Harvard Undergraduate Science Olympiad 2026
Open Round
Chemistry Syllabus: 7th-8th Grade

Reference Material:
You should memorize common formulas and reactions, but you need not memorize any constants as a periodic table and all needed constants will be provided **(see the provided formula sheet at the end of this document).**

Potential Topics Covered on the Exam:
Please note that not necessarily every topic on this list will be on the exam, don't get overwhelmed! The syllabus is meant to be exhaustive of all *potential* topics that could be on the exam. A great place to start is with making sure you're comfortable with the high school chemistry curriculum (see Khan academy). It will be a difficult exam, but remember you don't need to (nor do we expect you to) get a 100%! Just do your best and show us all that you've learned! Good luck and happy studying!

This syllabus contains topics which might be covered both in the open and the in person round. The exam will have questions testing a subset and not all of these bullet points in this extensive list of topics in the syllabus. We wish you a lot of good luck studying! **Organic chemistry will not be tested.**

Inorganic Chemistry:

- Periodic Table:
    - Elements classification;
        - Main group elements;
        - Transition group elements;
    - Isotopes:
        - Atomic number;
        - Mass number;
        - Relative atomic mass;

    - Electronic configuration of atoms and their ions:
        - Quantum numbers (n,l,m);
        - Orbital types (s,p,d);
        - Hund's rule,
        - Pauli principle;
    - Trends:
        - Trends in electronegativity;
        - Trends in electronaffinity;
        - Trends in reactivity;
        - Trends in metallic and nonmetallic character;
        - Trends in atomic and ionic size;
- Chemical Bonds:
    - Bond Types;
    - VSEPR theory;
        - Shapes;
        - Polarity;
        - Bond Angles;
    - Intermolecular Forces
    - Oxides (acid and base properties);
- Chemical Reactions:
    - Reaction types;
    - Balancing reactions;
    - Empirical formulas;
    - Stoichiometric calculations:
        - Concentrations;
        - Mole concept via volume, mass and number of atoms;
    - Oxidizing and reducing agents, identifying;

Analytical Chemistry:

- Solutions:
    - Different concentration measurements (molarity, molality, etc.)
    - Self ionization of water;
    - Hydrolysis of salts;
    - Acidity and Basicity:
        - Arrhenius acid-base theory;
        - Bronsted acid-base theory;
        - Lewis acids and bases theory;
        - pH and pOH definitions;
- Quantitative Analysis:
    - Acid-base titrations;
- Qualitative Analysis:

    - Flame tests;
    - Specific identification reactions for common cations and anions;
    - Solubility of Compounds:
        - Soluble, slightly soluble, and insoluble salts;
        - Working with solubility constants;
        - Saturated, unsaturated, and supersaturated solutions;

Physical Chemistry:

- Ideal Gas Law
    - Kinetic Molecular Theory
- Balancing Chemical Equations

Laboratory Skills:

- Choosing appropriate materials for common lab task;
- Identifying correct procedures for common lab tasks;
- Error analysis.

* There will not be a hands-on lab exam, but students will be asked about laboratory skills or planning on the online exam.

Preparation for Exam:

The following books which can be found online cover good fundamentals:

- General Chemistry Hardcover by Darrell Ebbing and Steven D. Gammon.

Note that none of these books are required to prepare for the exam, nor are they the only way possible to prepare. Reviewing past US National Chemistry Olympiad **local** exams (acs.org/olympiad) from old years (i.e. before 2015); IJSO chemistry exams (https://ijsoweb.org/downloads) again from old years (i.e before 2018), or mocking AP Chemistry exams are other ways recommended for preparation, but all of these are ABOVE the difficulty of this competition. Making sure you have a mastery of honors chemistry is the first priority. We would strongly recommend doing the chemistry practice problems on Khan Academy or past ICSE problems on Byju's for practice.

Formula Sheet Provided for both 7th-8th Grade and 9th-10th Grade Chemistry Exams:

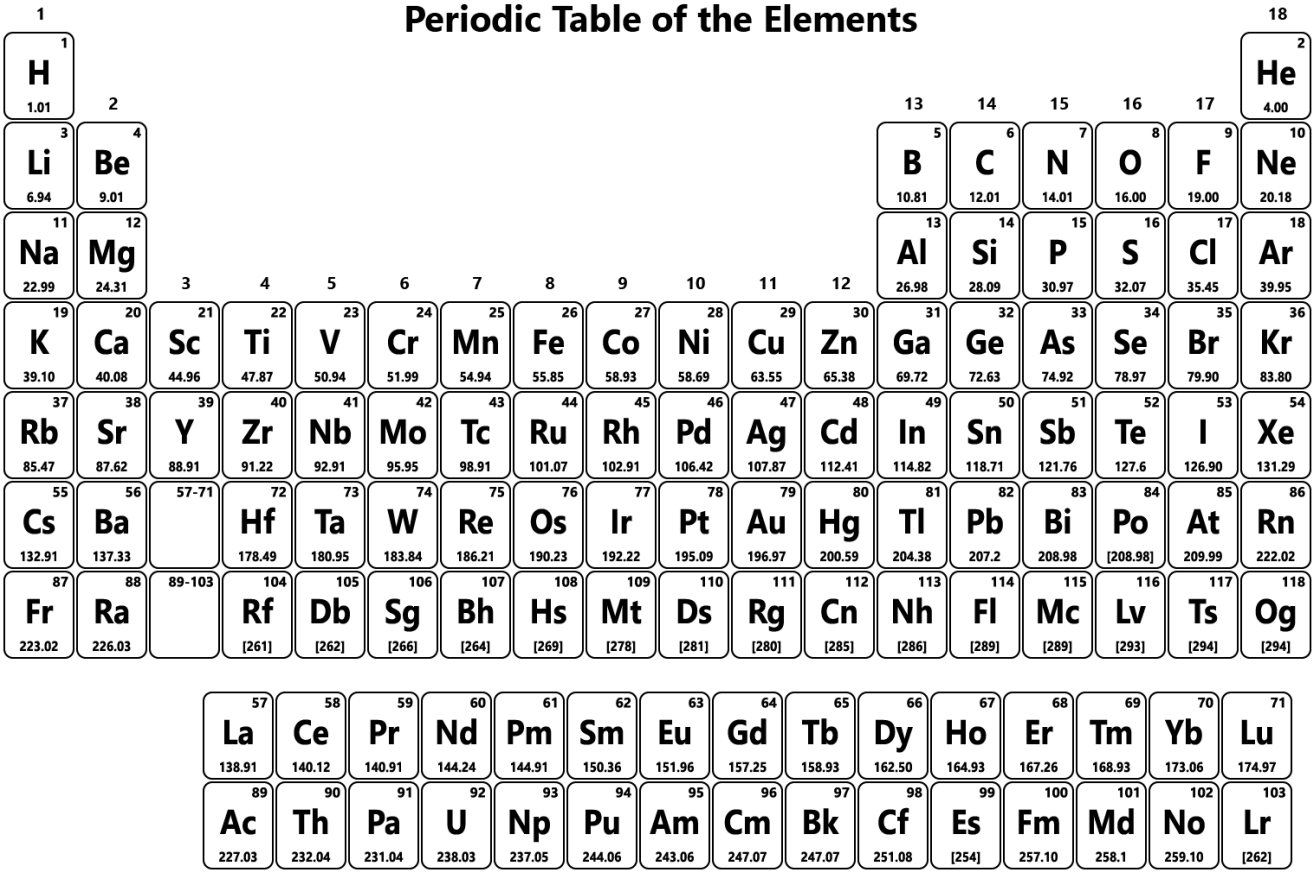
CONSTANTS:

$h = 6.626 \times 10^{-34}\ J \cdot s$

$F = 96485\ C/(mol\ e^-)$

$c = 2.998 \times 10^{8}\ m/s$

$R = 8.314\ J/(K \cdot mol) = 0.08206\ L \cdot atm/(mol \cdot K)$



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