

# Welcome to Your JEE Prep Journey!

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Study hard, and focus on learning. Don't get too caught up in thinking about how much you're going to score. Always remember, you can't work smart without first putting in the hard work.

## JEE Main Extensive List of High & Medium Probability Question Types/Concepts

*(Probability Scale: VH = Very High, H = High, M = Medium, L = Low but often easy marks)*

Question Type / Specific Concept Tested	Topic/Chapter	Probability
--- PHYSICS ---		
<b>Units, Dimensions, Errors, Measurement</b>		
1. Find dimensions of physical constants ( $G$ , $h$ , $\epsilon_0$ , $\mu_0$ ).	Units & Dimensions	M
2. Determine dimensions of a derived quantity involving multiple variables (e.g., $a*b/c$ ).	Units & Dimensions	M
3. Check dimensional consistency of an equation.	Units & Dimensions	M
4. Calculate percentage error in a quantity derived from measurements (using formula).	Error Analysis	M
5. Determine absolute/relative error from a set of measurements.	Error Analysis	L

6. Read measurements from Vernier Callipers (including zero error).	Measurement	M
7. Read measurements from Screw Gauge (including zero error).	Measurement	M

### **Kinematics**

8. Calculate displacement/distance/velocity/acceleration from $x(t)$ , $v(t)$ or $a(t)$ .	1D Motion	H
9. Solve problems involving motion under constant acceleration (equations of motion).	1D Motion	H
10. Interpret position-time graphs (find velocity, turning points).	Graphs	H
11. Interpret velocity-time graphs (find displacement, acceleration, distance).	Graphs	H
12. Interpret acceleration-time graphs (find change in velocity).	Graphs	M
13. Solve relative velocity problems in 1D (trains, objects moving towards/away).	Relative Motion	M
14. Solve relative velocity problems in 2D (rain-man, river-boat crossing - shortest time/path).	Relative Motion	M
15. Calculate time of flight, maximum height, horizontal range for projectile on level ground.	Projectile Motion	H
16. Find equation of trajectory for a projectile.	Projectile Motion	M
17. Solve projectile motion problems on an inclined plane.	Projectile Motion	M
18. Find velocity/angle at a given time/height during projectile motion.	Projectile Motion	M

### **Newton's Laws of Motion & Friction**

19. Apply NLM to find acceleration/tension in connected blocks (horizontal/vertical).	NLM	H
20. Solve problems involving pulley systems (Atwood machine variations).	NLM	H
21. Analyze motion on an inclined plane (with/without friction).	NLM	H
22. Apply concept of pseudo force in non-inertial frames (lift problems).	NLM	M
23. Determine limiting static friction and kinetic friction.	Friction	H
24. Find minimum force required to move a block (pushing vs pulling angle).	Friction	M
25. Solve problems involving friction in multi-block systems (block on block).	Friction	H
26. Banking of roads: find safe speed or angle of banking.	Circular Motion & NLM	M
27. Conical pendulum: relate speed, angle, radius, time period.	Circular Motion & NLM	M
<b>Work, Energy, Power &amp; Collisions</b>		
28. Calculate work done by constant/variable force (using $F \cdot d$ or $\int F \cdot dx$ ).	Work & Energy	H
29. Apply Work-Energy Theorem relating work done by net force to change in KE.	Work & Energy	VH
30. Calculate potential energy (gravitational, elastic spring).	Work & Energy	H
31. Apply Conservation of Mechanical Energy in conservative fields (gravity, spring).	Work & Energy	VH
32. Analyze vertical circular motion (min speed at top/bottom, tension variation).	Work & Energy	H

33. Calculate Power (instantaneous $P=F \cdot v$ or average $P=W/t$ ).	Power	M
34. Solve 1D elastic collision problems (finding final velocities).	Collisions	H
35. Solve 1D perfectly inelastic collision problems (finding final velocity, loss in KE).	Collisions	H
36. Analyze 2D collisions (using conservation of momentum in x and y).	Collisions	M
37. Calculate coefficient of restitution ( $e$ ).	Collisions	M
<b>Rotational Motion</b>		
38. Calculate Moment of Inertia (MI) for standard shapes (rod, ring, disk, sphere).	Rotational Motion	H
39. Apply Parallel Axis Theorem to find MI about a shifted axis.	Rotational Motion	VH
40. Apply Perpendicular Axis Theorem to find MI for planar objects.	Rotational Motion	VH
41. Calculate Radius of Gyration.	Rotational Motion	M
42. Relate torque, MI, and angular acceleration ( $\tau = I\alpha$ ).	Rotational Motion	H
43. Calculate work done by torque ( $W = \int \tau \, d\theta$ ).	Rotational Motion	M
44. Apply Conservation of Angular Momentum ( $L = I\omega$ ) during rotation/collision.	Rotational Motion	VH
45. Analyze pure rolling motion ( $v = R\omega$ , $a = R\alpha$ ).	Rotational Motion	H
46. Calculate kinetic energy of a rolling body (Translational + Rotational).	Rotational Motion	H
47. Find acceleration of an object rolling down an incline.	Rotational Motion	H

48. Solve problems involving equilibrium of rigid bodies (net force = 0, net torque = 0).	Rotational Motion	M
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**Gravitation**

49. Apply Newton's Law of Universal Gravitation (force between point/spherical masses).	Gravitation	M
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50. Calculate gravitational field and potential due to point mass/sphere.	Gravitation	M
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51. Determine variation of 'g' with altitude and depth.	Gravitation	M
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52. Calculate orbital velocity and time period of satellites.	Gravitation	M
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53. Calculate escape velocity from a planet/star.	Gravitation	M
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54. Apply Kepler's Laws of planetary motion (especially $T^2 \propto R^3$ ).	Gravitation	M
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**Properties of Solids & Fluids**

55. Calculate Young's Modulus, Bulk Modulus, Shear Modulus, stress, strain.	Mechanical Properties of Solids	M
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56. Calculate potential energy stored in a stretched wire.	Mechanical Properties of Solids	L
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57. Apply Pascal's Law (hydraulic lift).	Mechanical Properties of Fluids	L
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58. Apply Archimedes' Principle (buoyant force, apparent weight).	Mechanical Properties of Fluids	M
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59. Use equation of continuity ( $A_1 v_1 = A_2 v_2$ ).	Mechanical Properties of Fluids	M
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60. Apply Bernoulli's principle (pressure, velocity, height relationship).	Mechanical Properties of Fluids	M
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61. Calculate terminal velocity using Stokes' Law (viscous drag).	Mechanical Properties of Fluids	M
62. Calculate excess pressure inside drops and bubbles.	Surface Tension	M
63. Determine capillary rise or fall using Jurin's Law.	Surface Tension	M
<b>Heat &amp; Thermodynamics</b>		
64. Convert between temperature scales ( $^{\circ}\text{C}$ , F, K).	Thermal Properties	L
65. Calculate thermal expansion (linear, area, volume).	Thermal Properties	M
66. Apply principle of calorimetry (mixing substances at different temperatures).	Thermal Properties	M
67. Calculate heat transfer through conduction ( $dQ/dt = KA\Delta T/L$ ), thermal resistance.	Heat Transfer	H
68. Analyze heat transfer through composite slabs/rods (series/parallel).	Heat Transfer	H
69. Apply Newton's Law of Cooling.	Heat Transfer	M
70. Apply Stefan-Boltzmann Law ( $P = e\sigma AT^4$ ) and Wien's Displacement Law ( $\lambda_m T = \text{constant}$ ).	Heat Transfer	H
71. Relate pressure, volume, temperature using Ideal Gas Law ( $PV=nRT$ ).	Kinetic Theory of Gases (KTG)	H
72. Calculate RMS speed, average speed, most probable speed of gas molecules.	Kinetic Theory of Gases (KTG)	M
73. Relate internal energy to degrees of freedom ( $U = f/2 nRT$ ).	Kinetic Theory of Gases (KTG)	M
74. Apply First Law of Thermodynamics ( $\Delta U = Q - W$ ).	Thermodynamics	VH

75. Calculate work done during various thermodynamic processes (Isobaric, Isochoric, Isothermal, Adiabatic).	Thermodynamics	VH
76. Relate P, V, T for adiabatic processes ( $PV^\gamma = \text{const}$ , $TV^{\gamma-1} = \text{const}$ ).	Thermodynamics	H
77. Calculate molar heat capacities ( $C_p$ , $C_v$ ) and their ratio ( $\gamma = C_p/C_v$ ).	Thermodynamics	H
78. Apply Second Law concepts (entropy - qualitative, heat engines, refrigerators).	Thermodynamics	M
79. Calculate efficiency of Carnot engine ( $\eta = 1 - T_2/T_1$ ).	Thermodynamics	H
80. Calculate Coefficient of Performance (COP) for refrigerators.	Thermodynamics	M
<b>Oscillations &amp; Waves</b>		
81. Find amplitude, frequency, time period, phase from equation of SHM.	Simple Harmonic Motion (SHM)	H
82. Calculate velocity and acceleration in SHM as functions of time or position.	Simple Harmonic Motion (SHM)	H
83. Find KE, PE, Total Energy in SHM and their variations.	Simple Harmonic Motion (SHM)	M
84. Calculate time period of simple pendulum & spring-mass system (vertical/horizontal).	Simple Harmonic Motion (SHM)	H
85. Analyze combinations of springs (series/parallel).	Simple Harmonic Motion (SHM)	M
86. Analyze damped and forced oscillations (qualitative concepts, resonance).	Oscillations	L
87. Use equation of a travelling wave ( $y = A \sin(kx \pm \omega t + \phi)$ ).	Waves	M

88. Relate wave speed, frequency, and wavelength ( $v = f\lambda$ ).	Waves	H
89. Calculate speed of transverse wave on a string ( $v = \sqrt{T/\mu}$ ).	Waves on a String	M
90. Calculate speed of sound in gases ( $v = \sqrt{\gamma RT/M}$ or $\sqrt{B/\rho}$ ).	Sound Waves	M
91. Analyze superposition of waves, interference, standing waves.	Superposition	H
92. Find frequencies of harmonics/overtones in strings (fixed/free ends) and organ pipes (open/closed).	Standing Waves	H
93. Calculate beat frequency ( $f_{\text{beat}} =$	$f_1 - f_2$	).
94. Apply Doppler effect formula for sound (source/observer moving).	Doppler Effect	H
<b>Electrostatics</b>		
95. Apply Coulomb's Law to find force between point charges (vector form).	Electric Charges & Fields	H
96. Apply principle of superposition to find net force/field due to multiple charges.	Electric Charges & Fields	H
97. Calculate Electric Field due to point charge, dipole (axial/equatorial).	Electric Charges & Fields	VH
98. Calculate Electric Field due to continuous distributions (line, ring, disk - using integration).	Electric Charges & Fields	M
99. Calculate torque on a dipole in a uniform electric field ( $\tau = p \times E$ ).	Electric Charges & Fields	M
100. Apply Gauss's Law to find E-field for symmetric distributions (sphere, cylinder, sheet).	Electric Charges & Fields	H
101. Calculate electric potential due to point charge, dipole, system of charges.	Electric Potential & Capacitance	VH



102. Find potential difference between two points in an electric field ( $\Delta V = -\int \mathbf{E} \cdot d\mathbf{r}$ ).	Electric Potential & Capacitance	H
103. Calculate electric potential energy of a system of charges / a dipole.	Electric Potential & Capacitance	H
104. Relate Electric Field and Potential ( $E = -dV/dr$ ).	Electric Potential & Capacitance	H
105. Find equivalent capacitance for series/parallel combinations.	Capacitance	VH
106. Find equivalent capacitance for complex circuits (Wheatstone bridge symmetry).	Capacitance	H
107. Calculate charge, voltage, energy stored in capacitors in a circuit.	Capacitance	VH
108. Analyze effect of inserting dielectric slab (K) in a capacitor (battery connected/disconnected).	Capacitance	H

### Current Electricity

109. Relate current density (j), drift velocity (vd), electric field (E) ( $j = nev_d = \sigma E$ ).	Current Electricity	M
110. Apply Ohm's Law ( $V=IR$ ); calculate resistance/resistivity ( $R = \rho L/A$ ).	Current Electricity	H
111. Analyze effect of temperature on resistance.	Current Electricity	M
112. Find equivalent resistance for series/parallel combinations.	Current Electricity	VH
113. Find equivalent resistance for complex networks (symmetry, Wheatstone bridge).	Current Electricity	H
114. Apply Kirchhoff's Current Law (KCL) and Voltage Law (KVL) to solve circuits.	Current Electricity	VH

115. Calculate EMF and internal resistance of cells; terminal voltage ( $V = E - Ir$ ).	Current Electricity	H
116. Analyze combination of cells (series/parallel/mixed grouping).	Current Electricity	M
117. Calculate electrical power dissipated in resistors ( $P = VI = I^2R = V^2/R$ ).	Current Electricity	H
118. Solve problems based on Meter Bridge (finding unknown resistance).	Electrical Instruments	H
119. Solve problems based on Potentiometer (comparing EMFs, finding internal resistance).	Electrical Instruments	H
<b>Magnetic Effects of Current &amp; Magnetism</b>		
120. Calculate magnetic field (B) using Biot-Savart Law (straight wire segment, circular arc).	Magnetic Effects of Current	H
121. Apply Ampere's Circuital Law to find B (long wire, solenoid, toroid).	Magnetic Effects of Current	H
122. Calculate magnetic force on a moving charge ( $F = q(v \times B)$ ).	Magnetic Effects of Current	H
123. Analyze motion of charged particle in uniform B field (circular/helical path).	Magnetic Effects of Current	H
124. Calculate magnetic force on a current-carrying wire ( $F = I(L \times B)$ ).	Magnetic Effects of Current	H
125. Calculate force per unit length between two parallel current-carrying wires.	Magnetic Effects of Current	H
126. Calculate torque on a current loop in a uniform B field ( $\tau = M \times B$ ).	Magnetic Effects of Current	M
127. Understand principle and working of Moving Coil Galvanometer (conversion to Ammeter/Voltmeter).	Magnetic Effects of Current	M

128. Relate magnetic field lines to bar magnets; properties of magnetic materials (dia, para, ferro).	Magnetism & Matter	M
129. Understand components of Earth's magnetic field (dip angle, declination).	Magnetism & Matter	L
<b>Electromagnetic Induction &amp; AC</b>		
130. Calculate magnetic flux ( $\Phi = \int \mathbf{B} \cdot d\mathbf{A}$ ).	Electromagnetic Induction (EMI)	H
131. Apply Faraday's Law of Induction ( $\epsilon = -d\Phi/dt$ ) to find induced EMF.	Electromagnetic Induction (EMI)	H
132. Apply Lenz's Law to determine direction of induced current.	Electromagnetic Induction (EMI)	H
133. Calculate Motional EMF ( $\epsilon = Blv$ ) for a conductor moving in B field.	Electromagnetic Induction (EMI)	H
134. Calculate self-inductance (L) and mutual inductance (M).	Electromagnetic Induction (EMI)	M
135. Calculate energy stored in an inductor ( $U = \frac{1}{2}LI^2$ ).	Electromagnetic Induction (EMI)	M
136. Analyze growth and decay of current in LR circuits.	Electromagnetic Induction (EMI)	M
137. Analyze charging and discharging of capacitors in RC circuits.	Electromagnetic Induction (EMI)	M
138. Represent AC voltage/current using phasors; find RMS and peak values.	Alternating Current (AC)	H
139. Calculate reactance ( $X_L$ , $X_C$ ) and impedance (Z) for RLC series circuits.	Alternating Current (AC)	H

140. Find phase difference between voltage and current in RLC circuits.	Alternating Current (AC)	H
141. Determine resonance condition ( $X_L = X_C$ ) and resonant frequency in RLC circuits.	Alternating Current (AC)	H
142. Calculate average power consumed in AC circuits; define power factor ( $\cos \phi$ ).	Alternating Current (AC)	H
143. Understand principle of transformers (step-up/step-down, $V_p/V_s = N_p/N_s$ ).	Alternating Current (AC)	M
144. Analyze LC oscillations (frequency $\omega = 1/\sqrt{LC}$ ).	Alternating Current (AC)	M

### **Electromagnetic Waves**

145. Relate E and B fields in EM waves ( $E = cB$ ); determine direction of propagation.	EM Waves	M
146. Know properties and order of EM spectrum (Radio to Gamma).	EM Waves	M
147. Calculate energy density or intensity of EM waves.	EM Waves	L

### **Optics**

148. Apply laws of reflection; solve problems with plane/spherical mirrors.	Ray Optics	H
149. Use Mirror Formula ( $1/f = 1/v + 1/u$ ) and magnification ( $m = -v/u$ ).	Ray Optics	H
150. Apply Snell's Law ( $n_1 \sin i = n_2 \sin r$ ) for refraction at plane/curved surfaces.	Ray Optics	H
151. Calculate lateral shift and apparent depth due to refraction.	Ray Optics	M
152. Find conditions for Total Internal Reflection (TIR); calculate critical angle.	Ray Optics	H

153. Use Lens Formula ( $1/f = 1/v - 1/u$ ) and magnification ( $m = v/u$ ).	Ray Optics	H
154. Apply Lens Maker's Formula ( $1/f = (n_2/n_1 - 1)(1/R_1 - 1/R_2)$ ).	Ray Optics	H
155. Calculate equivalent focal length/power of combination of thin lenses.	Ray Optics	H
156. Calculate angle of deviation and dispersion through a prism.	Ray Optics	M
157. Understand working and calculate magnifying power of simple/compound microscope.	Optical Instruments	M
158. Understand working and calculate magnifying power of astronomical telescope.	Optical Instruments	M
159. Apply Huygens' Principle to explain reflection/refraction.	Wave Optics	L
160. Find path difference and phase difference in interference.	Wave Optics	H
161. Calculate fringe width ( $\beta = \lambda D/d$ ) and positions of bright/dark fringes in YDSE.	Wave Optics	H
162. Analyze intensity distribution in YDSE ( $I = I_0 \cos^2(\phi/2)$ ).	Wave Optics	M
163. Find condition for minima/maxima in single slit diffraction ( $a \sin \theta = n\lambda$ / $(n+1/2)\lambda$ ).	Wave Optics	M
164. Understand polarization by reflection (Brewster's Law: $\tan i_p = n$ ).	Wave Optics	M
165. Understand polarization by scattering; Malus's Law ( $I = I_0 \cos^2\theta$ ).	Wave Optics	L
<b>Modern Physics</b>		
166. Apply Einstein's photoelectric equation ( $KE_{\max} = hf - \phi$ ).	Dual Nature	H

167. Calculate threshold frequency/wavelength, work function, stopping potential.	Dual Nature	H
168. Understand intensity and frequency effects on photoelectric current.	Dual Nature	M
169. Calculate de Broglie wavelength ( $\lambda = h/p = h/mv$ ).	Dual Nature	H
170. Calculate radius, velocity, energy of electron in Bohr orbits (H-like atoms).	Atoms	H
171. Use Rydberg formula to find wavelength of spectral lines (Lyman, Balmer etc).	Atoms	H
172. Calculate nuclear radius ( $R = R_0 A^{(1/3)}$ ).	Nuclei	M
173. Calculate mass defect and binding energy (using $E=mc^2$ ).	Nuclei	H
174. Analyze binding energy per nucleon curve.	Nuclei	M
175. Apply law of radioactive decay ( $N = N_0 e^{(-\lambda t)}$ , $A = A_0 e^{(-\lambda t)}$ ).	Nuclei	H
176. Calculate half-life ( $T_{1/2}$ ) and mean life ( $\tau$ ).	Nuclei	H
177. Balance nuclear reactions (fission/fusion), calculate Q-value.	Nuclei	M

### **Semiconductor Electronics**

178. Distinguish between conductors, semiconductors, insulators based on energy bands.	Semiconductors	M
179. Understand properties of intrinsic/extrinsic semiconductors (n-type, p-type).	Semiconductors	M
180. Analyze I-V characteristics of p-n junction diode (forward/reverse bias).	Semiconductors	H

181. Understand working of half-wave and full-wave rectifiers.	Semiconductors	M
182. Analyze Zener diode as a voltage regulator.	Semiconductors	M
183. Identify basic Logic Gates (AND, OR, NOT, NAND, NOR, XOR) and their truth tables.	Logic Gates	H
184. Determine output of combinations of logic gates.	Logic Gates	H
185. Understand basic transistor action (CE configuration - less frequent now).	Transistors	L

### **Communication Systems**

186. Calculate modulation index for AM wave.	Communication Systems	M
187. Determine bandwidth required for AM/FM signals.	Communication Systems	M
188. Basic concepts of signal propagation (ground wave, sky wave, space wave).	Communication Systems	L

### **--- CHEMISTRY ---**

#### **Some Basic Concepts (Mole Concept) & Stoichiometry**

189. Convert mass to moles, moles to particles, moles to volume (at STP).	Mole Concept	H
190. Calculate molarity, molality, mole fraction, mass % for solutions.	Concentration Terms	H
191. Determine empirical and molecular formula from % composition or combustion data.	Stoichiometry	M
192. Identify limiting reagent in a reaction and calculate product yield.	Stoichiometry	H

193. Balance chemical equations (including redox reactions).	Stoichiometry	M
194. Perform stoichiometric calculations based on balanced equations (mass-mass, mass-vol).	Stoichiometry	H
<b>Atomic Structure</b>		
195. Calculate energy, frequency, wavelength of electron transitions (Bohr/Rydberg).	Atomic Structure	H
196. Relate wavelength and momentum (de Broglie hypothesis for particles).	Atomic Structure	M
197. Apply Heisenberg Uncertainty Principle ( $\Delta x \Delta p \geq h/4\pi$ ).	Atomic Structure	L
198. Identify valid sets of quantum numbers (n, l, m, s).	Atomic Structure	H
199. Determine number of orbitals/electrons for given n or l values.	Atomic Structure	H
200. Draw shapes of s, p, d orbitals.	Atomic Structure	M
201. Write electronic configurations of atoms/ions using Aufbau, Pauli, Hund's rules.	Atomic Structure	H
<b>Chemical Bonding &amp; Molecular Structure</b>		
202. Draw Lewis structures for simple molecules/ions.	Chemical Bonding	M
203. Calculate formal charges on atoms in Lewis structures.	Chemical Bonding	L
204. Predict molecular geometry and bond angles using VSEPR theory.	Chemical Bonding	VH
205. Determine hybridization ( $sp$ , $sp^2$ , $sp^3$ , $sp^3d$ , $sp^3d^2$ ) of central atoms.	Chemical Bonding	VH
206. Compare bond lengths, bond angles, bond energies.	Chemical Bonding	H



207. Determine polarity of molecules based on geometry and bond polarity (dipole moment).	Chemical Bonding	H
208. Explain bonding using Valence Bond Theory (VBT - overlap concept).	Chemical Bonding	M
209. Apply Molecular Orbital Theory (MOT) for diatomic species ( $N_2$ , $O_2$ , $F_2$ , etc.).	Chemical Bonding	H
210. Calculate bond order and predict magnetic properties using MOT.	Chemical Bonding	H
211. Identify types of intermolecular forces (dipole-dipole, H-bonding, London dispersion).	Chemical Bonding	M
<b>States of Matter (Gases &amp; Liquids)</b>		
212. Apply Boyle's Law, Charles's Law, Gay-Lussac's Law, Avogadro's Law.	States of Matter	M
213. Use Ideal Gas Equation ( $PV=nRT$ ) for calculations.	States of Matter	H
214. Apply Dalton's Law of Partial Pressures.	States of Matter	M
215. Use Graham's Law of Diffusion/Effusion.	States of Matter	M
216. Understand concepts of KTG (RMS speed, average KE vs T).	States of Matter	M
217. Understand deviations from ideal behaviour; van der Waals equation.	States of Matter	M
218. Concepts related to liquids: vapor pressure, surface tension, viscosity (qualitative).	States of Matter	L
<b>Thermodynamics</b>		
219. Differentiate between system/surroundings, state/path functions, intensive/extensive properties.	Thermodynamics	M

220. Calculate $\Delta U$ , $q$ , $w$ for various processes using First Law.	Thermodynamics	H
221. Calculate enthalpy changes ( $\Delta H$ ) for reactions; relate $\Delta H$ and $\Delta U$ .	Thermodynamics	H
222. Apply Hess's Law of Constant Heat Summation.	Thermodynamics	H
223. Use standard enthalpies of formation ( $\Delta_f H^\circ$ ), combustion ( $\Delta_c H^\circ$ ), bond energies.	Thermodynamics	H
224. Define entropy ( $\Delta S$ ) and predict sign of $\Delta S$ for processes/reactions.	Thermodynamics	M
225. Calculate Gibbs Free Energy change ( $\Delta G = \Delta H - T\Delta S$ ).	Thermodynamics	H
226. Relate $\Delta G$ to spontaneity and equilibrium constant ( $\Delta G^\circ = -RT \ln K$ ).	Thermodynamics	H
<b>Equilibrium</b>		
227. Write expressions for $K_p$ and $K_c$ for equilibrium reactions.	Chemical Equilibrium	H
228. Relate $K_p$ and $K_c$ ( $K_p = K_c(RT)^{\Delta n_g}$ ).	Chemical Equilibrium	H
229. Calculate $K_p$ or $K_c$ from equilibrium concentrations/pressures.	Chemical Equilibrium	H
230. Use ICE tables to find equilibrium concentrations.	Chemical Equilibrium	H
231. Apply Le Chatelier's principle (effect of conc, pressure, temp, inert gas).	Chemical Equilibrium	VH
232. Define acids/bases (Arrhenius, Bronsted-Lowry, Lewis).	Ionic Equilibrium	M
233. Calculate pH, pOH, $[H^+]$ , $[OH^-]$ for strong/weak acids/bases.	Ionic Equilibrium	VH
234. Use $K_a$ , $K_b$ , $pK_a$ , $pK_b$ values; relate $K_a * K_b = K_w$ .	Ionic Equilibrium	H

235. Calculate degree of dissociation ( $\alpha$ ).	Ionic Equilibrium	H
236. Calculate pH of buffer solutions (Henderson-Hasselbalch equation).	Ionic Equilibrium	H
237. Understand buffer action and buffer capacity.	Ionic Equilibrium	M
238. Calculate pH of salt solutions (hydrolysis of salts).	Ionic Equilibrium	H
239. Define solubility product ( $K_{sp}$ ); write $K_{sp}$ expressions.	Ionic Equilibrium	H
240. Calculate solubility ( $s$ ) from $K_{sp}$ , or $K_{sp}$ from solubility.	Ionic Equilibrium	H
241. Predict precipitation using ionic product ( $Q_{sp}$ ) vs $K_{sp}$ .	Ionic Equilibrium	M
242. Analyze effect of common ion on solubility.	Ionic Equilibrium	H

### Solutions

243. Define and calculate colligative properties: relative lowering of VP (Raoult's Law).	Solutions	H
244. Calculate elevation in boiling point ( $\Delta T_b = K_b \cdot m$ ).	Solutions	H
245. Calculate depression in freezing point ( $\Delta T_f = K_f \cdot m$ ).	Solutions	H
246. Calculate osmotic pressure ( $\pi = iCRT$ ).	Solutions	H
247. Determine molar mass of solute using colligative properties.	Solutions	H
248. Use van't Hoff factor ( $i$ ) to account for dissociation/association.	Solutions	H

### Electrochemistry

249. Balance redox reactions using oxidation number or ion-electron method.	Redox Reactions	M
250. Identify oxidizing/reducing agents; calculate oxidation numbers.	Redox Reactions	H
251. Construct and understand working of Galvanic/Electrochemical cells (notation).	Electrochemistry	H
252. Calculate standard cell potential ( $E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$ ).	Electrochemistry	H
253. Apply Nernst equation to find cell potential under non-standard conditions.	Electrochemistry	H
254. Relate $E^\circ_{\text{cell}}$ to $\Delta G^\circ$ and $K_{\text{eq}}$ .	Electrochemistry	H
255. Define conductivity, molar conductivity ( $\Lambda_m$ ), equivalent conductivity.	Electrochemistry	M
256. Analyze variation of conductivity/molar conductivity with concentration.	Electrochemistry	M
257. Apply Kohlrausch's law to find $\Lambda_m^\circ$ for weak electrolytes.	Electrochemistry	M
258. Apply Faraday's laws of electrolysis ( $w = ZIt$ ).	Electrochemistry	M
259. Predict products of electrolysis of aqueous solutions/molten salts.	Electrochemistry	M

### Chemical Kinetics

260. Define rate of reaction (average/instantaneous); write rate expressions.	Chemical Kinetics	H
261. Determine rate law, order of reaction, rate constant from experimental data.	Chemical Kinetics	H
262. Differentiate between order and molecularity.	Chemical Kinetics	M

263. Use integrated rate laws for zero-order and first-order reactions.	Chemical Kinetics	H
264. Calculate half-life ( $t_{1/2}$ ) for zero and first-order reactions.	Chemical Kinetics	H
265. Understand concepts of pseudo-first-order reactions.	Chemical Kinetics	M
266. Apply Arrhenius equation ( $k = Ae^{(-E_a/RT)}$ ); calculate activation energy ( $E_a$ ).	Chemical Kinetics	H
267. Understand effect of catalyst on activation energy and reaction rate.	Chemical Kinetics	M
268. Collision theory concepts (effective collisions, orientation factor).	Chemical Kinetics	L

### Surface Chemistry

269. Differentiate between physisorption and chemisorption.	Surface Chemistry	M
270. Understand factors affecting adsorption of gases on solids.	Surface Chemistry	M
271. Freundlich and Langmuir adsorption isotherms (basic concepts/graphs).	Surface Chemistry	L
272. Classify colloids (based on phases, interaction, particle type).	Surface Chemistry	M
273. Understand properties of colloids (Tyndall effect, Brownian movement, charge).	Surface Chemistry	M
274. Hardy-Schulze rule; coagulation; gold number.	Surface Chemistry	L

**Solid State** (Note: Reduced emphasis in recent syllabus, check current status)

275. Classify solids (crystalline/amorphous).	Solid State	L
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276. Identify types of unit cells (simple cubic, BCC, FCC); calculate atoms per unit cell.	Solid State	M
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277. Calculate packing efficiency for different unit cells.	Solid State	M
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278. Relate edge length (a), atomic radius (r), nearest neighbour distance.	Solid State	M
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279. Calculate density of crystal lattice ( $d = \frac{ZM}{a^3 \cdot N_A}$ ).	Solid State	M
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280. Identify types of crystal defects (Schottky, Frenkel).	Solid State	L
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### Classification of Elements & Periodicity

281. Explain trends in atomic radius, ionic radius across periods/groups.	Periodicity	H
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282. Explain trends in ionization enthalpy (factors affecting, exceptions).	Periodicity	H
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283. Explain trends in electron gain enthalpy (factors affecting, exceptions).	Periodicity	H
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284. Explain trends in electronegativity (Pauling scale).	Periodicity	H
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285. Relate periodic trends to metallic/non-metallic character, reactivity.	Periodicity	M
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### s, p, d, f Block Elements & Hydrogen (Focus on NCERT trends & reactions)

286. Compare properties (reactivity, hydration enthalpy etc.) of Alkali/Alkaline Earth metals.	s-Block	M
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287. Know preparation/properties/uses of important s-block compounds (NaOH, $\text{Na}_2\text{CO}_3$ , CaO, Plaster of Paris).	s-Block	M
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288. Explain diagonal relationships (Li-Mg, Be-Al).	s/p-Block	L
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289. Discuss structure/properties/reactions of Boron compounds (Diborane, Borax, Boric acid).	p-Block (Gp 13)	H
290. Explain inert pair effect in Group 13/14.	p-Block (Gp 13/14)	M
291. Discuss allotropes of Carbon (diamond, graphite, fullerene) & Silicon.	p-Block (Gp 14)	M
292. Know properties/uses of important Gp 14 compounds (Silicones, Silicates, CO, CO <sub>2</sub> ).	p-Block (Gp 14)	M
293. Discuss allotropes of Phosphorus; structure of PCl <sub>3</sub> , PCl <sub>5</sub> .	p-Block (Gp 15)	H
294. Know preparation/properties/structures of Oxoacids of Phosphorus.	p-Block (Gp 15)	H
295. Know preparation/properties of Ammonia (Haber's), Nitric Acid (Ostwald's).	p-Block (Gp 15)	M
296. Discuss allotropes of Sulphur; structure of SF <sub>4</sub> , SF <sub>6</sub> .	p-Block (Gp 16)	H
297. Know preparation/properties/structures of Oxoacids of Sulphur.	p-Block (Gp 16)	H
298. Know preparation/properties of Sulphuric Acid (Contact Process).	p-Block (Gp 16)	M
299. Compare properties (bond energy, oxidizing power, acidic strength) of Halogens.	p-Block (Gp 17)	H
300. Know preparation/properties/structures of Interhalogen compounds & Oxoacids of Halogens.	p-Block (Gp 17)	H
301. Explain anomalous behaviour of Fluorine/Oxygen/Nitrogen.	p-Block	M
302. Know uses of Noble Gases; structures of Xe compounds (XeF <sub>2</sub> , XeF <sub>4</sub> , XeF <sub>6</sub> , XeO <sub>3</sub> ).	p-Block (Gp 18)	H
303. Write electronic configurations of d-block elements.	d & f Block	H

304. Explain trends in properties of transition metals (atomic radii, IE, oxidation states, magnetic properties, color).	d & f Block	H
305. Explain catalytic properties and interstitial compound formation.	d & f Block	M
306. Know preparation/properties/reactions (esp. oxidizing action) of $\text{K}_2\text{Cr}_2\text{O}_7$ and $\text{KMnO}_4$ .	d & f Block	H
307. Write electronic configurations of Lanthanoids/Actinoids.	d & f Block	M
308. Explain Lanthanoid Contraction and its consequences.	d & f Block	M
309. Compare properties of Lanthanoids and Actinoids.	d & f Block	L
310. Preparation, properties, uses of Hydrogen; isotopes of Hydrogen.	Hydrogen	L
311. Structure of water, types of water hardness & removal methods.	Hydrogen	L
312. Structure, preparation, properties (oxidizing/reducing) of $\text{H}_2\text{O}_2$ .	Hydrogen	L

### Coordination Compounds

313. Define coordination terminology (ligand, coord number, complex ion etc.).	Coordination Compounds	H
314. Write IUPAC names of mononuclear coordination compounds.	Coordination Compounds	VH
315. Identify types of isomerism (geometrical, optical, linkage, coordination etc.).	Coordination Compounds	H
316. Apply Valence Bond Theory (VBT) to predict hybridization, geometry, magnetic properties.	Coordination Compounds	H
317. Explain Crystal Field Theory (CFT) - splitting in octahedral/tetrahedral fields.	Coordination Compounds	H



318. Calculate Crystal Field Stabilisation Energy (CFSE).	Coordination Compounds	M
319. Explain color and magnetic properties using CFT.	Coordination Compounds	H
320. Understand stability of coordination compounds (chelate effect).	Coordination Compounds	M

### **Metallurgy**

321. Identify common ores of Fe, Cu, Al, Zn.	Metallurgy	M
322. Understand principles of concentration (hydraulic washing, froth floatation etc.).	Metallurgy	M
323. Understand principles of extraction (calcination, roasting, smelting - C reduction).	Metallurgy	M
324. Explain self-reduction (Cu), electrolytic reduction (Al), cyanide process (Ag/Au).	Metallurgy	M
325. Understand principles of refining (distillation, liquation, electrolysis, zone refining, Mond's, van Arkel).	Metallurgy	M

### **Environmental Chemistry**

326. Identify major air pollutants (CO, SO <sub>2</sub> , NO <sub>x</sub> , particulates) and their sources/effects.	Environmental Chemistry	L
327. Understand concepts of Acid Rain, Smog (photochemical/classical), Ozone depletion, Greenhouse effect.	Environmental Chemistry	L
328. Identify major water pollutants (pathogens, organic waste - BOD, chemical).	Environmental Chemistry	L

### **Organic Chemistry - Basic Principles & Hydrocarbons**

329. Write IUPAC names for alkanes, alkenes, alkynes, cyclic, functionalized compounds.	Nomenclature	H
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330. Identify types of structural isomerism (chain, position, functional, metamerism).	Isomerism	H
331. Identify geometrical isomerism (cis/trans) in alkenes and cyclic compounds.	Isomerism	H
332. Identify optical isomerism (chiral centers, enantiomers, diastereomers, meso compounds).	Isomerism	H
333. Understand methods of purification (distillation, chromatography etc. - basic principles).	Purification	L
334. Qualitative/Quantitative analysis (Lassaigne's test, Kjeldahl's, Dumas - basic principles).	Analysis	L
335. Explain inductive effect, resonance (drawing structures), hyperconjugation.	General Organic Chem (GOC)	VH
336. Compare stability of reaction intermediates (carbocations, carbanions, free radicals).	General Organic Chem (GOC)	H
337. Identify electrophiles and nucleophiles.	General Organic Chem (GOC)	H
338. Compare acidic strength of alcohols, phenols, carboxylic acids, substituted versions.	General Organic Chem (GOC)	VH
339. Compare basic strength of amines (aliphatic vs aromatic, substituted).	General Organic Chem (GOC)	VH
340. Preparation of alkanes (Wurtz reaction, Kolbe's electrolysis, reduction).	Hydrocarbons	M
341. Mechanism of free radical halogenation of alkanes (selectivity).	Hydrocarbons	M
342. Preparation of alkenes (dehydration of alcohols, dehydrohalogenation - Saytzeff rule).	Hydrocarbons	H

343. Electrophilic addition to alkenes/alkynes (Halogenation, HX addition - Markovnikov rule).	Hydrocarbons	H
344. Hydroboration-oxidation of alkenes (Anti-Markovnikov hydration).	Hydrocarbons	H
345. Ozonolysis of alkenes/alkynes (predicting products/reactants).	Hydrocarbons	H
346. Acidity of terminal alkynes; preparation using alkynides.	Hydrocarbons	M
347. Structure of Benzene; concept of Aromaticity (Huckel's rule).	Hydrocarbons	H
348. Mechanism of Electrophilic Aromatic Substitution (Nitration, Halogenation, Sulphonation, Friedel-Crafts alkylation/acylation).	Hydrocarbons	VH
349. Effect of activating/deactivating groups on reactivity and orientation (ortho/para/meta directing).	Hydrocarbons	VH

#### **Organic Compounds Containing Halogens**

350. Preparation of haloalkanes (from alcohols, alkanes, alkenes).	Haloalkanes/Haloarenes	M
351. Preparation of haloarenes (electrophilic substitution, Sandmeyer reaction).	Haloalkanes/Haloarenes	M
352. Mechanism and factors affecting SN1 and SN2 reactions (substrate, nucleophile, solvent).	Haloalkanes/Haloarenes	H
353. Mechanism and factors affecting E1 and E2 reactions (Saytzeff/Hofmann elimination).	Haloalkanes/Haloarenes	H
354. Reactions of haloarenes (nucleophilic substitution - difficult conditions).	Haloalkanes/Haloarenes	M

#### **Alcohols, Phenols & Ethers**

355. Preparation of alcohols (hydration of alkenes, Grignard reagent, reduction of carbonyls).	Alcohols, Phenols, Ethers	H
356. Reactions of alcohols (dehydration, oxidation, esterification, reaction with HX/PX <sub>3</sub> ).	Alcohols, Phenols, Ethers	H
357. Distinguishing between 1°, 2°, 3° alcohols (Lucas test, oxidation).	Alcohols, Phenols, Ethers	M
358. Preparation of phenols (Dow's process, cumene process).	Alcohols, Phenols, Ethers	M
359. Acidity of phenols; effect of substituents.	Alcohols, Phenols, Ethers	H
360. Reactions of phenols (electrophilic sub - Br <sub>2</sub> , Nitration; Kolbe's, Reimer-Tiemann).	Alcohols, Phenols, Ethers	H
361. Preparation of ethers (Williamson synthesis).	Alcohols, Phenols, Ethers	H
362. Cleavage of ethers with HI.	Alcohols, Phenols, Ethers	M

### **Aldehydes, Ketones & Carboxylic Acids**

363. Preparation of aldehydes/ketones (oxidation of alcohols, ozonolysis, Rosenmund, Stephen, Friedel-Crafts acylation, Grignard + nitrile).	Aldehydes, Ketones, Acids	H
364. Mechanism of Nucleophilic Addition reactions (HCN, Grignard, alcohol, amine derivatives).	Aldehydes, Ketones, Acids	H
365. Important Name Reactions: Aldol condensation, Cross Aldol, Cannizzaro, Clemmensen/Wolff-Kishner reduction.	Aldehydes, Ketones, Acids	VH
366. Tests to distinguish Aldehydes & Ketones (Tollens', Fehling's, Iodoform).	Aldehydes, Ketones, Acids	H

367. Preparation of Carboxylic Acids (oxidation, hydrolysis of nitriles/esters).	Aldehydes, Ketones, Acids	M
368. Acidity of carboxylic acids; effect of substituents.	Aldehydes, Ketones, Acids	H
369. Reactions of carboxylic acids (reduction, decarboxylation, esterification, reaction with $\text{PCl}_5/\text{SOCl}_2$ , HVZ reaction).	Aldehydes, Ketones, Acids	H
370. Relative reactivity of carboxylic acid derivatives (acid chloride > anhydride > ester > amide).	Aldehydes, Ketones, Acids	M

### Organic Compounds Containing Nitrogen

371. Preparation of Amines (reduction of nitro/nitriles/amides, Gabriel phthalimide, Hofmann bromamide).	Amines	H
372. Basicity of amines in gaseous phase and aqueous solution; effect of substituents.	Amines	H
373. Reactions of amines (alkylation, acylation, carbylamine test, reaction with nitrous acid).	Amines	H
374. Electrophilic substitution in aniline (controlled reactions).	Amines	M
375. Preparation of Diazonium salts (diazotization).	Diazonium Salts	H
376. Reactions of Diazonium salts (Sandmeyer, Gattermann, replacement by $\text{H}/\text{OH}/\text{I}$ , coupling reactions).	Diazonium Salts	H

### Biomolecules

377. Classify carbohydrates (mono/oligo/polysaccharides); reducing/non-reducing sugars.	Biomolecules	H
378. Structures of Glucose, Fructose (open chain/cyclic - Haworth).	Biomolecules	H

379. Reactions of Glucose (confirming structure).	Biomolecules	M
380. Structure of Sucrose, Maltose, Lactose (glycosidic linkage).	Biomolecules	M
381. Structure of Starch, Cellulose, Glycogen (basic differences).	Biomolecules	M
382. Structure of Amino Acids (zwitterion, isoelectric point).	Biomolecules	M
383. Peptide bond formation; classify proteins (fibrous/globular); levels of structure ( $1^\circ/2^\circ/3^\circ/4^\circ$ - basic idea).	Biomolecules	M
384. Denaturation of proteins.	Biomolecules	L
385. Structure of Nucleotides, Nucleosides; basic structure of DNA/RNA (phosphodiester linkage).	Biomolecules	M
386. Vitamins: Classification (fat/water soluble), deficiency diseases (names).	Biomolecules	L

### **Polymers**

387. Classify polymers (source, structure, mode of polymerization, forces).	Polymers	H
388. Identify monomers of common addition polymers (Polythene, Teflon, PVC, Orlon, Polystyrene).	Polymers	H
389. Identify monomers of common condensation polymers (Nylon 6,6, Nylon 6, Dacron, Bakelite).	Polymers	H
390. Concept of natural rubber, vulcanization.	Polymers	M
391. Concept of biodegradable polymers (PHBV, Nylon 2-Nylon 6).	Polymers	L

### **Chemistry in Everyday Life**

392. Classify drugs (antacids, antihistamines, analgesics, tranquilizers, antibiotics etc.).	Chemistry in Everyday Life	M
393. Know examples for each class of drug mentioned in NCERT.	Chemistry in Everyday Life	M
394. Structure/action of soaps and detergents.	Chemistry in Everyday Life	M
395. Artificial sweetening agents, food preservatives (names/examples).	Chemistry in Everyday Life	L

### --- MATHEMATICS ---

#### Sets, Relations, Functions

396. Operations on sets (union, intersection, difference, complement); Venn diagrams.	Sets, Relations, Functions	M
397. Cardinality problems involving sets ( $A \cup B \cup C$ ).		
398. Identify types of relations (reflexive, symmetric, transitive, equivalence).	Sets, Relations, Functions	M
399. Identify types of functions (one-one, onto, into, many-one).	Sets, Relations, Functions	H
400. Find domain and range of functions (algebraic, rational, sqrt, log, trig, inverse trig).	Sets, Relations, Functions	H
401. Find composite functions (fog, gof) and inverse of a function.	Sets, Relations, Functions	M

#### Complex Numbers & Quadratic Equations

402. Perform algebra (add, sub, mul, div) with complex numbers in $a+ib$ form.	Complex Numbers	H
403. Find modulus, argument, conjugate of complex numbers.	Complex Numbers	H

404. Represent complex numbers in polar ( $r(\cos\theta + i\sin\theta)$ ) and Euler ( $re^{i\theta}$ ) forms.	Complex Numbers	H
405. Apply De Moivre's Theorem ( $(\cos\theta + i\sin\theta)^n = \cos(n\theta) + i\sin(n\theta)$ ).	Complex Numbers	M
406. Find cube roots / nth roots of unity and their properties.	Complex Numbers	M
407. Geometric interpretation (locus problems involving	$z - z_1$	$, \arg(z - z_1)$ .
408. Find roots of quadratic equations (using formula); nature of roots (discriminant).	Quadratic Equations	H
409. Use relations between roots and coefficients (sum/product of roots).	Quadratic Equations	H
410. Form quadratic equation given roots.	Quadratic Equations	M
411. Find common root(s) between two quadratic equations.	Quadratic Equations	M
412. Solve problems based on location of roots (conditions for roots $> k$ , $< k$ etc.).	Quadratic Equations	M
413. Find maximum/minimum value of quadratic expressions.	Quadratic Equations	M
<b>Matrices &amp; Determinants</b>		
414. Perform matrix addition, subtraction, scalar multiplication, matrix multiplication.	Matrices	H
415. Find transpose, symmetric, skew-symmetric matrices.	Matrices	M
416. Calculate determinant of 2x2 and 3x3 matrices.	Determinants	H
417. Apply properties of determinants to simplify calculations.	Determinants	VH
418. Find minors, cofactors, adjoint of a matrix.	Matrices & Determinants	H



419. Find inverse of a square matrix (using adjoint or elementary transformations).	Matrices & Determinants	H
420. Solve system of linear equations ( $Ax=B$ ) using matrix inverse method.	Matrices & Determinants	VH
421. Solve system of linear equations using Cramer's rule.	Matrices & Determinants	H
422. Determine consistency of system of equations (unique/infinite/no solution).	Matrices & Determinants	VH

### **Permutations & Combinations**

423. Apply Fundamental Principle of Counting.	Permutations & Combinations	H
424. Calculate permutations ( $nPr$ ) - arrangements of distinct/non-distinct objects.	Permutations & Combinations	H
425. Calculate combinations ( $nCr$ ) - selection of objects.	Permutations & Combinations	H
426. Solve problems involving distribution of objects into groups.	Permutations & Combinations	M
427. Solve problems involving circular permutations.	Permutations & Combinations	M
428. Find number of ways with restrictions (objects together/separated, gaps method).	Permutations & Combinations	H
429. Problems involving formation of numbers/words from digits/letters.	Permutations & Combinations	H

### **Binomial Theorem**

430. Expand $(x+y)^n$ using Binomial Theorem.	Binomial Theorem	H
431. Find general term ( $T_{r+1}$ ) in binomial expansion.	Binomial Theorem	H
432. Find middle term(s) in binomial expansion.	Binomial Theorem	H

433. Find term independent of $x$ or term containing a specific power of $x$ .	Binomial Theorem	H
434. Use properties of binomial coefficients ( $C_0 + C_1 + \dots + C_n = 2^n$ , etc.).	Binomial Theorem	M
435. Find sum of specific series involving binomial coefficients.	Binomial Theorem	M
436. Find numerically greatest term in expansion.	Binomial Theorem	L

### Sequences & Series

437. Find $n$ th term and sum of $n$ terms of an Arithmetic Progression (AP).	Sequences & Series	H
438. Find $n$ th term and sum of $n$ terms (finite/infinite) of a Geometric Progression (GP).	Sequences & Series	H
439. Find $n$ th term of a Harmonic Progression (HP).	Sequences & Series	M
440. Insert Arithmetic Means (AMs) / Geometric Means (GMs) between two numbers.	Sequences & Series	M
441. Use relation between AM and GM ( $AM \geq GM$ ).	Sequences & Series	M
442. Find sum of $n$ terms of Arithmetico-Geometric Progression (AGP).	Sequences & Series	M
443. Find sum of special series ( $\sum n$ , $\sum n^2$ , $\sum n^3$ ).	Sequences & Series	H
444. Find sum using method of differences ( $\nabla n$ method).	Sequences & Series	M

### Limits, Continuity & Differentiability

445. Evaluate limits using direct substitution, factorization, rationalization.	Limits, Continuity, Diff.	H
446. Evaluate limits using standard forms ( $\sin x/x$ , $(1+x)^{1/x}$ , $(a^x-1)/x$ etc.).	Limits, Continuity, Diff.	H

447. Evaluate limits using L'Hopital's Rule ( $0/0$ , $\infty/\infty$ forms).	Limits, Continuity, Diff.	VH
448. Evaluate limits using series expansions ( $e^x$ , $\log(1+x)$ , $\sin x$ etc.).	Limits, Continuity, Diff.	M
449. Check continuity of a function at a point ( $LHL=RHL=f(a)$ ).	Limits, Continuity, Diff.	H
450. Check continuity of piecewise defined functions.	Limits, Continuity, Diff.	H
451. Check differentiability of a function at a point ( $LHD=RHD$ ).	Limits, Continuity, Diff.	H
452. Check differentiability of functions involving modulus or max/min.	Limits, Continuity, Diff.	H
453. Relate continuity and differentiability.	Limits, Continuity, Diff.	M
<b>Methods of Differentiation</b>		
454. Differentiate using basic rules (sum, product, quotient).	Differentiation	H
455. Differentiate using Chain Rule.	Differentiation	H
456. Differentiate implicit functions.	Differentiation	M
457. Differentiate parametric functions.	Differentiation	M
458. Differentiate logarithmic functions (using log properties or $y = f(x)^{g(x)}$ ).	Differentiation	H
459. Differentiate inverse trigonometric functions.	Differentiation	M
460. Find second derivative ( $d^2y/dx^2$ ).	Differentiation	M
<b>Applications of Derivatives (AOD)</b>		
461. Find rate of change of quantities (related rates problems).	AOD	M

462. Find equations of tangent and normal to a curve at a given point.	AOD	H
463. Find angle between two curves.	AOD	M
464. Find intervals where a function is increasing/decreasing (monotonicity).	AOD	VH
465. Find critical points, local maxima, local minima (using first/second derivative test).	AOD	VH
466. Find absolute maximum/minimum value of a function in a closed interval.	AOD	H
467. Solve optimization problems (finding max/min values in word problems).	AOD	H
468. Rolle's Theorem and Lagrange's Mean Value Theorem (statement & application).	AOD	L

### **Indefinite Integration**

469. Integrate using standard formulas (algebraic, trig, exp, log).	Indefinite Integration	H
470. Integrate using substitution method (identifying appropriate substitution).	Indefinite Integration	VH
471. Integrate using trigonometric identities.	Indefinite Integration	H
472. Integrate using Integration by Parts (ILATE rule).	Indefinite Integration	H
473. Integrate rational functions using Partial Fractions.	Indefinite Integration	H
474. Integrate specific forms like $\int dx/(ax^2+bx+c)$ , $\int dx/\sqrt{(ax^2+bx+c)}$ , $\int (px+q)/(ax^2+bx+c) dx$ etc.	Indefinite Integration	H
475. Integrate forms like $\int \sqrt{(ax^2+bx+c)} dx$ .	Indefinite Integration	M

## Definite Integration

476. Evaluate definite integrals using Fundamental Theorem of Calculus ( $\int f(x)dx = F(b)-F(a)$ ).	Definite Integration	H
477. Apply properties of definite integrals ( $\int_a^b f(x) dx = \int_a^b f(t) dt$ , etc.).	Definite Integration	VH
478. Use property $\int_0^a f(x) dx = \int_0^a f(a-x) dx$ ("King" property).	Definite Integration	VH
479. Use property $\int_{-a}^a f(x) dx$ (even/odd function property).	Definite Integration	H
480. Evaluate definite integrals involving modulus function.	Definite Integration	M
481. Evaluate definite integrals involving greatest integer function.	Definite Integration	M
482. Evaluate definite integrals as limit of sums (less frequent).	Definite Integration	L
483. Differentiation under the integral sign (Leibniz rule).	Definite Integration	M

## Area Under Curves

484. Calculate area bounded by a curve and x-axis/y-axis.	Area Under Curves	H
485. Calculate area bounded by two curves.	Area Under Curves	H
486. Calculate area involving standard curves (lines, parabolas, circles, ellipses).	Area Under Curves	H

## Differential Equations

487. Determine order and degree of a differential equation.	Differential Equations	H
488. Form a differential equation from a given family of curves.	Differential Equations	M

489. Solve differential equations using Variable Separable method.	Differential Equations	H
490. Solve Homogeneous differential equations ( $y=vx$ substitution).	Differential Equations	H
491. Solve Linear differential equations ( $dy/dx + Py = Q$ ) using Integrating Factor.	Differential Equations	H
492. Solve problems involving application of DE (growth/decay - often physics link).	Differential Equations	L
<b>Coordinate Geometry (2D)</b>		
493. Use distance formula, section formula (internal/external), midpoint formula.	Straight Lines	M
494. Find area of triangle/quadrilateral given vertices.	Straight Lines	M
495. Find slope of a line; condition for parallel/perpendicular lines.	Straight Lines	H
496. Find equation of a line in various forms (slope-intercept, point-slope, two-point, intercept, normal).	Straight Lines	H
497. Find angle between two lines.	Straight Lines	H
498. Find distance of a point from a line; distance between parallel lines.	Straight Lines	H
499. Find equation of angle bisectors between two lines.	Straight Lines	M
500. Find image of a point with respect to a line.	Straight Lines	M
501. Problems related to centroid, orthocenter, circumcenter, incenter of a triangle.	Straight Lines	M
502. Find equation of circle given center/radius or general form.	Circles	H

503. Find center and radius from general equation of circle.	Circles	H
504. Find equation of tangent/normal to a circle at a given point or from external point.	Circles	H
505. Find condition for tangency (line to circle).	Circles	H
506. Find length of tangent from an external point to a circle.	Circles	M
507. Find equation of chord of contact, chord bisected at a point.	Circles	M
508. Find equation of radical axis; condition for orthogonality of circles.	Circles	L
509. Find equation of common tangents/common chords of two circles.	Circles	M
510. Find equation of parabola given focus/directrix/vertex.	Parabola	H
511. Identify vertex, focus, directrix, axis, latus rectum from standard equation.	Parabola	H
512. Find equation of tangent/normal to parabola (point, parametric, slope form).	Parabola	H
513. Find condition for tangency (line to parabola).	Parabola	H
514. Properties related to focal chord, focal distance.	Parabola	M
515. Find equation of ellipse given foci/vertices/eccentricity.	Ellipse	H
516. Identify center, foci, vertices, axes, directrices, eccentricity, latus rectum.	Ellipse	H
517. Find equation of tangent/normal to ellipse (point, parametric, slope form).	Ellipse	H

518. Find condition for tangency (line to ellipse).	Ellipse	H
519. Properties related to focal distance, director circle.	Ellipse	M
520. Find equation of hyperbola given foci/vertices/eccentricity.	Hyperbola	H
521. Identify center, foci, vertices, axes, directrices, eccentricity, latus rectum.	Hyperbola	H
522. Find equation of tangent/normal to hyperbola (point, parametric, slope form).	Hyperbola	H
523. Find condition for tangency (line to hyperbola).	Hyperbola	H
524. Find equations of asymptotes of a hyperbola.	Hyperbola	M
525. Concept of rectangular hyperbola.	Hyperbola	L

### **Vector Algebra**

526. Perform vector addition, subtraction, scalar multiplication.	Vector Algebra	H
527. Find magnitude, direction cosines/ratios of a vector.	Vector Algebra	H
528. Calculate dot product ( $\mathbf{a} \cdot \mathbf{b}$ ); find angle between vectors.	Vector Algebra	H
529. Find projection of one vector onto another.	Vector Algebra	H
530. Calculate cross product ( $\mathbf{a} \times \mathbf{b}$ ); find vector perpendicular to two vectors.	Vector Algebra	H
531. Calculate area of parallelogram/triangle using cross product.	Vector Algebra	H
532. Check collinearity of three points / coplanarity of four points using vectors.	Vector Algebra	M



533. Calculate Scalar Triple Product $[a \ b \ c] = a \cdot (b \times c)$ ; find volume of parallelepiped.	Vector Algebra	H
534. Properties of Scalar Triple Product ( $[a \ b \ c] = 0$ if coplanar).	Vector Algebra	H
535. Calculate Vector Triple Product $a \times (b \times c)$ .	Vector Algebra	M
<b>Three Dimensional Geometry</b>		
536. Find direction cosines/ratios of a line joining two points.	3D Geometry	H
537. Find equation of a line in vector and Cartesian forms (passing through point/two points).	3D Geometry	H
538. Find angle between two lines.	3D Geometry	H
539. Find shortest distance between two skew lines.	3D Geometry	VH
540. Find condition for intersection of two lines.	3D Geometry	M
541. Find equation of a plane in vector and Cartesian forms (normal form, intercept form, through 3 points).	3D Geometry	H
542. Find equation of plane passing through intersection of two planes.	3D Geometry	H
543. Check coplanarity of two lines.	3D Geometry	M
544. Find angle between two planes.	3D Geometry	H
545. Find angle between a line and a plane.	3D Geometry	H
546. Find distance of a point from a plane.	3D Geometry	H
547. Find distance between two parallel planes.	3D Geometry	M

548. Find image/foot of perpendicular from a point to a plane/line.	3D Geometry	H
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**Trigonometry**

549. Use fundamental trigonometric identities.	Trigonometric Ratios/Identities	M
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550. Use Allied angle formulas ( $\sin(90-\theta)$ , $\cos(180+\theta)$ etc.).	Trigonometric Ratios/Identities	M
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551. Use Compound angle formulas ( $\sin(A\pm B)$ , $\cos(A\pm B)$ , $\tan(A\pm B)$ ).	Trigonometric Ratios/Identities	H
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552. Use Multiple and Sub-multiple angle formulas ( $\sin 2A$ , $\cos 2A$ , $\tan 2A$ , $\sin(A/2)$ etc.).	Trigonometric Ratios/Identities	H
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553. Convert sum/difference into product (sum-to-product) and vice versa (product-to-sum).	Trigonometric Ratios/Identities	M
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554. Find maximum/minimum value of expressions like $a \cos \theta + b \sin \theta$ .	Trigonometric Ratios/Identities	M
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555. Find general solutions of trigonometric equations ( $\sin x = \sin \alpha$ , $\cos x = \cos \alpha$ etc.).	Trigonometric Equations	H
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556. Solve equations reducible to quadratic form in trig functions.	Trigonometric Equations	H
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557. Find principal value / domain / range of Inverse Trigonometric Functions (ITF).	Inverse Trig Functions	H
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558. Use properties of ITF ( $\sin^{-1}x + \cos^{-1}x = \pi/2$ , $\tan^{-1}x + \tan^{-1}y$ etc.).	Inverse Trig Functions	H
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559. Simplify expressions involving ITF (e.g., $\tan(\sin^{-1}x)$ ).	Inverse Trig Functions	H
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560. Solve equations involving ITF.	Inverse Trig Functions	H
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561. Solve problems involving heights and distances (angle of elevation/depression).	Heights & Distances	M
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**Statistics & Probability**

562. Calculate Mean, Median, Mode for ungrouped/grouped data.	Statistics	M
563. Calculate Mean Deviation about mean/median.	Statistics	L
564. Calculate Variance and Standard Deviation for ungrouped/grouped data.	Statistics	H
565. Analyze effect of changing observations on Mean and Variance/SD.	Statistics	H
566. Use basic probability definition ( $P(E) = n(E)/n(S)$ ).	Probability	H
567. Apply addition theorem of probability ( $P(A \cup B)$ ).	Probability	H
568. Calculate Conditional Probability ( $P(A B)$ ).	Probability	H
569. Apply multiplication theorem of probability; independent events.	Probability	H
570. Apply Theorem of Total Probability.	Probability	M
571. Apply Bayes' Theorem.	Probability	H
572. Define Probability Distribution of a random variable; find Mean (Expected Value).	Probability	M
573. Apply Binomial Distribution $P(X=r) = {}^nC_r \cdot p^r \cdot q^{n-r}$ ; find Mean ( $np$ ) and Variance ( $npq$ ).	Probability	H

**Mathematical Reasoning**

574. Identify statements, negation, compound statements (AND, OR, Implies).	Mathematical Reasoning	L
575. Construct truth tables for compound statements.	Mathematical Reasoning	L

576. Check for Tautology / Contradiction / Contingency.

Mathematical Reasoning

L

**Question Type / Specific Concept Tested**

**Topic/Chapter**

**Probability**

**--- PHYSICS (Continued) ---**

578. Calculate moment of inertia of composite bodies (e.g., disk with hole, rod+sphere).

Rotational Motion

H

579. Analyze collisions involving rotational motion (e.g., bullet hitting a rod).

Rotational Motion + Collisions

M

580. Determine angular velocity/KE change when moment of inertia changes (e.g., dancer).

Rotational Motion (Cons. Ang Mom)

H

581. Calculate gravitational potential/field due to non-uniform or partial bodies (arcs).

Gravitation

L

582. Problems involving binary star systems (time period, separation).

Gravitation

L

583. Calculate energy required to move a satellite between orbits.

Gravitation

M

584. Determine pressure difference using a manometer in fluid dynamics problems.

Fluids

M

585. Apply equation of continuity & Bernoulli to find efflux velocity (Torricelli).

Fluids

M

586. Calculate work done in forming a soap bubble or liquid drop (Surface Tension).

Surface Tension

M

587. Analyze energy distribution in spectrum of blackbody radiation (graphical).

Heat Transfer

M

588. Calculate rate of cooling involving both convection and radiation.

Heat Transfer

M

589. Find degrees of freedom for mixtures of gases.	KTG	M
590. Calculate efficiency of multi-stage or combined thermodynamic cycles.	Thermodynamics	L
591. Analyze P-V, V-T, P-T diagrams for thermodynamic cycles; calculate net work/heat.	Thermodynamics	H
592. Calculate entropy change for simple thermodynamic processes (isothermal, phase change).	Thermodynamics	L
593. Analyze superposition of SHMs (same/perpendicular directions, Lissajous figures - conceptual).	SHM	L
594. Find time period of oscillation for complex systems (e.g., liquid in U-tube, floating cylinder).	SHM	M
595. Calculate intensity of sound wave and relate it to decibel level.	Sound Waves	L
596. Analyze Doppler effect with reflection (echo).	Doppler Effect	M
597. Calculate electric field/potential inside/outside non-uniformly charged spheres/cylinders.	Electrostatics	L
598. Find force/potential energy between a point charge and a dipole.	Electrostatics	M
599. Analyze circuits with multiple capacitors and dielectrics inserted partially/fully.	Capacitance	H
600. Calculate force between plates of a parallel plate capacitor.	Capacitance	M
601. Find equivalent resistance of infinite ladder networks.	Current Electricity	M
602. Analyze circuits involving non-ideal batteries (internal resistance effects).	Current Electricity	H
603. Determine temperature coefficient of resistance from R vs T data.	Current Electricity	M

604. Calculate potential gradient in a potentiometer wire.	Electrical Instruments	H
605. Analyze sensitivity of potentiometer / meter bridge.	Electrical Instruments	M
606. Calculate magnetic field on the axis of a current carrying ring.	Magnetic Effects of Current	M
607. Use Ampere's law for thick wires or coaxial cables.	Magnetic Effects of Current	M
608. Analyze motion of charged particle in combined E and B fields (velocity selector).	Magnetic Effects of Current	M
609. Calculate Hall voltage (Hall Effect - conceptual understanding).	Magnetic Effects of Current	L
610. Calculate induced electric field due to time-varying magnetic field.	EMI	L
611. Analyze energy conservation in motional EMF problems (induced current power = external force power).	EMI	M
612. Calculate quality factor (Q-factor) of an LCR circuit.	AC Circuits	M
613. Analyze parallel AC circuits (less common than series).	AC Circuits	L
614. Calculate displacement current (Maxwell's equations - conceptual).	EM Waves	L
615. Calculate intensity and pressure exerted by EM waves.	EM Waves	L
616. Analyze deviation without dispersion / dispersion without deviation using prisms.	Ray Optics	L
617. Find image formation by combination of lenses and mirrors.	Ray Optics	H
618. Spherical aberration and chromatic aberration (qualitative understanding).	Ray Optics	L

619. Analyze interference in thin films (conditions for constructive/destructive).	Wave Optics	M
620. Determine resolving power of optical instruments (telescope, microscope).	Wave Optics	L
621. Calculate intensity in diffraction pattern (central max width, relative intensities).	Wave Optics	M
622. Analyze X-ray production (cutoff wavelength, characteristic X-rays).	Atoms	M
623. Moseley's Law relating X-ray frequency and atomic number.	Atoms	L
624. Calculate activity of radioactive sample after multiple half-lives or given time.	Nuclei	H
625. Carbon dating problems (using half-life of C-14).	Nuclei	L
626. Find Q-value of nuclear reactions using binding energies or masses.	Nuclei	M
627. Understand V-I characteristics of solar cells and photodiodes.	Semiconductors	L
628. Analyze transistor as an amplifier or oscillator (basic concepts, gain - less emphasized now).	Transistors	L
629. Calculate antenna height required for Line-of-Sight (LOS) communication.	Communication Systems	L
<b>--- CHEMISTRY (Continued) ---</b>		
630. Calculations involving normality and equivalent weight (especially in titrations).	Mole Concept	M
631. Determine oxidation state in unusual compounds (peroxides, superoxides, fractions).	Redox / Basic Concepts	H

632. Calculate number of radial and angular nodes for a given orbital.	Atomic Structure	M
633. Compare stability of resonance structures based on rules (octet, charge separation).	Chemical Bonding / GOC	H
634. Predict effect of H-bonding on properties like boiling point, solubility.	Chemical Bonding	M
635. Compare lattice energies of ionic compounds (using factors like charge, size).	Chemical Bonding	L
636. Calculate compressibility factor (Z) and understand its deviation implications.	States of Matter	M
637. Relate kinetic energy of gas molecules to RMS speed and temperature.	KTG	M
638. Calculate enthalpy of neutralization for strong/weak acids/bases.	Thermodynamics	M
639. Use Kirchhoff's equation relating $\Delta H$ variation with temperature ( $\Delta H_2 - \Delta H_1 = \Delta C_p(T_2 - T_1)$ ).	Thermodynamics	L
640. Calculate degree of dissociation/association using equilibrium constant $K_p/K_c$ .	Chemical Equilibrium	H
641. Determine pH of polyprotic acids/bases (stepwise dissociation).	Ionic Equilibrium	L
642. Apply simultaneous equilibrium concepts (e.g., solubility with complexation).	Ionic Equilibrium	L
643. Calculate indicator choice for acid-base titrations.	Ionic Equilibrium	L
644. Determine molality/molarity from density and mass percent of solution.	Solutions	H
645. Analyze deviations from Raoult's Law (positive/negative deviations, azeotropes).	Solutions	M



646. Construct and interpret titration curves (strong acid/base, weak acid/base).	Ionic Equilibrium / Titrations	M
647. Calculate potential of concentration cells using Nernst equation.	Electrochemistry	H
648. Determine order of reaction using graphical methods ( $\ln[A]$ vs $t$ , $1/[A]$ vs $t$ ).	Chemical Kinetics	H
649. Analyze kinetics of parallel or consecutive reactions (less common).	Chemical Kinetics	L
650. Understand mechanism steps and relate them to overall rate law (RDS).	Chemical Kinetics	M
651. Calculate EMF required for electrolysis or predict products based on potential.	Electrochemistry	M
652. Concepts of electrophoresis and electro-osmosis in colloids.	Surface Chemistry	L
653. Relate voids (tetrahedral/octahedral) to formula of compound in solid state.	Solid State	M
654. Calculate limiting radius ratio and predict coordination number.	Solid State	L
655. Compare ionic character using Fajan's rules.	Chemical Bonding	M
656. Understand structures of various silicates (ortho, pyro, cyclic, chain, sheet, 3D).	p-Block (Gp 14)	L
657. Disproportionation reactions involving P, S, Halogens.	p-Block	H
658. Magnetic moment calculation for d-block ions (spin-only formula).	d & f Block	H
659. Calculate Effective Atomic Number (EAN) in coordination compounds.	Coordination Compounds	L
660. Identify ligands based on denticity (mono, bi, polydentate, ambidentate).	Coordination Compounds	H

661. Explain stability differences between coordination isomers.	Coordination Compounds	M
662. Ellingham diagrams: predicting feasibility of reduction.	Metallurgy	L
663. Assign R/S configuration to chiral centers.	Isomerism (Organic)	H
664. Determine relationship between pairs of stereoisomers (enantiomers, diastereomers, identical).	Isomerism (Organic)	H
665. Calculate number of stereoisomers for a given structure.	Isomerism (Organic)	H
666. Compare heat of hydrogenation / combustion for isomeric alkenes/alkanes.	GOC / Hydrocarbons	M
667. Predict regioselectivity and stereochemistry of addition reactions (syn/anti addition).	Hydrocarbons	H
668. Aromaticity of non-benzenoid compounds (e.g., pyridine, pyrrole, furan, azulene).	Hydrocarbons / Heterocyclic	M
669. Compare reactivity of different positions in substituted benzene rings.	Hydrocarbons	H
670. Compare rates of SN1/SN2 reactions for different substrates/conditions.	Haloalkanes/Haloarenes	H
671. Stereochemical outcome of SN1 (racemization) and SN2 (inversion) reactions.	Haloalkanes/Haloarenes	H
672. Competition between Substitution (SN1/SN2) and Elimination (E1/E2).	Haloalkanes/Haloarenes	H
673. Pinacol-Pinacolone rearrangement mechanism.	Alcohols	L
674. Mechanism of esterification (acid catalyzed).	Alcohols / Carboxylic Acids	M
675. Perkin reaction, Knoevenagel condensation (less frequent name reactions).	Aldehydes, Ketones	L

676. Mechanism of Aldol condensation and Cannizzaro reaction.	Aldehydes, Ketones	H
677. Relative reactivity of aldehydes vs ketones towards nucleophilic addition.	Aldehydes, Ketones	H
678. Hofmann rearrangement, Curtius rearrangement, Schmidt reaction (amide conversions).	Amines / Carboxylic Acid Deriv.	L
679. Hinsberg test to distinguish 1°, 2°, 3° amines.	Amines	M
680. Mutarotation of Glucose.	Biomolecules	L
681. Determination of protein structure (primary structure - sequence).	Biomolecules	L
682. Difference between DNA and RNA structures.	Biomolecules	M
683. Calculate number-average and weight-average molecular mass of polymers; PDI.	Polymers	L
684. Identify thermosetting vs thermoplastic polymers based on structure.	Polymers	M
685. Match drugs with their therapeutic action category.	Chemistry in Everyday Life	M
686. Identify structure of common artificial sweeteners or food preservatives.	Chemistry in Everyday Life	L
<b>--- MATHEMATICS (Continued) ---</b>		
687. Problems involving properties of greatest integer function $[x]$ and fractional part $\{x\}$ .	Functions	M
688. Finding period of trigonometric and combined functions.	Functions	M
689. Locus problems involving complex numbers represented geometrically (circles, lines).	Complex Numbers	M

690. Transformation of quadratic equations (finding equation whose roots are $f(\alpha)$ , $f(\beta)$ ).	Quadratic Equations	M
691. Finding range of rational functions $y = (ax^2+bx+c)/(px^2+qx+r)$ .	Quadratic Equations / Functions	M
692. Properties of symmetric/skew-symmetric matrices ( $A+A^T$ , $A-A^T$ , $\det(A)$ ).	Matrices	M
693. Cayley-Hamilton Theorem (characteristic equation) application (finding $A^{-1}$ , $A^n$ ).	Matrices	L
694. Rank of a matrix (less common).	Matrices	L
695. Multinomial theorem application (finding coefficients).	Binomial Theorem	L
696. Derangements (number of ways to arrange such that no object is in original position).	Permutations & Combinations	L
697. Inclusion-Exclusion Principle in counting problems.	Permutations & Combinations	M
698. Summation of series involving combinations of AP and GP terms.	Sequences & Series	M
699. Evaluating limits involving indeterminate forms like $1^\infty$ , $0^0$ , $\infty^0$ .	Limits	H
700. Determining differentiability using the definition $\lim (f(a+h)-f(a))/h$ .	Differentiability	M
701. Finding approximate values using differentials ( $dy \approx f'(x)\Delta x$ ).	AOD	L
702. Point of inflection calculation and interpretation.	AOD	L
703. Integration of $\int e^x (f(x) + f'(x)) dx = e^x f(x) + C$ form.	Indefinite Integration	H
704. Walli's Formula for evaluating $\int_0^{\pi/2} \sin^n x \cos^m x dx$ (less common direct use).	Definite Integration	L

705. Finding area bounded by parametric curves.	Area Under Curves	L
706. Solving Bernoulli's differential equation (reducible to linear form).	Differential Equations	L
707. Finding orthogonal trajectories of a family of curves.	Differential Equations	L
708. Finding locus of a point related to lines (e.g., midpoint of intercept).	Straight Lines	M
709. Family of lines passing through intersection of two lines ( $L_1 + \lambda L_2 = 0$ ).	Straight Lines	M
710. Pair of straight lines: homogeneous equation, angle, bisectors, combined equation.	Straight Lines	L
711. Equation of circle passing through intersection of a line and a circle ( $S + \lambda L = 0$ ).	Circles	M
712. Equation of circle passing through intersection of two circles ( $S_1 + \lambda S_2 = 0$ ).	Circles	M
713. Director circle equation and properties for conic sections.	Conic Sections	M
714. Equation of chord of contact / chord bisected at a point for conics.	Conic Sections	M
715. Parametric coordinates and their use in locus problems for conics.	Conic Sections	H
716. Reflection properties of parabola, ellipse, hyperbola.	Conic Sections	L
717. Condition for coplanarity of vectors using Scalar Triple Product.	Vector Algebra	H
718. Geometrical interpretation of Vector Triple Product.	Vector Algebra	L
719. Shortest distance between parallel lines in 3D.	3D Geometry	M

720. Equation of plane containing two lines (intersecting or parallel).	3D Geometry	H
721. Finding intersection point of a line and a plane.	3D Geometry	H
722. Solving trigonometric inequalities.	Trigonometry	L
723. Summation of trigonometric series (C+iS method).	Trigonometry	L
724. Finding variance/SD of first n natural numbers.	Statistics	M

**--- PHYSICS (Further Extended) ---**

726. Dimensional analysis involving universal constants (G, h, c, $\epsilon_0$ ) to form a quantity with specific dimensions (e.g., length, time).	Units & Dimensions	M
727. Error analysis where intermediate calculations are needed before finding final error.	Error Analysis	M
728. Kinematics problem solvable by calculus (non-constant acceleration given as $f(t)$ or $f(x)$ ).	Kinematics + Calculus	H
729. Relative motion in 2D involving minimum distance calculation between two moving objects.	Kinematics + Vectors/Calculus	M
730. NLM problems involving impulse and momentum change during collisions or forces acting for short durations.	NLM + Impulse-Momentum	H
731. Work done by frictional forces on rough curved paths (using Work-Energy Theorem).	Work-Energy + Friction	M
732. Power delivered by variable forces or to objects moving with variable velocity.	Work-Energy-Power + Calculus	M
733. Conservation of energy in systems involving both gravitational and spring potential energy.	Work-Energy	H

734. Moment of Inertia calculation requiring integration for non-standard shapes or densities.	Rotational Motion + Calculus	L
735. Problems combining conservation of linear and angular momentum (e.g., object sticking to rotating disk).	Rotational Motion + Cons. Momentum	H
736. Rolling motion problems involving energy loss due to friction.	Rotational Motion + Work-Energy	M
737. Escape velocity calculation considering planetary rotation.	Gravitation	L
738. Geostationary satellite problems (finding height, conditions).	Gravitation	L
739. Fluid dynamics problem combining Bernoulli's principle with projectile motion (e.g., liquid from orifice).	Fluids + Kinematics	M
740. Heat conduction through composite shapes (cylindrical/spherical shells).	Heat Transfer	M
741. Thermodynamics: calculating $\Delta S$ for irreversible processes (using reversible path).	Thermodynamics	L
742. KTG: calculating ratio of specific heats ( $\gamma$ ) for gas mixtures.	KTG + Thermodynamics	M
743. SHM: Finding amplitude/frequency resulting from superposition of two SHMs.	SHM + Waves	M
744. Finding equation of standing wave given incident/reflected waves.	Waves	M
745. Doppler effect problems involving accelerating source/observer.	Doppler Effect + Kinematics	L
746. Electrostatics: Finding potential/field due to finite line charge or charged arc.	Electrostatics + Integration	M
747. Finding equilibrium position/stability of a charge placed near other fixed charges.	Electrostatics + Mechanics	H

748. Capacitors: Problems involving RC circuits with time constants (charging/discharging).	Capacitance + Current Electricity	H
749. Current Electricity: Finding equivalent resistance of circuits using symmetry arguments (folding/equipotential points).	Current Electricity	H
750. Problems involving variation of resistance/resistivity with temperature.	Current Electricity	M
751. Magnetic field calculation involving superposition from multiple sources (wires, loops).	Magnetic Effects of Current	H
752. Motion of charged particle in non-uniform magnetic field (qualitative or simple cases).	Magnetic Effects of Current	L
753. EMI: Calculating induced charge flow ( $\Delta Q = \Delta \Phi / R$ ).	EMI	M
754. EMI: Analyzing LR or LC oscillations (energy transfer between L and C).	EMI + AC Circuits	M
755. AC Circuits: Power calculations in circuits with multiple components (finding average power).	AC Circuits	H
756. Optics: Image formation involving refraction at multiple spherical surfaces.	Ray Optics	M
757. Optics: Problems involving apparent depth/shift due to multiple slabs or liquids.	Ray Optics	M
758. YDSE: Effect of inserting thin transparent sheet in front of one slit (fringe shift).	Wave Optics	H
759. YDSE: Finding wavelength using fringe width measurements.	Wave Optics (Numerical)	H
760. Photoelectric effect: Graph interpretation (Stopping potential vs freq, Current vs Intensity).	Dual Nature	H
761. Calculating recoil momentum/energy of atom during photon emission.	Atoms + Momentum Conservation	L



762. Nuclear Physics: Calculating number of alpha/beta particles emitted in a decay series.	Nuclei	M
763. Semiconductors: Finding voltage gain/current gain in a simple transistor circuit (if included).	Semiconductors	L
764. Logic Gates: Designing a simple logic circuit to achieve a specific truth table/Boolean expression.	Logic Gates	M

--- CHEMISTRY (Further Extended) ---

765. Stoichiometry involving percentage purity or percentage yield calculations.	Mole Concept	H
766. Titration problems involving normality/equivalents (acid-base, redox).	Mole Concept / Equilibrium / Redox	H
767. Problems based on Bohr model applied to $\text{He}^+$ , $\text{Li}^{2+}$ etc. ions.	Atomic Structure	H
768. Calculating shielding effect / effective nuclear charge (Slater's rules - less likely).	Atomic Structure / Periodicity	L
769. Comparing bond angles in molecules with lone pairs (using VSEPR accurately).	Chemical Bonding	VH
770. Comparing stability of molecules/ions using resonance energy concept.	Chemical Bonding / GOC	H
771. Applying van der Waals equation to calculate pressure/volume or constants a, b.	States of Matter	M
772. Relating thermodynamic parameters ( $\Delta H$ , $\Delta S$ , $\Delta G$ ) to spontaneity over different temperatures.	Thermodynamics	H
773. Calculating $K_p/K_c$ for reactions involving dissociation (e.g., $\text{PCl}_5$ , $\text{N}_2\text{O}_4$ ).	Chemical Equilibrium	H
774. Calculating pH of mixtures of acids/bases or amphoteric salts.	Ionic Equilibrium	H

775. Selective precipitation problems using $K_{sp}$ values.	Ionic Equilibrium	M
776. Determining molar mass from colligative properties involving abnormal molar mass (using 'i').	Solutions	H
777. Calculating $E_{cell}$ using Nernst equation for concentration cells or complex setups.	Electrochemistry	H
778. Relating limiting molar conductivity ( $\Lambda_m^\infty$ ) to ionic conductivities (Kohlrausch).	Electrochemistry	M
779. Determining order of reaction from integrated rate law graphs or half-life data.	Chemical Kinetics	H
780. Calculating time required for a certain fraction of reaction completion (1st order).	Chemical Kinetics	H
781. Explaining trends in periodic properties based on electronic configuration/shielding.	Periodicity	H
782. Reactions of p-block oxoacids (disproportionation, redox behaviour).	p-Block	H
783. Predicting products of hydrolysis of p-block halides ( $SiCl_4$ , $PCl_3$ , $PCl_5$ etc.).	p-Block	M
784. Explaining color of transition metal complexes using CFT (d-d transitions).	Coordination Compounds	H
785. Calculating magnetic moment (spin-only) for coordination compounds and correlating with geometry/ligand type.	Coordination Compounds	H
786. Matching ores with extraction processes or metals.	Metallurgy	M
787. Calculating number of stereoisomers (geometrical/optical) for coordination compounds.	Coordination Compounds	H
788. Determining absolute configuration (R/S) for molecules with multiple chiral centers.	Isomerism (Organic)	H

789. Identifying meso compounds or racemic mixtures from given structures.	Isomerism (Organic)	H
790. Comparing stability of alkenes based on heat of hydrogenation/combustion data.	GOC / Hydrocarbons	M
791. Multi-step organic synthesis problems involving sequence of reactions.	Organic Reactions (Multiple Chapters)	H
792. Predicting major product considering regioselectivity & stereochemistry in eliminations (E1/E2).	Haloalkanes / Alcohols	H
793. Identifying reactants/products based on named reactions (Aldol, Cannizzaro, Grignard, Wittig, etc.).	Aldehydes, Ketones, etc.	VH
794. Differentiating between functional groups using specific chemical tests (Lucas, Tollens', Fehling's, Iodoform, Carbylamine, Nitrous acid).	Functional Group Analysis	H
795. Comparing relative rates of electrophilic aromatic substitution based on activating/deactivating groups.	Hydrocarbons / Aromatic Compounds	H
796. Mechanism tracing involving carbocation rearrangements.	Organic Reaction Mechanisms	M
797. Identifying structure of monosaccharide (Glucose/Fructose) based on its reactions.	Biomolecules	M
798. Calculating isoelectric point (pI) of amino acids (simple cases).	Biomolecules	L
799. Identifying monomers from polymer structure or vice versa.	Polymers	H
800. Matching drug names with their specific examples or structures (NCERT focus).	Chemistry in Everyday Life	M

**--- MATHEMATICS (Further Extended) ---**

801. Solving inequalities involving modulus, greatest integer, or fractional part functions.	Functions / Inequalities	M
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802. Finding range of functions involving combinations of different function types.	Functions	H
803. Problems involving properties of roots of unity (sum, product, geometric representation).	Complex Numbers	M
804. Finding equation whose roots are related symmetrically to roots of given equation ( $\alpha/\beta$ , $\beta/\alpha$ ).	Quadratic Equations	M
805. Solving systems of linear equations with parameters; finding conditions for solutions.	Matrices & Determinants	VH
806. Using determinant properties to prove identities or solve equations ( $\det(A)=0$ ).	Determinants	H
807. Combinatorics problems involving distribution where objects or groups are identical/distinct.	Permutations & Combinations	M
808. Finding coefficient of $x^k$ in expansion of $(1+x+x^2\dots)^n$ or product of binomials.	Binomial Theorem	M
809. Telescoping series summation (method of differences).	Sequences & Series	M
810. Limits involving Sandwich Theorem (Squeeze Play Theorem).	Limits	L
811. Determining continuity/differentiability of functions defined by integrals (Leibniz rule).	Continuity/Diff. + Definite Integral	M
812. Finding maxima/minima in problems involving geometry (e.g., largest cone in sphere).	AOD + Geometry	H
813. Integration using substitutions involving trigonometric functions ( $t=\tan(x/2)$ ).	Indefinite Integration	M
814. Evaluating definite integrals using reduction formulae (less common).	Definite Integration	L
815. Finding area bounded by implicitly defined curves or regions.	Area Under Curves	M

816. Solving exact differential equations (if applicable).	Differential Equations	L
817. Locus problems involving parameters related to lines (variable lines).	Straight Lines	M
818. Finding equation of circle touching axes or other lines.	Circles	H
819. Problems involving family of circles ( $S + \lambda L = 0$ , $S_1 + \lambda S_2 = 0$ ).	Circles	M
820. Finding condition for normals / tangents from a point to a conic section.	Conic Sections	M
821. Locus problems involving tangents/normals to conics (e.g., point of intersection).	Conic Sections + Coordinate Geometry	H
822. Vector problems involving geometrical proofs (e.g., proving properties of quadrilaterals).	Vector Algebra	M
823. Problems involving volume related to Scalar Triple Product or finding if vectors are coplanar.	Vector Algebra	H
824. Finding equation of plane passing through a point and perpendicular to another plane/line.	3D Geometry	H
825. Finding coordinates of the image of a point in a line or a plane.	3D Geometry	H
826. Solving trigonometric equations involving inverse functions.	Trigonometry + ITF	H
827. Problems combining probability with permutations/combinations (e.g., probability of forming specific number/word).	Probability + P&C	H
828. Finding probability using geometrical arguments (length, area, volume).	Probability + Geometry	L
829. Calculating Variance/Mean of Binomial Distribution.	Probability + Statistics	H

--- PHYSICS (Deeper Dive) ---

831. Dimensional Analysis: Finding relation between quantities when proportionality constants have dimensions.	Units & Dimensions	L
832. Vernier/Screw Gauge: Problems involving volume/density calculation using measured dimensions.	Measurement + Basic Math	M
833. Kinematics: Motion analysis where acceleration is a function of velocity ( $a=f(v)$ ).	Kinematics + Differential Equations	M
834. Projectile Motion: Finding radius of curvature at the peak or other points of trajectory.	Projectile Motion + Circular Motion Concepts	L
835. NLM: Multi-pulley systems with accelerating supports or inclined planes.	NLM	M
836. Friction: Problems where direction of friction force changes during motion (e.g., block on turning table).	Friction + Circular Motion	M
837. Work-Energy: Calculating work done by pseudo forces in non-inertial frames.	Work-Energy + NLM	L
838. Collisions: Oblique impact of a sphere on a smooth surface (relating angles and 'e').	Collisions + Mechanics	L
839. Rotational Motion: Angular impulse calculation and its effect on angular momentum.	Rotational Motion	M
840. Rotational Motion: Stability analysis (e.g., condition for toppling of a block on accelerating truck).	Rotational Motion + NLM + Equilibrium	M
841. Gravitation: Potential energy calculation for systems of more than two masses.	Gravitation	M
842. Fluid Dynamics: Application of Venturi meter principle.	Fluids	L
843. Surface Tension: Energy changes when multiple small drops coalesce into a larger drop.	Surface Tension	M

844. Thermal Expansion: Effect of temperature on the time period of a simple pendulum (bimetallic strips).	Thermal Properties + SHM	L
845. Heat Transfer: Problems involving variable thermal conductivity $K(x)$ .	Heat Transfer + Calculus	L
846. Thermodynamics: Calculating efficiency of engines using non-standard cycles (e.g., Otto, Diesel - conceptual).	Thermodynamics	L
847. Thermodynamics: Mixing of two different ideal gases (calculating final temp, pressure, $\Delta S$ ).	Thermodynamics + KTG	M
848. SHM: Oscillation of a piston in a cylinder containing gas (adiabatic/isothermal process).	SHM + Thermodynamics	L
849. Waves: Intensity variation in standing waves on a string.	Waves	M
850. Sound Waves: Resonance tube experiments - calculating end correction.	Sound Waves	M
851. Electrostatics: Finding electric field/potential inside a cavity within a conductor/insulator .	Electrostatics	M
852. Electrostatics: Method of image charges for simple cases (charge near conducting plane).	Electrostatics (Advanced concept)	L
853. Capacitance: Circuits involving charging/discharging with multiple time constants (multiple $R/C$ ).	Capacitance + Current Electricity	M
854. Current Electricity: Potentiometer used to calibrate an ammeter or voltmeter.	Electrical Instruments	M
855. Current Electricity: Maximum power transfer theorem application in DC circuits.	Current Electricity	L
856. Magnetic Effects: Force/Torque on a magnetic dipole (bar magnet) in a non-uniform $B$ field.	Magnetism	L

857. Magnetic Effects: Betatron principle (induced E field acceleration - conceptual).	EMI	L
858. EMI: Eddy currents concept and applications (damping, induction furnace).	EMI	L
859. AC Circuits: Analyzing RLC circuits using complex impedance (phasor algebra).	AC Circuits	M
860. AC Circuits: Resonance in parallel LCR circuits.	AC Circuits	L
861. EM Waves: Poynting vector calculation and interpretation (energy flow direction).	EM Waves	L
862. Ray Optics: Lens displacement method for finding focal length.	Ray Optics (Experiment based)	L
863. Ray Optics: Thick lens formula application (less common).	Ray Optics	L
864. Wave Optics: Coherence requirements for interference (temporal/spatial).	Wave Optics (Conceptual)	L
865. Wave Optics: Diffraction grating principles (condition for maxima, resolving power).	Wave Optics	L
866. Dual Nature: Davisson-Germer experiment interpretation (electron diffraction).	Dual Nature (Conceptual)	L
867. Atoms: Fine structure concept (qualitative).	Atoms	L
868. Nuclei: Radioactive equilibrium (secular/transient).	Nuclei	L
869. Nuclei: Estimating age using radioactive isotopes other than Carbon-14.	Nuclei	L
870. Semiconductors: Understanding energy band diagrams for biased p-n junctions.	Semiconductors	M



--- CHEMISTRY (Deeper Dive) ---

871. Mole Concept: Calculations involving POAC (Principle of Atom Conservation).	Mole Concept	M
872. Mole Concept: Eudiometry problems (volume analysis of gaseous reactions).	Mole Concept + States of Matter	M
873. Atomic Structure: Calculating probability density ( $\psi^2$ ) or radial probability at a distance $r$ .	Atomic Structure (Quantum Mech.)	L
874. Chemical Bonding: Bent's rule application (bond angles/lengths with electronegativity).	Chemical Bonding	L
875. Chemical Bonding: Bridge bonding concept (e.g., in Diborane).	Chemical Bonding	M
876. States of Matter: Calculating collision frequency and mean free path.	KTG	L
877. Thermodynamics: Born-Haber cycle calculations for lattice enthalpy.	Thermodynamics + Bonding	M
878. Thermodynamics: Calculating $\Delta S$ for mixing ideal gases.	Thermodynamics	M
879. Equilibrium: Relationship between $K_p$ , $K_c$ , $K_x$ (mole fraction based constant).	Chemical Equilibrium	M
880. Equilibrium: Effect of temperature on $K_{eq}$ (van't Hoff equation: $d(\ln K)/dT = \Delta H^\circ/RT^2$ ).	Chemical Equilibrium + Thermo	M
881. Ionic Equilibrium: pH calculation of solutions containing salts of weak acid & weak base.	Ionic Equilibrium	H
882. Ionic Equilibrium: Solubility calculation in presence of complexing agents.	Ionic Equilibrium	L
883. Solutions: Reverse osmosis calculation and applications.	Solutions	L

884. Electrochemistry: Calculating thermodynamic efficiency of fuel cells.	Electrochemistry	L
885. Electrochemistry: Overpotential concept in electrolysis.	Electrochemistry	L
886. Chemical Kinetics: Kinetics of enzyme-catalyzed reactions (Michaelis-Menten - basic idea).	Chemical Kinetics	L
887. Chemical Kinetics: Temperature coefficient of reaction rate.	Chemical Kinetics	M
888. Surface Chemistry: BET equation for multilayer adsorption (conceptual).	Surface Chemistry	L
889. Solid State: Calculating distance between planes using Miller indices ( $d=a/\sqrt{(h^2+k^2+l^2)}$ ).	Solid State	L
890. Solid State: Relating density to defects (effect of Schottky/Frenkel defects on density).	Solid State	L
891. Periodicity: Calculating electronegativity using Allred-Rochow or Mulliken scales (less common).	Periodicity	L
892. p-Block: Structures and bonding in Oxides of Nitrogen ( $N_2O$ , $NO$ , $N_2O_3$ , $NO_2$ , $N_2O_4$ , $N_2O_5$ ).	p-Block (Gp 15)	M
893. p-Block: Structure and properties of Caro's acid ( $H_2SO_5$ ) and Marshall's acid ( $H_2S_2O_8$ ).	p-Block (Gp 16)	M
894. d-Block: Disproportionation reactions of $Cu^+$ , $MnO_4^{2-}$ etc.	d-Block	M
895. Coordination Compounds: Synergic bonding in metal carbonyls.	Coordination Compounds	M
896. Coordination Compounds: Jahn-Teller distortion (effect on geometry/splitting - qualitative).	Coordination Compounds	L
897. Metallurgy: Thermodynamic principles applied to Ellingham diagrams (predicting reducing agent).	Metallurgy + Thermodynamics	M

898. Isomerism (Organic): Concept of atropisomerism (restricted rotation).	Isomerism (Organic)	L
899. GOC: Application of Hammond's postulate (relating transition state structure to stability).	GOC	L
900. GOC: Kinetic vs Thermodynamic control in reactions (e.g., addition to conjugated dienes).	GOC / Hydrocarbons	M
901. Hydrocarbons: Birch reduction mechanism and products.	Hydrocarbons	L
902. Haloalkanes: S <sub>N</sub> i (Substitution Nucleophilic internal) mechanism (e.g., reaction with SOCl <sub>2</sub> ).	Haloalkanes / Alcohols	L
903. Alcohols: Oxidation using specific reagents (PCC, Collins reagent, Jones reagent).	Alcohols	M
904. Aldehydes/Ketones: Wittig reaction mechanism and application.	Aldehydes, Ketones	M
905. Aldehydes/Ketones: Baeyer-Villiger oxidation.	Aldehydes, Ketones	L
906. Carboxylic Acids: Arndt-Eistert synthesis (acid homologation).	Carboxylic Acids	L
907. Amines: Cope elimination mechanism.	Amines	L
908. Amines: Electrophilic substitution on pyridine vs pyrrole vs benzene.	Amines / Heterocyclic	M
909. Biomolecules: Kiliani-Fischer synthesis (carbohydrate chain lengthening).	Biomolecules	L
910. Biomolecules: Edman degradation or Sanger's reagent for N-terminal analysis of peptides.	Biomolecules	L
911. Polymers: Ziegler-Natta catalyst application in polymerization.	Polymers	L
912. Chemistry in Everyday Life: Structure recognition of specific drugs mentioned in NCERT (e.g., aspirin, paracetamol).	Chem in Everyday Life	M

--- MATHEMATICS (Deeper Dive) ---

913. Functions: Checking periodicity of composite functions or sum/difference of functions.	Functions	M
914. Functions: Solving functional equations (simple types like $f(x+y)=f(x)+f(y)$ ).	Functions	L
915. Complex Numbers: Geometry involving rotation of complex numbers ( $z_2 - z_0 = (z_1 - z_0)e^{i\theta}$ ).	Complex Numbers	M
916. Quadratic Eqns: Condition for quadratic expression to be positive/negative for all x.	Quadratic Equations	H
917. Quadratic Eqns: Finding range of expressions involving roots of a quadratic equation.	Quadratic Equations	M
918. Matrices: Finding rank of a matrix using row echelon form.	Matrices	L
919. Matrices: Properties of orthogonal matrices ( $AA^T = I$ ).	Matrices	L
920. P&C: Number of non-negative/positive integral solutions of linear equations (Beggar's method).	Permutations & Combinations	H
921. P&C: Generating functions application (simple cases).	Permutations & Combinations	L
922. Binomial Theorem: Finding sum of series involving product of binomial coefficients.	Binomial Theorem	L
923. Binomial Theorem: Application to approximations ( $(1+x)^n \approx 1+nx$ for small x).	Binomial Theorem	L
924. Sequences & Series: Use of inequalities ( $AM \geq GM \geq HM$ ) to find max/min values.	Sequences & Series	M
925. Limits: Evaluating limits of the form $f(x)^{g(x)}$ using logarithmic limit method.	Limits	H

926. Limits: Existence of limit for piecewise functions at boundary points.	Limits	H
927. Continuity/Diff: Differentiability implying continuity, but not vice-versa (counterexamples).	Continuity & Differentiability	M
928. AOD: Lagrange's Mean Value Theorem application to prove inequalities.	AOD	L
929. AOD: Concavity/convexity determination using second derivative.	AOD	M
930. Indefinite Integration: Integration by parts involving $\int \sec^3 x \, dx$ or similar types.	Indefinite Integration	M
931. Definite Integration: Gamma function definition and properties (basic).	Definite Integration (Advanced)	L
932. Definite Integration: Proving inequalities using properties of definite integrals.	Definite Integration	L
933. Area Under Curves: Finding area using polar coordinates (Area = $\frac{1}{2} \int r^2 \, d\theta$ ).	Area Under Curves (Advanced)	L
934. Differential Equations: Clairaut's equation form and solution.	Differential Equations (Advanced)	L
935. Straight Lines: Finding equation of line passing through a point and making a given angle with another line.	Straight Lines	M
936. Circles: Condition for a line to be a tangent to a circle using perpendicular distance from center.	Circles	H
937. Circles: Finding locus related to variable circles (e.g., center locus).	Circles	M
938. Conics: Equation of pair of tangents from an external point ( $SS_1 = T^2$ ).	Conic Sections	M
939. Conics: Equation of chord joining two points (parametric form) on a conic.	Conic Sections	M

940. Conics: Auxiliary circle and eccentric angle properties for ellipse/hyperbola.	Conic Sections	M
941. Vector Algebra: Vector equation of angle bisectors.	Vector Algebra	L
942. Vector Algebra: Application of vectors to prove theorems in geometry (Apollonius, etc.).	Vector Algebra	L
943. 3D Geometry: Equation of sphere in various forms.	3D Geometry	L
944. 3D Geometry: Finding the equation of a plane bisecting the angle between two planes.	3D Geometry	M
945. 3D Geometry: Projection of a line segment on another line or a plane.	3D Geometry	M
946. Trigonometry: Finding solutions of trigonometric equations within a specific interval.	Trigonometric Equations	H
947. Trigonometry: Summation of series involving $\sin(a)$ , $\sin(a+d)$ ... or $\cos(a)$ , $\cos(a+d)$ ...	Trigonometry	L
948. ITF: Simplifying complex expressions involving sums/differences of inverse trig functions.	Inverse Trig Functions	H
949. Probability: Problems involving geometric probability.	Probability	L
950. Probability: Expectation and Variance of probability distributions.	Probability	M

### Top 100 Must-Know Concepts/Question Types for JEE Main

#### PHYSICS (Approx. 34)

- **Mechanics (Units, Kinematics, NLM, WEP, Rotation, Gravitation, SHM)**
  1. Dimensional Analysis (Checking correctness, deriving relations).

2. Kinematics Graphs (v-t, x-t, a-t): Interpretation, calculating displacement/velocity/acceleration.
  3. Projectile Motion (Range, Height, Time of Flight - level ground).
  4. Newton's Laws Application: Connected blocks, pulleys, inclined planes (with friction).
  5. Work-Energy Theorem: Applying  $W_{\text{net}} = \Delta KE$ .
  6. Conservation of Mechanical Energy (Gravity + Springs).
  7. Collisions (1D Elastic & Inelastic): Finding final velocities, loss in KE.
  8. Moment of Inertia: Calculation using standard formulae + Parallel/Perpendicular Axis Theorems.
  9. Rotational Dynamics: Applying  $\tau = I\alpha$  and Conservation of Angular Momentum ( $L = I\omega$ ).
  10. Rolling Motion (Pure rolling condition, Energy, Acceleration on incline).
  11. Simple Harmonic Motion (SHM): Equation (x, v, a), Time period (spring-mass, simple pendulum).
- - **Heat & Thermodynamics**
    12. Heat Transfer: Conduction through composite rods/slabs (series/parallel).
    13. Heat Transfer: Stefan-Boltzmann Law & Wien's Displacement Law (Blackbody Radiation).
    14. Thermodynamics: First Law application ( $\Delta U = Q - W$ ) in various processes.
    15. Thermodynamics: Calculating Work Done in Isobaric, Isothermal, Adiabatic processes.
    16. Thermodynamics: Efficiency of Carnot Engine.
  - **Electromagnetism (Electrostatics, Current, Magnetism, EMI, AC)**
    17. Electrostatics: Calculating E-field & Potential (Point charges, Dipoles - axial/equatorial).
    18. Electrostatics: Gauss's Law application (Sphere, Cylinder, Sheet).
    19. Capacitors: Equivalent Capacitance (Series, Parallel, Wheatstone-like).
    20. Capacitors: Energy Stored, Effect of Dielectrics (Battery connected/disconnected).
    21. Current Electricity: Kirchhoff's Laws (KVL/KCL) application to solve circuits.
    22. Current Electricity: Equivalent Resistance (Series, Parallel, Complex networks).
    23. Current Electricity: Potentiometer (Comparing EMF, Internal Resistance).
    24. Current Electricity: Meter Bridge (Finding unknown resistance).
    25. Magnetic Field Calculation: Biot-Savart Law (Straight wire, Circular loop/arc).
    26. Magnetic Field Calculation: Ampere's Law (Long wire, Solenoid).
    27. Magnetic Force: On moving charge ( $F = q(v \times B)$ ), on current-carrying wire ( $F = I(L \times B)$ ).
    28. Electromagnetic Induction (EMI): Faraday's Law ( $\epsilon = -d\Phi/dt$ ) & Lenz's Law.
    29. EMI: Motional EMF ( $\epsilon = Blv$ ).
    30. Alternating Current (AC): LCR Series Circuits (Impedance, Resonance Frequency,

Phase Angle).

31. AC Circuits: Power Factor and Average Power calculation.

- **Optics**

32. Ray Optics: Lens Formula & Mirror Formula application, Magnification.

33. Ray Optics: Combination of Lenses/Mirrors.

34. Wave Optics: Young's Double Slit Experiment (YDSE) - Fringe width, Position of fringes, Intensity pattern basics.

- **Modern Physics & Semiconductors**

35. Dual Nature: Photoelectric Effect Equation ( $K_{\text{Emax}} = hf - \phi$ ), calculating threshold freq/work function.

36. Atoms: Bohr Model calculations (Energy levels, Radius - H-like atoms).

37. Atoms: Spectral Lines calculation using Rydberg formula.

38. Nuclei: Binding Energy calculation (Mass defect,  $E=mc^2$ ).

39. Nuclei: Radioactive Decay Law ( $N=N_0e^{-\lambda t}$ ), Half-life calculations.

40. Semiconductor Electronics: Logic Gates (Identifying output of combinations - AND, OR, NOT, NAND, NOR).

## **CHEMISTRY (Approx. 34)**

- **Physical Chemistry**

41. Mole Concept: Stoichiometry, Limiting Reagent calculations.

42. Mole Concept: Concentration Terms (Molarity, Molality, Mole Fraction).

43. Atomic Structure: Quantum Numbers (valid sets), Electronic Configuration writing.

44. Chemical Bonding: VSEPR Theory (Predicting Geometry & Hybridization).

45. Chemical Bonding: Molecular Orbital Theory (Bond order, Magnetism - diatomics like  $N_2$ ,  $O_2$ ,  $F_2$ ).

46. Chemical Bonding: Dipole Moment comparison.

47. Thermodynamics (Chemical): Calculating  $\Delta H$ ,  $\Delta U$ ,  $\Delta G$ ,  $\Delta S$  for reactions (using Hess's Law,  $\Delta G = \Delta H - T\Delta S$ ,  $\Delta G^\circ = -RT\ln K$ ).

48. Equilibrium: Calculating  $K_p$ ,  $K_c$ ; Relation between  $K_p$  &  $K_c$ .

49. Equilibrium: Le Chatelier's Principle application (Effect of Conc, Pressure, Temp).

50. Ionic Equilibrium: pH calculations (Strong/Weak Acids/Bases, Buffers - Henderson-Hasselbalch).

51. Ionic Equilibrium: Solubility Product ( $K_{sp}$ ) calculation and relation to solubility (s).

52. Solutions: Colligative Properties Calculation (using  $\Delta T_b = K_b m$ ,  $\Delta T_f = K_f m$ ,  $\pi = iCRT$ , Raoult's Law).

53. Solutions: Van't Hoff factor (i) application in colligative properties.

54. Electrochemistry: Nernst Equation application (calculating  $E_{\text{cell}}$ ).



55. Electrochemistry: Relation between  $E^\circ_{\text{cell}}$ ,  $\Delta G^\circ$ , and  $K_{\text{eq}}$ .
56. Chemical Kinetics: Determining Rate Law, Order, Rate Constant from experimental data.
57. Chemical Kinetics: Integrated Rate Laws (Zero & First order), Half-life calculations.
58. Chemical Kinetics: Arrhenius Equation (Calculating  $E_a$ , effect of T on k).

- **Inorganic Chemistry**

59. Classification & Periodicity: Trends in Radius, Ionization Enthalpy, Electronegativity.
60. Chemical Bonding: (Covered in Physical - VSEPR, MOT, Dipole Moment).
61. p-Block Elements (Gr 15-18): Structures of Oxoacids (P, S, Halogens -  $\text{H}_3\text{PO}_4$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HClO}_4$  etc.).
62. p-Block Elements (Gr 15-18): Properties/Reactions of important compounds (Ammonia, Nitric Acid, Ozone,  $\text{SO}_2$ ,  $\text{H}_2\text{SO}_4$ , Interhalogens, Xe compounds like  $\text{XeF}_2$ ,  $\text{XeF}_4$ ).
63. d & f Block Elements: Electronic Configuration, Properties (Oxidation states, Magnetic moment, Color).
64. d & f Block Elements: Reactions involving  $\text{KMnO}_4$  and  $\text{K}_2\text{Cr}_2\text{O}_7$  (Oxidizing action).
65. Coordination Compounds: IUPAC Nomenclature.
66. Coordination Compounds: Isomerism (Geometrical, Optical, Linkage).
67. Coordination Compounds: Bonding Theories (VBT - Hybridization/Geometry/Magnetism; CFT - Splitting in octahedral/tetrahedral, Color/Magnetism).

- **Organic Chemistry**

68. Nomenclature & Isomerism: IUPAC Naming, Identifying Structural & Stereoisomers (Geometrical/Optical).
69. General Organic Chemistry (GOC): Electronic Effects (Inductive, Resonance, Hyperconjugation).
70. GOC: Comparing Acidic/Basic Strength (Alcohols, Phenols, Carb. Acids, Amines).
71. GOC: Stability of Reaction Intermediates (Carbocations, Carbanions, Free Radicals).
72. Hydrocarbons: Electrophilic Addition to Alkenes/Alkynes (Markovnikov Rule, Halogenation).
73. Hydrocarbons: Electrophilic Aromatic Substitution (Nitration, Halogenation, Friedel-Crafts - Mechanism, Directing Effects).
74. Haloalkanes & Haloarenes:  $\text{SN}_1$  &  $\text{SN}_2$  Reactions (Mechanism, Factors affecting, Stereochemistry).
75. Haloalkanes & Haloarenes:  $\text{E}_1$  &  $\text{E}_2$  Reactions (Mechanism, Saytzeff Rule).
76. Alcohols, Phenols & Ethers: Important Name Reactions (Kolbe's, Reimer-Tiemann, Williamson Synthesis).
77. Alcohols, Phenols & Ethers: Acidity comparison (Phenols vs Alcohols).
78. Aldehydes, Ketones & Carb. Acids: Nucleophilic Addition Mechanism.
79. Aldehydes, Ketones & Carb. Acids: Important Name Reactions (Aldol Condensation,

Cannizzaro Reaction, Grignard reagent addition).

80. Aldehydes, Ketones & Carb. Acids: Tests to distinguish Aldehydes/Ketones (Tollens', Fehling's).

81. Organic Compounds containing Nitrogen: Basicity of Amines comparison.

82. Organic Compounds containing Nitrogen: Reactions involving Diazonium Salts (Sandmeyer, Coupling).

83. Biomolecules: Structures of Glucose, Fructose; Concept of Anomers, Glycosidic linkage.

84. Polymers: Identifying Monomers of common Addition/Condensation Polymers (Polythene, PVC, Nylon, Dacron, Bakelite).

### **MATHEMATICS (Approx. 33)**

- **Algebra (Sets, Complex, Quadratic, Matrices, P&C, Binomial, Seq/Series, Probability)**

85. Complex Numbers: Algebra, Modulus, Argument, Polar/Euler form.

86. Quadratic Equations: Nature of Roots (Discriminant), Relation between roots & coefficients.

87. Matrices & Determinants: Properties of Determinants (Evaluation).

88. Matrices & Determinants: Inverse of a Matrix calculation (Adjoint method).

89. Matrices & Determinants: Solving System of Linear Equations (Matrix Inverse/Cramer's Rule/Consistency Check).

90. Permutations & Combinations: Arrangements & Selections ( $nPr$ ,  $nCr$ ), problems with restrictions.

91. Binomial Theorem: Finding General Term, Middle Term, Term independent of  $x$ .

92. Sequences & Series:  $n$ th term & Sum of  $n$  terms for AP & GP.

93. Sequences & Series: Sum of special series ( $\sum n$ ,  $\sum n^2$ ,  $\sum n^3$ ).

94. Probability: Basic Probability, Addition Theorem, Conditional Probability ( $P(A|B)$ ).

95. Probability: Bayes' Theorem application.

96. Probability: Binomial Distribution ( $P(X=r) = nCr p^r q^{n-r}$ ).

- **Calculus (Limits, Continuity, Diff, AOD, Integration, Area, DE)**

97. Limits: Evaluating limits using standard forms & L'Hopital's Rule.

98. Continuity & Differentiability: Checking at a point (especially for piecewise/modulus functions).

99. Applications of Derivatives (AOD): Finding Maxima & Minima (First/Second Derivative Test).

100. AOD: Finding Tangents & Normals to curves.

101. AOD: Determining Intervals of Increasing/Decreasing (Monotonicity).

102. Indefinite Integration: Using standard formulae, Substitution, Integration by Parts.

103. Definite Integration: Applying Properties of Definite Integrals (esp. King Property:  $\int_a^a f(x)dx = 0$ ).

$$f(x)dx = \int_0^a f(a-x)dx.$$

104. Area Under Curves: Calculating area bounded by simple curves (lines, parabola, circle).

105. Differential Equations: Solving using Variable Separable method.

106. Differential Equations: Solving Linear Differential Equations (Integrating Factor method).

- **Coordinate Geometry**

107. Straight Lines: Finding equation (various forms), Angle between lines, Distance formulae.

108. Circles: Finding equation, Tangent/Normal equations.

109. Parabola: Standard Equation, Identifying parameters (focus, directrix), Tangent equation.

110. Ellipse: Standard Equation, Identifying parameters (foci, vertices, eccentricity), Tangent equation.

111. Hyperbola: Standard Equation, Identifying parameters (foci, vertices, eccentricity), Tangent equation.

- **Vector Algebra & 3D Geometry**

112. Vector Algebra: Dot Product & Cross Product (Calculation & applications - angle, projection, area).

113. Vector Algebra: Scalar Triple Product (Calculation & application - volume, coplanarity).

114. 3D Geometry: Equation of a Line (Vector/Cartesian).

115. 3D Geometry: Equation of a Plane (Vector/Cartesian).

116. 3D Geometry: Shortest Distance between two Skew Lines.

117. 3D Geometry: Angle between Lines/Planes/Line-Plane.

- **Trigonometry & Others**

118. Inverse Trigonometric Functions: Properties & Solving Equations.

119. Statistics: Calculating Variance & Standard Deviation.

120. Mathematical Reasoning: Identifying Tautology/Contradiction (Truth Tables/Equivalence).