GENERAL CHEMISTRY

Year I / Semester I

Both the seminars and the laboratory practices are realized in the Chemistry Building according to the following schedule:

Seminar: 2 hours/week

Monday 8:00 – 10:00 Room D404	**Pharmacy gr. 28** (Dr. Attila Forgács)
Monday 8:00 – 10:00 Room E213	**Pharmacy gr. 29** (Dr. József Kalmár)
Friday 12:00 – 14:00 Room E213	**Biochemical engineers, Chemical engineers, Chemistry B.Sc.** (Enikő Tóth-Molnár)

Laboratory practice: 4 hours/week

Tuesday 8:00 – 12:00 Lab. D311	**Pharmacy gr. 28** (Dr. Attila Forgács, Imre Nagy, Ferenc Najóczki)
Tuesday 8:00 – 12:00 Lab. D308	**Pharmacy gr. 29** (Dr. József Kalmár, Petra Herman, Györgyi Szunyog)
Thursday 8:00 – 12:00 Lab. D311	**Biochemical engineers, Chemical engineers, Chemistry B.Sc.** (Enikő Tóth-Molnár, Richárd Botár, Tibor Csupász)

Objectives:

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 fundamental experiments to familiarize themselves with chemical laboratory work. The seminar involves solving exercises and calculation problems connected to stoichiometry, concentration units and pH measurement.

General rules:

The **laboratory manual** is available to the students at the beginning of the semester. The introductory material to be studied to prepare for the actual laboratory work is overviewed before the description of each experiment in this manual. The weekly syllabus lists the particular topics covered on a given practice and gives a full description of the experiments. The word '*Demonstration*' in the syllabus refers to those experiments that will be carried out by the instructors for the students.

Students should come to each laboratory session fully prepared. This means, that students should ***learn*** the core theoretical background of each experiment and solve the *"Pre-lab exercises"* in the laboratory manual every week before the actual laboratory session. Students can ask questions regarding the introductory material for the laboratory during the seminar each week. Every laboratory session begins with a short test (not longer than 20 minutes) based on the introductory material of that week and the previous week and the results of the experiments carried out the previous week. The short tests also cover the material of the calculation seminars. Altogether, there are 8 short tests during the semester, and each short test worth 25 points. Students are also required to write 2 general tests (week 5 and week 11) that are based

on theoretical material of 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 grade for the course is based on the results of the tests, the quality of the laboratory manual and the quality of laboratory work. The average score from both the short tests and the general tests must be above 40 % to avoid the *1 (fail)* final grade. This means that in order to pass the laboratory practice, students should collect min. 80 points from the short tests and min. 40 points from the general tests. Those students, whose results are lower than 25% either from the short tests or from the general tests will automatically receive a *1 (fail)* final grade. Students with scores between 25% and 40% can write 1 final test in the examination period to earn the *2 (pass)* mark. Students with *1 (fail)* final grade have to retake the course the next year.

It is not allowed to miss any laboratory sessions or seminars. Under exceptional circumstances, i.e. certified medical or legal reasons, 1 laboratory session or seminar can be missed in the semester. However, if a student misses 2 laboratory sessions or seminars even for certified reasons, the student will automatically fail the course with a *"signature denied"* final mark. Missed laboratory sessions cannot be made up for.

Each laboratory practice starts at 8:00 am local time. Those students who enter the laboratory later than 8:00 am will automatically receive 0 (zero) points for the actual test. Those students who do not show up until the end of the test-writing period will automatically be expelled from the actual laboratory session, and this occasion is taken as an absence.

At the beginning of each practice the instructors check the *"Pre-lab exercises"* in the students' laboratory manuals. If these are not complete the student will be expelled from the laboratory, and this occasion is taken as an absence. The sections *"Laboratory notes"* and *"Review exercises and problems"* should be completed during the actual laboratory session. After each session, the instructors review the laboratory manuals and make corrections if necessary.

In the laboratory students receive pieces of laboratory equipment for use. If a student breaks something during the semester, the student has to pay a compensation for the damage. At the end of the semester the instructors check the inventory of the students' cabinets. If something is missing (either broken or lost) the owners of the cabinet have to pay compensations for the damage. The final grades for the course will be registered only if all damage balances are zeroed out.

Supporting materials:

http://www.inorg.unideb.hu/oktatas/85

Login (Felhasználónév): analitika09 [case sensitive]
Password (Jelszó): [no password]

Timetable

	Pharmacy Group 28.	**Pharmacy Group 29.**	**Engineers, Chemists**
Seminar 1	10.09.	10.09.	14.09.
Seminar 2	17.09.	17.09.	17.09.
Seminar 3	01.10.	01.10.	28.09.
Seminar 4	08.10.	08.10.	05.10.
Seminar 5	15.10.	15.10.	12.10.
Seminar 6	29.10.	29.10.	19.10.
Seminar 7	05.11.	05.11.	26.10.
Seminar 8	12.11.	12.11.	09.11.
Seminar 9	19.11.	19.11.	16.11.
Seminar 10	26.11.	26.11.	23.11.
Seminar 11	03.12.	03.12.	30.11.
Seminar 12	10.12.	10.12.	07.12.
Practice 1	18.09.	18.09.	20.09.
Practice 2	02.10.	02.10.	27.09.
Practice 3	09.10.	09.10.	04.10.
Practice 4	16.10.	16.10.	11.10.
Practice 5	30.10.	30.10.	18.10.
Practice 6	06.11.	06.11.	25.10.
Practice 7	13.11.	13.11.	08.11.
Practice 8	20.11.	20.11.	15.11.
Practice 9	27.11.	27.11.	22.11.
Practice 10	04.12.	04.12.	29.11.
Practice 11	11.12.	11.12.	06.12.

Seminar

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 for TUESDAY - Pharmacy gr. 28 & 29

Week 1 (18th September 2018)

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

Week 2 (2nd October 2018)

1. Weighing on analytical and standard laboratory balances (**Lab Manual, 2, 2.1, pages: 10-12, Supplement B1–9**)
2. Measurement of volume: pipette, burette, volumetric flask **(demonstration, Lab Manual 2.2; pages: 13-14, Supplement C1–C2**)
3. Use of gas burners (**demonstration, Lab Manual 1.3, page: 9**)
4. Calibration of a pipette (**Lab Manual 2.3, pages: 14-15**)

Week 3 (9th October 2018)

1. Grinding, preparation of solution (**demonstration, Lab Manual 3, pages: 16-17, Supplement E1–6, F1-F5**)
2. Preparation of a standard solution from crystalline solid: $Zn(CH_3COO)_2 \cdot 2H_2O$, $KAl(SO_4)_2 \cdot 12H_2O$, $CuSO_4 \cdot 5H_2O$, $Na_2HPO_4 \cdot 2H_2O$ (**Lab Manual 3, page: 16-17**)
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: 18-20**)

Week 4 (16th October 2018)

1. Decant, centrifuging, filtration (**demonstration, Lab Manual 5, 5.1 pages 21-22, Supplement E1-E6**)
2. Heating, cooling, use of a water bath (**demonstration, Lab Manual 6, page: 24-25**)
3. Purification of a benzoic acid sample contaminated with sodium chloride (**Lab Manual 5.2, pages: 23**)
4. Preparation of a double salt (substance #1) (**Lab Manual 8, pages: 30-34, Supplement E1–E6**)
    a) iron(III) ammonium sulfate (**Lab Manual 8.1**)
    b) potassium aluminum sulfate (**Lab Manual 8.2**)
    c) basic zinc carbonate (**Lab Manual 8.3**)
    d) chromium(III) potassium sulfate (**Lab Manual 8.4)**

Week 5 (30th October 2018)

1. General mid-term test #1

2. Determination of the composition of a mixture of $KClO_3$ and KCl (**Lab Manual 7, pages: 27-29**)
3. Determination of the melting point of the purified benzoic acid (**Lab Manual 6.1, pages: 25-26**)
4. Substance #1 due in

Week 6 (6th November 2018)

1. Demonstration of an acid-base titration (**demonstration, Supplement G1–4**)
2. Concentration determination of the standard NaOH solution (**Lab Manual 9., 9.2, pages: 36-38**)
3. Molecular weight determination of the purified benzoic acid based on acid-base titration (**Lab Manual 9.3, pages: 38-39**)
4. Purified benzoic acid due in

Week 7 (13th November 2018)

1. Laboratory work with gases: gas cylinders, other methods for gas generation (**demonstration, Lab Manual 10, 10.1, 10.2, pages: 40-44, Supplement H1–2**)
2. Preparation of oxygen in a laboratory gas generator, burning of sulfur in oxygen (**Lab Manual, 10.3, page: 44**)
3. Determination of molecular weight based on ideal gas law (**Lab Manual 11, 46-48**)

Week 8 (20th November 2018)

1. Preparation of a salt from its metal (substance #2) (**Lab Manual 12, pages: 49-53**)
    a) lead(II) chloride (**Lab Manual 12.1**)
    b) iron(II) ammonium sulfate (**Lab Manual 12.2**)
    c) aluminium(III) sulfate (**Lab Manual 12.3**)
    d) magnesium sulfate (**Lab Manual 12.4)**
2. Studies of reactions involving gas formation or precipitation (**Lab Manual 13, pages: 54-58**)

Week 9 (27th November 2018)

1. Quantitative study of a precipitation reaction (**Lab Manual 14, pages: 59-62**)
2. Dependence of reaction rate on the concentration of reactants (**Lab Manual 15, pages: 63-65.**)
3. Substance #2 due in

Week 10 (4th December 2018)

1. Liquid-liquid extraction (**demonstration, Supplement I1–2**)
2. Study of buffer solutions (**Lab Manual 16, pages: 66-69**)
    a) acetic acid – sodium acetate buffer (**16.1**)
    b) ammonia – ammonium chloride buffer (**16.2**)
3. Hydrolysis of salts (**Lab Manual 17, pages: 70-72**)

Week 11 (11th December 2018)

1. ***General test #2***
2. Standard electrode potentials and chemical reactions (**Lab Manual 18, 18.1, pages: 73-76**)
3. Study of a Daniell cell (**demonstration, Lab Manual 18.2, pages: 77-78**)
4. Return of equipment

Laboratory practices for <u>THURSDAY</u> – Engineers, Chemists

Week 1 (20th September 2018)

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

Week 2 (27th September 2018)

1. Weighing on analytical and standard laboratory balances (**Lab Manual, 2, 2.1, pages: 10-12, Supplement B1–9**)
2. Measurement of volume: pipette, burette, volumetric flask **(demonstration, Lab Manual 2.2; pages: 13-14, Supplement C1–C2**)
3. Use of gas burners (**demonstration, Lab Manual 1.3, page: 9**)
4. Calibration of a pipette (**Lab Manual 2.3, pages: 14-15**)

Week 3 (4th October 2018)

1. Grinding, preparation of solution (**demonstration, Lab Manual 3, pages: 16-17, Supplement E1–6, F1-F5**)
2. Preparation of a standard solution from crystalline solid: $Zn(CH_3COO)_2 \cdot 2H_2O$, $KAl(SO_4)_2 \cdot 12H_2O$, $CuSO_4 \cdot 5H_2O$, $Na_2HPO_4 \cdot 2H_2O$ (**Lab Manual 3, page: 16-17**)
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: 18-20**)

Week 4 (11th October 2018)

1. Decant, centrifuging, filtration (**demonstration, Lab Manual 5, 5.1 pages 21-22, Supplement E1-E6**)
2. Heating, cooling, use of a water bath (**demonstration, Lab Manual 6, page: 24-25**)
3. Purification of a benzoic acid sample contaminated with sodium chloride (**Lab Manual 5.2, pages: 23**)
4. Preparation of a double salt (substance #1) (**Lab Manual 8, pages: 30-34, Supplement E1–E6**)
    a) iron(III) ammonium sulfate (**Lab Manual 8.1**)
    b) potassium aluminum sulfate (**Lab Manual 8.2**)
    c) basic zinc carbonate (**Lab Manual 8.3**)
    d) chromium(III) potassium sulfate (**Lab Manual 8.4)**

Week 5 (18th October 2018)

1. <u>General mid-term test #1</u>

2. Determination of the composition of a mixture of $KClO_3$ and KCl (**Lab Manual 7, pages: 27-29**)
3. Determination of the melting point of the purified benzoic acid (**Lab Manual 6.1, pages: 25-26**)
4. Substance #1 due in

Week 6 (25th October 2018)

1. Demonstration of an acid-base titration (**demonstration, Supplement G1–4**)
2. Concentration determination of the standard NaOH solution (**Lab Manual 9., 9.2, pages: 36-38**)
3. Molecular weight determination of the purified benzoic acid based on acid-base titration (**Lab Manual 9.3, pages: 38-39**)
4. Purified benzoic acid due in

Week 7 (8th November 2018)

1. Laboratory work with gases: gas cylinders, other methods for gas generation (**demonstration, Lab Manual 10, 10.1, 10.2, pages: 40-44, Supplement H1–2**)
2. Preparation of oxygen in a laboratory gas generator, burning of sulfur in oxygen (**Lab Manual, 10.3, page: 44**)
3. Determination of molecular weight based on ideal gas law (**Lab Manual 11, 46-48**)

Week 8 (15nd November 2018)

1. Preparation of a salt from its metal (substance #2) (**Lab Manual 12, pages: 49-53**)
    a) lead(II) chloride (**Lab Manual 12.1**)
    b) iron(II) ammonium sulfate (**Lab Manual 12.2**)
    c) aluminium(III) sulfate (**Lab Manual 12.3**)
    d) magnesium sulfate (**Lab Manual 12.4)**
2. Studies of reactions involving gas formation or precipitation (**Lab Manual 13, pages: 54-58**)

Week 9 (22th November 2018)

1. Quantitative study of a precipitation reaction (**Lab Manual 14, pages: 59-62**)
2. Dependence of reaction rate on the concentration of reactants (**Lab Manual 15, pages: 63-65.**)
3. Substance #2 due in

Week 10 (29th November 2018)

1. Liquid-liquid extraction (**demonstration, Supplement I1–2**)
2. Study of buffer solutions (**Lab Manual 16, pages: 66-69**)
    a) acetic acid – sodium acetate buffer (**16.1**)
    b) ammonia – ammonium chloride buffer (**16.2**)
3. Hydrolysis of salts (**Lab Manual 17, pages: 70-72**)

Week 11 (6th December 2018)

1. ***General test #2***
2. Standard electrode potentials and chemical reactions (**Lab Manual 18, 18.1, pages: 73-76**)
3. Study of a Daniell cell (**demonstration, Lab Manual 18.2, pages: 77-78**)
4. Return of equipment