FORMULA SHEET

IB Chemistry data booklet guide for first assessment 2025

The booklet prints 19 equations, three uncertainty rules and 21 data sections; you must still recall percentage yield, Kc, rate equations, Ka and Kb, and the bond enthalpy sum.

IN THE BOOKLET printed in the official booklet or sheet in the exam LEARN IT students must recall it

Structure 1: atoms, moles and gases

Equations printed in the booklet; rows marked HL only sit in additional higher level statements of the guide.

Wave equation for light HL only (S1.3.6, S3.1.10). c is the speed of light, f frequency in Hz, λ wavelength in m.	$c = f\lambda$	IN THE BOOKLET
Photon energy HL only (S1.3.6). E is energy in J, h the Planck constant, f frequency in Hz.	$E = hf$	IN THE BOOKLET
Amount from mass n in mol, m in g, M in g mol^{-1} (S1.4).	$n = \frac{m}{M}$	IN THE BOOKLET
Amount from concentration n in mol, C in mol dm^{-3}, V in dm^3 (S1.4).	$n = CV$	IN THE BOOKLET
Ideal gas equation Use SI units: P in Pa, V in m^3, T in K (S1.5).	$PV = nRT$	IN THE BOOKLET
Combined gas law Fixed amount of gas; T in kelvin, same units for both pressures and both volumes (S1.5).	$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$	IN THE BOOKLET

Reactivity 1: energy changes and spontaneity

Heat energy from a temperature change Q in J, m in g, c in J g^{-1} K^{-1} (water 4.18), change in T in K or °C (R1.1).	$Q = mc\Delta T$	IN THE BOOKLET
Enthalpy change from enthalpies of formation Products minus reactants; multiply each value by its coefficient (R1.2.4).	$\Delta H^\circ = \sum \Delta H_f^\circ(\text{products}) - \sum \Delta H_f^\circ(\text{reactants})$	IN THE BOOKLET
Enthalpy change from enthalpies of combustion Reactants minus products, the opposite way round to formation data (R1.2.4).	$\Delta H^\circ = \sum \Delta H_c^\circ(\text{reactants}) - \sum \Delta H_c^\circ(\text{products})$	IN THE BOOKLET
Gibbs energy change HL only (R1.4.2). Convert so that all terms use kJ or all use J; T in K.	$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$	IN THE BOOKLET
Gibbs energy away from standard state HL only (R1.4.4). Q is the reaction quotient; R = 8.31 J K^{-1} mol^{-1}.	$\Delta G = \Delta G^\circ + RT \ln Q$	IN THE BOOKLET

Gibbs energy and equilibrium constant HL only (R1.4.4, R2.3.7). With R in J, ΔG comes out in J mol^{-1}.	$\Delta G^\circ = -RT\ln K$	IN THE BOOKLET

Reactivity 2: how much, how fast, how far

Percentage atom economy Use the balanced equation, including coefficients (R2.1.5).	$\%\ \text{atom economy} = \dfrac{\text{molar mass of desired product}}{\text{molar mass of all reactants}} \times 100$	IN THE BOOKLET
Arrhenius equation HL only (R2.2.12). k rate constant, A Arrhenius factor, Ea in J mol^{-1}, T in K.	$k = Ae^{-E_a/RT}$	IN THE BOOKLET
Arrhenius equation, linear form HL only (R2.2.12). Plot ln k against 1/T: gradient is -Ea/R, intercept is ln A.	$\ln k = -\dfrac{E_a}{RT} + \ln A$	IN THE BOOKLET

Reactivity 3: acids, bases and electron transfer

pH The booklet also prints the form with [H3O+]; they mean the same thing (R3.1.4).	$\text{pH} = -\log_{10}[\text{H}^+]$	IN THE BOOKLET
Ionic product of water The value of Kw at 298 K is printed in the constants table (R3.1.5).	$K_w = [\text{H}^+][\text{OH}^-]$	IN THE BOOKLET
pOH HL only (R3.1.9).	$\text{pOH} = -\log_{10}[\text{OH}^-]$	IN THE BOOKLET
Gibbs energy and cell potential HL only (R3.2.14). n electrons transferred, F the Faraday constant in C mol^{-1}, E in V.	$\Delta G^\circ = -nFE^\circ$	IN THE BOOKLET

Uncertainties

Three propagation rules for processed data, added in the February 2024 version of the booklet; they apply at SL and HL.

Adding or subtracting measurements Add the absolute uncertainties, even when you subtract the values.	$y = a \pm b \ \Rightarrow\ \Delta y = \Delta a + \Delta b$	IN THE BOOKLET
Multiplying or dividing measurements Add the percentage (relative) uncertainties.	$y = \dfrac{ab}{c} \ \Rightarrow\ \dfrac{\Delta y}{y} = \dfrac{\Delta a}{a} + \dfrac{\Delta b}{b} + \dfrac{\Delta c}{c}$	IN THE BOOKLET
Raising to a power Multiply the relative uncertainty by the size of the power.	$y = a^n \ \Rightarrow\ \dfrac{\Delta y}{y} = \lvert n\rvert \dfrac{\Delta a}{a}$	IN THE BOOKLET

Data tables in the booklet

What each table is for; the values are in the booklet you receive in the exam, so learn how to use them rather than the numbers.

Physical constants Gives e, electron, proton and neutron masses, c, h, the Avogadro constant, R, molar volume at STP (22.7 dm^3 mol^{-1}, specific heat capacity of water, Kw and the Faraday constant. SL and HL.	Table: physical constants	IN THE BOOKLET

Metric (SI) multipliers Converts between prefixes such as kilo, milli, micro, nano and pico. SL and HL.	Table: SI prefixes	IN THE BOOKLET
Unit conversions and standard conditions Gives K = °C + 273.15, dm^3 to m^3, and defines STP (273.15 K, 100 kPa) and SATP (298.15 K, 100 kPa). SL and HL.	Table: unit conversions and STP/SATP	IN THE BOOKLET
Electromagnetic spectrum Orders the regions by wavelength and energy and shows visible light as 400 to 700 nm; used with $c = f \lambda$. SL and HL.	Table: electromagnetic spectrum	IN THE BOOKLET
Names of the elements Lists each element with its symbol and atomic number. SL and HL.	Table: names of elements	IN THE BOOKLET
Periodic table Gives groups, periods and relative atomic masses for calculating molar masses. SL and HL.	Table: periodic table	IN THE BOOKLET
Melting and boiling points of the elements Compares physical properties and explains periodic trends in bonding and structure. SL and HL.	Table: melting and boiling points	IN THE BOOKLET
First ionization energy, electron affinity and electronegativity Explains periodic trends, bond polarity and (with the triangle) bond type. SL and HL.	Table: ionization energy, electron affinity, electronegativity	IN THE BOOKLET
Atomic and ionic radii Explains trends across periods and down groups, and why cations are smaller and anions larger than their atoms. SL and HL.	Table: atomic and ionic radii	IN THE BOOKLET
Covalent bond lengths Compares single, double and triple bond lengths and links length to bond strength. SL and HL.	Table: bond lengths	IN THE BOOKLET
Bond enthalpies Estimates enthalpy changes from bonds broken minus bonds formed (average values, so approximate). SL and HL.	Table: bond enthalpies	IN THE BOOKLET
Thermodynamic data for selected compounds Formation enthalpies feed Hess's law calculations at SL and HL; standard entropies and Gibbs energies of formation are for the HL entropy and spontaneity topic.	Table: enthalpy of formation, Gibbs energy of formation, entropy	IN THE BOOKLET
Enthalpies of combustion Gives molar combustion enthalpies for Hess's law and for comparing fuels. SL and HL.	Table: enthalpies of combustion	IN THE BOOKLET
Colour wheel with wavelengths HL only (S3.1.10). Finds the colour absorbed or observed for transition element complexes, with wavelength ranges.	Table: colour wheel	IN THE BOOKLET

Lattice enthalpies Compares ionic bond strength and completes Born-Haber cycle values; the values are for the endothermic separation of gaseous ions. SL and HL.	Table: lattice enthalpies	IN THE BOOKLET
Triangular bonding diagram Places a binary compound as ionic, covalent, metallic or in between using average electronegativity and the difference. SL and HL.	Table: van Arkel-Ketelaar bonding triangle	IN THE BOOKLET
Acid-base indicators HL only (R3.1.14, R3.1.15). Gives pKa, pH range and colours so you can choose an indicator for a titration.	Table: acid-base indicators	IN THE BOOKLET
Standard reduction potentials HL only (R3.2.12 to R3.2.15). Gives E-standard for half-cells to predict spontaneity, work out cell potential and predict electrolysis products.	Table: standard reduction potentials	IN THE BOOKLET
Infrared data HL only (S3.2.9). Matches wavenumber ranges to bonds and functional groups in IR spectra.	Table: infrared absorptions	IN THE BOOKLET
Proton NMR data HL only (S3.2.10, S3.2.11). Matches chemical shifts to proton environments when deducing structures.	Table: 1H NMR chemical shifts	IN THE BOOKLET
Mass spectral fragments lost HL only (S3.2.8). Links the mass lost from the molecular ion to the fragment that left.	Table: mass spectral fragments	IN THE BOOKLET

Learn these: not in the booklet

Number of particles

$$N = nN_A$$

Relative atomic mass from isotopes

$$A_r = \frac{\sum(\text{abundance} \times \text{isotope mass})}{\sum \text{abundance}}$$

Gas volume at STP

$$n = \frac{V}{V_m}, \quad V_m = 22.7\ \text{dm}^3\,\text{mol}^{-1}$$

The value is printed; the relationship is not.

Mass concentration

$$\text{concentration in g dm}^{-3} = C \times M$$

Dilution

$$C_1V_1 = C_2V_2$$

Percentage yield

$$\frac{\text{experimental yield}}{\text{theoretical yield}} \times 100$$

Enthalpy change per mole from calorimetry

$$\Delta H = -\frac{Q}{n}$$

Bond enthalpy sum

$$\Delta H = \sum(\text{bonds broken}) - \sum(\text{bonds formed})$$

Rate of reaction

$$\text{rate} = \frac{\Delta[\text{reactant or product}]}{\Delta t}$$

Equilibrium constant expression

$$K_c = \frac{[\text{C}]^c[\text{D}]^d}{[\text{A}]^a[\text{B}]^b}$$

Hydrogen ion concentration

$$[\text{H}^+] = 10^{-\text{pH}}$$

Percentage uncertainty

$$\frac{\Delta a}{a} \times 100$$

Standard entropy change (HL)

$$\Delta S^\circ = \sum S^\circ(\text{products}) - \sum S^\circ(\text{reactants})$$

Reaction quotient (HL)

$$Q = \frac{[\text{C}]^c[\text{D}]^d}{[\text{A}]^a[\text{B}]^b}$$

Uses concentrations that are not at equilibrium.

Rate equation (HL)

$$\text{rate} = k[\text{A}]^m[\text{B}]^n$$

Ionic product link (HL)

$$\text{pH} + \text{pOH} = 14 \text{ at } 298\text{ K}, and [\text{OH}^-] = 10^{-\text{pOH}}$$

Acid and base constants (HL)

$$K_a = \frac{[\mathrm{H^+}][\mathrm{A^-}]}{[\mathrm{HA}]}, \quad K_b = \frac{[\mathrm{BH^+}][\mathrm{OH^-}]}{[\mathrm{B}]}$$

Conjugate pair relationship (HL)

$$K_a \times K_b = K_w$$

pK values (HL)

$$\mathrm{p}K_a = -\log_{10} K_a, \quad \mathrm{p}K_b = -\log_{10} K_b$$

Buffer pH (HL, derived from the K_a expression)

$$\mathrm{pH} = \mathrm{p}K_a + \log_{10} \frac{[\mathrm{A^-}]}{[\mathrm{HA}]}$$

Standard cell potential (HL)

$$E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$$

Use standard reduction potentials for both electrodes.

Formal charge (HL)

$$\mathrm{FC} = V - N - \tfrac{1}{2}B$$

V valence electrons, N non-bonding electrons, B bonding electrons.

Using the sheet in the exam

- Work with the booklet open throughout the course so you know where each table sits before the exam.
- Match units before substituting: Delta H is in kJ mol^-1 but Delta S and R use J, so convert before using Delta G equations.
- The bond enthalpy table gives values only; write the broken minus formed sum yourself and show each bond and its count.
- With the reduction potentials table, do not change the sign of E when you multiply a half-equation to balance electrons.
- For Arrhenius data (HL), plot ln k against 1/T: the gradient is -Ea/R, so convert Ea to kJ mol^-1 only at the end.

Checked against the official documents: International Baccalaureate Diploma Programme Chemistry (SL and HL, first assessment 2025), Chemistry data booklet, first assessment 2025, version 1.1, and Chemistry guide, first assessment 2025. Updated 31 October 2026. Boards update their booklets from time to time: always practise with the version your exam uses. More free sheets and topic worksheets at curatedprep.com.