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OLYMPIADES DE CHIMIE
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G0-1
English (Official)

SwissChO Syllabus

Dear participant

Welcome to the Swiss Chemistry Olympiad! To aid you in the upcoming events and to give you a sense of your own level, we have compiled a list of learning objectives. Don't be afraid if you do not immediately recognise every single thing on the syllabus —it is a long list.

This is simply a list of common topics that *can* appear on the exams lying ahead of you. We hope you are eager to experience more of the magic of chemistry, but what you want to learn is in your own hands. Self-study is not required to pariticipate and advance in SwissChO, but it can of course be helpful.

All learning objectives have been split into three rough categories: **Inorganic Chemistry**, **Organic Chemistry** and **Physical Chemistry**. However, as all fields are tightly interconnected, the boundaries of the subdisciplines can become somewhat blurry. A cross is placed in the column of the respective exam, if an exercise pertaining to the learning objective is likely to be encountered at this level. If you are uncertain about something on the table, do not hesitate to ask your friends, teachers or someone from the SwissChO association.

Moreover, for book suggestions, the following textbooks are recommended resources:

- *Chemistry* by C. Housecroft and E. Constable - in-depth general chemistry. Available in English.
- *Chemie, das Basiswissen der Chemie* by Charles E. Mortimer and U. Müller - general chemistry. Available in German.
- *Chimie de base et avancée* by M. Rebstein and C. Soerensen - general chemistry. Available in French.
- *Chimica più.verde* by V. Posca and T. Fiorani - general (green) chemistry. Available in Italian.
- *Organic Chemistry* by J. Clayden, N. Greeves and S. Warren - an excellent organic chemistry textbook. Available in English and German.

We hope that you enjoy your time during the competition and experience the wonders of chemistry alongside newly forged friendships and bonds!

Enjoy!

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Inorganic Chemistry

Nr.	Objective	First Round	Central Exam	Final Exam	IChO
1	Balancing chemical equations	×	×	×	×
2	Stoichiometric calculations	×	×	×	×
3	Equilibria and their influence • Acid-base eq. • Solubility eq. • Complexometric eq.	×	×	×	×
4	Oxidation numbers	×	×	×	×
5	Titrations • Acid-base	×	×	×	×
6	Definitions of pH, pOH, K_w, K_a, K_b, pK_a, pK_b	×	×	×	×
7	Lewis structures	×	×	×	×
8	Buffer equations	×	×	×	×
9	Different definitions of acids and bases	×	×	×	×
10	Binary non-metal-hydrogen compounds • General properties • Acid-base properties	×	×	×	×
11	Trends in the periodic table: • Electronegativity • Atomic radius • Energy of ionisation • etc.	×	×	×	×
12	Acid-base-properties of common compounds and ions	×	×	×	×
13	VSEPR	×	×	×	×
14	Electron configuration	×	×	×	×
15	Electrochemistry • EMF under standard conditions	×	×	×	×
16	Acidity and influences on its strength	×	×	×	×
17	pH calculations	×	×	×	×
18	Reaction coordinates and the basic idea of a transition state		×	×	×
19	Shapes of the (hybrid) orbitals		×	×	×

20	Titrations • Redox • Complexometric	×	×
21	Coordination chemistry, including stereochemistry	×	×
22	Crystal field theory • Resulting para- and diamagnetism	×	×
23	Electrochemistry • pH-dependency of certain redox reactions (exemplified by MnO_4^- and $Cr_2O_7^{2-}$) • Relationships between ΔG, K, EMF, Latimer and Frost diagrams • Nernst equation	×	×
24	Valence Bond Theory	×	×
25	Unit cells	×	×
26	Common transition metals • Colours of aqua complexes • Common oxidation states	×	×
27	Hard and soft acid-base theory	×	×

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Organic Chemistry

Nr.	Objective	First Round	Central Exam	Final Exam	IChO
1	Organic structures	×	×	×	×
2	Identification of common functional groups	×	×	×	×
3	Alkenes and their (*E*/*Z*)-isomerism	×	×	×	×
4	Benzene, its structure and stability	×	×	×	×
5	Resonance, conjugation	×	×	×	×
6	Stereochemistry • *R*/*S* • Optical activity and chirality • Meso forms • Enantiomers and diastereomers	×	×	×	×
7	Simple organic nomenclature	×	×	×	×
8	Chemoselectivity • E.g. ketones/aldeydes being more reactive than esters/amides • 2° vs. 1° alcohols • Alkenes, alkynes • Leaving groups		×	×	×
9	Carboxylic acids and their derivatives • Reactions • Preparations		×	×	×
10	Redox reactions of alcohols and carbonyls		×	×	×
11	Electtrophilic additions, Markovnikov's rule and carbocation stability		×	×	×
12	Tautomerism		×	×	×
13	Cylcoalkanes • Ring strain		×	×	×
14	Carbohydrates • Fischer and Haworth projections • Open/closed-chain forms • Glucose and fructose		×	×	×
15	Amines, their structure and reactivity		×	×	×

16	Zwitterionic forms and isoelectric point	×	×	×
17	Classic reactions • S_N1, S_N2, S_N2' • E1, E2, $E1_{cb}$ • SAr • Combinations of the above	×	×	×
18	Nucleophilic addition reactions to carbonyls		×	×
19	Simple and most common named reactions • Aldol • Grignard • Ozonolysis • Hydroboration-oxidation • Michael additions • Swern oxidation • Lemieux-Johnson periodate cleavage • Williamson ether synthesis • Wittig • Diels-Alder • Being able to apply newly introduced reactions		×	×
20	Hybrid orbital theory		×	×
21	Reading and interpreting a 1D NMR spectrum • ^{1}H • ^{13}C		×	×
22	IR spectroscopy		×	×
23	1,4-additions to dienes		×	×
24	Radical reactions		×	×
25	Aciditiy of alcohols and phenols		×	×
26	Regioselectivity		×	×
27	Stereoselectivty		×	×

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Physical Chemistry

Nr.	Objective	First Round	Central Exam	Final Exam	IChO
1	Properties of ideal gases	×	×	×	×
2	Factors affecting reaction rates	×	×	×	×
3	Beer-Lambert law	×	×	×	×
4	Structure of the nucleus, isotopes	×	×	×	×
5	Radioactive decay and its types	×	×	×	×
6	Easy concepts of thermodynamics • Heat capacity • Determining Gibbs free energy given ΔS, ΔH and deriving spontaneity • Intuition for entropy, enthalpy • $\Delta G = -RTlnK$ • Le Châtelier's principle	×	×	×	×
7	Easy concepts of kinetics • Reaction order • Determination of correct rate law based on a given reaction	×	×	×	×
8	Basic concepts of thermodynamics • Reading ΔG, ΔH, ΔS from a table • Hess' law • Latent heat • Different types of enthalpies (ΔH_{fus}, ΔH_{sol}, etc.)		×	×	×
9	Energy levels of atomic orbitals		×	×	×
10	Basic concepts of kinetics • Rate-determining step • Half-life and reaction rate of zeroth and first order reaction • Arrhenius' law		×	×	×
11	Advanced concepts in thermodynamics • Clausius-Clapeyron • van't Hoff • Basic statistical thermodynamics ($S = k_B \ln \Omega$) • Kirchhoff's Law (temperature-dependence of H) • Phase diagrams			×	×

12	Advanced concepts in kinetics • Enzyme kinetics, Michaelis-Menten • Half-life and reaction rate of second order reaction	×	×
13	Molecular orbital theory • Orbital diagrams • Linear combination of atomic orbitals (LCAO)	×	×