SYLLABUS CHECKLIST

AP Chemistry

Course and Exam Description (updated for 2024–25 onwards) · 113 items

Source: AP Chemistry Course and Exam Description and Course at a Glance (apcentral.collegeboard.org)

Tick each box when you can explain the point without notes. Item wording is shortened from the official document; check the original for exact wording. Not affiliated with or endorsed by the exam board.

Units 1 and 2: atoms and compounds

Unit 1 Atomic Structure and Properties (7–9%)

- [ ] **1.1a** Moles and molar mass: n = m ÷ M; Avogadro's number 6.022 × 10^{23}
- [ ] **1.1b** Average mass of one particle in amu equals the molar mass in g/mol
- [ ] **1.2a** Mass spectra of elements: each peak is an isotope, height is relative abundance
- [ ] **1.2b** Average atomic mass from isotope masses and abundances
- [ ] **1.3a** Elemental composition of pure substances: law of definite proportions
- [ ] **1.3b** Empirical formula from mass percent
- [ ] **1.4a** Composition of mixtures: mass percent of components
- [ ] **1.4b** Elemental analysis to find purity of a mixture
- [ ] **1.5a** Coulomb's law: force $\propto q_1q_2 \div r^2$
- [ ] **1.5b** Electron configurations (aufbau); shells and subshells
- [ ] **1.5c** Core and valence electrons; effective nuclear charge
- [ ] **1.6a** Photoelectron spectroscopy: peak position = binding energy, height = number of electrons
- [ ] **1.6b** Reading electron configurations from a PES spectrum
- [ ] **1.7a** Periodic trends: atomic radius, ionisation energy, electron affinity, electronegativity
- [ ] **1.7b** Explaining trends with Coulomb's law and shielding
- [ ] **1.8a** Valence electrons and typical ionic charges
- [ ] **1.8b** Predicting formulas of ionic compounds from periodic position

Unit 2 Compound Structure and Properties (7–9%)

- [ ] **2.1a** Ionic, covalent (polar and nonpolar) and metallic bonds
- [ ] **2.1b** Electronegativity difference and bond type
- [ ] **2.2a** Potential energy versus internuclear distance graph
- [ ] **2.2b** Bond length and bond energy from the graph; effect of bond order and atom size
- [ ] **2.3a** Structure of ionic solids: lattice of alternating ions
- [ ] **2.3b** Lattice energy and Coulombic attraction (charge and ion size)
- [ ] **2.4a** Metals: positive ions in a sea of delocalised electrons
- [ ] **2.4b** Interstitial and substitutional alloys
- [ ] **2.5a** Lewis diagrams: octet rule and its exceptions
- [ ] **2.6a** Resonance structures and delocalised electrons
- [ ] **2.6b** Formal charge and choosing the best Lewis structure
- [ ] **2.7a** VSEPR shapes and bond angles (2 to 6 electron domains)
- [ ] **2.7b** Hybridisation sp, sp^2, sp^3; σ and π bonds
- [ ] **2.7c** Molecular polarity

Units 3 and 4: substances, mixtures and reactions

Unit 3 Properties of Substances and Mixtures (18–22%)

- [ ] **3.1a** London dispersion, dipole–dipole, hydrogen bonding, ion–dipole forces
- [ ] **3.1b** Polarisability and strength of dispersion forces
- [ ] **3.2a** Properties of ionic, covalent network, molecular and metallic solids
- [ ] **3.2b** Crystalline versus amorphous solids
- [ ] **3.3a** Particle-level structure of solids, liquids and gases
- [ ] **3.4a** Ideal gas law PV = nRT; Dalton's law of partial pressures
- [ ] **3.4b** Mole fraction and partial pressure
- [ ] **3.5a** Kinetic molecular theory; kinetic energy ∝ temperature
- [ ] **3.5b** Maxwell–Boltzmann distribution of speeds
- [ ] **3.6a** Deviations from ideal behaviour: high pressure, low temperature, strong forces
- [ ] **3.7a** Solutions; molarity M = n ÷ V
- [ ] **3.8a** Particulate representations of solutions
- [ ] **3.9a** Separation: paper and column chromatography, distillation
- [ ] **3.10a** Solubility: "like dissolves like"; intermolecular forces between solute and solvent
- [ ] **3.11a** Electromagnetic spectrum and molecular transitions (microwave, IR, UV-visible)
- [ ] **3.12a** Photons: E = hν and c = λν
- [ ] **3.13a** Beer–Lambert law A = εbc; spectrophotometry

Unit 4 Chemical Reactions (7–9%)

- [ ] **4.1a** Evidence of reactions; physical versus chemical changes
- [ ] **4.2a** Net ionic equations and spectator ions
- [ ] **4.3a** Representations: balanced equations and particle diagrams
- [ ] **4.4a** Physical and chemical changes at the particle level
- [ ] **4.5a** Stoichiometry: mole ratios, limiting reactant, percent yield
- [ ] **4.6a** Titration: equivalence point, finding an unknown concentration
- [ ] **4.7a** Types of reaction: acid–base, redox, precipitation
- [ ] **4.8a** Brønsted–Lowry acids and bases; conjugate pairs; amphoteric water
- [ ] **4.9a** Oxidation numbers; balancing redox half-reactions

Units 5 and 6: kinetics and thermochemistry

Unit 5 Kinetics (7–9%)

- [ ] **5.1a** Reaction rate and the factors affecting it
- [ ] **5.2a** Rate law rate = k[A]^m[B]^n; orders from initial rates
- [ ] **5.3a** Integrated rate laws for zero, first and second order; linear plots
- [ ] **5.3b** First-order half-life t½ = 0.693 ÷ k
- [ ] **5.4a** Elementary reactions: rate law from molecularity
- [ ] **5.5a** Collision model: orientation and energy
- [ ] **5.6a** Reaction energy profile: activation energy, transition state
- [ ] **5.6b** Arrhenius idea: effect of temperature on k
- [ ] **5.7a** Mechanisms: intermediates, sum of elementary steps
- [ ] **5.8a** Rate law from the rate-determining step
- [ ] **5.9a** Pre-equilibrium approximation (fast equilibrium before slow step)

- [ ] **5.10a** Multistep energy profiles
- [ ] **5.11a** Catalysts: new pathway, lower Ea; acid–base, surface and enzyme catalysis

Unit 6 Thermochemistry (7–9%)

- [ ] **6.1a** Endothermic and exothermic processes
- [ ] **6.2a** Energy diagrams
- [ ] **6.3a** Heat transfer and thermal equilibrium
- [ ] **6.4a** Heat capacity and calorimetry $q = mc\Delta T$
- [ ] **6.5a** Energy of phase changes (enthalpies of fusion and vaporisation)
- [ ] **6.6a** Enthalpy of reaction from calorimetry
- [ ] **6.7a** Bond enthalpies: $\Delta H = \Sigma(\text{bonds broken}) - \Sigma(\text{bonds formed})$
- [ ] **6.8a** Standard enthalpies of formation: $\Delta H°rxn = \Sigma\Delta H°f(\text{products}) - \Sigma\Delta H°f(\text{reactants})$
- [ ] **6.9a** Hess's law

Units 7 and 8: equilibrium, acids and bases

Unit 7 Equilibrium (7–9%)

- [ ] **7.1a** Dynamic equilibrium: equal forward and reverse rates
- [ ] **7.2a** Direction of reversible reactions
- [ ] **7.3a** Reaction quotient Q and equilibrium constant K (Kc and Kp)
- [ ] **7.4a** Calculating K from equilibrium amounts
- [ ] **7.5a** Magnitude of K: product- or reactant-favoured
- [ ] **7.6a** Properties of K: reversing, multiplying, adding reactions
- [ ] **7.7a** Equilibrium concentrations with ICE tables
- [ ] **7.8a** Particulate representations of equilibrium
- [ ] **7.9a** Le Châtelier's principle
- [ ] **7.10a** Comparing Q and K to predict shifts
- [ ] **7.11a** Solubility equilibria and Ksp; molar solubility
- [ ] **7.12a** Common-ion effect

Unit 8 Acids and Bases (11–15%)

- [ ] **8.1a** $K_w = [H^+][OH^-] = 1.0 \times 10^{-14}$ at 25 °C; pH and pOH
- [ ] **8.2a** pH and pOH of strong acids and bases
- [ ] **8.3a** Weak acid and base equilibria: Ka, Kb, percent ionisation
- [ ] **8.4a** Acid–base reactions and buffers
- [ ] **8.5a** Titration curves: equivalence point, half-equivalence point pH = pKa
- [ ] **8.6a** Molecular structure and acid strength (bond polarity, conjugate base stability)
- [ ] **8.7a** pH and pKa: which form dominates
- [ ] **8.8a** Properties of buffers
- [ ] **8.9a** Henderson–Hasselbalch equation $pH = pKa + \log([A^-] \div [HA])$
- [ ] **8.10a** Buffer capacity
- [ ] **8.11a** pH and solubility

Unit 9: thermodynamics and electrochemistry

Unit 9 Thermodynamics and Electrochemistry (7–9%)

- [ ] **9.1a** Entropy: dispersal of matter and energy
- [ ] **9.2a** Absolute entropy; $\Delta S^\circ = \Sigma S^\circ(\text{products}) - \Sigma S^\circ(\text{reactants})$
- [ ] **9.3a** Gibbs free energy $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$; thermodynamic favourability
- [ ] **9.4a** Thermodynamic versus kinetic control
- [ ] **9.5a** Free energy and equilibrium: $\Delta G^\circ = -RT \ln K$
- [ ] **9.6a** Free energy of dissolution
- [ ] **9.7a** Coupled reactions
- [ ] **9.8a** Galvanic (voltaic) and electrolytic cells: anode, cathode, salt bridge
- [ ] **9.9a** Cell potential and free energy: $\Delta G^\circ = -nFE^\circ$
- [ ] **9.10a** Nonstandard conditions: Nernst equation (qualitative and with Q)
- [ ] **9.11a** Electrolysis and Faraday's law: $q = It$