cos^{-1}x\right) = 1$, then find the value of x.

Que 21) If $2\tan^{-1}(\cos x) = \tan^{-1}(2\operatorname{cosec} x)$, then find the value of x.

Que 22) If $\tan^{-1}2x + \tan^{-1}3x = \frac{\pi}{4}$, then find the value of x.

Que 23) Show that $\cos^{-1}\frac{\sqrt{3}}{2} + 2\sin^{-1}\frac{\sqrt{3}}{2} = \frac{5\pi}{6}$

Que 24) If $\tan^{-1}x + \tan^{-1}y + \tan^{-1}z = \frac{\pi}{2}$, then show that

$xy + yz + zx = 1$

Pair of Straight Lines

Que 1) Find the combined equation of the following pair of lines :

i] $2x+y=0$ and $3x-y=0$

ii] passing through $(-1, 2)$, one is parallel to $x+3y-1=0$ and other is perpendicular to $2x-3y-1=0$

Que 2) Find the separate equations of the lines represented by the following equations :

i] $3y^2+7xy=0$ ii] $x^2-4xy=0$

iii] $3x^2-10xy-8y^2=0$

Que 3) Find the combined equation of the pair of lines passing through the origin and perpendicular to the lines represented by following equations :

i] $5x^2-8xy+3y^2=0$

ii] $xy+y^2=0$

iii] $3x^2-4xy=0$

Que 4) Find k, if

i] the sum of the slopes of the lines represented by $x^2+kxy-3y^2=0$ is twice their product.

ii] the slopes of the lines represented by $3x^2+kxy-y^2=0$ differ by 4.

iii] the slopes of one of the lines given by, $kx^2+4xy-y^2=0$ exceeds the slope of the other by 8.

Que 5) If the angle between the lines represented by $ax^2+2hxy+by^2=0$ is equal to the angle between the lines $2x^2-5xy+3y^2=0$ then show that $100(h^2-ab)=(a+b)^2$

Que	c)	Find the condition that
		i) the line $4x+5y=0$ coincides, with one of the lines given by $ax^2+2hxy+by^2=0$
		ii) the line $3x+y=0$ may be perpendicular to one of the lines given by $ax^2+2hxy+by^2=0$
Que	7)	Find the combined equation of the pair of lines through the origin and making an equilateral triangle with the line $y=3$.
Que	8)	If the slope of one of the lines given by $ax^2+2hxy+by^2=0$ is four times the other, show that $16h^2=25ab$.
Que	9)	Show that the equations $2x^2-xy-3y^2-6x+19y-20=0$ represents a pair of lines.
Que	10)	Show that the equation $2x^2+xy-y^2+x+4y-3=0$ represents a pair of lines. Also, find the acute angle between them.
Que	11)	Find the value of k, if the following equations represent a pair of lines: $kxy+10x+6y+4=0$
Que	12)	Find p and q, if the equation $px^2-8xy+3y^2+14x+2y+q=0$ represents a pair of perpendicular lines.
Que	13)	Find p and q, if the equation $2x^2+8xy+py^2+qx+2y-15=0$ represent a pair of parallel lines.

Que	14)	Show that the lines represented by $3x^2-4xy-3y^2=0$ are perpendicular to each other.
Que	15)	Find the value of k, if the lines represented by $kx^2+4xy-4y^2=0$ are perpendicular to each other.
Que	16)	Find the measure of the acute angle between the lines represented by : i] $3x^2-4\sqrt{3}xy+3y^2=0$ ii] $4x^2+5xy+y^2=0$
Que	17)	Find the combined equation of lines passing through the origin each of which making an angle of 30° with the line $3x+2y-11=0$
Que	18)	If the angle between the lines represented by $ax^2+2hxy+by^2=0$ is equal to the angle between the lines $2x^2-5xy+3y^2=0$, then show that $100(h^2-ab)=(a+b)^2$
Que	19)	Find the value of b, if the angle between the lines given by $6x^2+xy+by^2=0$ is 45°.
Que	20)	Solve the following
	i]	Find the joint equation of the lines: (a) passing through the origin having slopes 2 and 3. (b) passing through the origin having inclinations 60° and 120°. (c) which are at a distance of 9 units from the Y-axis. (d) passing through the point (3,2), one of which is parallel to the line $x-2y=2$ and other is perpendicular to the line $y=3$. (e) passing through the origin and perpendicular to the lines $x+2y=19$ and $3x+y=18$

Que	21)	Find k, if : i] the sum of the slopes of the lines given by $3x^2+kxy-y^2=0$ is zero. ii] the sum of the slopes of the lines given by $x^2+kxy-3y^2=0$ is equal to their product. iii] the slope of one of the lines given by $3x^2-4xy+ky^2=0$ is 1. iv] one of the lines given by $3x^2-kxy+5y^2=0$ is perpendicular to the lines $5x+3y=0$ v] the slopes of the lines given by $3x^2+4xy+ky^2=0$ is three times the other. vi] the slopes of lines given by $kx^2+5xy+y^2=0$ differ by 1. vii] one of the lines given by $6x^2+kxy+y^2=0$ is $2x+y=0$
Que	22)	Find the joint equation of the pair of lines through the origin and making an equilateral triangle with the line $x=3$.
Que	23)	If the slope of one of the lines given by $ax^2+2hxy+by^2=0$ is three times the other, prove that $3h^2=4ab$.
Que	24)	Find a, if the sum of the slopes of the lines represented by $ax^2+8xy+5y^2=0$ is twice their product.
Que	25)	Show that the difference between the slopes of the lines given by $(\tan^2\theta+\cos^2\theta)x^2-2xy\tan\theta+(\sin^2\theta)y^2=0$ is two.
Que	26)	Find the condition that the equation $ay^2+bxy+ex+dy=0$ may represent a pair of lines.
Que	27)	If the lines given by $ax^2+2hxy+by^2=0$ form an equilateral triangle with the line $lx+my=1$, show that

$(3a+b)(a+3b) = 4h^2$

Que 28) Prove the combined of the pair of lines passing through the origin and perpendicular to the lines $ax^2 + 2hxy + by^2 = 0$ is $bx^2 - 2hxy + ay^2 = 0$

Que 29) If eq^n $ax^2 - y^2 + 2y + c = 1$ represents a pair of perpendicular lines, then find a and c.

VECTORS

Que	1)	ABCDEF is a regular hexagon. Show that $\overline{AB} + \overline{AC} + \overline{AD} + \overline{AE} + \overline{AF} = 6\,\overline{AO}$, where O is the centre of the hexagon.
Que	2)	Show that the following points are collinear : $A = (3, 2, -4)$, $B(9, 8, -10)$, $C = (-2, -3, 1)$
Que	3)	Are the four points $A(1, -1, 1)$, $B(-1, 1, 1)$, $C(1, 1, 1)$ and $D(2, -3, 4)$ coplanar ? Justify your answer.
Que	4)	Express $-\hat{i} - 3\hat{j} + 4\hat{k}$ as the linear combination of the vectors $2\hat{i} + \hat{j} - 4\hat{k}$, $2\hat{i} - \hat{j} + 3\hat{k}$ and $3\hat{i} + \hat{j} - 2\hat{k}$.
Que	5)	If $A(1, 2, 3)$, $B(3, 4, 5)$ and $C(p, q, 7)$ are collinear, find p and q.
Que	6)	If two of the vertices of a triangle are $A(3, 1, 4)$ and $B(-4, 5, -3)$ and the centroid of the triangle is at $G(-1, 2, 1)$, then find the coordinates of the third vertex C of the triangle.
Que	7)	If the centroid of a tetrahedron OABC is $(1, 2, -1)$ where $A = (a, 2, 3)$, $B = (1, b, 2)$, $C = (2, 1, c)$ respectively, find the distance of $P(a, b, c)$ from origin.
Que	8)	If the origin is the centroid of the triangle whose vertices are $A(2, p, -3)$, $B(q, -2, 5)$ and $C(-5, 1, r)$, then find the values of p, q and r.
Que	9)	If $A(1, 4, 2)$, $B(-2, 3, -5)$ are the vertices and $G\left(\frac{4}{3}, 0, \frac{-2}{3}\right)$ is the centroid of the ΔABC, then by vector method find the midpoint of the side BC.

Que	10)	Using vector method, find the incentre of the triangle whose vertices are $P(0,4,0)$, $Q(0,0,3)$, $R(0,4,3)$.
Que	11)	Find two unit vectors each of which is perpendicular to both $\bar{u}$ and $\bar{v}$ where $\bar{u} = 2\hat{i}+\hat{j}-2\hat{k}$, $\bar{v} = \hat{i}+2\hat{j}-2\hat{k}$.
Que	12)	Find the values of c so that for all real x, the vectors $xc\hat{i}-6\hat{j}+3\hat{k}$ and $x\hat{i}+2\hat{j}+2cx\hat{k}$ make an obtuse angle.
Que	13)	Prove by vector method, that the angle subtended on semi-circle is a right angle.
Que	14)	If $\bar{a} = 5\hat{i}-\hat{j}+7\hat{k}$ and $\bar{b} = \hat{i}-\hat{j}+\lambda\hat{k}$, find λ for which $\bar{a}+\bar{b}$ and $\bar{a}+\bar{b}$ are perpendicular.
Que	15)	Using vector method, prove that the perpendicular bisectors of the sides of a triangle are concurrent.
Que	16)	Prove that the altitudes of a triangle are concurrent.
Que	17)	If $\bar{a} = 2\hat{i}+\hat{j}-3\hat{k}$ and $\bar{b} = \hat{i}-2\hat{j}+\hat{k}$, find a vector of magnitude 5 perpendicular to both $\bar{a}$ and $\bar{b}$.
Que	18)	If $\bar{a} = \hat{i}-2\hat{j}+3\hat{k}$, $\bar{b} = 4\hat{i}-3\hat{j}+\hat{k}$, $\bar{c} = \hat{i}-\hat{j}+2\hat{k}$ verify that $\bar{a} \times (\bar{b}+\bar{c}) = \bar{a}\times\bar{b} + \bar{a}\times\bar{c}$.
Que	19)	Find the area of parallelogram whose diagonals are determined by the vectors $\bar{a} = 3\hat{i}-\hat{j}-2\hat{k}$ and $\bar{b} = -\hat{i}+3\hat{j}-3\hat{k}$.
Que	20)	If $\bar{a} = \hat{i}+\hat{j}+\hat{k}$ and $\bar{c} = \hat{j}-\hat{k}$, find a vector $\bar{b}$ satisfying $\bar{a}\times\bar{b} = \bar{c}$ and $\bar{a}\cdot\bar{b} = 3$.
Que	21)	Find the direction ratios of a vector perpendicular to the two lines whose direction ratios are i) $-2, 1, -1$ and $-3, -4, 1$

Que	22)	If $A(1,1,1)$, $B(-2,4,3)$, $C(-1,5,5)$ and $D(2,2,6)$ are four points, find the vectors of magnitude 4 units perpendicular to both $\overline{AB}$ and $\overline{CD}$.
Que	23)	If the vectors $-3\hat{i}+4\hat{j}-2\hat{k}$, $\hat{i}+2\hat{k}$ and $\hat{i}-p\hat{j}$ are coplanar, then find the value of p.
Que	24)	Find the volume of tetrahedron whose vertices are $A(-1,2,3)$ $B(3,-2,1)$, $C(2,1,3)$ and $D(-1,-2,4)$.
Que	25)	Are the points $P(1,-1,-1)$, $Q(3,1,-1)$, $R(0,2,1)$ and $S(-2,0,1)$ coplanar? Justify.
Que	26)	If A, B, C, D are $(1,1,1)$, $(2,1,3)$, $(3,2,2)$, $(3,3,4)$ respectively, then find the volume of the parallelopiped with AB, AC and AD as the concurrent edges.

IMP THEOREMS

Theorem	1)	If $\bar{a}$ and $\bar{b}$ any two non-zero, non-collinear vectors lying in the same plane, then prove that any vector $\bar{r}$ is coplanar with them if and only if there exist unique scalars t_1, t_2 such that $r = t_1 a + t_2 b$.
Theorem	2)	Three non-zero vectors $\bar{a}, \bar{b}, \bar{c}$ are coplanar if and only if there exist scalars x, y, z, not all zero simultaneously such that $x\bar{a}+y\bar{b}+z\bar{c}=\bar{0}$.
Theorem	3)	Section formula for Internal Division: $\bar{r} = \frac{m\bar{b}+n\bar{a}}{m+n}$
Theorem	4)	Section formula for External Division: $\bar{r} = \frac{m\bar{b}-n\bar{a}}{m-n}$

Theorem	5)	If l, m, n are the direction cosines of a line, then $l^2 + m^2 + n^2 = 1$
Theorem	6)	If $\bar{a}$ and $\bar{b}$ represent the diagonals of a parallelogram, then the area of the parallelogram is $\frac{1}{2} \lvert \bar{a} \times \bar{b} \rvert$.

LINE AND PLANE

Que	1)	Find the vector equation of the line passing through the point having position vector $\hat{i}+2\hat{j}+3\hat{k}$ and perpendicular to the vectors $\hat{i}+\hat{j}+\hat{k}$ and $2\hat{i}-\hat{j}+\hat{k}$.
Que	2)	Find the vector equation of the line passing through the point having position vector $-\hat{i}-\hat{j}+2\hat{k}$ and parallel to the line $\bar{r} = (\hat{i}+2\hat{j}+3\hat{k}) + \lambda(3\hat{i}+2\hat{j}+\hat{k})$.
Que	3)	A line passes through $(3,-1,2)$ and perpendicular to the lines $\bar{r} = (\hat{i}+\hat{j}-\hat{k}) + \lambda(2\hat{i}-2\hat{j}+\hat{k})$ and $\bar{r} = (2\hat{i}+\hat{j}-3\hat{k}) + u(\hat{i}-2\hat{j}+2\hat{k})$. Find its equation.
Que	4)	Find the vector equation of the line passing through the point $(-1,-1,2)$ and parallel to the line $2x-2 = 3y+1 = 6z-2$
Que	5)	If the lines $\frac{x-1}{3} = \frac{y-2}{2k} = \frac{z-3}{2}$ and $\frac{x-1}{3k} = \frac{y-1}{1} = \frac{z-6}{-5}$ are at right angle, then find the value of k.
Que	6)	Find the angle between the lines $\frac{x-1}{4} = \frac{y-3}{1} = \frac{z}{8}$ and $\frac{x-2}{2} = \frac{y+1}{2} = \frac{z-4}{1}$.
Que	7)	Find the length of the perpendicular from $(2,3,-1)$ to the line $\frac{x+1}{2} = \frac{y-3}{3} = \frac{z+1}{-1}$.
Que	8)	Find the shortest distance between the lines $\bar{r} = (4\hat{i}-\hat{j}) + \lambda(\hat{i}+2\hat{j}-3\hat{k})$ and $\bar{r} = (\hat{i}-\hat{j}+2\hat{k}) + u(\hat{i}+4\hat{j}-5\hat{k})$
Que	9)	Find the shortest distance between the lines $\frac{x+1}{7} = \frac{y+1}{-6} =$

		$\frac{z+1}{1}$ and $\frac{x-3}{1} = \frac{y-5}{-2} = \frac{z-7}{1}$
Que	10)	If the lines $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-1}{4}$ and $\frac{x-3}{1} = \frac{y-k}{2} = \frac{z}{1}$ intersect each other, then find k.
Que	11)	Find the shortest distance between the pair of parallel lines whose equations are $\bar{r} = (\hat{i}+\hat{j}) + \lambda(2\hat{i}-\hat{j}+\hat{k})$ and $\bar{r} = (2\hat{i}+\hat{j}-\hat{k}) + \mu(4\hat{i}-2\hat{j}+2\hat{k})$
Que	12)	Find the length of the perpendicular from the point (3, 2, 1) to the line $\frac{x-7}{-2} = \frac{y-7}{2} = \frac{z-6}{3}$.
Que	13)	Find the cartesian equations of the line which passes through the point (-2, 4, -5) and parallel to the line $\frac{x+2}{3} = \frac{y-3}{5} = \frac{z+5}{6}$.
Que	14)	Find the vector equation of the line which passes through the origin and the point (5, -2, 3).
Que	15)	Find the cartesian equations of the line passing through A(3, 2, 1) & B(1, 3, 1).
Que	16)	If the lines $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-1}{4}$ and $\frac{x-2}{1} = \frac{y+m}{2} = \frac{z-2}{1}$ intersect each other, then find m.
Que	17)	Find the vector equation of a plane which is at 42 units from the origin & which is normal to the vector $2\hat{i}+\hat{j}-2\hat{k}$

Que	18)	Find the perpendicular distance of the origin from the plane $6x-2y+3z-7=0$
Que	19)	Find the coordinates of the foot of the perpendicular drawn from origin to the plane $2x+6y-3z=63$.
Que	20)	Find the vector equation of the plane passing through the point having position vector $\hat{i}+\hat{j}+\hat{k}$ and perpendicular to the vector $4\hat{i}+5\hat{j}+6\hat{k}$.
Que	21)	Find the cartesian equation of the plane passing through $A(7,8,6)$ and parallel to the XY-plane.
Que	22)	Find the vector equation of the plane passing through the point $(A)(-2,5,7)$ & parallel to the vectors $4\hat{i}-\hat{j}+3\hat{k}$ and $\hat{i}+\hat{j}+\hat{k}$.
Que	23)	Find the cartesian equation of the plane $\bar{r}=(5\hat{i}-2\hat{j}-3\hat{k})+\lambda(\hat{i}+\hat{j}+\hat{k})+u(\hat{i}-2\hat{j}+3\hat{k})$
Que	24)	Find the vector equation of the plane passing through the points $\hat{i}+\hat{j}-2\hat{k}$, $\hat{i}+2\hat{j}+\hat{k}$, $2\hat{i}-\hat{j}+\hat{k}$.
Que	25)	Find the equation of the plane passing through the intersection of the planes $3x+2y+z+1=0$ and $x+y+z-2=0$ and the point $(2,2,1)$.
Que	26)	Find the distance of the point $4\hat{i}-3\hat{j}+\hat{k}$ from the plane $\bar{r}.(2\hat{i}+3\hat{j}-6\hat{k})=21$
Que	27)	Find the distance of the point $(1,1,-1)$ from the plane $3x+4y-12z+20=0$

Que 28) Find the angle between the planes $\bar{r}.(\hat{i}+\hat{j}+2\hat{k}) = 13$ and $\bar{r}.(2\hat{i}-\hat{j}+\hat{k}) = 31$.

Que 29) Find the acute angle between the line $\bar{r}.(\hat{i}+2\hat{j}+2\hat{k}) + \lambda(2\hat{i}+3\hat{j}-6\hat{k})$ and the plane $\bar{r}.(2\hat{i}-\hat{j}+\hat{k}) = 0$.

LINEAR PROGRAMMING

Que 1) Solve graphically :

i) $x \geq 0$ ii) $y \geq 0$

iii) $x \geq 0$ and $y \geq 0$ iv) $x \geq 0$ and $y \leq 0$

Que 2) Solve graphically :

i) $2x - 3 \geq 0$ ii) $2y - 5 \geq 0$

iii) $x + 2y \leq 6$ iv) $3x + 2y \geq 0$

Que 3) Solve graphically :

i) $x - y \leq 2$ and $x + 2y \leq 8$

ii) $2x + 3y \leq 6$ and $x + 4y \geq 4$

iii) $2x + y \geq 5$ and $x - y \leq 1$

Que 4) Find the feasible solution of the following inequations graphically :

i) $3x + 2y \leq 18$, $2x + y \leq 10$, $x \geq 0$, $y \geq 0$

ii) $0 \leq x \leq 3$, $0 \leq y \leq 3$, $x + y \leq 5$, $2x + y \geq 4$

Que 5) A furniture dealer deals in tables and chairs. He has ₹ 1,50,000 to invest and a space to store at most 60 pieces. A table costs him ₹1500 and a chair ₹750. Construct the inequations and find the feasible solution.

Que 6) In a cattle breading firm, it is prescribed that the food ration for one animal must contain 14, 22 and 1 units of nutrients A, B and C respectively. Two different kinds

of fodder are available. Each unit of these two contains the following amounts of these three nutrients.

Nutrient ↓ \ Fodder →	Fodder 1	Fodder 2
Nutrients A	2	1
Nutrients B	2	3
Nutrients C	1	1

The cost of fodder 1 is ₹3 per unit and that of fodder 2 ₹2. formulate the LPP to minimize the cost.

Que 7) A company manufactures two types of chemicals A and B. Each chemical requires two types of raw materials P and Q. The table below shows numbers of units of P and Q required to manufacture one unit of A and one unit of B and the total availability of P and Q.

Raw Material ↓ \ Chemical →	A	B	Availability
P	3	2	120
Q	2	5	160

The company gets profits of ₹350 and ₹400 by selling one unit of A and one unit of B respectively. (Assume that the entire production of A and B can be sold.) How many units of the chemicals A and B should be manufactured so that the company gets maximum profit? Formulate the problem as LPP to maximize profit.

Que 8) If John drives a car at a speed of 60 km/hour, He has to spend ₹5 per km on petrol. If he drives at a faster speed of 90 km/hr, the cost of petrol increases to ₹8 per km. He has ₹600 to spend on petrol and wishes to travel the maximum distance within an hour. Formulate the above problem as LPP.

Que 9) Solve the following LPP by graphical method:

1. Maximize : $z = 11x + 8y$, subject to $x \leq 4$, $y \leq 6$, $x + y \leq 6$, $x \geq 0$, $y \geq 0$.

2. Maximize : $z = 7x + 11y$, subject to $3x + 5y \leq 26$, $5x + 3y \leq 30$, $x \geq 0$, $y \geq 0$

3. Maximize : $z = 3x + 5y$, subject to $x + 4y \leq 24$, $3x + y \leq 21$, $x + y \leq 9$, $x \geq 0$, $y \geq 0$. Also, find maximum value of z.

4. Minimize : $z = 7x + y$, subject to $5x + y \geq 5$, $x + y \geq 3$, $x \geq 0$, $y \geq 0$

5. Minimize : $z = 8x + 10y$, subject to $2x + y \geq 7$, $2x + 3y \geq 15$, $y \geq 2$, $x \geq 0$, $y \geq 0$

Que 10) Solve each of the following LPP:

i) Maximize : $z = 5x_1 + 6x_2$ subject to $2x_1 + 3x_2 \leq 18$, $2x_1 + x_2 \leq 12$, $x_1 \geq 0$, $x_2 \geq 0$

ii) Minimize : $z = 4x + 2y$ subject to $3x + y \geq 27$, $x + y \geq 21$, $x \geq 0$, $y \geq 0$

iii) Maximize : $z = 2x + 3y$ subject to $x - y \geq 3$, $x \geq 0$, $y \geq 0$.

DIFFERENTIATION

Que 1) Differentiate the following w.r.t. x.

i] $\sqrt{x^2+4x-7}$ ii] $\sqrt{x^2+\sqrt{x^2+1}}$

Que 2) Differentiate the following w.r.t. x

i] $\cos(x^2+a^2)$ iii] $\sqrt{\tan x \sqrt{x}}$

ii] $\log\left[\tan\left(\frac{x}{2}\right)\right]$ iv] $\operatorname{cosec}\left(\sqrt{\cos x}\right)$

v] $\sec\left[\tan\left(x^4+4\right)\right]$ vi] $\sin\sqrt{\sin\sqrt{x}}$

vii] $\left[\log\left\{\log(\log x)\right\}\right]^2$

Que 3) Differentiate the following w.r.t. x :

i] $\log(\sec 3x + \tan 3x)$

ii] $\cot\left(\frac{\log x}{2}\right) - \log\left(\frac{\cot x}{2}\right)$

iii] $\frac{e^{2x}-e^{-2x}}{e^{2x}+e^{-2x}}$

iv] $\log\left(\sqrt{\frac{1-\cos 3x}{1+\cos 3x}}\right)$

v] $\log\left(\sqrt{\frac{1-\sin x}{1+\sin x}}\right)$

vi] $\log\left[4^{2x}\left(\frac{x^2+5}{\sqrt{2x^3-4}}\right)^{3/2}\right]$

Que 4) If $h(x) = \sqrt{4f(x) + 3g(x)}$, $f(1)=4$, $g(1)=3$, $f'(1)=3$, $g'(1)=4$ find $h'(1)$.

Que 5) If $f(x) = x^3 + x - 2$, find $(f^{-1})(-2)$.

Que 6) Using derivative, prove that :

i] $\tan^{-1}x + \cot^{-1}x = \frac{\pi}{2}$ ii] $\cot^{-1}(x^3)$

iii] $\cos^{-1}(1-x^2)$ iv] $\cos^3[\cos^{-1}(x^3)]$

v] $\tan^{-1}\left[\frac{1-\tan(x/2)}{1+\tan(x/2)}\right]$ vi] $\cot^{-1}\left(\frac{\sin 3x}{1+\cos 3x}\right)$

vii] $\tan^{-1}\left(\sqrt{\frac{1+\cos x}{1-\cos x}}\right)$

Que 7) Differentiate the following w.r.t. x :

i] $\operatorname{cosec}^{-1}\left[\frac{10}{6\sin(2^x) - 8\cos(2^x)}\right]$

Que 8) Differentiate the following w.r.t. x :

i] $\sin^{-1}\left(\frac{1-x^2}{1+x^2}\right)$ ii] $\sin^{-1}(2x\sqrt{1-x^2})$

iii] $\cos^{-1}\left(\frac{1-9^x}{1+9^x}\right)$

Que 9) Differentiate the following w.r.t. x :

i] $\cot^{-1}\left(\frac{1+35x^2}{2x}\right)$ ii] $\tan^{-1}\left(\frac{a+b\tan x}{b-a\tan x}\right)$

iii] $\cot^{-1}\left(\frac{4-x-2x^2}{3x+2}\right)$

Que 10) Differentiate the following w.r.t. x :

i] $\frac{x^5 \tan^3 4x}{\sin^2 3x}$ ii] $(\sin x^x)$

iii] $(\log x)^x - (\cot x)^{\cot x}$ iv] $x^{e^x} + (\log x)^{\sin x}$

v] $(\sin x)^{\tan x} + (\cos x)^{\cot x}$ vi] $[(\tan x)^{\tan x}]^{\tan x}$ at $x = \frac{\pi}{4}$

Que 11) Show that $\frac{dy}{dx} = \frac{y}{x}$ in the following, where a and p are constants :

i] $x^7 \cdot y^5 = (x+y)^{12}$ ii] $\cos^{-1}\left(\frac{7x^4+5y^4}{7x^4-5y^4}\right) = \tan^{-1} a$

Que 12) i] If $\log(x+y) = \log(xy) + p$, where p is a constant, then prove that $\frac{dy}{dx} = \frac{-y^2}{x^2}$

ii] If $\log_{10}\left(\frac{x^3-y^3}{x^3+y^3}\right) = 2$, show that $\frac{dy}{dx} = -\frac{99x^2}{101y^2}$

iii] If $y = \sqrt{\log x + \sqrt{\log x + \sqrt{\log x + \ldots \infty}}}$, show that $\frac{dy}{dx} = \frac{1}{x(2y-1)}$.

iv] If $y = x^{x^{x^{\cdots \infty}}}$, show that $\frac{dy}{dx} = \frac{y^2}{x(1-\log y)}$.

v] If $e^y = y^x$, then show that $\frac{dy}{dx} = \frac{(\log y)^2}{\log y - 1}$

Que 13) If $\sqrt{\frac{x}{y}} + \sqrt{\frac{y}{x}} = 6$, show that $\frac{dy}{dx} = \frac{y}{x}$

Que 14) Find $\frac{dy}{dx}$, if :

i] $x = a\cot\theta$, $y = b\,\mathrm{cosec}\,\theta$

ii] $x = \sqrt{a^2+m^2}$, $y = \log(a^2+m^2)$

iii] $x = \mathrm{cosec}^2\theta$, $y = \cot^3\theta$ at $\theta = \frac{\pi}{6}$

iv] $x = 2\cot t + \cos 2t$, $y = 2\sin t - \sin 2t$ at $t = \frac{\pi}{4}$

Que 15) i] If $x = a\sqrt{\sec\theta - \tan\theta}$, $y = a\sqrt{\sec\theta + \tan\theta}$ show that $\frac{dy}{dx} = -\frac{y}{x}$

ii] If $x = e^{\sin 3t}$, $y = e^{\cos 3t}$, then show that $\frac{dy}{dx} = \frac{y\log x}{x\log y}$

iii] If $x = \frac{t+1}{t-1}$, $y = \frac{t-1}{t+1}$, then show that $y^2 + \frac{dy}{dx} = 0$.

iv] If $x = \frac{2bt}{1+t^2}$, $y = a\left(\frac{1-t^2}{1+t^2}\right)$ show that $\frac{dx}{dy} = \frac{b^2y}{a^2x}$.

Que 16) i] Differentiate $\sin^{-1}\left(\frac{2x}{1+x^2}\right)$ w.r.t. $\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$.

ii] Differentiate $\tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right)$ w.r.t. $\tan^{-1}\left(\frac{2x\sqrt{1-x^2}}{1-2x^2}\right)$

Que 17) Find the second order derivatives of the following :

i] $e^{4x}\cdot\cos 5x$ ii] $x^3\cdot\log x$.

Que 18) Find $\frac{d^2y}{dx^2}$ of the following :

i] $x = a(\theta - \sin\theta)$, $y = a(1-\cos\theta)$

ii) $x = a\cos\theta$, $y = b\sin\theta$ at $\theta = \frac{\pi}{4}$

Que 19) i) If $x = at^2$ and $y = 2at$, then show that $xy \cdot \frac{d^2y}{dx^2} + a = 0$.

ii) If $y = e^{m\tan^{-1}x}$, show that $(1+x^2)\frac{d^2y}{dx^2} + (2x-m)\frac{dy}{dx} = 0$

iii) If $y = x + \tan x$, show that $\cos^2 x \cdot \frac{d^2y}{dx^2} - 2y + 2x = 0$

iv) If $\sec^{-1}\left(\frac{7x^3-5y^3}{7x^3+5y^3}\right) = m$, show that $\frac{d^2y}{dx^2} = 0$.

v) If $y = \sin(m\cos^{-1}x)$, then show that $(1-x^2)\cdot\frac{d^2y}{dx^2} - x\cdot\frac{dy}{dx} + m^2y = 0$

Que 20) If $y^2 = a^2\cos^2 x + b^2\sin^2 x$, show that $y + \frac{d^2y}{dx^2} = \frac{a^2b^2}{y^3}$

APPLICATIONS OF DERIVATIVES

Que	1)	Find the equations of tangents and normals to the following curves at the indicated points on them :
		i] $x^3+y^3-9xy=0$ at $(2,4)$
		ii] $x^2-\sqrt{3}xy+2y^2=5$ at $(\sqrt{3},2)$
		iii] $2xy+\pi\sin y=2\pi$ at $\left(1,\frac{\pi}{2}\right)$
Que	2)	Find the point of the curve $y=\sqrt{x-3}$ where the tangent is perpendicular to the line $6x+3y-5=0$
Que	3)	Find the equations of the tangents to the curve $x^2+y^2-2x-4y+1=0$ which are parallel to the X-axis.
Que	4)	A spherical soap bubble is expanding so that its radius is increasing at the rate of 0.02 cm/sec. At what rate is the surface area increasing, when its radius is 5 cm ?
Que	5)	The surface area of a spherical balloon is increasing at the rate of $2cm^2$/sec. At what rate is the volume of the balloon is increasing, when the radius of the balloon is 6 cm ?
Que	6)	The edge of a cube is decreasing at the rate of 0.6 cm/sec. Find the rate at which its volume is decreasing, when the edge of the cube is 2cm.
Que	7)	A man of height 2 metres walks at a uniform speed of 6 km/hr away from a lamp post of 6 metres high. Find the rate at which the length of the shadow is increasing.
Que	8)	A man of height 1.5 metres walks towards a lamp post of height 4.5 metres, at the rate of $\left(\frac{3}{4}\right)$ metre/sec.
		Find the rate at which i] his shadow is shortening.
		ii] the tip of shadow is moving.

Que	9)	The displacement of a particle at time t is given by $s = t^3 - 4t^2 - 5t$. Find the velocity and accleration at $t = 2$.
Que	10)	The displacement s of a particle at time t is given by $s = 2t^3 - 5t^2 + 4t - 3$. Find i] the time when the acceleration is 14 ft/sec^2. ii] the velocity and displacement at that time.
Que	11).	Find the approximate values of: i] $\sqrt{8.95}$ ii] $\sqrt[5]{31.89}$ iii] $(3.97)^4$ iv] $\sin(29°30')$, given that $1° = 0.00175^c$, $\sqrt{3} = 1.732$. v] $\tan(45°40')$, given that $1° = 0.00175^c$.
Que	12)	Find the approximate values of i] $\tan^{-1}(0.999)$ ii] $\cot^{-1}(0.999)$
Que	13)	Find the approximate values of: i] $e^{0.995}$, given that $e = 2.7183$ ii] $\log_e(101)$, given that $\log_{10} 10 = 2.3026$ iii] $\log_{10}(1016)$, given that $\log_{10} e = 0.4343$.
Que	14)	Find the approximate value of: $f(x) = x^3 - 3x + 5$ at $x = 1.99$
Que	15)	Given an interval $[a, b]$ that satisfies hypothesis of Rolle's theorem for the function $f(x) = x^4 + x^2 - 2$. It is known that $a = -1$. Find the value of b.

Que 16) Verify Rolle's Theorem for the following functions:

i] $f(x) = \sin(x/2)$, $x \in [0, 2\pi]$

ii] $f(x) = x^2 - 5x + 9$, $x \in [1, 4]$

Que 17) If Rolle's Theorem holds for the function $f(x) = x^3 + px^2 + qx + 5$, $x \in [1, 3]$ with $c = 2 + \frac{1}{\sqrt{3}}$, find the values of p and q.

Que 18) If Rolle's theorem holds for the function $f(x) = (x-2)\log x$, $x \in [1, 2]$, show that the equation $x \log x = 2 - x$ is satisfied by at least one value of x in $(1, 2)$

Que 19) Verify Lagrange's mean value theorem for the following functions:

i] $f(x) = \log x$ on $[1, e]$

ii] $f(x) = (x-1)(x-2)(x-3)$ on $[0, 4]$

iii] $f(x) = \frac{x-1}{x-3}$ on $[4, 5]$

Que 20) Test whether the following functions are increasing or decreasing:

i] $f(x) = 2 - 3x + 3x^2 - x^3$, $x \in R$

ii] $f(x) = 3 + 3x - 3x^2 + x^3$

Que 21) Find the values of x for which of the following functions are strictly decreasing:

i] $f(x) = 2x^3 - 3x^2 - 12x + 6$

ii] $f(x) = x^3 - 9x^2 + 24x + 12$

Que 22) Find the values of x for which $f(x) = \frac{x}{x^2+1}$ is

(a) strictly increasing.

(b) strictly decreasing.

Que 23) Find the maximum and minimum of the following functions:

i) $f(x) = 2x^3 - 21x^2 + 36x - 20$

ii) $f(x) = x^2 + \frac{16}{x^2}$

iii) $f(x) = \frac{\log x}{x}$

Que 24) Divide the number 30 into two parts such that their product is maximum.

Que 25) A wire of length 36 metres is bent in the form of a rectangle find its dimensions if the area of the rectangle is maximum.

Que 26) Find the largest size of a rectangle that can be inscribed in a semicircle of radius 1 unit, so that two vertices lie on the diameter.

Que 27) An open cylindrical tank whose base is a circle is to be constructed of metal sheet so as to contain a volume of πa^3 cu cm of water. Find the dimensions so that the quantity of the metal sheet required is minimum.

Que 28) A box with a square base is to have an open top. The surface area of the box is 192 sq.cm What should be its dimension in order that the volume is largest?

Que 29) The profit function $P(x)$ of a firm, selling x items per day is given by $P(x) = (150 - x)x - 1625$.
find the number of items the firm should manufacture to get maximum profit. Find the maximum profit.

Que 30) Find two numbers whose sum is 15 and when the square of one multiplied by the cube of the other is maximum.

Que 31) Show that the height of a closed right circular cylinder of given volume and least surface area is equal to its diameter.

Que 32) Show that the altitude of the right circular cone of maximum volume that can be inscribed in a sphere of radius r is $\frac{4r}{3}$

INDEFINITE INTEGRATION

Que 1) Integrate the following functions w.r.t.x.

i] $\int \frac{\sin 2x}{\cos x}\,dx$

ii] $\int \frac{\cos 2x}{\sin^2 x}\,dx$

iii] $\int \frac{\cos 2x}{\sin^2 x \cdot \cos^2 x}\,dx$

iv] $\int \frac{\sin x}{1+\sin x}\,dx$

v] $\int \frac{\tan x}{\sec x + \tan x}\,dx$

vi] $\int \sqrt{1+\sin 2x}\,dx$

vii] $\int \sin 4x \cdot \cos 3x\,dx$

viii] $\int \frac{4x+3}{2x+1}\,dx$

Que 2) Evaluate the following integrals:

i] $\int \frac{2x-7}{\sqrt{x+5}}\,dx$

ii] $\int \frac{2}{\sqrt{x}-\sqrt{x+3}}$

Que 3) If $f'(x) = x - \frac{3}{x^3}$, $f(1) = \frac{11}{2}$, then find $f(x)$.

Que 4) Integrate the following functions w.r.t. x.

i] $\frac{1+x}{x \cdot \sin(x+\log x)}$

ii] $\frac{x \cdot \sec^2(x^2)}{\sqrt{\tan^3(x^2)}}$

iii] $\frac{x^2+2}{(x^2+1)} \cdot a^{x+\tan^{-1}x}$

iv] $\frac{e^{2x}+1}{e^{2x}-1}$

v] $x^9 \sec^2(x^{10})$

vi] $\frac{\sqrt{\tan x}}{\sin x \cdot \cos x}$

vii] $\frac{(x-1)^2}{(x^2+1)^2}$

viii] $\frac{2\sin x \cdot \cos x}{3\cos^2 x + 4\sin^2 x}$

ix] $\frac{10x^9 + 10^x \cdot \log 10}{10^x + x^{10}}$

Que 5) Integrate the following functions w.r.t. x. :

i] $\frac{\cos x}{\sin(x-a)}$ ii] $\frac{\sin(x-a)}{\cos(x+b)}$

iii] $\frac{\sin x + 2\cos x}{3\sin x + 4\cos x}$ iv] $\frac{4e^x - 25}{2e^x - 5}$

v] $\tan^5 x$ vi] $\tan 3x \tan 2x \tan x$

vii] $\frac{\sin 6x}{\sin 10x \sin 4x}$ viii] $\frac{\sin x \cdot \cos^3 x}{1 + \cos^2 x}$

Que 6) Evaluate the following :

i] $\int \frac{1}{4x^3 - 3}\, dx$ ii] $\int \frac{1}{7 + 2x^3} \cdot dx$

iii] $\int \sqrt{\frac{10+x}{10-x}} \cdot dx$ iv] $\int \frac{1}{x^2 + 8x + 12} \cdot dx$

v] $\int \frac{1}{\sqrt{3x^2 + 5x + 7}} \cdot dx$ vi] $\int \frac{1}{\sqrt{(x-3)(x+2)}} \cdot dx$

vii] $\int \frac{1}{\cos 2x + 3\sin^2 x} \cdot dx$

Que 7) Evaluate the following :

i] $\int \frac{1}{3 + 2\sin x} \cdot dx$ ii] $\int \frac{1}{3 + 2\sin x - \cos x}\, dx$

iii] $\int \frac{1}{3 - 2\cos 2x} \cdot dx$ iv] $\int \frac{1}{\cos x - \sin x} \cdot dx$

Que 8) Evaluate the following integrals :

i] $\int \frac{x^2-1}{x^4+1} \cdot dx$ ii] $\int \frac{\cos x}{\sqrt{\sin^2 x - 2\sin x + 5}} \cdot dx$

iii] $\int \sqrt{1+\sec x} \cdot dx$

Que 9) Evaluate the following integrals :

i] $\int \frac{3x+4}{x^2+6x+5} \cdot dx$ ii] $\int \frac{3x+4}{\sqrt{2x^2+2x+1}} \cdot dx$

iii] $\int \sqrt{\frac{x-7}{x-9}} \cdot dx$ iv] $\int \frac{3\cos x}{4\sin^2 x + 4\sin x - 1} \cdot dx$

Que 10) Evaluate the following :

i] $\int x^2 \tan^{-1} \cdot dx$ ii] $\int x^3 \tan^{-1} x \cdot dx$

iii] $\int (\log x)^2 \cdot dx$ iv] $\int x \sin^{-1} x \cdot dx$

v] $\int \frac{\log(\log x)}{x} \cdot dx$

Que 11) Integrate the following functions w.r.t. x :

i] $e^{2x} \cdot \sin 3x$ ii] $[2 + \cot x - \operatorname{cosec}^2 x] e^x$

iii] $\left(\frac{1+\sin x}{1+\cos x}\right) e^x$ iv] $\left[\frac{x}{(x+1)^2}\right] e^x$

v] $\operatorname{cosec}(\log x)\,[1 - \cot(\log x)]$

Que 12) Evaluate the following integrals :

i] $\int e^x \frac{(x-1)}{(x+1)^3} \cdot dx$ ii] $\int e^x \frac{(1+x^2)}{(1+x)^2} \cdot dx$

iii) $\int e^x \left(\frac{1-x}{1+x^2}\right)^2 dx$ iv) $\int \frac{\log x}{(1+\log x)^2} dx$

v) $\int e^x \frac{(x+3)}{(x+4)^2} \cdot dx$

Que 13) Integrate the following functions w.r.t. x :

i) $\frac{x^2+2}{(x-1)(x+2)(x+3)}$ ii) $\frac{x^2+x-1}{x^2+x-6}$

iii) $\frac{6x^3+5x^2-7}{3x^2-2x-1}$ iv) $\frac{3x-2}{(x+1)^2(x+3)}$

v) $\frac{5x^2+20x+6}{x^3+2x^2+x}$ vi) $\frac{5e^x}{(e^x+1)(e^{2x}+9)}$

vii) $\frac{2\log x+3}{x(3\log x+2)[(\log x)^2+1]}$

DEFINITE INTEGRATION

Que 1) Evaluate the following integrals as limit of a sum :

i] $\int_1^3 (3x-4)\cdot dx$ ii] $\int_0^2 e^x \cdot dx$

iii] $\int_0^2 (3x^2-1)\cdot dx$

Que 2) Evaluate :

i] $\int_2^3 \frac{1}{x^2+5x+6}\, dx$ ii] $\int_{\pi/4}^{\pi/2} \cot^2 x \cdot dx$

iii] $\int_3^5 \frac{1}{\sqrt{2x+3}-\sqrt{2x-3}}\, dx$ iv] $\int_0^{\pi/4} \sqrt{1+\sin 2x}\, dx$

v] $\int_{-4}^{2} \frac{1}{x^2+4x+13}\, dx$ vi] $\int_0^{1} x \tan^{-1} x\, dx$

vii] $\int_0^{\pi/4} \frac{\sin 2x}{\sin^4 x + \cos^4 x}\, dx$ viii] $\int_0^{\pi/2} \frac{1}{5+4\cos x}\, dx$

ix] $\int_0^{\pi/2} \frac{\cos x}{(1+\sin x)(2+\sin x)}\, dx$

Que 3) Evaluate the following :

i] $\int_0^a \frac{1}{x+\sqrt{a^2-x^2}}\, dx$ ii] $\int_0^{\pi/2} \log(\tan x)\cdot dx$

iii] $\int_0^{\pi/2} \frac{\sin x - \cos x}{1+\sin x \cdot \cos x}\, dx$ iv] $\int_{-\pi/2}^{\pi/2} \log\left(\frac{2+\sin x}{2-\sin x}\right) dx$

v] $\int_0^1 \frac{\log(x+1)}{x^2+1}\, dx$

Que 4) Evaluate :

i] $\int_0^{\pi/2} \frac{\sin x \cos x}{1+\sin^4 x}$

ii] $\int_0^{\pi/2} \frac{dx}{4\cos x + 9\sin x}$

iii] $\int_1^2 \frac{dx}{x(1+\log x)^2}$

iv] $\int_1^3 x^2 \cdot \log x \, dx$

v] $\int_{\pi/2}^{\pi} e^x \left(\frac{1-\sin x}{1-\cos x}\right) dx$

vi] $\int_0^{\pi/2} \frac{\sqrt[3]{\sec x}}{\sqrt[3]{\sec x} + \sqrt[3]{\operatorname{cosec} x}} dx$

vii] $\int_0^{\pi} \frac{x \cdot \tan x}{\sec x + \tan x} dx$

viii] $\int_0^{\pi/2} \log \sin x \, dx$

ix] $\int_0^{\pi} \frac{x \sin x}{1+\sin x} dx$

x] $\int_0^2 |4x-5| \, dx.$

Que 5) Evaluate the following :

i] $\int_0^1 \frac{1}{1+\sqrt{x}} dx$

ii] $\int_0^{\pi/4} \frac{\tan^3 x}{1+\cos 2x} dx$

iii] $\int_0^{\pi} x \sin x \cdot \cos^4 x \, dx$

iv] $\int_0^{\pi} \frac{x}{1+\sin^2 x} dx$

v] $\int_{\pi/5}^{3\pi/10} \frac{\sin x}{\sin x + \cos x} dx$

vi] $\int_{-2}^{3} |x-2| \, dx$

Que 6) If $\int_0^k \frac{1}{2+8x^2} dx = \frac{\pi}{16}$, find k.

DIFFERENTIAL EQUATIONS

Que 1) Determine the order and degree of each of the following differential equations.

i] $\frac{d^2y}{dx^2} + x\left(\frac{dy}{dx}\right) + y = 2\sin x$

ii] $(y''')^2 + 3y'' + 3xy' + 5y = 0$

iii] $\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}} = 8\frac{d^2y}{dx^2}$

iv] $\left(\frac{d^3y}{dx^3}\right)^{\frac{1}{2}} \cdot \left(\frac{dy}{dx}\right)^{\frac{1}{3}} = 20$

v] $x + \frac{d^2y}{dx^2} = \sqrt{1 + \left(\frac{d^2y}{dx^2}\right)^2}$

Que 2) From the differential equation of family of circles touching Y-axis at the origin and having their centres on the X-axis.

Que 3) Obtain the differential equation by eliminating the arbitrary constants from the following equations:

i] $Ax^2 + By^2 = 1$

ii] $y = A\cos(\log x) + B\sin(\log x)$

iii] $(y-a)^2 = 4(x+b)$

iv] $y = C_1 e^{2x} + C_2 e^{5x}$

v] $y = e^{-2x}(A\cos x + B\sin x)$

Que 4) Find the differential equation all parabolas having length of latus rectum 4a and axis is parallel to the X-axis.

Que 5) Find the differential equation of the ellipse whose major axis is twice its minor axis.

Que 6) Find the differential equation of all circles having radius 9 and centre at point $A(h,k)$.

Que 7) In each of the following examples, verify that the given expression is a solution of the corresponding differential equation:

i] $xy = \log y + c$; $\frac{dy}{dx} = \frac{y^2}{1-xy}$

ii] $y = e^{-x} + Ax + B$; $e^x \frac{d^2y}{dx^2} = 1$

iii] $y = e^{ax}$; $x\frac{dy}{dx} = y\log y$

Que 8) Solve the following differential equations:

i] $\log\left(\frac{dy}{dx}\right) = 2x + 3y$

ii] $\cos x \cdot \cos y \cdot dy - \sin x \cdot \sin y\, dx = 0$

iii] $\frac{dy}{dx} = e^{x+y} + x^2 e^y$

Que 9) For each of the following differential equations find the particular solution satisfying the given condition:

i] $3e^x \tan y \cdot dx + (1+e^x)\sec^2 y\, dy = 0$, When $x=0$, $y=\pi$.

ii] $(x - y^2x)\cdot dx - (y + x^2y)\cdot dy = 0$, when $x=2$, $y=0$

iii] $(e^y+1)\cos x + e^y \sin x \cdot \frac{dy}{dx} = 0$, when $x = \frac{\pi}{6}$, $y=0$.

Que 10) Reduce each of the following differential equations to the variable separable form and hence solve:

i] $\frac{dy}{dx} = \cos(x+y)$

		ii] $x+y.\frac{dy}{dx} = \sec(x^2+y^2)$
Que	11)	Solve the D.E. $\left(y + x\frac{dy}{dx}\right)\sin xy = \cos x$, using the substitution $xy = u$. Also, find the particular solution if $y=0$, when $x=0$.
Que	12)	Solve the following differential equations. :
		i] $\frac{dy}{dx} + \frac{y}{x} = x^3 - 3$
		ii] $(x+2y^3).\frac{dy}{dx} = y$
		iii] $x\frac{dy}{dx} + 2y = x^2.\log x.$
		iv] $(x+a)\frac{dy}{dx} - 3y = (x+a)^5$
		v] $dr + (2r\cot\theta + \sin 2\theta).d\theta = 0$
		vi] $y.dx + (x-y^2).dy = 0$
Que	13)	Find the equation of the curve passing through the point $\left(\frac{3}{\sqrt{2}}, \sqrt{2}\right)$ having slope of the tangent to the curve at any point (x,y) is $-\frac{4x}{9y}$.
Que	14)	If the slope of the tangent to the curve at each of its point is equal to the sum of abscissa and the product of the abscissa and ordinate of the point. Also, the Curve passes through the point $(0,1)$. Find the equation of the curve.
Que	15)	In a certain culture of bacteria, the rate of increase is proportional to the number present. If it is found that the number doubles in 4 hours., find the number of times the bacteria are increased in 12 hours.

Que	16)	If a body cools from 80°C to 50°C at room temperature of 25°C in 30 minutes, find the temperature of the body after 1 hour.
Que	17)	The rate of decay of certain substance is directly proportional to the amount present at that instant. Initially, there are 25 gm of certain substance and two hours later it is found that 9 gm are left. Find the amount left after one more hour.
Que	18)	A body cools according to Newton's law from 100°C to 60°C in 20 minutes. The temperature of the surrounding being 20°C. How long will it take to cool down to 30°C.?
Que	19)	A right circular cone has height 9 cm. and radius of the base 5 cm. It is inverted and water is poured into it. If at any instant the water level rises at the rate of $\left(\frac{\pi}{a}\right)$ cm/sec, where A is the area of the water surface at that instant, show that the vessel will be full in 75 seconds.
Que	20)	Assume that a spherical raindrop evaporates at a rate proportional to its surface area. If its radius originally is 3 mm and 1 hour later has been reduced to 2 mm., find an expression for the radius of the raindrop at any time t.
Que	21)	The rate of growth of population of a city at any time t is proportional to the size of population. For a certain city it is found that the constant of proportionality is 0.04. Find the population of the city after 25 years, if the initial population is 10,000. [Take e = 2.7182]

APPLICATION OF DEFINITE INTEGRATION

Que	1)	Find the area enclosed between $y = \sin x$ and X-axis between $x = 0$ and $x = 4\pi$
Que	2)	Find the area enclosed between $y = \cos x$ and X-axis between the limits.
	i]	$0 \leq x \leq \frac{\pi}{2}$
	ii]	$\frac{\pi}{2} \leq x \leq \pi$
	iii]	$0 \leq x \leq \pi$
Que	3)	Find the area of the region bounded by the following curves, X-axis and given lines:
	i]	$y = 2x$, $x = 0$, $x = 5$
	ii]	$y^2 = x$, $x = 0$, $x = 4$
	iii]	$y^2 = 16x$, $x = 0$, $x = 4$
Que	4)	Find the area of the region bounded by the parabola:
	i]	$y^2 = 16x$ and its latus rectum.
	ii]	$y = 4 - x^2$ and the X-axis.
Que	5)	Find the area of the region included between:
	i]	$y^2 = 2x$ and the line $y = 2x$
	ii]	$y = x^2$ and the line $y = 4x$
	iii]	$y = x^2 + 3$ and the line $y = x + 3$
Que	6)	Find the area of region lying in the first quadrant and bounded by $y = 4x^2$, $x = 0$, $y = 2$ and $y = 4$.
Que	7)	Find the area of the region bounded by the curve $y = 2x - x^2$ and X-axis.
Que	8)	Find the area lying above the X-axis and included between the circle $x^2 + y^2 = 8x$ and the parabola $y^2 = 4x$.

Que	9)	Find the area under the curve $y = 3 - 2x - x^2$, up to the X-axis, bounded by the ordinates at $x = -1$ and $x = 3$.
Que	10)	Find the area bounded by the curve $y = x^2 - 3x$ and the line $y = 2x$.
Que	11)	Find the area of the region enclosed by the curves $y = \sin x$ and $y = \cos x$ and Y-axis.
Que	12)	find the area enclosed within the curves $\lvert x \rvert + \lvert y \rvert = 1$
Que	13)	find the area of the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$ using integration.
Que	14)	Find the area of the region lying between the parabolas: i] $4y^2 = 9x$ and $3x^2 = 16y$ ii] $y^2 = x$ and $x^2 = y$
Que	15)	Find the area of the region bounded by the parabola $y^2 = x$ and the line $y = x$ in the first quadrant.
Que	16)	Find the area of the region bounded by the curve $(y-1)^2 = 4(x+1)$ and the line $y = (x-1)$.
Que	17)	Find the area of the region bounded by the straight line $2y = 5x + 7$, X-axis and $x = 2$, $x = 5$.
Que	18)	Find the area of the region bounded by the curve $y = 4x^2$, Y-axis and the lines $y = 1$, $y = 4$.

PROBABILITY DISTRIBUTION

Que 1) Find the probability distribution of

i] number of trails in the simultaneous tosses of three coins.
ii] number of heads in four tosses of a coin.

Que 2) Find the probability distribution of number of successes in two tosses of a die, where success is defined as number greater than 4 appears on at least one die.

Que 3) A coin is biased so that the head is 3 times as likely to occur as tail. If the coin is tossed twice, find the probability distribution of number of trials.

Que 4) A random variable X has the following probability distribution:

X	0	1	2	3	4	5	6	7
P(x)	0	k	2k	2k	3k	k^2	$2k^2$	$7k^2+k$

Determine : i] k ii] $P(X<3)$ iii] $P(X>4)$

Que 5) The probability distribution of X is as follows :

X = x	0	1	2	3	4
P(X = x)	0.1	k	2k	2k	k

Find : (a) k
(b) $P(X<2)$

Que 6) Find expected value and variance X, where X is number obtained on the uppermost face when a fair die is thrown.

Que 7) Find the mean number of head in three tosses of a fair coin.

Que 8) Find the expected value, variance and standard deviation of r.v. X whose p.m.f. is given as

$X = x$	1	2	3
$P(X)$	$\frac{1}{5}$	$\frac{2}{5}$	$\frac{2}{5}$

Que 9) Two dice are thrown simultaneously. If X denotes the number of sixes, find the expectation of X.

Que 10) The p.m.f. of r.v. X is

$P(x) = \frac{1}{15}$ for $x = 1, 2, \ldots, 14, 15$

$= 0$ otherwise. find i] $E(X)$ ii] $Var(X)$.

Que 11) Let X have p.m.f.

$P(x) = kx^2$, $x = 1, 2, 3, 4$

$= 0$, otherwise.

Find mean and Variance of X.

Que 12) The following is the p.d.f. of r.v. X:

$f(x) = \frac{x}{8}$, for $0 < x < 4$ and $= 0$ otherwise.

Find (a) $P(x < 1.5)$

(b) $P(1 < x < 2)$

(c) $P(x > 2)$

Que 13) Find k if the following functions represent p.d.f. of r.v. X:

i] $f(x) = kx$, for $0 < x < 2$ and $= 0$, otherwise.

Also, find $P\left(\frac{1}{4} < x < \frac{3}{2}\right)$.

ii] $f(x) = kx(1-x)$, for $0 < x < 1$ and $= 0$, otherwise.

Also, find $P\left(\frac{1}{4} < x < \frac{1}{2}\right)$, $P\left(x < \frac{1}{2}\right)$.

Que 14) Suppose the error involved in making a certain measurement is a continuous r.v. X with p.d.f.

$$f(x) = \begin{cases} k(4-x^2) & \text{for } -2 \leq x \leq 2 \\ 0 & \text{otherwise.} \end{cases}$$

Compute

i] $P(X > 0)$.

ii] $P(-1 < x < 1)$.

iii] $P(X < -0.5 \text{ or } X > 0.5)$.

Que 15) For each of the following p.d.f.'s of X, find $P(X < 1)$ and $P(|X| < 1)$:

i] $f(x) = \frac{x^2}{18}, \quad -3 < x < 3$

$= 0, \quad$ otherwise.

ii] $f(x) = \begin{cases} \frac{x+2}{18}, & -2 < x < 4 \\ 0, & \text{otherwise.} \end{cases}$

Que 16) A fair coin is tossed 4 times. Let X denote the number of heads obtained. Write down the probability distribution of X. Also, find the formula for p.m.f of X.

Que 17) Let the p.m.f. of r.v. X be

$P(x) = \frac{3-x}{10}$, for $x = -1, 0, 1, 2$ and $= 0$ otherwise.

Calculate $E(X)$ and $\text{Var}(X)$.

BINOMIAL DISTRIBUTION

Que 1) A die is thrown 6 times. If 'getting an odd number' is a success, find the probability of

i] 5 successes.

ii] at least 5 successes.

iii] at most 5 successes.

Que 2) A pair of dice is thrown 4 times. If getting a doublet is considered a success, find the probability of two successes.

Que 3) There are 5% defective items in a large bulk of items. What is probability that a sample of 10 items will include not more than one defective item?

Que 4) A person buys a lottery ticket in 50 lotteries, in each of which his chance of winning a prize is $\frac{1}{100}$, find the probability that he will win a prize

i] at least once.

ii] exactly once.

iii] at least twice.

Que 5) Find the probability of throwing at most 2 sixes in 6 throws of a single die.

Que 6) Given $X \sim B(n,p)$

i] If $n=10$ and $p=0.4$, find $E(x)$ and $Var(x)$.

ii] If $p=0.6$ and $E(x)=6$, find n and $Var(x)$.

iii] If $n=10$, $E(x)=8$, find $Var(x)$.

Que 7) The sum of mean and variance of a binomial distribution is 15 and sum of their squares is 117. Determine the distribution.

Que 8) Suppose that 80% of all families own a television set. If 10 families are interviewed at random, find the probability that

i] seven families own a television set.

ii] at most three families own a television set.

Que 9) A student answers that the mean of a binomial distribution is 18 and variance is equal to 12. Check whether the answer of the student is correct or not.

Que 10) Let the p.m.f. of r.v. X be

$$p(x) = \binom{4}{x}\left(\frac{5}{9}\right)^{x}\left(\frac{4}{9}\right)^{4-x} \qquad x = 0, 1, 2, 3, 4.$$

Find $E(X)$ and $Var(X)$.

Que 11) Find the probability of guessing correctly at least seven out of ten answers in a 'true' or 'false' objective test.

Que 12) The probability of India winning a test match against England is $2/3$. Assuming independence from match to match, find the probability that in a 7-match series India's third win occurs at the 5th match.

Que 13) Let $X \sim B(n, p)$

i] If $n = 10$, $E(X) = 5$, find p and $Var(X)$.

ii] If $E(X) = 5$ and $Var(X) = 2.5$, find n and p.

Que 14) A lot of 100 items contains 10 defective items. Five items are selected at random from the lot and sent to the retail store. What is the probability that the store will recieve at most one defective item?

HSC BOARD

IMPORTANT QUESTIONS

BIOLOGY

HSC 2027

Chapter-wise Question Collection

For study and revision

1. Reproduction in lower & higher plants

1) Definition:- **i) Parthenocarpy** **ii) Protandry**

iii) Stock **iv) Scion**

v) Polyembryony

2) With neat labelled diagram explain Development of male & female gametophyte.

3) Describe with neat labelled diagram V.S. of anatropous ovule.

4) Development of endosperm.

5) Pollination agents and their adaptations.

6) Describe Outbreeding devices which encourage cross pollination.

7) Give any four significance of double fertilization.

8) With neat labelled diagram of T.S. of Anther.

9) Give difference between anemophily & entomophily.

2. Reproduction in lower and higher animal

1) Definition:- **i) Cryptorchidism** **ii) IVF**
iii) Cell of Raubers **iv) Trophoblast** **v) Implantation**
vi) Morula

2) Explain with neat labelled diagram of structure of Human Sperm.

3) Infertility treatment. (Tubectomy & Vasectomy)

4) Explain phases of menstrual cycle with its hormonal control.

5) Explain process of fertilization and give any four significance fertilization.

6) Mention any two organ derived from ectoderm, mesoderm, endoderm Role of Hormones.

7) Explain with neat labelled diagram of Secondary oocyte.

8) What is spermatogenesis? Draw neat labelled diagram of spermatogenesis.

9) A women was unable to conceive because of blockage in her upper oviduct. State the infertility treatment given to her and describe it.

10) What is oogenesis? Draw neat labelled diagram of oogenesis.

11) Give role of oxytocin,corpus luteum & LTH in fertilization?

12) Name the enzyme present in acrosome and give its roll.

13) Explain T.S. of testis and write note on glands.

14) With neat labelled diagram human male reproductive system.

3. Inheritance and Variations

1) **Definition:-** i) Recessive ii) Homozygous
iii) Heterozygous iv) Gene
v) Test cross vi) back cross
vii) Phenotype viii) Genotype
ix) Linkage

2) **Give reasons of Mendels success in his hybridization.**
3) **Give the graphic representation of back cross and test cross. Differentiate between them.**
4) **Explain "Law of dominance" with suitable example.**
5) **Define-Incomplete dominance.**
6) **Differentiate between X-chromosome and Y-chromosome.**
7) **Give any five contrasting traits studies by mendel.**
8) **Identify disorder development.**
9) **What is test cross? Explain significance.**
10) **Explain the types of chromosomes on the basis of position of centromere.**
11) **State any two symptoms of Down's syndrome/klinefilters syndrome.**
12) **A pea plant homozygous for yellow round seed is crossed with its recessive parents. Calculate the phenotypic and genotypic ratio with the help of checker board.**
13) **Identify chromosomal disorder caused due to non-disjunction of 21st number of chromosome and enlist symptoms.**
14) **Explain the law of dominance and compare how it differs from incomplete dominance and co-dominance.**
15) **What is sex linkage?**
16) **Explain the mechanism of sex determination in human being.**
17) **Why the ratio in pleiotropy is 2:1? Explain with example.**
18) **Explain the mechanism of sex determination in birds?**

4. Molecular basis of Inheritance

1) Definition:- **i) Codon** **ii) Anti-Codon**

iii) Genome **iv) Transcription**

v) Translation.

2) Explain process of DNA fingerprinting.

3) Explain with neat labelled diagram of process of DNA replication.

4) Explain with neat labelled diagram of Protein synthesis.

5) Transcription & Translation.

6) Give any four properties of Codon.

7) What are application of DNA fingerprinting.

8) Draw neat labelled diagram i) Nucleosome ii) t- RNA iii) Transcription unit

9) Give difference between Euchromatin and Heterochromatin.

10) Give flow chart of central dogma.

12) Give difference between DNA and RNA.

13) Write aims of human genome project.

14) Draw neat labeled diagram of Transcription and processing of hnRNA to mRNA. Explain terms splicing, capping, tailing.

15) Explain action of two strains of Diplococcus pneumoniae in Griffith's experiment an give his conclusion

16) What is R.F.L.P.?

17) Explain with neat labelled diagram Lac operon.

5. Origin and Evolution

1) Explain theory of natural selection by example Industrial melanism.

2) What is Connecting link? Which fossil is consider as connecting link between reptiles and birds. Give any one character of each class found in it.

3) Explain major changes to place in evolution of man.

4) Speciation **i) Intra specific :- a) Allopatric b) Sympatric**

ii) Inter specific

5) Explain Chromosomal Aberration.

6) Give morphological evidences with respect to given :-

i) Homologus **ii) Analogus** **iii) Vestigeal**

7) Define : **i)Gene flow** **ii) Genetic recombination**

iii) Genetic Drift **iv) Homologous organs**

v) Gene Mutation vi) Adapting radiation.

8) Define palaeontology and give examples of types of fossils.

9) Give two examples of vestigial organs and analogus organs.

10) State *Hardy Weinberg's* Principle.

11) Give reason why birds are said to be glorified reptiles?

12) Enlist characteristics of Neanderthal man and handyman.

6. Plant water Relation

1) Define any two types of water.

2) Explain why water is called "elixir of life"?

3) Describe structure of root hair with neat labelled diagram.

4) Give difference Properties of water.

5) Explain Root pressure theory.

6) Root hair is absorption

7) Water acts as a thermal buffer. Justify the statement.

8) Definition : -

i)Imbibition **ii)Diffusion**

iii) Symplast pathway **iv) Apoplast pathway.**

v) Guttation. **vi) Differentiation**

vii) Dedifferentiation **viii) Redifferentiation**

ix) Vernalization **x) Heterophylly**

9) Write a short note on plasticity.

10) Explain growth curve with neat labelled diagram.

11) Short note on **i) Vernalization** **ii) Photoperiodism**

7. Plant Growth & Mineral Nutrition

1) Give name Complete the chart - Plant hormones.

2) Physiological effects and application of given hormones

3) Give names of precursors of hormones & examples.

4) Give the name of deficiency symptoms caused due to sulphur in stem and root.

5) Give reason : ABA is also called as antitranspirant hormone.

6) Explain role of chlorophyllase enzyme in banana.

7) Define :- **i) ABA** **ii) Ethylene** **iii) Auxin**

iv) Gibberellin **v) Cytokinin**

8. Respiration & Circulation-

Q.1) Write short notes on :-

i) Chloride Shift or hamburger's Phenomenon

ii) Regulation of Breathing

iii) Artificial ventilation

iv) Erythrocytes.

v) ECG

Q.2) Differentiate between-

i) Inspiration & Expiration

ii) Artery & Vein

iii) Single Circulation & Double circulation.

Q.3. Short answer questions-

1) How does exchange of gases takes place at alveolar level?

2) What is double Circulation? Give its Significance?

3) What is repolarization & depolarization?

4) What is blood clotting ? How does it occur?

Q.4. Brief answer questions -

i) Describe the details cardiac cycle?

ii) With the help of Suitable diagram describe the conducting system of Human heart?

iii) With the help of well. labelled diagram describe the internal structure of Human heart?

iv) Give an account of external features of Human heart?

v) Describe different types of leucocytes.

vi) How does transport of O_2 & Co_2 take place in man?

vii) Describe respiratory system of Human?

9. Control and coordination

Q.1) Write short notes on-

i) Nervous System of Hydra / Planaria?

ii) Electrical synapse.

iii) Meninges of CNS

iv) Al*zheimer's* disease?

v) Hormones of Adenohypophysis?

Q.2) Short answer questions.

1) Write about types of nerves?

2) Structure of spinal cord with diagram?

3) Significance of reflex?

4) Importance of hypothalamus?

5) Diagram of T.S. of Spinal cord.

6) Diagram Formation of spinal nerve

7) Diagram- Mechanism of Hormone action

8) Diagram -Histology of thyroid

Q.3. Long answer questions -

1) Explain transmission of never impulse across a synapse.

2) Structure & function of mid brain Hindbrain.

3) Describe TS of spinal cord.

4) Mechanism of reflex action.

5) Describe briefly structure of eye with diagram.

6) Describe internal structure of Human ear with diagram

7) Hormones secreted by adrenal cortex.

8) Hormones of pituitary gland.

10. Human Health & diseases -

Q.1) Difference between :

i) Inborn immunity & Acquired immunity.

ii) Ascariasis & Filariasis

Q.2) short note on :-

1) Unique features of acquired immunity

2) Symptoms of Pneumonia.

3) Diagnosis & treatment of filariasis.

4) Preventive measures of malaria

5) Clinical manifestation of AIDS

6) Structure of HIV with diagram.

7) Adverse effect of drugs.

8) Rh factor

9) Erythroblastosis foetalis

10) life cycle of plasmodium

11) Ringworm

12) Structure of antibody with diagram

Q.3. Long answer question-

1) Which epithelial Surface offers innate immunity?

2) Explain ABO blood group system in Humans?

3) Main causes of cancer & its treatment?

11. Enhancement of food production

Q.1) What are the different breeding methods of Plant?

Q.2) Why are honey bees called as best pollinators.

Q.3) Single cell protein - Short note

Q.4) Short note on fish farming

Q.5) Industrial use of enzyme

Q.6) Microorganisms in sewage.

Q.7) Requirements a beekeeping.

Q.8) Objectives of Biofortification.

Q.9) Requirements of beekeeping.

Q.10) Explain concept of outbreeding and its types.

Q.11) Which dairy products are prepared using microorganisms?

Q.12) It Different types of mycorrhizae?

Q.13) What are biofertilizers? Explain its different types of biofertilizers with examples.

12. Biotechnology

Q.1) Short note on:

i) Electrophoresis **ii) Restriction sites.**

iii) Plasmids cloning vectors. **iv) Bt Cotton**

v) Golden rice **vi) Transgenic cattle**

Q.2) Short answer questions

1) What are different techniques and devices used in r-DNA technology?

2) What are basic requirements of PCR technique?

3) Explain how Ti plasmid of Agrobacterium tumefaciens acts as a vector?

4) What are different ways in which gene therapy is used?

5) Define transgenic crops with examples.

6) How transgenic animals are produced?

7) What is bioethics?

8) PCR-diagram.

Q.3) Long answer questions.

1) Describe r-DNA technology in detail.

2) Biopiracy & Biopatent.

3) Explain PCR with diagram

13. Organism & Population

Q.1. Distinguish between Natality & Mortality.

Q.2. Write note on population interaction.

Q.3. What is mutualism? give example.

Q.4. What is Brood parasitism?

Q.5. What are main types of niches ?

Q.6. What is sex ratio.

Q.7. Effects of Parasite on host.

Q.8. With suitable example explain Commensalism

Q.9. What are different population attributes

Q.10. What are different ways in which adapt to changes in environment?

Q.11. Describe exponential growth curve & logistic growth curve.

Q.12. Explain Predation & Parasitism with examples.

14. Ecosystem & Energy Flow

Q.1) Short notes :- i) Zonation in wetland **ii) Primary succession**

iii) Succession of Plants. **iv) Pioneer species.**

v) Succession in aquatic habitat.

Q.2) Short answer questions :-

i) Describe functions of an ecosystem

ii) Types of ecosystem.

iii) Describe the concept of energy flow.

iv) What is climax community

v) Explain inverted Pyramid of Biomass in oceans.

vi) What is secondary productivity? What Biosphere net primary productivity of

vii) Describe Pathway of Phosphorus in an ecosystem.

Q.3) long answer

1) What are the most important ecological Services whose valves cannot be determined.

2) Describe the Carbon cycle with diagram.

15. Biodiversity, Conservation & Environmental issues

Q.1) Difference between - Insitu & Exsitu Conservation

Q.2) Short answers.

i) Write note on Ecological diversity.

ii) What is Habitat loss & fragmentation.

iii) Coextinctions Define & explain with example.

iv) Write note on Particulate air pollutants.

v) Write note on thermal pollution

vi) Write note on effects Greenhouse Gases & its

vii) Explain species diversity with examples.

viii) Explain Productivity Stability Hypothesis

ix) India's wealth in biodiversity.

x) Effects of air pollution

xi) What are ways to reduce noise pollution.

xii) Explain BOD & its effects on aquatic ecosystem

xiii) What is solid waste? How is it disposed

xiv) What is e-waste

xv) How is ozone hole formed.

xvi) major effects of deforestation.

Q.3. Long answer question

1) Species richness goes on decreasing as we move from equator to pole? Explain.

2) Explain Rivet Popper Hypothesis?

3) Describe Eutrophication and its type.