**GENERAL CHEMISTRY**

**Year I/semester 1**

*Seminar*: Monday 8am – 10am Room D404 (Chemistry Building)
Monday 8am – 10am Room D302 (Chemistry Building)

*Lab*: 4 hours/week, Tuesday 8am – 12noon Laboratory D308 (Chemistry Building)
4 hours/week, Tuesday 8am – 12noon Laboratory D311 (Chemistry Building)

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Subject:

The objective of the laboratory work is to introduce first-year students of different background to laboratory work, the use of basic laboratory equipment, simple laboratory operations and measurements. In addition, students are expected to prepare certain simple chemicals and run various basic experiments to familiarize themselves with chemical laboratory work. The seminar involves solving exercises and problems connected to stoichiometry, concentration measurement and pH calculation.

The **lab manual** is available to the students at the beginning of the semester as an English translation of the Hungarian original. The preparatory material to be studied before laboratory work is overviewed before each experiment description in this manual.

The weekly syllabus lists the particular topics covered and gives a full description of the experiments. The word '**demonstration**' in the syllabus refers to experiments that the instructors carry out for the students. Students should come to lab sessions fully prepared. Students should ***learn*** the core theoretical background of the experiments (reading the material once is insufficient) and solve the pre-lab exercises in the lab manual every week before the lab session. The sections '*Laboratory notes*' and '*Review exercise and problems*' should be completed during the laboratory session. After each session the instructors overview the lab notes and make corrections if necessary. Students can ask questions regarding the laboratory preparation material during the seminar each week before the lab session.

Each week the laboratory session begins with a short test (not more than 20 minutes) based exclusively on the preparatory material of that week and the previous week and the results of the experiments carried out the previous week. With each short test a student can collect 25 points. Altogether there are eight short tests during the semester. Students are also required to write two general tests (week 5 and week 11) which are based on the course material for weeks 1-5 and 6-11, respectively. Each general test is worth 50 points. Grading is based on a five-level scale: 1 (fail), 2 (pass), 3 (average), 4 (good), 5 (excellent). The final course grade is given based on the results of these tests, the quality of the laboratory notes and the quality of laboratory work. The average score from both the short tests and

the general tests must be above 40 % to avoid a 'fail' final course grade. In order to pass the laboratory practice, a student should collect minimum 80 points from the short tests and minimum 40 points from the general tests. Students with 'fail' final course grade due to inadequate laboratory work have to retake the course the next year. Students with 'fail' final course grade due to low test results can re-take a comprehensive test exam in the examination period. **Please note:** those students, whose results are lower than 25% either from the short test or from the general test, cannot write a final exam, they will receive a 'fail' final course grade.

It is not allowed to miss any laboratory practices/seminars. If a student misses one or two lab practices, medical certification is needed. If a student misses three lab practices/seminars even for any medical reasons, the student's lecture book won't be signed and she or he has to retake the course next year. It is not possible to miss short tests at the beginning of the laboratory practice. If a student misses more than two short tests, the laboratory practice will not be accepted for him or her. The students cannot miss either of the general tests, otherwise no signature and final grade is given to the student.

In the laboratory, you receive pieces of laboratory equipment for use. If you break something during the semester, you have to pay for it. At the end of the semester the instructors check the students' cabinet again. If something is missing (either because someone broke it or somebody took it away), you will have to pay for it as well.

## Timetable

### Seminars

1 Atomic weight, molecular weight, empirical formula, molecular formula, amount of substance. Determination of empirical formula based on weight percent composition and on elemental analysis.

2 Units of concentration, solution preparation. Interconversion of units.

3 Interconversion of concentration units, exercises.

4 Exercises involving crystallization.

5 Composition of solid and gas mixtures. Stoichiometric calculations based on chemical equations.

6 Exercises based on acid-base titrations. Stoichiometric calculations based on chemical equations.

7 Exercises in stoichiometry and concentration calculations.

8 Gas laws, exercises connected to evolution of gases.

9 Balancing of redox reactions. Calculations based on redox reactions.

10 Balancing of redox reactions. Calculations based on redox reactions.

11 Exercises in concentration calculation and redox reactions.

12 Definition of pH. Calculation of pH for strong acids and bases.

13 Calculation of pH for weak acids and bases.

14 Electrochemical exercises. Review exercises.

**Laboratory practices**

**Week 1 (2nd October 2012)**
1. General rules of laboratory work (**Lab Manual 1**)
2. Safety training (**Lab Manual 1, pages: 6-8., Supplement S1–3**)
3. Introduction to laboratory equipment (**Lab Manual 1, page: 9., Supplement A1–4**)
4. Use of gas burners (**demonstration, Lab Manual 1, page: 10.**)
5. Overview of received equipment

**Week 2 (9th October 2012)**
1. Weighing on analytical and standard laboratory balances (**Lab Manual Introduction, 2, 2.1., pages: 11-14., Supplement B1–9**)
2. Measurement of volume: pipette, burette, volumetric flask, solution preparation
**(demonstration, Lab Manual 2.2; pages: 14-16., Supplement C1–C2**)
3. Calibration of a pipette (**Lab Manual 2.3, pages: 16-17.**)

**Week 3 (16th October 2012)**
1. Grinding, preparation of solution, decanting, centrifuging, filtration
(**demonstration, Lab Manual 5., 5.1., pages: 24-25., Supplement E1–6, F1-F5**)
2. Preparation of a standard solution from crystalline solid: $Zn(CH_3COO)_2 \cdot 2H_2O$, $Ca(CH_3COO)_2 \cdot H_2O$, $KAl(SO_4)_2 \cdot 12H_2O$, $Na_2HPO_4 \cdot 12H_2O$ (**Lab Manual 3, 3.1., pages: 18-19.**)
3. Measurement of density: determination of the density of the prepared solution with a picnometer, calculation of the weight percent composition (**Lab Manual 4., 4.1., pages: 20-23.**)

**Week 4 (30th October 2012)**
1. Heating, cooling, use of a water bath (**demonstration, Lab Manual 6., page: 28.**)
2. Purification of a benzoic acid sample contaminated with sodium chloride (**Lab Manual 5.2., pages: 26-27.**)
3. Preparation of an alum (substance #1) (**Lab Manual 8., pages: 34-39., Supplement E1–E6**)
a) iron(III) ammonium sulfate (**Lab Manual 8.1.**)
b) potassium aluminum sulfate (**Lab Manual 8.2.**)
c) potassium chromium(III) sulfate (**Lab Manual 8.3.**)
d) zinc ammonium sulfate (**Lab Manual 8.4.**)

**Week 5 (6th November 2012)**
1. ***General mid-term test #1***
2. Determination of the composition of a mixture of $KClO_3$ and KCl (**Lab Manual 7., 7.1., pages: 31-33.**)
3. Melting point measurement: the melting point of $Na_2S_2O_3$ (**Lab Manual 6. 6.1., pages: 28-30.**)
4. Determination of the melting point of purified benzoic acid (**Lab Manual 5.2., pages: 27, 29-30.**)
5. Substance #1 due in

**Week 6 (13th November 2012)**
1. Demonstration of an acid-base titration (**demonstration, Supplement G1–4**)
2. Preparation of a standard solution of sodium hydroxide by dilution of a concentrated solution (**Lab Manual 9.1., pages: 40-42.**)
3. Concentration determination of the standard sodium hydroxide solution prepared (**Lab Manual 9.2., pages: 43-44.**)
4. Molecular weight determination of the purified benzoic acid based on acid-base titration (**Lab Manual 9.3, pages: 45-46.**)
5. Purified benzoic acid due in

**Week 7 (20th November 2012)**
1. Laboratory work with gases: gas cylinders, other methods for gas generation (**demonstration, Lab Manual 10., 10.1., 10.2., pages: 47-53., Supplement H1–2**)
2. Preparation of oxygen in a laboratory gas generator, burning of sulfur in oxygen (**Lab Manual, 10.3., page: 54.**)
3. Determination of molecular weight based on ideal gas law (**Lab Manual 11., 11.1., 55-58.**)

**Week 8 (27th November 2012)**
1. Preparation of a salt from its metal (substance #2) (**Lab Manual 12., pages: 59-63.**)
    a) lead(II) chloride (**Lab Manual 12.1.**)
    b) iron(II) ammonium sulfate (**Lab Manual 12.2.**)
    c) zinc(II) sulfate (**Lab Manual 12.3.**)
2. Studies of reactions involving gas formation or precipitation (**Lab Manual 13., pages: 64-68.**)

**Week 9 (4th December 2012)**
1. Quantitative study of a precipitation reaction (**Lab Manual 14., 14.1., pages: 69-72.**)
2. Dependence of reaction rate on the concentration of reactants (**Lab Manual 15., 15.1., pages: 73-76.**)
3. Substance #2 due in

**Week 10 (11th December 2012)**
1. Liquid-liquid extraction (**demonstration, Supplement I1–2**)
2. Study of buffer solutions (**Lab Manual 16., pages: 77-80.**)
    a) Acetic acid – sodium acetate buffer
    b) ammonia – ammonium chloride buffer
3. Hydrolysis of salts (**Lab Manual 17., 17.1, pages: 81-84.**)

**Week 11 (18th December 2012)**
1. ***General test #2***
2. Standard electrode potentials and chemical reactions (**Lab Manual 18., 18.1., pages: 85-89.**)
3. Study of a Daniell cell (**Lab Manual 18.2., pages: 90-91.**)
4. Return of equipment