IB WORLD SCHOOL 1309 (ZSO13 Gdańsk)

Chemistry SL/HL

syllabus & course of study

(based on Chemistry guide

First assessment 2016,

4h per week for SL, 6h per week for HL)

A. COURSE AIMS:

1. Provide opportunities for study and creativity within a global context that will stimulate and challenge students developing the skills necessary for independent and lifelong learning.

2. Provide a body of knowledge, methods and techniques that characterize chemistry.

3. Enable students to apply and use a body of knowledge, methods and techniques that characterize chemistry.

4. Demonstrate initiative in applying thinking skills critically to identify and resolve complex problems.

5. Engender an awareness of the need for, and the value of, effective collaboration and communication in resolving complex problems.

6. Develop logical and critical thinking as well as experimental, investigative and problem-solving skills.

7. Develop and apply the students' information and communication technology skills in the study of chemistry to communicate information confidently and effectively.

8. Raise awareness of the moral, ethical, social, economic and environmental implications of using science and technology.

9. Develop an appreciation of the possibilities and limitations associated with continued developments in chemistry.

10. Encourage an understanding of the relationships between scientific disciplines and the overarching nature of the scientific method.

B. COURSE OBJECTIVES:

It is the intention of the course that students are able to fulfill the following objectives:

1. Demonstrate knowledge and understanding of: a. facts, concepts, and terminology

    b. methodologies and techniques

    c. communicating scientific information.

2. Apply:

    a. facts, concepts, and terminology

    b. methodologies and techniques

    c. methods of communicating scientific information.

3. Formulate, analyse and evaluate:

    a. hypotheses, research questions and predictions

    b. methodologies and techniques

    c. primary and secondary data

    d. scientific explanations.

4. Demonstrate the appropriate research, experimental, and personal skills necessary to carry out insightful and ethical investigations.

C. COURSE OVERVIEW:

SL/HL CORE:

Topic 1: **Stoichiometric relationships** (Nature of matter and chemical change./The mole concept./Reacting masses and volumes.)

Topic 2: **Atomic structure** (The nuclear atom./Electron configuration.)

Topic 3: **Periodicity** (Periodic table./Periodic trends.)

Topic 4: **Chemical bonding and structure** (Ionic bonding and structure./Covalent bonding./Covalent structures./Intermolecular forces./Metallic bonding.)

Topic 5: **Energetics / thermochemistry** (Measuring energy changes./Hess's Law./Bond enthalpies.)

Topic 6: **Chemical kinetics** (Collision theory and rates of reaction.)

Topic 7: **Equilibrium** (Equilibrium.)

Topic 8: **Acids and bases** (Theories of acids and bases./Properties of acids and bases./The pH scale./Strong and weak acids and bases./Acid deposition.)

Topic 9: **Redox processes** (Oxidation and reduction. / Electrochemical cells.)

Topic 10: **Organic chemistry** (Fundamentals of organic chemistry. / Functional group chemistry.)

Topic 11: **Measurement and data processing** (Uncertainties and errors in measurement and results. / Graphical techniques. / Spectroscopic identification of organic compounds.)

HL EXTENSION:

Topic 12: **Atomic structure** (Electrons in atoms.)

Topic 13: **The periodic table – the transition metals.** (First-row d-block elements. / Coloured complexes.)

Topic 14: **Chemical bonding and structure** (Further aspects of covalent bonding and structure. / Hybridization.)

Topic 15: **Chemical kinetics** (Energy cycles. / Entropy and spontaneity.)

Topic 17: **Equilibrium** (The equilibrium law.)

Topic 18: **Acids and bases** (Lewis acids and bases. / Calculations involving acids and bases. / pH curves.)

Topic 19: **Redox processes** (Electrochemical cells.)

Topic 20: **Organic chemistry** (Types of organic reactions. / Synthetic routes. / Stereoisomerism.)

Topic 21: **Measurement and data processing** (Spectroscopic identification of organic compounds)

SL/HL OPTION: Biochemistry

GROUP 4 PROJECT - a collaborative activity where students from different group 4 subjects work together on a scientific or technological topic

Textbook:

Chemistry for the IB Diploma, Steve Owen, Caroline Ahmed, Chris Martin, Roger Woodward, Cambridge University Press, 2014

Oxford IB Study Guides: Chemistry for the IB Diploma, Geoff Neuss, Oxford University Press, 2014

D. COURSE OF STUDY

Topic / Option	Content	Minimum time (hours)
1. Stoichiometric relationships	Nature of matter and chemical change. The mole concept. Reacting masses and volumes.	13,5
2./12. Atomic structure	The nuclear atom. Electron configuration.	6
	Electrons in atoms. (HL only)	2
3./13. Periodicity / The periodic table – the transition metals.	Periodic table. Periodic trends.	6
	First-row d-block elements. (HL only) Coloured complexes. (HL only)	4
4./14. Chemical bonding and structure	Ionic bonding and structure. Covalent bonding. Covalent structures. Intermolecular forces. Metallic bonding.	13,5
	Further aspects of covalent bonding and structure. (HL only) Hybridization. (HL only)	7
5./15. Energetics / thermochemistry	Measuring energy changes. Hess's Law. Bond enthalpies.	9
	Energy cycles. (HL only) Entropy and spontaneity. (HL only)	7
6./16. Chemical kinetics	Collision theory and rates of reaction.	7
	Rate expression and reaction mechanism. (HL only) Activation energy. (HL only)	6
7./17. Equilibrium	Equilibrium.	4,5
	The equilibrium law. (HL only)	4
8./18. Acids and bases	Theories of acids and bases. Properties of acids and bases. The pH scale. Strong and weak acids and bases. Acid deposition.	6,5
	Lewis acids and bases. (HL only) Calculations involving acids and bases. (HL only) pH curves. (HL only)	10
9./19. Redox processes	Oxidation and reduction. Electrochemical cells.	8
	Electrochemical cells – extension. (HL only)	6
10./20. Organic chemistry	Fundamentals of organic chemistry. Functional group chemistry.	11

	Types of organic reactions. (HL only) Synthetic routes. (HL only) Stereoisomerism. (HL only)	12
11./21. Measurement and data processing	Uncertainties and errors in measurement and results. Graphical techniques. Spectroscopic identification of organic compounds.	10
	Spectroscopic identification of organic compounds – extension. (HL only)	2
Option B. Biochemistry	Introduction to biochemistry. Proteins and enzymes. Lipids. Carbohydrates. Vitamins. Biochemistry and the environment.	15
	Proteins and enzymes. (Additional HL topics) Nucleic acids. (Additional HL topics) Biological pigments. (Additional HL topics) Stereochemistry in biomolecules. (Additional HL topics)	10

E. ASSESSMENT

SL:

Assessment component	Weighting
External assessment (3 hours)	**80%**
Paper 1 (¾ hours) • 30 multiple-choice questions on core, about 15 of which are common with HL. • The questions on paper 1 test assessment objectives 1, 2 and 3. • The use of calculators is not permitted. • Students will be provided with a periodic table. • No marks are deducted for incorrect answers. (30 marks)	**20%**
Paper 2 (1¼ hours) • Short-answer and extended-response questions on core material. • The questions on paper 2 test assessment objectives 1, 2 and 3. • The use of calculators is permitted. (See calculator section on the OCC.) • A chemistry data booklet is to be provided by the school. (50 marks)	**40%**

Paper 3 (1 hour) • This paper will have questions on core and SL option material. • Section A: one data-based question and several short-answer questions on experimental work. • Section B: short-answer and extended-response questions from one option. • The questions on paper 3 test assessment objectives 1, 2 and 3. • The use of calculators is permitted. (See calculator section on • the OCC.) • A chemistry data booklet is to be provided by the school. (35 marks)	**20%**
Internal assessment (10 hours) This component is internally assessed by the teacher and externally moderated by the IB at the end of the course. The task will have the same assessment criteria for SL and HL. The five assessment criteria are personal engagement, exploration, analysis, evaluation and communication. The internal assessment task will be one scientific investigation taking about 10 hours and the write-up should be about 6 to 12 pages long. Investigations exceeding this length will be penalized in the communication criterion as lacking in conciseness. (24 marks)	**20%**
Group 4 project (10 hours) The group 4 project is an interdisciplinary activity in which all Diploma Programme science students **must participate**. The intention is that students from the different group 4 subjects analyse a common topic or problem. The exercise should be a collaborative experience where the emphasis is on the processes involved in, rather than the products of, such an activity.	**(obligatory attendance)**

HL

Assessment component	Weighting
External assessment (4 hours 30 minutes) **Paper 1 (1 hour)** • 40 multiple-choice questions on core and AHL, about 15 of which are common with SL. • The questions on paper 1 test assessment objectives 1, 2 and 3.	**80%** **20%**

• The use of calculators is not permitted. • Students will be provided with a periodic table. • No marks are deducted for incorrect answers. (40 marks) **Paper 2 (2¼ hours)** • Short-answer and extended-response questions on the core and AHL material. • The questions on paper 2 test assessment objectives 1, 2 and 3. • The use of calculators is permitted. (See calculator section on the OCC.) • A chemistry data booklet is to be provided by the school. (95 marks) **Paper 3 (1¼ hours)** • This paper will have questions on core, AHL and option material. • Section A: one data-based question and several short-answer questions on experimental work. • Section B: short-answer and extended-response questions from one option. • The questions on paper 3 test assessment objectives 1, 2 and 3. • The use of calculators is permitted. (See calculator section on the OCC.) • A chemistry data booklet is to be provided by the school. (45 marks)	**36%** **24%**
Internal assessment (10 hours) This component is internally assessed by the teacher and externally moderated by the IB at the end of the course. The task will have the same assessment criteria for SL and HL. The five assessment criteria are personal engagement, exploration, analysis, evaluation and communication. The internal assessment task will be one scientific investigation taking about 10 hours and the write-up should be about 6 to 12 pages long. Investigations exceeding this length will be penalized in the communication criterion as lacking in conciseness. (24 marks)	**20%**
Group 4 project (10 hours) The group 4 project is an interdisciplinary activity in which all Diploma Programme science students **must participate**. The intention is that students from the different group 4 subjects analyse a common topic or problem. The exercise should be a collaborative experience where the emphasis is on the processes involved in, rather than the products of, such an activity.	**(obligatory attendance)**

Internal assessment maximal marks

Criterion	Marks	Description (for maximal marks)
Personal engagement	2 (8%)	The evidence of personal engagement with the exploration is clear with significant independent thinking, initiative or creativity. The justification given for choosing the research question and/or the topic under investigation demonstrates personal significance, interest or curiosity. There is evidence of personal input and initiative in the designing, implementation or presentation of the investigation.
Exploration	6 (25%)	The topic of the investigation is identified and a relevant and fully focused research question is clearly described. The background information provided for the investigation is entirely appropriate and relevant and enhances the understanding of the context of the investigation. The methodology of the investigation is highly appropriate to address the research question because it takes into consideration all, or nearly all, of the significant factors that may influence the relevance, reliability and sufficiency of the collected data. The report shows evidence of full awareness of the significant safety, ethical or environmental issues that are relevant to the methodology of the investigation (if applicable).
Analysis	6 (25%)	The report includes sufficient relevant quantitative and qualitative raw data that could support a detailed and valid conclusion to the research question. Appropriate and sufficient data processing is carried out with the accuracy required to enable a conclusion to the research question to be drawn that is fully consistent with the experimental data. The report shows evidence of full and appropriate consideration of the impact of measurement uncertainty on the analysis. The processed data is correctly interpreted so that a completely valid and detailed conclusion to the research question can be deduced.
Evaluation	6 (25%)	A detailed conclusion is described and justified which is entirely relevant to the research question and fully supported by the data presented. A conclusion is correctly described and justified through relevant comparison to the accepted scientific context. Strengths and weaknesses of the investigation, such as limitations of the data and sources of error, are discussed and

		provide evidence of a clear understanding of the methodological issues involved in establishing the conclusion. The student has discussed realistic and relevant suggestions for the improvement and extension of the investigation.
Communication	4 (17%)	The presentation of the investigation is clear. Any errors do not hamper understanding of the focus, process and outcomes. The report is well structured and clear: the necessary information on focus, process and outcomes is present and presented in a coherent way. The report is relevant and concise thereby facilitating a ready understanding of the focus, process and outcomes of the investigation. The use of subject specific terminology and conventions is appropriate and correct. Any errors do not hamper understanding.