

# INTRODUCTION TO CHEMISTRY

## Year I/semester II

Both the seminars and laboratory practices will be organized in the Chemistry Building, according to the following schedule:

*Seminar:* 2 hours/week

Thursday 16:00 – 18:00 Room E213 – **Biology BSc and Physics BSc** (Dr. Gábor Bellér)

*Lab:* 4 hours/week

Tuesday 14:00 – 18:00 Laboratory D308 – **2<sup>nd</sup> year Physics BSc** (Dr. Attila Forgács & Fruzsina Simon)

Friday 10:00 – 14:00 Laboratory D308 – **Biology BSc** (Dr. Gábor Bellér & Márton Lukács)

## Subject and general rules:

The objective of the laboratory work is to introduce 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. At the beginning of each laboratory practice the instructors check the "*Pre-lab exercises*" part in the students' lab manuals. If it is not completed, the student must leave the laboratory and it is taken as an absence. 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 three short tests during the semester. Students are also required to write one general test (on week 5) which is based on the course material for weeks 1-5. The 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 test must be above 40 % to avoid a 'fail' final course grade. 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 tests 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 practice, medical certification is needed. If a student misses two lab practices/seminars even for any medical reasons, the student's lecture book will not 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 the general test, otherwise no signature and final grade is given to the student.

In the laboratory, students receive pieces of laboratory equipment for use. At the beginning of the semester, the students perform a full inventory of the cabinets with the laboratory equipment. During the laboratory practices, the students take full responsibility of the equipment they use for performing the experiments. At the end of each laboratory practice, the students restore the pieces of equipment to their place and lock the cabinets. At the end of the semester, the instructors check the students' cabinets again and if something is missing (either because the given item is broken, damaged or lost), the student will be charged.

## Timetable

	<b>2<sup>nd</sup> year Physics BSc</b>	<b>Biology BSc</b>
Seminar 1	14/02	14/02
Seminar 2	21/02	21/02
Seminar 3	28/02	28/02
Seminar 4	07/03	07/03
Practice 1	12/02	15/02
Practice 2	19/02	22/02
Practice 3	26/02	01/03
Practice 4	05/02	08/02
Practice 5	12/03	22/03

### 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. Interconversion of concentration units, exercises. Stoichiometric calculations based on chemical equations. Exercises in stoichiometry and concentration calculations.
- 3 Exercises based on acid-base titrations. Stoichiometric calculations based on chemical equations.  
Balancing of redox reactions. Calculations based on redox reactions.
- 4 Definition of pH. Calculation of pH for strong acids and bases.

# Laboratory practices for TUESDAY

## Week 1 (12<sup>th</sup> February 2019)

1. General rules of laboratory work (**Lab Manual 1**)
2. Safety training (**Lab Manual 1.1, pages: 5-6, Supplement S1–3**)
3. Introduction to laboratory equipment (**Lab Manual 1.2, page: 7, Supplement A1–4**)
4. Use of gas burners (**demonstration, Lab Manual 1.3, page: 8**)
5. Overview of received equipment

## Week 2 (19<sup>th</sup> February 2019)

1. Weighing on analytical and standard laboratory balances (**Lab Manual, 2, 2.1, pages: 9-11, Supplement B1–9**)
2. Measurement of volume: pipette, burette, volumetric flask (**demonstration, Lab Manual 2.2; pages: 12-13, Supplement C1–C2**)
3. Calibration of a pipette (**Lab Manual 2.3, pages: 13-14**)

## Week 3 (26<sup>th</sup> February 2019)

1. Grinding, preparation of solution (**demonstration, Lab Manual 3, pages: 15-16, Supplement E1–6, F1-F5**)
2. Preparation of a standard solution from crystalline solid:  $\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ ,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ,  $\text{Na}_2\text{HPO}_4 \cdot 2\text{H}_2\text{O}$  (**Lab Manual 3, pages: 15-16**)
3. Measurement of density: determination of the density of the prepared solution with a picnometer, calculation of the weight percent composition (**Lab Manual 4, pages: 17-19**)

## Week 4 (5<sup>th</sup> March 2019)

1. Decantation, centrifuging, filtration (**demonstration, Lab Manual 5.1 pages 20-21, Supplement E1-E6**)
2. Heating, cooling, use of a water bath (**demonstration, Lab Manual 6, page: 23-24**)
3. Purification of a benzoic acid sample contaminated with sodium chloride (**Lab Manual 5.2, pages: 22**)

## Week 5 (12<sup>th</sup> March 2019)

### 1. General test

2. Demonstration of an acid-base titration (**demonstration, Supplement G1–4**)
3. Determination of the concentration of a diluted HCl solution (**Lab Manual 7.2, pages: 25-28**)
4. Return of equipment

# Laboratory practices for FRIDAY

## Week 1 (15<sup>th</sup> February 2019)

1. General rules of laboratory work (**Lab Manual 1**)
2. Safety training (**Lab Manual 1.1, pages: 5-6, Supplement S1–3**)
3. Introduction to laboratory equipment (**Lab Manual 1.2, page: 7, Supplement A1–4**)
4. Use of gas burners (**demonstration, Lab Manual 1.3, page: 8**)
5. Overview of received equipment

## Week 2 (22<sup>th</sup> February 2019)

1. Weighing on analytical and standard laboratory balances (**Lab Manual, 2, 2.1, pages: 9-11, Supplement B1–9**)
2. Measurement of volume: pipette, burette, volumetric flask (**demonstration, Lab Manual 2.2; pages: 12-13, Supplement C1–C2**)
3. Calibration of a pipette (**Lab Manual 2.3, pages: 13-14**)

## Week 3 (1<sup>st</sup> March 2019)

1. Grinding, preparation of solution (**demonstration, Lab Manual 3, pages: 15-16, Supplement E1–6, F1-F5**)
2. Preparation of a standard solution from crystalline solid:  $\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ ,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ,  $\text{Na}_2\text{HPO}_4 \cdot 2\text{H}_2\text{O}$  (**Lab Manual 3, pages: 15-16**)
3. Measurement of density: determination of the density of the prepared solution with a picnometer, calculation of the weight percent composition (**Lab Manual 4, pages: 17-19**)

## Week 4 (8<sup>th</sup> March 2019)

1. Decantation, centrifuging, filtration (**demonstration, Lab Manual 5.1 pages 20-21, Supplement E1-E6**)
2. Heating, cooling, use of a water bath (**demonstration, Lab Manual 6, page: 23-24**)
3. Purification of a benzoic acid sample contaminated with sodium chloride (**Lab Manual 5.2, pages: 22**)

## Week 5 (22<sup>th</sup> March 2019)

### 1. General test

2. Demonstration of an acid-base titration (**demonstration, Supplement G1–4**)
3. Determination of the concentration of a diluted HCl solution (**Lab Manual 7.2, pages: 25-28**)
4. Return of equipment