Regulations of the International Chemistry Olympiad (IChO)

General Statement

§ 1 Aims of the competition

The International Chemistry Olympiad (IChO) is a chemistry competition for students at secondary school level with the aim of promoting international contacts in chemistry. It is intended to stimulate the activities of students interested in chemistry by a way of independent and creative solving of chemical problems. The IChO competitions help to enhance friendly relations among young people from different countries; they encourage cooperation and international understanding.

Organization of the IChO

§ 2 Organization and invitation

(1) The IChO is organized every year, as a rule at the beginning of July in one of the participating countries by the Education Ministry or another appropriate institution of the organizing country (hereafter referred to as the organizer).

(2) The organizer is obliged to invite all countries participating in the previous IChO competition. The official invitation to participate in the forthcoming IChO should be sent to countries by the November preceding the competition. The invited countries must confirm their participation in the IChO according to requirements of the organizer.

(3) Moreover, other countries may apply for the participation in IChO but the organizer has the right to invite the countries only on agreement with the organizers of two forthcoming IChOs. Incoming countries must send observers to two consecutive Olympiads before its pupils can participate in IChO (see also § 3, section 5).

§ 3 Delegations

(1) Each participating country's delegation may consist of four competitors and two accompanying persons (also known as mentors). Countries may include two scientific observers in their delegation.

(2) The competitors must not be university students. They can only be students of secondary schools that are not specialized in chemistry and, if they are already graduated before May 1st in the year of the competition, the organizer must be informed about the month and year of their graduation. Moreover, they must be under the age of 20 at the 1st of July in the year of the competition.
The competitors must be passport holders of the country they represent or they had to take part in the secondary school educational system of this country for more than one academic year.
All members of a delegation must provide themselves with medical insurance for the journey to/from the organizing country and the stay in the country.

(3) The mentors act as members of the International Jury (see § 6) and one of them is designated as the head of delegation.

(4) The mentors:

a) must guarantee the fulfilment of those conditions given in section 2 of this paragraph,
b) must be capable of translating the text of competition tasks from English into the mother tongue of their students and be able to judge the set of tasks and correct the work of the students.
c) have the right to enter a protest which should be addressed to the Chair of the International Jury and, when necessary, ask for solving the problem at the next meeting of the International Jury.

(5) Incoming countries that are invited by the organizer, and intend to take part in future IChOs, may send one scientific observer.

§ 4 Obligations of the Organizer

(1) The organizer provides:
a) the itinerary of the IChO,
b) transportation from/to an airport/station decided by the host country on the day of arrival and departure,
c) the organization of the competition following the regulations,
d) accident insurance for all participants in connection with the organized programme,
e) the opportunity for the mentors to inspect the working room and practical apparatus to be used for the practical tasks before the competition takes place,
f) arrangement for the observance of the safety regulations,
g) the medals, certificates and prizes, which are presented at the official closing ceremony,
h) a report on the competition in the form of a printed report or a CD ROM to be distributed not later than six months after the competition.

(2) A meeting of the Steering Committee must be hosted in the organizing country in the December prior to the IChO. The organizing country will provide some travel assistance.

§ 5 Financing

(1) The participating country covers the return travel costs of the students and the accompanying persons to the designed airport/station or to the place where the competition is held.

(2) The participating country must pay for the participation fee the amount of which must be approved by the International Jury.

(3) All other costs being in connection with the organized programme, including the costs of accommodation for all competitors and members of the International Jury, are covered by the organizer.

(4) The organizers of the next two consecutive Olympiads may send two observers to the current IChO with their expenses covered by the host as mentioned in the preceding section 3.

Institutions of the IChO

§ 6 International Jury

(1) The International Jury consists of its chair and members. The chair of the International Jury is nominated by the organizer. The members of the International Jury are the two mentors from the individual delegations and the chair of the Steering Committee (see § 8).

(2) The chair of the International Jury or his/her delegate calls and chairs all the meetings of the International Jury concerning the current competition.

(3) Resolutions of common International Jury sessions or its split sessions are passed by the International Jury when they are agreed by a simple majority of votes in the presence of at least 75% of the delegations. Each participating country has one vote. Changes in the regulations can only be done at the common sessions of the International Jury and require a qualified majority of two thirds of the votes. The chair has a casting vote in the event of a tie. The decisions of the International Jury are binding for both organizer and participants.

(4) The working language of the International Jury is English.

§ 7 Responsibilities of the International Jury

(1) The International Jury:
   a) is in charge of the actual competition and its supervision according to the regulations,
   b) discusses in advance the competition tasks presented by the organizer, their solutions and the marking guidelines, gives comments and decides in case of changes,
   c) supervises the marking of the examination papers and guarantees that all participants are judged by equal criteria,
   d) determines the winners and decides on prizes and documents for the competitors,
   e) monitors the competition and suggests changes to the regulations, organization and contents for future IChOs,
   f) takes decisions on excluding of a participant or a whole team from the competition (see also § 11, section 7),
   g) elects members of the Steering Committee of the IChO,
   h) may form working groups to solve specific chemistry related problems of the IChO.

(2) The members of the International Jury:
   a) are obliged to maintain a professional discretion about any relevant information they receive during the IChO and must not assist any participants,
   b) keep the marking and results secret until proclaimed by the International Jury.

(3) The working groups of the International Jury should draw its membership from IChO participating countries and those interested in IChO competitions. The working groups meet for working sessions and submit the results of the deliberations to the Steering Committee.

§ 8 Steering Committee

(1) The long term work involved in organizing the International Chemistry Olympiads is coordinated by the Steering Committee.

(2) Members of the Committee are elected by the International Jury. They are representatives from various geographical areas (3 from Europe, 1 from Americas, 1 from Asia and 1 from Pacific Rim), to serve a two year term. Members are elected for no more than two consecutive terms. Moreover, 1 - 3 experts may be selected by the Steering Committee for their particular expertise for periods of one year.

(3) There are four ex-officio members of the Steering Committee:
   a) chair of the current IChO,
   b) chair of the immediate past IChO,
   c) representatives of the following two IChOs,

(4) The Steering Committee elects its own Chair. The Chair:
   a) calls and chairs the meetings of the Steering Committee,
   b) calls and chairs the business meetings of the International Jury dealing with general problems of future International Chemistry Olympiads,
   c) may invite non-voting guests to the meetings of the Steering Committee after consultation with the host of the meeting,
   d) has the right to call a special meeting of the International Jury when necessary for some exceptional reasons.

(5) The Steering Committee:
   a) provides organizational oversight for the International Chemistry Olympiad,
   b) proposes items for consideration at the International Jury sessions.

(6) The Steering Committee has no right to make any decisions about the International Chemistry Olympiad that would interfere with the responsibilities of the International Jury (see § 7 and 8).

§ 9 International Information Center

There is an International Information Center of the International Chemistry Olympiads gathering and providing (when necessary) all the documentation of the IChOs from the very beginning of the Olympiad to the present. The seat of the Office is in Bratislava, Slovakia.

Competition

§ 10 Preparation for the IChO competition

(1) The organizer distributes a set of preparatory tasks written in English to all participating countries in the January of the competition year. The preparatory tasks are intended to give students a good idea of the type and difficulty of the competition tasks, including safety aspects (see §12 and Appendix “B”). SI units should preferably be used throughout the preparatory tasks.

(2) The total number of theoretical and experimental tasks in the set of preparatory problems cannot be lower than 25 and 5, respectively.

(3) Appendix C of the regulations contains a list of concepts and skills expected to be mastered by the participants. Organizers may freely include questions and tasks

in the theoretical or experimental competition based on the knowledge listed there.
The organizer can include problems in the exams based on the use of concepts and skills from not more than 6 theoretical and 2 practical fields outside this list, if a minimum of 2 tasks from each field is included and the necessary skills demonstrated in the set of preparatory problems. Examples of such external fields are also listed in Appendix C. Fields not already listed should have a breadth similar to the examples. These 6 theoretical and 2 practical fields must be stated explicitly at the beginning of the Preparatory problems. If an equation not covered by the listed fields is required for the solution of the exam questions, then this should be defined in the exam text.

(4) Appendix D contains an outline of the factual knowledge supposedly familiar to the competitors. If specific facts not included here are required for the solution of the exam questions, then these should be included in the exam text or in the preparatory problems and their solutions.

(5) Training or any other special instruction, that is carried out for a selected group of 50 or fewer students, containing the IChO team, must be no longer than two weeks.

§ 11 Organization of the IChO Competition

(1) The competition consists of two parts:
   a) part one, the practical (experimental) competition,
   b) part two, the theoretical competition.

(2) A working time of four to five hours is allotted for each part. There is at least one day of rest between the two parts.

(3)Competitors receive all the relevant information in the language of their choice and are allowed to write the solutions in that language.

(4)There must be no contact between mentors and competitors once the mentors received the competition tasks for consideration. No information about the competition tasks must be passed to the competitors directly or indirectly prior and during the competition.

(5) When pocket calculators are not provided by the organizer, only non-programmable pocket calculators may be used in the competition.

(6) The safety regulations announced by the organizer are binding for all participants.

(7) Breaking of any rules given in the preceding paragraphs (§ 3. section 2, § 10 section 5, § 11 sections 4, 5, and 6) has as its consequence excluding from the whole or a part of the competition.

§ 12 Safety

(1) During the experimental part, the competitors must wear laboratory coats and eye protection. The competitors are expected to bring their own laboratory coats. Other means of protection for laboratory work are provided by the organizer.

(2) When handling with liquids, each student must be provided with a pipette ball or filler. Pipetting by mouth is strictly forbidden.

(3) The use of very toxic substances (designation T+) is strictly forbidden. The use of toxic substances (designation T) is not recommended, but may be allowed if special precautions are taken. Substances belonging to the categories R 45, R 46, R 47 must not be used under any circumstances (see Appendix B for definitions of these categories).

(4) The organizer provides a list of chemicals from which the chemicals used in practical preparatory and competition tasks are drawn. The list of chemicals must include information of the maximum amounts of materials needed or in the case of solutions their maximum concentrations. Any hazardous materials on the list must be accompanied by detailed instructions for safe handling. The list must be provided together with the preparatory tasks (see § 10).
Each participating country has three months to file a substantiated dissent concerning the use of a special chemical. Silence indicates acceptance. The organizer should try to revise the list in order to satisfy any objections. The final revision of the list will be distributed to the delegation leaders at the start of the Olympiad.

(5) Detailed recommendations involving students´ safety and the handling and disposal of chemicals can be found in Appendices A 1, A 2, and B.
   a) Appendix A 1: Safety Rules for Students in the laboratory.
   b) Appendix A 2: Safety Rules and Recommendations for the Host Country of the IChO.
   c) Appendix B contains:
      B 1: Hazard Warning Symbols and Hazard Designations;
      B 2: R-Ratings and S-Provisions: Nature of special risks (R) and safety advice (S);
      B 3: Explanation of Danger Symbols (for use of chemicals in schools);

§ 13 Competition Tasks

(1) The organizer is responsible for the preparation of competition tasks by competent experts/authors, who constitute the Scientific Board of the IChO. They propose the methods of solution and the marking scheme.

(2) The tasks, their solutions and the marking schemes are submitted to the International Jury for consideration and approval. The authors of the tasks should be present during the discussion.

(3) The Chair of the International Jury may put the Chair of the Scientific Board in charge of the proceedings when the tasks are considered.

(4) The total length of the theoretical or experimental tasks, answer sheets including should be kept to a minimum and not exceed 25,000 characters. The number of characters must be stated at the end of each exam paper. SI units should preferably be used throughout the competition tasks.

(5) In the experimental part of the competition the following conditions must be fulfilled:
   a) The experimental part must contain at least two independent tasks.
   b) No part of the grade can subjectively be evaluated by the staff.
   c) Competitors must receive the same substances when solving the tasks from qualitative analytical chemistry.

d) When solving tasks from quantitative analytical chemistry competitors must receive the same substances but with different concentrations.
e) In evaluating the quantitative tasks the master values must not be based on average results of the competitors.
f) The great majority of the grade in quantitative tasks must be given to the mean value as reported by the competitors while some marks may also be given to the corresponding equations, calculations, or explanations directly related to the work. Points must not be awarded for reproducibility.

§ 14 Correcting and Marking

(1) A maximum of 60 points is allocated to the theoretical tasks and 40 points to the practical tasks, making a total of 100 points.

(2) The competition tasks are corrected independently by the authors and by the mentors. Consequential marking should be used so that students are not punished twice for the same error. Both corrections are then compared; however, the authors present their evaluation first. After a discussion the final score for each participant is reached and agreed by both sides. The organizer retains the original marked manuscripts.

(3) The International Jury discusses the results and decides on the final scores.

(4) In order to eliminate any doubts about possible mistakes in the processing of the results the organizer must provide the mentors with a list of their students' total results before the closing awards' ceremony.

§ 15 Results and Prizes

(1) Official results of the competition and the number of medals awarded are decided by the International Jury.

(2) The number of gold medals awarded is in the range of 8% to 12%, silver 18% to 22%, and bronze medals 28% to 32% of the total number of competitors. The exact number of medals is decided on the basis of an anonymous review of the results.

(3) Every medallist must receive the medal and a corresponding certificate from the organizer.

(4) In addition to the medals other prizes may be awarded.

(5) An honourable mention is awarded to competitors who are among the best 10% of non medallists.

(6) Each competitor receives a certificate of participation.

(7) In the awarding ceremony, the non medallists are called in alphabetical order.

(8) No team classification takes place.

(9) The organizer must provide a complete list of results as a part of the final report.

§ 16 Final Regulations

(1) Those who take part in the competition acknowledge these regulations through their very participation.

(2) This version of regulations has been approved by the International Jury in Budapest (Hungary) in July 2008 and is issued to replace the former one approved in Gyeongsan (Greece) in 2006.

(3) The regulations are valid from September 1st, 2008. Changes in them can only be made by the International Jury and require a qualified majority (two third of the votes with regard to total number of participating countries).

APPENDIX A

A 1: SAFETY RULES FOR STUDENTS IN THE LABORATORY

All students of chemistry must recognize that hazardous materials cannot be completely avoided. Chemists must learn to handle all materials in an appropriate fashion. While it is not expected that all students participating in the International Chemistry Olympiad know the hazards of every chemical, the organizers of the competition will assume that all participating students know the basic safety procedures. For example, the organizers will assume that students know that eating, drinking or smoking in the laboratory or tasting a chemical is strictly forbidden.
In addition to the common-sense safety considerations to which students should have been previously exposed, some specific rules, listed below, must also followed during the Olympiad. If any question arises concerning safety procedures during the practical exam, the student should not hesitate to ask the nearest supervisor for direction.

Rules regarding personal protection

1. Eye protection must be worn in the laboratories at all times. If the student wears contact lenses, full protection goggles must also be worn. Eye protection will be provided by the host country.
2. A laboratory coat is required. Each student will supply this item for himself/herself.
3. Long pants and closed-toed shoes are recommended for individual safety. Long hair and loose clothing should be confined.
4. Pipetting by mouth is strictly forbidden. Each student must be provided with a pipette bulb or pipette filler.

Rules for Handling Materials

1. Specific instructions for handling hazardous materials will be included by the host country in the procedures of the practical exam. All potentially dangerous materials will be labelled using the international symbols below. Each student is responsible for recognizing these symbols and knowing their meaning (see Appendix B 1, B 2 and B 3).
2. Do not indiscriminately dispose chemicals in the sink. Follow all disposal rules provided by the host country.

A 2: SAFETY RULES AND RECOMMENDATIONS FOR THE HOST COUNTRY OF THE INTERNATIONAL CHEMISTRY OLYMPIAD

Certainly it can be assumed that all students participating in the IChO have at least modest experience with safety laboratory procedures. However, it is the responsibility of the International Jury and the organizing country to be sure that the welfare of the students is carefully considered. Reference to the Safety Rules for Students in the Laboratory will show that the students carry some of the burden for their own safety. Other safety matters will vary from year to year, depending on practical tasks. The organizers of these tasks for the host country are therefore assigned responsibility in the areas listed below. The organizers are advised to carefully test the practical tasks

in advance to ensure the safety of the experiments. This can best be accomplished by having students of ability similar to that of IChO participants carry out the testing.

Rules for the Host Country (see also A 1):

1. Emergency first-aid treatment should be available during the practical examination.
2. Students must be informed about the proper methods of handling hazardous materials.
   a) Specific techniques for handling each hazardous substance should be included in the written instructions of the practical examination.
   b) All bottles (containers) containing hazardous substances must be appropriately labelled using international symbols (see Appendix B 1).
3. Chemical disposal instructions should be provided to the students within the written instructions of the practical examination. Waste collection containers should be used for the chemicals considered dangerous to the environment.
4. The practical tasks should be designed for appropriate (in other words, minimum) quantities of materials.
5. The laboratory facilities should be chosen with the following in mind:
   a) Each student should not only have adequate space in which to work, but should be in safe distance from other students.
   b) There should be adequate ventilation in the rooms and a sufficient number of hoods when needed.
   c) There should be more than one emergency exit for each room.
   d) Fire extinguishers should be near by.
   e) Electrical equipment should be situated in an appropriate spot and be of a safe nature.
   f) The should be appropriate equipment available for spill clean-up.
6. It is recommended that one supervisor be available for every four students in the laboratory to adequately ensure safe conditions.
7. The organizers should follow international guidelines for the use of toxic, hazardous or carcinogenic substances in the IChO.

APPENDIX B

B 1: HAZARD WARNING SYMBOLS AND HAZARD DESIGNATIONS AND THEIR EXPLANATION (Applied for Chemicals in Schools)

1. Explosive substances (E)

These are substances which can be caused to explode by exposure to a flame or which are more sensitive to impact of friction than 1,3-dinitrobenzene (e.g. picrates, organic peroxides). In particular they include substances with R ratings R1 - R3 (see B 2), designation E.
When using and storing these substances, the S provisions (S15 - S17) must be observed (see B 2).

2. Fire inducing substances, Oxidizing (O)

These are substances which can have a strong exothermic reaction on coming into contact with other, particularly flammable substances or organic peroxides. They include in particular substances R 7 to R 9, designation O.

3. Highly flammable, easily flammable and flammable substances (F+, F)

In liquid form, highly flammable substances have an ignition point below 0 °C and a boiling point of 35 °C maximum. They are to be designated by the danger symbol F+ and the rating R 12.
Substances are easily flammable if they:

a) can heat up and ignite at normal air temperature without energy supply,
b) are easily ignited in solid state by short exposure to a source of flammation and continue to burn or glow after removal of the latter,
c) ignite below 21 °C in liquid state,
d) ignite in gaseous state if mixed with air at 101.3 kPa and 20 °C,
e) develop easily flammable gases in dangerous quantities when in contact with water or damp air,
f) ignite if brought into contact with air when in dustlike state.

These substances are to be designated with the danger symbol F and the rating R 11.
Flammable substances have in liquid form an ignition point of 21 °C to 55 °C and are to designated with the rating R 10, no danger symbol.
When dealing with highly flammable, easily flammable and flammable liquids may only be heated using sealed electrical heating equipment which is not in itself a source of flammation. All substances must be heated in such a way that the dangerous vapours liberated by heating cannot escape into the atmosphere. This does not apply to fire hazardous substances in small quantities for fire demonstrations.
The regulations laid down by the state fire authorities must be observed.

4. Toxic substances (T +, T, Xn)

Legislation applying to chemicals distinguishes three categories of toxicants:
highly toxic substances (R 26 R 28), danger symbol T+,
toxic substances (R 23 R 25), danger symbol T,
less toxic substances (R 20 R 22), danger symbol Xn.

Highly toxic substances are those which can cause grave acute or chronic health damage or death almost immediately if inhaled, swallowed or absorbed through the skin in small amounts.
Toxic substances are those which can cause considerable acute or chronic health damage or death if inhaled, swallowed or absorbed through the skin in small amounts.
Less toxic substances (noxious substances) are those which can cause restricted health damage if inhaled, swallowed or absorbed through the skin.
If highly toxic or toxic substances are produced in the course of an experiment (e.g. chlorine, hydrogen sulfide), these may only be produced in the quantities necessary for the experiment. in the case of volatile substances, the experiment must be conducted under a hood where the gas can be drawn off. Residue must be appropriately disposed of after the experiment and may on no account be stored. If the facilities for disposal are not available, the experiment may not be conducted.
Less toxic substances and preparations may be obtained without a permit. Less toxic substances are also those which contain a highly toxic or toxic substance at a level of concentration below that determined by law as the maximum for classification as noxious. Chlorine water, bromine water and hydrogen sulfide solution in a concentration of up to 1% may therefore be used in instruction.

5. Corrosives and irritants (C, X i)

Caustic or corrosive substances (R 34, R 35), designation C, are those which can destroy living materials by their action upon it. Substances are classed as irritants (R 36 R 38), designation Xi, if they cause inflammation without being corrosive on direct, prolonged or repeated contact with the skin or mucous membranes. The relevant safety recommendations (S 22 S 28) should be observed.

6. Carcinogenic, genotype or embryo damaging, chronically harmful substances

Substances may not be used for instruction if they have a proven carcinogenic effect (R 45), if they cause hereditary damage (R 46) or embryo damage (R 47), or if they are chronically damaging (R 48), particularly those substances classed as unmistakably carcinogenic. Such substances must be removed from all school stocks. Storage is not permitted under any circumstances.
Further, substances for which there is a well founded suspicion of carcinogenic potential (R 40) may only be used if corresponding safety precautions are taken and only in such cases where they cannot be replaced by less dangerous chemicals.

B 2: R RATINGS AND S PROVISIONS

Nature of special risks (R)

R 1 Explosive when dry.
R 2 Risk of explosion by shock, friction, fire or other sources of ignition.
R 3 Extreme risk of explosion by shock, friction, fire or other sources of ignition.
R 4 Forms very sensitive explosive metallic compounds.
R 5 Heating may cause an explosion.
R 6 Explosive with or without contact with air.
R 7 May cause fire.

R 8 Contact with combustible material may cause fire.
R 9 Explosive when mixed with combustible material.
R 10 Flammable.
R 11 Highly flammable.
R 12 Extremely flammable.
R 13 Extremely flammable liquefied gas.
R 14 Reacts violently with water.
R 15 Contact with water liberates highly flammable gases.
R 16 Explosive when mixed with oxidizing substances.
R 17 Spontaneously flammable in air.
R 18 In use, may form flammable/explosive vapour air mixture.
R 19 May form explosive peroxides.
R 20 Harmful by inhalation.
R 21 Harmful in contact with skin.
R 22 Harmful if swallowed.
R 23 Toxic by inhalation.
R 24 Toxic in contact with skin.
R 25 Toxic if swallowed.
R 26 Very toxic by inhalation.
R 27 Very toxic in contact with skin.
R 28 Very toxic if swallowed.
R 29 Contact with water liberates toxic gas.
R 30 Can become highly flammable in use.
R 31 Contact with acids liberates toxic gas.
R 32 Contact with acids liberates very toxic gas.
R 33 Danger of cumulative effects.
R 34 Causes burns.
R 35 Causes severe burns.
R 36 Irritating to eyes.
R 37 Irritating to respiratory system.
R 38 Irritating to skin.
R 39 Danger of very serious irreversible effects.
R 40 Possible risks of irreversible effects.
R 41 Danger of serious eye damage.
R 42 May cause sensitization by inhalation.
R 43 May cause sensitization by skin contact.
R 44 Risk of explosion if heated by occlusion.
R 45 May cause cancer.
R 46 May cause hereditary damage.
R 47 May cause embryo damage.
R 48 Danger of chronic damage.

Safety advice (S)

S 1 Keep locked up.
S 2 Keep out of reach of children.
S 3 Keep in a cool place.
S 4 Keep away from living quarters.

S 5 Keep contents under .... (appropriate liquid to be specified by the manufacturer).
S 6 Keep under .... (inert gas to be specified by the manufacturer).
S 7 Keep container tightly closed.
S 8 Keep container dry.
S 9 Keep container in a well ventilated place.
S 10 Keep contents wet.
S 11 Avoid contact with air.
S 12 Do not keep the container sealed.
S 13 Keep away from food, drink and animal feeding stuffs.
S 14 Keep away from .... (incompatible materials to be indicated by the manufacturer).
S 15 Keep away from heat.
S 16 Keep away from sources of ignition No smoking.
S 17 Keep away from combustible materials.
S 18 Handle and open container with care.
S 20 When using do not eat or drink.
S 21 When using do not smoke.
S 22 Do not inhale dust.
S 23 Do not inhale gas/fumes/vapour/spray.
S 24 Avoid contact with skin.
S 25 Avoid contact with eyes.
S 26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S 27 Take off immediately all contaminated clothing.
S 28 After contact with skin, wash immediately with plenty of .... (to be specified by the manufacturer).
S 29 Do not empty into drains.
S 30 Never add water to this product.
S 31 Keep away from explosive materials.
S 33 Take precautionary measures against static discharges.
S 34 Avoid shock and friction.
S 35 This material and its container must be disposed of in a safe way.
S 36 Wear suitable protective clothing.
S 37 Wear suitable gloves.
S 38 In case of insufficient ventilation, wear suitable respiratory equipment.
S 39 Wear eye/face protection.
S 40 To clean the floor and all objects contaminated by this material, use .... (to be specified by the manufacturer).
S 41 In case of fire and/or explosion do not breathe fumes.
S 42 During fumigation/spraying wear suitable respiratory equipment.
S 43 In case of fire, use .... (indicate in space the precise type of fire fighting equipment. If water increases the risk, add Never use water).
S 44 If you feel unwell, seek medical advice (show the label where possible).
S 45 In case of accident or if you feel unwell, seek medical advice (show the label where

Appendix C

Concepts and skills expected to be known by all participants:

(predominantly equivalent to former number 1 and 2 topics)

Concepts

Estimation of experimental errors, use of significant figures;

Nucleons, isotopes, radioactive decay and nuclear reactions (alpha, beta, gamma);
Quantum numbers (n,l,m) and orbitals (s,p,d) in hydrogen-like atoms;
Hund's rule, Pauli exclusion principle;
Electronic configuration of main group and the first row transition metal atoms and their ions;
Periodic table and trends (electronegativity, electron affinity, ionization energy, atomic and ionic size, melting points, metallic character, reactivity);
Bond types (covalent, ionic, metallic), intermolecular forces and relation to properties;
Molecular structures and simple VSEPR theory (up to 4 electronpairs);

Balancing equations, empirical formulae, mole concept and Avogadro constant, stoichiometric calculations, density, calculations with different concentration units;

Chemical equilibrium, Le Chatelier's principle, equilibrium constants in terms of concentrations, pressures and mole fractions;
Arrhenius and Bronsted acid-base theory, pH, self ionization of water, equilibrium constants of acid-base reactions, pH of weak acid solutions, pH of very dilute solutions and simple buffer solutions, hydrolysis of salts;
Solubility constants and solubility;
Complexation reactions, definition of coordination number, complex formation constants;

Basics of electrochemistry: Electromotive force, Nernst equation; Electrolysis, Faraday's laws;

Rate of chemical reactions, elementary reactions, factors affecting the reaction rate, rate law for homogeneous and heterogeneous reactions, rate constant, reaction order, reaction energy profile, activation energy, catalysis, influence of a catalyst on thermodynamic and kinetic characteristics of a reaction;

Energy, heat and work, enthalpy and energy, heat capacity, Hess' law, standard formation enthalpies, solution, solvation and bond enthalpies;

Definition and concept of entropy and Gibbs' energy, second law of thermodynamics, direction of spontaneous change;

Ideal gas law, partial pressures;

Principles of direct and indirect titration (back titration);
Acidi- and alkalimetry, acidimetric titration curves, choice and color of indicators for acidimetry;

Redox titrations (permanganometric and iodometric);
Simple complexometric and precipitation titrations;

Basic principles of inorganic qualitative analysis for ions specified in factual knowledge, flame tests;

Lambert-Beer law;

Organic structure-reactivity relations (polarity, electrophilicity, nucleophilicity, inductive effects, relative stability)
Structure-property relations (boiling point, acidity, basicity);
Simple organic nomenclature;
Hybridization and geometry at carbon centers;
Sigma and pi bonds, delocalization, aromaticity, mesomeric structures;
Isomerism (constitutional, configuration, conformation, tautomerism)
Stereochemistry (E-Z, cis-trans isomers, chirality, optical activity, Cahn-Ingold-Prelog system, Fisher projections);
Hydrophilic and hydrophobic groups, micelle formation;
Polymers and monomers, chain polymerizations, polyaddition and polycondensation;

Laboratory skills

Heating in the laboratory, heating under reflux;
Mass and volume measurement (with electronic balance, measuring cylinder, pipette and burette, volumetric flask);
Preparation and dilution of solutions and standard solutions;
Operation of a magnetic stirrer;
Carrying out of test tube reactions;
Qualitative testing for organic functional groups (using a given procedure);
Volumetric determination, titrations, use of a pipette bulb;
Measurement of pH (by pH paper or calibrated pH meter);

Examples of concepts and skills allowed in the exam only if included and demonstrated in the preparatory problems

6 theoretical and 2 practical topics from these or other topics of similar breadth are allowed in a preparatory problem set. It is intended that a topic can be introduced and discussed in a lecture of 2-3 hours before a prepared audience.

- VSEPR theory in detail (with more than 4 ligands);
- Inorganic stereochemistry, isomerism in complexes;
- Solid state structures (metals, NaCl, CsCl) and Bragg’s law;
- Relation of equilibrium constants, electromotive force and standard Gibbs energy;
- Integrated rate law for first order reactions, half-life, Arrhenius equation, determination of activation energy;
- Analysis of complex reactions using steady-state and quasi-equilibrium approximations, mechanisms of catalytic reactions, determination of reaction order and activation energy for complex reactions;

- Collision theory
- Simple phase diagrams and the Clausius-Clapeyron equation, triple and critical points;
- Stereoselective transformations (diastereoselective, enantioselective), optical purity
- Conformational analysis, use of Newman projections, anomeric effect
- Aromatic nucleophilic substitution, electrophilic substitution on polycyclic aromatic compounds and heterocycles
- Supramolecular chemistry
- Advanced polymers, rubbers, copolymers, thermosetting polymers. Polymerization types, stages and kinetics of polymerization;
- Amino acid side groups, reactions and separation of amino acids, protein sequencing;
- Secondary, tertiary and quaternary structures of proteins, non-covalent interactions, stability and denaturation, protein purification by precipitation, chromatography and electrophoresis;
- Enzymes and classification according to reaction types, active sites, coenzymes and cofactors, mechanism of catalysis;
- Monosaccharides, equilibrium between linear and cyclic forms, pyranoses and furanoses, Haworth projection and conformational formulae;
- Chemistry of carbohydrates, oligo- and polysaccharides, glycosides, determination of structure;
- Bases, nucleotides and nucleosides with formulae, Functional nucleotides, DNA and RNA, hydrogen bonding between bases, replication, transcription and translation, DNA based applications;
- Complex solubility calculations (with hydrolyzing anions, complex formation);
- Simple Schrödinger equations and spectroscopic calculations;
- Simple MO theory;
- Basics of mass spectrometry (molecular ions, isotope distributions);
- Interpretation of simple NMR spectra (chemical shift, multiplicity, integrals);
- Synthesis techniques: filtrations, drying of precipitates, thin layer chromatography.
- Synthesis in microscale equipment;
- Advanced inorganic qualitative analysis;
- Gravimetric analysis;
- Use of a spectrophotometer;
- Theory and practice of extraction with immiscible solvents;
- Column chromatography;

Appendix D

Outline of the factual knowledge supposed to be known by the competitors:

Reactions of s-block elements with water, oxygen and halogens, their color in flame tests;
Stoichiometry, reactions and properties of binary non-metal hydrides;
Common reactions of carbon, nitrogen and sulfur oxides (CO, CO_2, NO, NO_2, N_2O_4, SO_2, SO_3);
Common oxidation states of p-block elements, stoichiometry of common halides and oxoacids (HNO_2, HNO_3, H_2CO_3, H_3PO_4, H_3PO_3, H_2SO_3, H_2SO_4, HOCl, $HClO_3$, $HClO_4$);
Reaction of halogens with water;
Common oxidation states of first row transition metals (Cr(III), Cr(VI), Mn(II), Mn(IV), Mn(VII), Fe(II), Fe(III), Co(II), Ni(II), Cu(I), Cu(II), Ag(I), Zn(II), Hg(I), and Hg(II))and the color of these ions;
Dissolution of these metals and Al, amphoteric hydroxides ($Al(OH)_3$, $Cr(OH)_3$, $Zn(OH)_2$);
Permanganate, chromate, dichromate ions and their redox reactions;
Iodometry (reaction of thiosulfate and iodine);
Identification of Ag^+, Ba^{2+}, Fe^{3+}, Cu^{2+}, Cl^-, CO_3^{2-}, SO_4^{2-} ;

Organic:
Common electrophiles and nucleophiles
Electrophilic addition: addition to double and triple bonds, regioselectivity (Markovnikoff's rule), stereochemistry
Electrophilic substitution: substitution on aromatic rings, influence of substituents on the reactivity and regioselectivity, electrophilic species;
Elimination: E1 and E2 reactions at sp^3 carbon centers, stereochemistry, acid-base catalysis, common leaving groups;
Nucleophilic substitution: SN1 and SN2 reactions at sp^3 carbon centers, stereochemistry;
Nucleophilic addition: addition to carbon-carbon and carbon-hetero atom double and triple bonds, addition-elimination reactions, acid-base catalysis;
Radical substitution: reaction of halogens and alkanes;
Oxidations and reductions: switching between the different oxidation levels of common functional groups (alkyne – alkene – alkane – alkyl halide, alcohol – aldehyde, ketone – carboxylic acid derivatives, nitriles – carbonates)
Cyclohexane conformations;
Grignard reaction, Fehling and Tollens reaction;

Simple polymers and their preparation (polystyrene, polyethylene, polyamides, polyesters);
Amino acids and their classification in groups, isoelectric point, peptide bond, peptides and proteins;
Carbohydrates: open chain and cyclic form of glucose and fructose;
Lipids: general formulae of triacyl glycerides, saturated and unsaturated fatty acids;