SYLLABUS CHECKLIST

International Chemistry Olympiad (IChO)

Appendix C of the IChO Regulations (current version, used for IChO 2026) · 125 items

Source: IChO Regulations, Appendix C: concepts and skills, as published for IChO 2026 (icho2026.uz)

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.

Core theory: can appear in any IChO exam

1 General skills and maths

- [ ] 1.1 Experimental errors and significant figures
- [ ] 1.2 Quadratic and simultaneous equations (two unknowns)
- [ ] 1.3 Logarithms and exponentials
- [ ] 1.4 Sine, cosine and Pythagoras' theorem
- [ ] 1.5 Plotting and reading graphs

2 Atomic and nuclear structure

- [ ] 2.1 Nucleons, isotopes, radioactive decay; α, β and γ nuclear reactions
- [ ] 2.2 Quantum numbers n, l, m; s, p and d orbitals in hydrogen-like atoms
- [ ] 2.3 Hund's rule and the Pauli exclusion principle
- [ ] 2.4 Configurations of main-group atoms and ions, and first-row transition metals and ions

3 Periodic trends and bonding

- [ ] 3.1 Electronegativity, electron affinity, ionisation energy
- [ ] 3.2 Atomic and ionic size, melting points, metallic character, reactivity
- [ ] 3.3 Covalent, ionic, metallic and coordination bonds
- [ ] 3.4 Intermolecular forces and their effect on properties
- [ ] 3.5 Lewis theory; molecular shapes by VSEPR

4 Stoichiometry

- [ ] 4.1 Balancing equations; empirical formulas
- [ ] 4.2 Mole concept and the Avogadro constant; stoichiometric calculations
- [ ] 4.3 Density; concentration units

5 Equilibria

- [ ] 5.1 Chemical equilibrium and Le Chatelier's principle
- [ ] 5.2 Equilibrium constants in concentrations, pressures and mole fractions
- [ ] 5.3 Arrhenius and Brønsted acid–base theory; pH; self-ionisation of water
- [ ] 5.4 Acid–base constants; pH of weak acids and of very dilute solutions
- [ ] 5.5 Simple buffers; hydrolysis of salts
- [ ] 5.6 Solubility constants and solubility
- [ ] 5.7 Complexation: coordination number, formation constants
- [ ] 5.8 Partition coefficients
- [ ] 5.9 Electromotive force, Nernst equation, electrolysis, Faraday's laws

6 Kinetics

- [ ] **6.1** Rate, elementary reactions, factors affecting rate
- [ ] **6.2** Rate laws (homogeneous and heterogeneous), rate constant, order
- [ ] **6.3** Energy profiles, activation energy, Arrhenius equation
- [ ] **6.4** Catalysis: effect on kinetic and thermodynamic quantities
- [ ] **6.5** Zero- and first-order rate laws, exponential decay, half-life

7 Thermodynamics

- [ ] **7.1** Energy, heat, work, enthalpy, heat capacity
- [ ] **7.2** Hess's law; Born–Haber cycles
- [ ] **7.3** Standard enthalpies of formation, solution, solvation; bond enthalpies
- [ ] **7.4** Entropy, Gibbs energy, second law, spontaneity
- [ ] **7.5** Equilibrium constants from ΔH° and ΔS°
- [ ] **7.6** Ideal gas law; partial pressures

8 Analytical chemistry and spectroscopy

- [ ] **8.1** Direct, indirect and back titrations
- [ ] **8.2** Acid–base titrations: curves, indicator choice and colours
- [ ] **8.3** Redox titrations: permanganometry, iodometry
- [ ] **8.4** Simple complexometric and precipitation titrations
- [ ] **8.5** Inorganic qualitative analysis; flame tests
- [ ] **8.6** Light: wavelength, frequency, wavenumber, photon energy; Beer–Lambert law

9 Inorganic chemistry

- [ ] **9.1** s-block elements with water, oxygen and halogens; flame colours
- [ ] **9.2** Binary hydrides of non-metals
- [ ] **9.3** Oxides of carbon, nitrogen and sulfur: CO, CO_2, NO, NO_2, N_2O_4, SO_2, SO_3
- [ ] **9.4** p-block oxidation states; halides; oxoacids HNO_2, HNO_3, H_2CO_3, H_3PO_4, H_3PO_3, H_2SO_3, H_2SO_4, HOCl, $HClO_3$, $HClO_4$
- [ ] **9.5** Reactions of the halogens with water
- [ ] **9.6** First-row transition metals: oxidation states and ion colours
- [ ] **9.7** Dissolving these metals and Al; amphoteric $Al(OH)_3$, $Cr(OH)_3$, $Zn(OH)_2$
- [ ] **9.8** Permanganate, chromate and dichromate redox reactions
- [ ] **9.9** Iodometry: thiosulfate and iodine
- [ ] **9.10** Identifying Ag^+, Ba^{2+}, Fe^{3+}, Cu^{2+}, Cl^-, CO_3^{2-}, SO_4^{2-}

10 Organic chemistry

- [ ] **10.1** Structure and reactivity: polarity, electrophilicity, nucleophilicity, inductive effects, stability
- [ ] **10.2** Structure and properties: boiling point, acidity, basicity
- [ ] **10.3** Simple nomenclature
- [ ] **10.4** Hybridisation and geometry at carbon and other centres
- [ ] **10.5** σ and π bonds, delocalisation, aromaticity, resonance
- [ ] **10.6** Isomerism: constitutional, configurational, conformational, tautomerism
- [ ] **10.7** Stereochemistry: E/Z, cis/trans, chirality, optical activity, CIP rules, Fischer projections, D/L
- [ ] **10.8** Cyclohexane conformations

- [ ] **10.9** Common electrophiles and nucleophiles
- [ ] **10.10** Electrophilic addition: Markovnikov and anti-Markovnikov (Kharasch), stereochemistry
- [ ] **10.11** Electrophilic aromatic substitution; substituent effects
- [ ] **10.12** E1 and E2 elimination: stereochemistry, leaving groups
- [ ] **10.13** SN1 and SN2 substitution: stereochemistry
- [ ] **10.14** Nucleophilic addition; addition–elimination
- [ ] **10.15** Radical halogenation of alkanes
- [ ] **10.16** Oxidation-level interconversions: alkyne/alkene/alkane/halide, alcohol/aldehyde/ketone/acid derivatives, nitriles, carbonates
- [ ] **10.17** Grignard reaction; Fehling's and Tollens' tests
- [ ] **10.18** Protecting groups; simple multistep synthesis

11 Polymers and biochemistry

- [ ] **11.1** Polystyrene, polyethylene, polyamides, polyesters: monomers and preparation
- [ ] **11.2** Chain polymerisation, polyaddition, polycondensation
- [ ] **11.3** Amino acids: classification, isoelectric point, peptide bond, proteins
- [ ] **11.4** Carbohydrates: open-chain and cyclic forms of glucose and fructose
- [ ] **11.5** Lipids: di- and triacylglycerides, saturated and unsaturated fatty acids
- [ ] **11.6** DNA and RNA: structure, base pairing, replication, transcription
- [ ] **11.7** Hydrophilic and hydrophobic groups; micelles and bilayers

Core practical skills

12 Laboratory skills

- [ ] **12.1** Heating and heating under reflux
- [ ] **12.2** Measuring mass and volume: balance, cylinder, pipette, burette, volumetric flask
- [ ] **12.3** Reading thermometers; magnetic stirrers
- [ ] **12.4** Preparing standard solutions; dilution
- [ ] **12.5** Test-tube tests for organic functional groups
- [ ] **12.6** Titration with a pipette filler
- [ ] **12.7** Measuring pH (paper or calibrated meter)
- [ ] **12.8** Gravity filtration; drying precipitates
- [ ] **12.9** Simple digital instruments; plotting and analysing data

Advanced topics: only if the host lists them in the preparatory problems

13 Advanced theory

- [ ] **13.1** Inorganic stereochemistry; isomerism in complexes
- [ ] **13.2** Solid state: unit cells (metals, NaCl, CsCl), Bragg's law, packing, radius ratios
- [ ] **13.3** Crystal field theory; magnetic moments
- [ ] **13.4** Thermodynamic cycles, adiabatic processes, flame temperatures, heat engines
- [ ] **13.5** Temperature dependence of K; complex equilibrium calculations
- [ ] **13.6** Cell potentials from thermodynamic or equilibrium data, and back
- [ ] **13.7** Latimer, Frost and Pourbaix diagrams
- [ ] **13.8** Higher-order rate laws; kinetic isotope effects
- [ ] **13.9** Steady-state and pre-equilibrium approximations; catalytic mechanisms
- [ ] **13.10** Kinetic theory of gases; collision theory

- [ ] **13.11** Phase diagrams; Clausius–Clapeyron equation; triple and critical points
- [ ] **13.12** Axial and planar chirality
- [ ] **13.13** Stereoselective reactions; enantiomeric and diastereomeric excess
- [ ] **13.14** Conformational analysis, Newman projections, anomeric effect
- [ ] **13.15** Nucleophilic aromatic substitution
- [ ] **13.16** Electrophilic substitution of polycyclic aromatics and heterocycles
- [ ] **13.17** Pericyclic reactions: cycloadditions, sigmatropic and electrocyclic reactions
- [ ] **13.18** Advanced polymers: rubbers, copolymers, thermosets, polymerisation kinetics
- [ ] **13.19** Monosaccharides: pyranoses, furanoses, Haworth projections, glycosides
- [ ] **13.20** Amino acid side chains, separation, protein sequencing
- [ ] **13.21** Translation, genetic code, tRNA, aminoacyl-tRNA synthetases
- [ ] **13.22** Nucleobases, nucleosides, nucleotides; PCR; DNA chips
- [ ] **13.23** Protein structure, folding, denaturation, purification
- [ ] **13.24** Enzymes: classification, active sites, cofactors, kinetics, inhibitors
- [ ] **13.25** Complex solubility calculations (hydrolysing anions, complex formation)
- [ ] **13.26** Quantum mechanics: Schrödinger equation, particle in a box, angular momentum
- [ ] **13.27** Rotational, vibrational and electronic transitions; simple MO theory
- [ ] **13.28** Mass spectrometry: molecular ions, isotope patterns
- [ ] **13.29** IR spectroscopy: vibrations and characteristic peaks
- [ ] **13.30** ^{1}H and ^{13}C NMR: shift, multiplicity, integration; simple heteronuclear NMR

14 Advanced practical

- [ ] **14.1** Vacuum filtration; thin-layer chromatography
- [ ] **14.2** Microscale synthesis
- [ ] **14.3** Advanced inorganic qualitative analysis
- [ ] **14.4** Using a spectrophotometer
- [ ] **14.5** Extraction with immiscible solvents
- [ ] **14.6** Column chromatography; recrystallisation
- [ ] **14.7** Distillation and vacuum distillation
- [ ] **14.8** Viscometry; spreadsheet analysis of data