Physics:

- Mechanics:
  - A body is projected vertically upwards with an initial velocity of 'v'. What is the maximum height reached by the body?
  - What is the relationship between kinetic energy and momentum?
- Electricity and Magnetism:
  - What is the principle of a transformer?
  - Calculate the equivalent resistance of a series circuit.
- Optics:
  - What is the phenomenon of total internal reflection?
  - Describe the formation of a rainbow.

Chemistry:

- Inorganic Chemistry:
  - What are the properties of transition elements?
  - Explain the formation of ionic bonds.
- Organic Chemistry:
  - What are the functional groups present in aldehydes and ketones?
  - Describe the process of polymerization.
- Physical Chemistry:
  - What is the law of chemical equilibrium?
  - Explain the concept of pH.

Mathematics:

- Algebra:
  - Solve the quadratic equation: ax2+bx+c=0.
  - What are the properties of matrices?
- Calculus:
  - Find the derivative of y=sin(x).
  - Calculate the integral of ∫x2dx.
- Trigonometry:
  - What is the value of sin(90°)?
  - Solve trigonometric equations.
- Coordinate Geometry:
  - Find the equation of a line given two points.
  - Find the distance between two points.
- Rotational Motion:
  - A flywheel rotating at a certain angular velocity is brought to rest by applying a constant torque. Calculate the angular retardation.
  - What is the moment of inertia of a solid sphere about its diameter?
- Thermodynamics:
  - Explain the Carnot cycle and its efficiency.
  - What are the laws of thermodynamics?
- Modern Physics:
  - Describe the photoelectric effect.
  - What is radioactive decay?

CollegeDekho

    - What are the properties of photons?

Chemistry Examples:

- Chemical Kinetics:
    - What are the factors affecting the rate of a chemical reaction?
    - Derive the rate law for a first-order reaction.
- Coordination Compounds:
    - Explain Werner's theory of coordination compounds.
    - What are the types of isomerism in coordination compounds?
- Electrochemistry:
    - Explain the Nernst equation.
    - What is the Faraday's law of electrolysis?

Mathematics Examples:

- Differential Equations:
    - Solve the differential equation: dxdy+py=q.
    - Find the general solution of a homogeneous differential equation.
- Vector Algebra:
    - Find the dot product and cross product of two vectors.
    - Determine if the three points are collinear.
- Probability:
    - Calculate the probability of drawing a specific card from a deck.
    - Solve problems related to binomial and Poisson distributions.
- Complex Numbers:
    - Find the real and imaginary parts of a complex number.
    - Solve equations involving complex numbers.
- Waves and Oscillations:
    - Derive the equation for a simple harmonic oscillator.
    - Explain the Doppler effect and its applications.
    - What are standing waves, and how are they formed?
- Electromagnetic Induction:
    - Explain Faraday's law of electromagnetic induction and Lenz's law.
    - Describe the working principle of an AC generator.
    - What is self-inductance and mutual inductance?
- Semiconductor Devices:
    - Explain the working of a p-n junction diode.
    - Describe the characteristics of a transistor.
    - What are logic gates, and how are they used in digital circuits?

Chemistry:

- Solutions:
    - Explain Raoult's law and its applications.
    - Describe the colligative properties of solutions.
    - What are ideal and non-ideal solutions?
- Chemical Bonding:
    - Explain the valence bond theory and molecular orbital theory.
    - Describe the shapes of molecules based on VSEPR theory.

CollegeDekho

    - What are hydrogen bonds and their significance?
- Environmental Chemistry:
    - Explain the causes and effects of air and water pollution.
    - Describe the greenhouse effect and global warming.
    - What are the methods for waste management?

Mathematics:

- Matrices and Determinants:
    - Find the inverse of a matrix using elementary row operations.
    - Solve systems of linear equations using matrices.
    - What are the properties of determinants?
- Conic Sections:
    - Find the equation of a tangent to a parabola or ellipse.
    - Determine the foci and directrix of a hyperbola.
    - Solve problems related to the eccentricity of conic sections.
- Integration:
    - Evaluate definite integrals using substitution and integration by parts.
    - Find the area under a curve.
    - Solve problems related to volumes of solids of revolution.
- Linear Programming:
    - Solve linear programming problems using the graphical method.
    - Find the optimal solution for a given objective function.

- Rotational Motion (Moment of Inertia):
    - To find the moment of inertia of a solid sphere about its diameter, you'd use the formula: I=52MR2, where M is the mass and R is the radius of the sphere.
- Thermodynamics (Carnot Cycle):
    - The Carnot cycle involves four reversible processes: isothermal expansion, adiabatic expansion, isothermal compression, and adiabatic compression.
    - The efficiency of the Carnot cycle is given by: η=1−ThTc, where Tc is the cold reservoir temperature and Th is the hot reservoir temperature.
    -
- Electromagnetic Induction (Faraday's Law):
    - Faraday's law states that the induced EMF in a circuit is proportional to the rate of change of magnetic flux through the circuit: ε=−dtdΦ.
    -
    - Lenz's law states that the induced current will flow in a direction that opposes the change that produced it.

Chemistry Solutions/Outlines:

- Chemical Kinetics (First-Order Reaction):
    - The integrated rate law for a first-order reaction is: ln[A]t−ln[A]0=−kt, where [A]t is the concentration at time t, [A]0 is the initial concentration, and k is the rate constant.
- Coordination Compounds (Werner's Theory):

CollegeDekho

    - Werner's theory explains the bonding in coordination compounds by proposing that metal ions have primary and secondary valences.
    - Primary valences correspond to the oxidation state, and secondary valences correspond to the coordination number.
- Electrochemistry (Nernst Equation):
    - The Nernst equation relates the reduction potential of an electrochemical reaction to the standard electrode potential, temperature, and activities (or concentrations) of the chemical species undergoing reduction and oxidation. The general equation is: $E=E0-nFRTlnQ$
    -

Mathematics Solutions/Outlines:

- Matrices and Determinants (Inverse of a Matrix):
    - To find the inverse of a matrix using elementary row operations, you can augment the matrix with the identity matrix and then perform row operations to transform the original matrix into the identity matrix. The resulting matrix on the right side will be the inverse.
- Calculus (Integration by Parts):
    - Integration by parts is used to integrate products of functions: $\int udv=uv-\int vdu$.
- Conic Sections (Tangent to a Parabola):
    - To find the equation of a tangent, you can use the derivative to find the slope of the tangent at a given point, and then use the point-slope form of a line.

CollegeDekho