Study Guide for Biochemistry 214

IN 2003

AT THE UNIVERSITY OF STELLENBOSCH

STUDY GUIDE FOR BIOCHEMISTRY 214

Contents

Study Guide for Biochemistry 214

General

❑ Welcoming

Welcome in the Department of Biochemistry and more specifically in the Biochemistry 214 course. The Department wishes you success in everything you attempt this year. More specifically, we trust that all will go well with your academic life and in particular with your Biochemistry. We hope that you will, during the course of this year, come to share in our enthusiasm for Biochemistry. This guide contains all the applicable information in connection with your course. Study it well and keep it somewhere you can easily lay your hands on it to look up important information.

❑ Educational policy

The Department, in its education policy, emphasises the mastering of specific generic, Biochemical and practical skills. Continuous attention will be given to the critical association with the subject. Critical association involves the understanding, use and application of concepts while keeping the mere regurgitation of memorised factual knowledge to a minimum. In addition, it is felt very strongly that you, the student, must be intimately involved in your own learning process; you, in fact, bear the primary responsibility for it. The lecturer only acts as a facilitator in the process. The course is, therefore, presented in such a manner that it enables you to achieve both the generic and the specific outcomes, by self-study and the attendance of scheduled contact sessions. This approach will be reflected in all aspects of the contact sessions in this course.

- During the **formal lectures,** the content and extent of the field of knowledge will be explained and demarcated while, at the same time, elucidating the contact areas between various aspects of the work. The more difficult aspects will, however, be discussed in detail. Student involvement is essential and will be expected of you throughout. Specific assignments will be used to encourage your involvement, to stimulate your interest and as an incentive toward critical thinking. There will also be the opportunity to practice the essential numerical and problem solving skills.

- Formal lectures are not seen as a complete revision of the work and you are strongly advised to master the finer detail of the work by means of **self-study**, using the textbooks and course outcomes as guidelines. The numeric and problem solving skills, in particular, must be practiced in your own time.

- **Tutorials** follow each of the themes in this module and are considered to be the opportunity where students can evaluate and discuss the homework problems in groups under the guidance of a tutor. You are expected to keep up with the work and make a concerted effort to solve the self-study problems. Problems are specifically used to apply and establish the more difficult concepts but also to integrate the various parts of the course and to point out the contact areas. Numerical problems give you the opportunity to practice your numeric and problem solving skills. Peer evaluation of problems in tutorials and the ensuing discussion serves a fourfold purpose. Firstly, the evaluation of another person's work requires conversance with the material, i.e. an active participation in the learning process and a high level of cognitive interaction. Secondly, the group discussions will allow students to talk about Biochemistry in smaller, safer environment, thereby establishing a greater familiarity and more comfortable association with the subject. Thirdly, it provides a valuable opportunity for students to compare learning strategies and, under the guidance of the tutor, to analyse the processes involved in problem solving. In the last instance, it is a directive from the Education Authorities that group work must be actively encouraged at tertiary educational institutions and that it must be stated as a specific outcome.

- **Structural recognition and characterisation** of bio molecules is one of the central outcomes of this module. During each practical you will have the opportunity to practice this skill by identifying ball-and-stick models of molecules, characterising them, and entering the answers in your laboratory books. An Identification and characterisation exercise will form part of the practical skills test.

- Biochemistry is an experimental, laboratory-orientated subject and students must therefore be well versed in both the theoretical substructure and principles of the scientific method, as well as the practical implementation of specific **laboratory techniques** and **procedures**. Practicals will therefore be presented that address the **underlying theory** as well as giving the opportunity to practice your practical **skills**. An integral part of all this is setting up a **flow diagram** while preparing for the practical and keeping a **laboratory work book** when conducting the actual experiment. You must learn to recognise those aspects that are important to correctly apply the scientific **method** and to prepare a **scientific report** on the experiment. PLEASE NOTE: *The laboratory workbook is neither a report book nor a scientific report!*

- Both the practicals and the preparation are carried out and evaluated in **group context** (working in pairs) in order to develop your skills in working as a member of a team. A working pair must **plan**, **execute** the experiment and apply effective **time management** as a team. You will be required to set up flow diagrams, keep a laboratory workbook up to date and prepare scientific reports. Your peers, under the guidance of a tutor, will evaluate your efforts during practice sessions. At each practical session, your attention will be drawn to both the theoretical aspects as well as the key skills that need to be practiced. A lecture before each practical will be utilised to highlight these aspects and

to give you the opportunity to complete supplementary problems as self-study exercises. These problems will be subject to peer evaluation during the practical sessions.

- Effective **communication skills** are seen as an important part of your Biochemistry training and opportunities to develop them in written and in oral form are created.
  - The written **seminar** is the opportunity to learn to retrieve scientific information, process it and present it in written form. An information session with the Biochemistry subject librarian has been arranged where you will become acquainted with the appropriate sources and correct methods of retrieving information. Supplementary to the examples and guidelines in your notes you will also, at this occasion, be given further information on aspects such as the correct use of references and how to avoid plagiarism. A computer based first draft of the seminar will be handed in, evaluated and discussed during the second term. The final, printed copy will be handed in and marked during the second term. The complete details will be given to you at the appropriate time. Seminar subjects at the second year level are not chosen exclusively because of their Biochemistry content, but also to stimulate student's enthusiasm and encourage them to read more widely about science.
  - Each 214-student must hand in a computer based **scientific report** on one of the practicals he or she carried out. This will be compiled from your own notes in the laboratory workbook and the specific guidelines given to you. Writing reports is an essential skill for every student in the practical sciences and you will be given the opportunity to first prepare a practice report from a practical that is demonstrated to you. This practice report will be marked and discussed in group context by peer evaluation under the guidance of a tutor.
  - **Oral presentations** of a specific practical will be given by each pair to a group of about 20 fellow students, a lecturer and a tutor. The presentation will be marked according to specific criteria by all present and each pair is afforded the opportunity to evaluate all the other pairs in the group.

Purpose of the module

The Biochemistry 214 student will:

- have the opportunity to acquire the necessary knowledge and skills to recognise and characterise any bio molecule, known or unknown and predict the characteristics and behaviour of the molecule in specified environments;
- be given specific tasks in which the student may learn to retrieve scientific information, process it and present it in writing and orally;
- learn to plan an experiment, document the experimental procedure and afterwards write a scientific report on it;
- acquire specific basic, scientific and practical skills and be afforded opportunities where these skills can be practiced;
- be afforded the opportunity to master and practice numerical as well as problem solving skills in a Biochemical context.

The reason for the existence of the module

To give the student taking Biochemistry 214 a:

- broad background on Biochemical aspects as required by the variety of scientific disciplines in the Biological Sciences that prescribe this course;
- basis upon which more advanced Biochemistry courses can build during the third year.

Outcomes of the module

General Outcomes

The Biochemistry 214 student must, given a specific subject, be able to:

- retrieve scientific information about the subject by using primary sources such as research articles and secondary sources such as text books and review articles
- sum up, process and critically evaluate the information
- present the information coherently and logically in a written seminar, prepared with the aid of a specified computer program and according to specified guidelines on the page layout and format.

Outcomes for the theory

The Biochemistry 214 student must be able to achieve every specific outcome in each of the sections below. You must therefore be able to DO all of them.

- With regard to the cell, you must be able to do the following.
  - Name the differences between eukaryotic and prokaryotic cells.
  - From a given list, be able to assign biochemical functions to each cell organelle, give an indication of whether the organelle is topologically a continuation of the cytosol and say if it is separated by one or two membranes from it.
  - Name organelles that occur only in plants or only in animals.
- In connection with bio molecules, in general, you must be able to do the following.
  - Interpret the role of water in molecular interactions.
  - Be able to identify the functional group(s) in a molecule and explain their influence on the interaction(s) between the molecule and the environment.
  - Explain the relationship between the polarity of the environment and the degree of dissociation of a molecule and quantify this by means of a calculation.
- With regard to nucleic acids, you must be able to do the following.
  - Be able to define the concepts pairing, denature, renature, translation, transcription and replication and apply them to given examples.
  - Define the central dogma.
  - Define the concepts kodon and anti-kodon and use the genetic code to solve given problems.
- With regard to proteins, you must be able to do the following.
  - Group amino acids according to the nature of their side chains as polar and ionisable, polar and non-ionisable, aromatic, acidic or basic.
  - Recognise different isomers of amino acids and define the differences.
  - Know the four sequential organisational levels of protein structure, be able to define them and to recognise them in a diagram.
  - Based on the primary structure of a peptide predict what type(s) of secondary structure(s) it will adopt.
  - Predict the behaviour of a peptide in a changing environment based on its primary structure.
- With regard to ligand binding you must be able to do the following.
  - Know and use the concepts complimentary, saturated, hyperbolic equation, cooperative and sigmoidal to describe and interpret the behaviour of proteins and ligands.
  - Using the appropriate formulae quantify this interaction in calculations.
- With regard to enzymes, you must be able to do the following.
  - Know and use the concepts regulate, catalysis, specificity, activation energy, rate constant, reaction rate, active site, enzyme-substrate complex, saturation kinetics, allosteric, Michaelis-Menten, Lineweaver-Burk, Direct Linear and kinetic parameters to describe and interpret the interaction between proteins and substrates.
  - Deduce the dependence of enzyme mechanisms on functional groups in the active site and predict the type of interaction.
  - Classify enzyme reactions according to the six main classes of enzymes and the international classification system.
- With regard to vitamins, coenzymes & cofactors you must be able to do the following.
  - Allocate coenzymes to a reaction according to the type of reaction involved.
  - Recognise the active portion of a coenzyme and be able to give its function in the reaction mechanism.
  - Define the differences between coenzymes, prosthetic groups and cofactors.
- With regard to carbohydrates, you must be able to do the following.
  - Define the concepts mutarotation, ring closure, reducing and non-reducing with regard to carbohydrates and apply them to given problems.
  - Identify the different ring forms of monosaccharides and state the implications in biological reactions.

- Point out the occurrence of specific mono-, di- and polysaccharides in different structures as well as assign metabolic and physiological functions to them.

❖ With regard to lipids and biological membranes, you must be able to do the following.

- Define and apply terms such as amphipathic, lipid double layer, non-covalent, cooperative, two dimensional fluid, asymmetric, vesicle formation, vesicle fusion and membrane fluidity in the correct context.
- Predict the influence of changes to individual components on the nature of biological membranes.
- Relate the permeability of lipid membranes to membrane composition and the chemical characteristics of individual molecules.
- Name different types of transport across membranes as well as give and apply the principles according to which each one functions in solving specific problems.

♦ ***Outcomes of practicals***

The Biochemistry 214 student must be able to achieve each one of the specific outcomes in the following subsections. You must therefore be able to DO all of them.

❖ As a team, set up a flow diagram on the computer from the given description of the experiment, this summarises the experiment and reflects your planning. This must include the equipment; glassware and chemicals required, a time estimate for each step as well as the task allocation between the team members and each member's contribution to the compilation of the flow diagram.

❖ As a team carry out an experiment from the flow diagram and individually do the following in a laboratory work book:

- notes all observations, problems and their solutions as well as noting all conclusions drawn,
- correctly record all results obtained,
- do all the applicable calculations and processing and
- draw meaningful conclusions from your results.

❖ From given or acquired data:

- Suggest or identify controls required,
- Process the data by carrying out all applicable calculations and/or drawing graphs, so that valid deductions and sound conclusions can be drawn,
- Write a report which:
  - Is compiled with the aid of word processing and spread sheet programs
  - Contains the following:
    - ✓ Introduction and objective
      - o discuss the theoretical background of the experiment or the technique used
    - ✓ Methods and materials
      - o containing a logical coherent description of the experimental procedure and of the reagents and equipment used
    - ✓ Results
      - o tabulate all figures and observations, give an example of each type of calculation and clearly give all formulae used
    - ✓ Conclusion/Deduction
      - o a well argued conclusion or deduction based on the results
- with your team-mate, present the report verbally, within a specific time limit to an audience and answer questions about it.

❖ Be able to do the following with your team mate in the laboratory or on your own in the practical skills test:

- the basic laboratory techniques:
  - weighing,
  - prepare solutions,
  - pipeting,
  - titrating
  - preparing dilutions,
  - determining pH-values,
  - prepare, carry out and correctly handle chromatograms,

- carry out spectrophotometric measurements.

❖ Set up and correctly operate the instruments below.

- balances
- pH-meters
- spectrophotometers

❖ Recognise and correctly use the following equipment:

- beakers
- burettes
- measuring cylinders
- micropipettes
- pipette fillers
- pipettes
- volumetric flasks

❖ Master key concepts in the substructure of the practical (e.g. dimensional correctness, the correct usage of units, masses, volumes, solutions, concentrations, dilutions, equilibrium reactions, buffer action, light absorption, enzyme kinetics and chromatography) in order to be able to process results quickly and correctly, elucidate them and make scientifically responsible predictions based on them.

❑ The Biochemistry 214-students must be able to keep a practical laboratory notebook.

❖ Keeping records and the interpretation of data is a skill that you will require throughout your scientific career, irrespective of the scientific field in which you are going to work. The ability to prepare an adequate and reliable record of your results is a fundamental requirement for all experimental work.

- The most important requirement for an acceptable laboratory workbook is that the record must be complete enough so that a second person can follow your experimental work in order to repeat your experiment and obtain the same results.
  - Number all pages in the book beforehand and do not remove any pages.
  - Make all records of your work **while you are working.**
- The records must be such a good representation of your work that you can interpret any result outside expected parameters at a later stage, even if you do not notice the deviation while you are conducting the experiment. Calculations and processing of results may, if no other option is available, be carried out at a later stage.
- All entries in the workbook **must be done in ink**, i.e. not in pencil!
- All data and observations must be entered directly into the workbook and never made on odd bits of paper, the palms of you hands or you laboratory coat. If you make mistakes you simply cross them out with a single line, do not obliterate them!
  - **Never erase or "Tipex-out" results**, as you may, at a later stage, find that the information is useful.
- There is the temptation to wait until after the practical so that you can make your entries "neatly", but it is far more important to have a complete and accurate record of all original data and observations: even if this means that there will be splashes, smears and crossed out words in the book.
- Your workbook must give a synoptic account of all the laboratory work you did during the semester in Biochemistry 214.
- Should you need to leave out a whole page of information you simply draw a cross across the entire page and make an entry in the margin as to why this was done. The page must not be removed.
- On the cover, you must have your course (Biochemistry 214), the year, day of the week on which you do practical, your bench number, your first name, surname and initials, student number and course. At the bottom of the cover page, you must write the first name, surname and initials, student number and course of your team-mate. An example is displayed in the laboratory and outside on the notice board.
- The first page (Page 1) is for the table of contents. At the head of this page, you enter your initials and surname and just below that write "Contents". On a weekly basis, you enter the titles and numbers of the experiments you carry out as well as the page number on which the experiment begins in your workbook.
- The first experiment starts on page two. At the top of page two and at the top of each page in the rest of the book write the following: Your surname and initials, the date as well as the number and title of the experiment to which the data and particulars on that page belong.

- It is useful to make your entries in the form of numbered steps and, although full sentences are not a prerequisite, the entries must not be so cryptic that you have no idea what they mean the next day, next week or next month. Neither is an exceptionally neat handwriting a prerequisite, although it is a great asset, but your handwriting must be legible, both for yourself as well as for other people.
- As soon as you complete each page, sign it and leave sufficient space for the laboratory stamp.

❖ Before the first practical, you must do the following.

- Complete the cover page.
- Number each page.
- Enter the relevant information on page one (the contents page).
- Make the required entries at the head of all other pages.

❖ Before the each practical, you must do the following.

- At the head of the first open page write the date, the title and number of the experiment you will be carrying out.
- Make a note of the source of the experiment. In the course, it will mostly be "Biochemistry 214 practical notes".
- The purpose of the experiment. Why are you doing the experiment and what do you expect to learn. **Do not** simply copy what is in the practical notes!
- Make a list of the chemicals, glassware and equipment you are going to use. Include items such as matches (if the experiment requires a gas flame) and graph paper (if a graph has to be drawn).
- Prepare a flow diagram. The flow diagram must be as short and concise as possible (preferably one page or even less), but you ought to be able to carry out the experiment from the flow diagram with little or no reference to your notes.

Administrative information

❑ Module

❖ 11053 BIOCHEMISTRY: 214 (16) Structure, function relationships
Structural characteristics and functions of bio molecule (bio elements, water, nucleic acids, proteins, carbohydrates, lipids and coenzymes)

❑ Examination

❖ Examined by means of continuous evaluation

❑ Prerequisites:

❖ P Biology 124
PP Chemistry 114 of Chemistry B134 of Chemistry (Medical Science) 111
P Chemistry 154
OR

❖ P Biology 124
PP Chemistry 154 of Chemistry (Medical Science) 111
P Chemistry 114 of Chemistry B 134

❑ Lecturers

❖ Ms. D. Africander (Nucleic acids – Group II)

❖ Mr EJF Foster

❑ Practical & Administration

❖ Ms L du Toit

❑ Compulsory study sources

❖ *Biochemistry*, 2nd Edition (1995). Donald Voet & Judith G. Voet. John Wiley & Sons, Inc.

❖ *Biochemical Calculations*, 2nd Edition (1976). Irwin H. Segel. John Wiley & Sons.

❑ Contact Sessions

Lecture schedule

L1	Administration & Introduction
Theme A: The Living Cell	
L2	Cellular structure and organization (Biology-124 notes on cytology, V&V 2-11).
Theme B: Molecular evolution	
L3	The evolution of bio molecules and the origin of life (V&V 18-24 & 123-133 & 208-211).
Theme C: Bio molecules	
L4	Water the solvent of life, Acids, bases and buffers (V&V 29-39).
L5	Bio-elements, Molecular hierarchy of biological structures, Functional groups, Covalent & non-covalent forces (V&V 13-18 & class work).
L6	Non-covalent interactions, Electrostatic interactions (V&V 30-32, 144, 174-179 & class work)
L7	Tutorial, themes A, B & C (V&V Prob. 4 p.27, Prob. 2, 5 p.40 & Prob. 12 p.41, V&V Prob. 8 p.53, Prob. 11 p.54, Prob. 15 p.190; Segel (S) Prob. 1-8, Prob. 1-9, 1-10, 1-11, 1-12, 1-13, 1-27 & 1-31)
Theme D: Nucleic acids	
L8	Nucleotides, nucleotides, and DNA, mRNA, rRNA, tRNA (V&V 795-797, 803, 806, 816, 821-822, 849-850, 918, 967-971, 981-986)
L9	DNA secondary structures, stability, size & packaging (V&V 850-870, 873-882)
L10	DNA-replication, transcription and translation as well as the genetic code (V&V 854-855, 1020-1024, 1034, 1038, 1041, 1044, 991-1004, 959-981, 1007-1010
L11	Tutorial, theme D (V&V p.913, Prob. 2, 4, p.1019, Prob. 1, 15, 19, p.1018 Prob. 6, 7)
Theme E: Proteins	
L12	Chemical structure, stereochemistry & characteristics of amino acids (V&V 56-69)
L13	Peptides, peptide bonds and levels of protein conformation (V&V 105-137, 141-185)
L14	Protein folding, denaturation (V&V 191-248)
L15	Solubility, separation & purification (V&V 71-102)
L16	Tutorial, theme E (V&V p.70, Prob. 2, 5, 9, 10
Theme F: Binding of ligands to proteins	
L17	Protein-binding sites for ligands (V&V p.332-337)
L18	Binding equilibriums & Binding parameters (V&V p.217-220)
L19	Binding equilibriums & Binding parameters, Cooperative binding (V&V p.227-233, 218, 217-220))
L20	Cooperative binding (V&V p.227-233, 218)
L21	Tutorial, theme F (V&V p.250 Prob. 1, 2, 4, 10, 16)
Theme G: Enzymes	
L22	General enzyme characteristics & how they accelerate reactions. (V&V p.338-343)
L23	Catalytic mechanisms (V&V p.338-343)
L24	Catalytic mechanisms & chemical kinetics (V&V p.345-351)
L25	Enzyme kinetics (V&V p.345-364)
L26	Michaelis-Menten & Practical determination of kinetic parameters (V&V p.345-364)
L27	Enzyme catalysis, factors influencing enzyme reactions (V&V p.371-381 & class work)
L28	Tutorial, theme G (V&V p.344, Prob. 4, 5, 8 p.369, Prob. 1, 3, 4, 5, p. 408-410, Prob. 2, 6, 9, 10, 18)

Theme H: Vitamins, coenzymes and cofactors	
L29	Coenzymes and Vitamins, reduced electron carrying coenzymes. (V&V p.337-338, 826, 675 & class work)
L30	Biotin, TPP, PALP &THF (Look up the references in the text book yourself.)
L31	Pantothenic acid derivatives, Lipoic acid, Vitamin B_{12} & metals (Look up the references in the text book yourself.)
L32	Tutorial, theme H (Make a list (table) of the different coenzymes, the vitamins they are derived from, the types of reactions & enzymes they are associated with and, wherever possible the symptoms of a deficiency of each vitamin. Make a connection between the type(s) of reaction(s) with which the specific coenzyme is associated.)
Theme I: Carbohydrates	
L33	Functional groups in carbohydrates, monosaccharide configuration & conformation. (V&V p.251-256)
L34	Monosaccharide configuration & conformation, sugar derivatives & polysaccharides (V&V p.256-263)
L35	Polysaccharides, Glycosamine Glucans & Glycoproteins. (V&V p.264-274)
L36	Tutorial, theme I (V&V p.276, Prob. 1, 7, 8, 14 & 16)
Theme J: Lipids, membranes and cellular transport	
L37	Naming fatty acids, acylglycerols & phosphoacylglycerols as well as the classification, structure & function of the fatty acids and lipids. (V&V p.277-284)
L38	Lipid aggregates, membrane lipids & biological membranes. (V&V p.285-297)
L39	Biological membranes and membrane transport. (V&V p.297-310, 314-325, 513-534)
L40	Membrane transport. (V&V p.513-534)
L41	Tutorial, theme J. (V&V p.329, Prob. 1, 2, 5, 7, 8 & 9, p.536-537, Prob. 1, 3, 8 & 11)

Schedule for practicals and longer tutorials.

Practical 1	Safety, setting up flow diagrams & keeping a laboratory workbook.
Practical 2	Writing a scientific report
Practical 3	SI-units solutions and concentrations, numeric correctness & weighing:
Tutorials: A to D	An extension of the work already done in the class tutorial.
Practical 4	Chemical equations, pH & buffer solutions, Acid/base titrations.
Practical 5	Ionisation of amino acids and proteins and their buffer characteristics.
Practical 6	Spectrophotometry
Practical 7	Enzyme kinetics
Practical 8	Chromatography

❑ Assessment

The course is evaluated on a continuous basis and presents an adequate number of opportunities for you to ascertain if you have mastered the outcomes satisfactorily.

- Evaluation of the theoretical aspects is by means of two **open book tests**. This is in accordance with our education policy that it is essential to understand, use and apply concepts and that the extensive memorization of facts needs to be eliminated as far as possible.
- Evaluation of the theoretical substructure of the practical and the scientific method is by means of an **open book practical theory test** and of the practical skills by means of a **practical skills test** in which students have to carry out specific practical assignments. Flow diagrams are evaluated in group context and a mark will be given for teamwork. Flow diagrams are evaluated as part of the **laboratory workbook** and each student must hand in one **scientific report** for evaluation.

- **Communication skills**, i.e. seminar, scientific report and oral are evaluated according to specific guidelines that will be given to you at a later stage.
- **Peer evaluation** is used throughout the course for several reasons: it encourages you to maintain a high level of conversance with the course material and to participate actively in the learning process. You also learn to evaluate a product according to a set of guidelines and to associate with knowledge at a higher cognitive level.

- Composition of marks:

Final Mark: 40% Practical and 60% Theory with a sub minimum of 50% for both sections.

- Theory:
  - Open book test 1 40%
  - Seminar 20%
  - Open book test 2 40%
- Practical:
  - Laboratory workbook 15%
  - Practical Scientific Report 20%
  - Practical Skills Test 20%
  - Open Book Practical Theory Test 35%
  - Oral 10%

- **Other Special Requirements**

Copyright Warning: No Photostats of textbooks or parts of textbooks will be allowed in open book tests.

Outcomes for die Biochemistry 214 course.

The Biochemistry 214-studente must:

- **Be able to define and use correctly in descriptions and discussions all the terms in the word list at the end of this handout.**
- **In connection with the cell and the concept of the evolutionary development of molecules, be able to do the following.**
  - Compare Eukaryotic and Prokaryotic cells.
  - Assign one or more of the following functions to each cellular organelle.
    - DNA-break down
    - DNA-synthesis
    - Photosynthesis – Light dependent reactions
    - Photosynthesis – Light independent reactions
    - Carbohydrate break down
    - Carbohydrate synthesis
    - Lipid oxidation
    - Lipid synthesis
    - Oxidative phosphorylation
    - Protein break down
    - Protein modification
    - Protein synthesis
    - RNA-break down
    - RNA-synthesis
  - Indicate if an organelle is topologically continuous with the cytosol or whether it is separated from it by one or two membranes.
  - Name the organelles that occur only in plants or only in animals.
  - Explain the endosymbiotic theory and indicate why it supports the evolution process.
  - Explain how bio molecules are used as markers for the process known as evolution.
  - Explain the concept “conserved” in terms of molecular evolution and point out its role in the interpretation of the evolutionary process.
- **With regard to atomic and molecular interactions;**
  - Define and recognise each of the following and predict if a specific functional group or bio molecule will participate in it.
    - Dielectric constant
    - Dipole-dipole.
    - Dipole-induced dipole.
    - Dispersion forces.
    - Hydrophobic interactions.
    - Ion-dipole interactions.
    - Ion-induced dipole
    - Charge-charge interactions (Ionic Interactions)
    - Non-polar covalent bonds
    - Polar covalent bonds
    - Temporary dipole-induced dipole
    - Van der Waals radius
    - Hydrogen bonds (Linear or non-linear)
  - Predict how the strength of the interactions above will vary depending on the nature of the environment in which they are experienced.
  - Use the electronegativity differences between the most prevalent bio elements to predict differences in polarity and dissociation.
  - Explain the role of water in the molecular interactions involved in each of the following.
    - The hydrophobic effect
    - Dissociation
    - Hydration layers
    - Ionisation
    - Non-polar interactions
    - Polar interactions
    - Formation of hydrogen bonds
  - Explain the relationship between the polarity of the environment and the degree of dissociation of a molecule.
  - Explain why carbon, oxygen and nitrogen are limited to specific structural roles.

❖ If given a ball-and-stick-model, figure or the name of a bio molecule, you must be able to supply the following information, if it is applicable to the particular molecule:

- Identify the following functional groups.
  - Aldehyde
  - Alcohol (Primary)
  - Alcohol (Secondary)
  - Amide
  - Amine
  - Ammonium
  - Acetate
  - Acetyl
  - Acyl
  - Ester
  - Ether
  - Phenyl
  - Phosphate
  - Phospho-anhydride
  - Phospho-ester
  - Phosphoric
  - Hydroxide
  - Hydroxyl
  - Amino-
  - Carboxylic acid
  - Carboxyl ate
  - Carbonyl
  - Kato
  - Methyl
  - Ethylene
  - Sulphydryl
  - Acid Anhydride
  - Thiol ester
- Describe the influence of the functional groups on the interaction between the molecule and the environment and other molecules.
- Place the molecule in one of the following main groups, identify it as a specific subgroup or one of the subdivisions, and characterise it according to one of the headings under each subgroup.

❑ With regard to carbohydrates

- **Polysaccharides**
  - Identify if it has a reserve function or a structural function.
  - Identify the type of glycosidic bond(s) between the monomers.
  - Identify the monomers and characterise them according to the headings under disaccharides & monosaccharides.
- **Disaccharides & Monosaccharides**.
  - Aldose and/or Ketose
    - Hexose
    - Pentoses
    - Tetroses
    - Trioses
      - ✓ Determine if it is non-reducing or reducing.
      - ✓ Determine if it is mutarotational.
      - ✓ Determine if a monosaccharide is an aldose or a ketose.
      - ✓ Determine if a monosaccharide is in the D- or L- configuration.
      - ✓ Determine if a monosaccharide is in the alpha- or beta-configuration.
      - ✓ Determine the type of glycosidic bond between the component monosaccharides (MAINLY disaccharides)
      - ✓ Identify the monosaccharides as pyranose or furanose.
      - ✓ Convert bi-directionally between Fischer- and Haworth-representations.
      - ✓ Assign IUPAC-names for mono- or disaccharides depicted as Haworth-representations.

❑ With regard to lipids

- **Fatty acids**
  - Saturated or unsaturated
    - Give IUPAC-names or, if the IUPAC-name is given, give the structure.
- **Acylglycerols**
  - Monoacylglycerols
  - Diacylglycerols
  - Triacylglycerols
    - Give IUPAC-names or, if the IUPAC-name is given, give the structure.

- **Phosphoacylglycerols**
- **Sterols**
- **Steroids**
- **Sphingolipids.**
- **Leucotrienes**

❑ **With regard to proteins**

- **Structural and dynamic proteins.**
  - Define the structural levels given below and identify them in a sketch or diagram.
    - Primary
    - Secondary
    - Tertiary
    - Quaternary
  - If given the amino acid sequence, identify the C-terminal and N-terminal amino acids.
  - Define the secondary structures given below and identify them in a sketch or diagram.

    α-Helix
    β-Sheet
- **Amino acids**
  - Group amino acids according to the following characteristics of their side chains.
    - Aromatic or aliphatic.
    - Charged or uncharged.
    - Hydrophobic or hydrophilic.
    - Polar or non-polar.
    - Acidic or basic.
    - Saturated or unsaturated.
  - Give the ordinary/common name.

❑ **With regard to nucleic acids**

- **Deoxyribonucleic acid (DNA) and Ribonucleic acid (RNA**
  - Distinguish the different forms of DNA double helix from each other in a figure.
  - Identify the following parts of the molecule (DNA & RNA).
    - Nitrogen bases

    Indicate if it is a purine or a pyrimidine.
    Know the names of the different nitrogen bases.
    - Sugars

    Identify the sugar and number it correctly.
    - Phosphoryl groups.
    - The N-glycosidic bond.
    - The phospho-ester bonds.
  - Define the following secondary structures in nucleic acids and identify them in a sketch or diagram.
    - Primary
    - Secondary
    - Tertiary
    - Quaternary
- **Nucleotides and Nucleosides**
  - Distinguish between the following and give the correct names and abbreviations.
    - Mononucleotides
    - Dinucleotides
    - Trinucleotides
    - Cyclic mononucleotides

❖ Given a structure, or name of a bio molecule with applicable parameters such as pK_a-values of the ionisable groups, pH and concentrations or species quantities, you must be able to do the following.

- Write down the equilibrium equation for the reaction in which the molecule participates.
- Calculate the net charge of the molecule at a specific pH.
- Determine the dominant ionic species at a specific pH.
- Calculate the mole fractions and concentrations of different molecular species at a specific pH.

❖ With reference to nucleic acids

- Define each of the following and apply it to given example
  - Anti-kodon
  - Base paring
  - Chromatin
  - Chromosome
  - Denaturation
  - Histone
  - Initiation kodon
  - Kodon
  - Renaturation
  - Replication
  - Semi-conservative replication
  - Central dogma
  - Stop kodon
  - Super coiling
  - Transcription
  - Translation
- Give a step for step explanation of the central dogma.
- Apply Chargaff's rule.
- Explain the formation of the double helix (DNA).
- Give the full names and correct abbreviations of the different forms of RNA.
- Explain the functions of the different forms of RNA.
- Define the concepts kodon and anti-kodon.
- Use the genetic code to determine amino acid sequences.
- Know the factors that determine the melting point of DNA and explain how they exercise their influence.
- Explain the differences in the packaging of the genetic material in prokaryotes and eukaryotes.
- Given any one of the following determine the other three: base sequence of the DNA–sense strand, base sequence of the DNA-non-sense strand, base sequence of the mRNA and the amino acid sequence of the peptide.

❑ **With regard to ligand binding.**

- Define the following concepts and use them to describe and interpret the conduct of proteins and ligands.
  - Binding curves of ligands and binding sites.
  - Hyperbolic curves that represent binding data.
  - Complementarity of ligands and binding sites.
  - Negative cooperative binding of ligands.
  - Positive cooperative binding of ligands.
  - Sigmoidal curves that represent specific binding data and effects.
  - Saturation of binding sites.
- Define rate constants, apply the concept in problems and use it to process results.
- Know the relationship between binding constants and dissociation constants and be able to give them in terms of concentrations and rate constants and use them to solve problems.
- Know the factors that determine binding saturation and be able to apply them to given problems.
- Understand the mathematical relationships that describe the concentration dependence of monomeric proteins and be able to apply them to solve problems and process results.
- Distinguish the mathematical relationships that describe the concentration dependence of oligomeric proteins from those of monomeric proteins and be able to use the applicable formulae to solve problems and process results.
- Give the relationship between affinity and the dissociation constant.
- If given the appropriate information calculate the degree or percentage saturation of a protein.
- Process binding data, represent it by means of the appropriate graph and be able to convert one graphic representation into another.
- Discuss the models for allosteric binding to a tetramer.

- **With regard to proteins and enzymes**
  - Use the Chou & Fasman method to predict if a given amino acid sequence will form an α-helix or a β-sheet type of secondary structure.
  - Explain the process involved in protein folding.
  - Recognise a peptide bond in a sketch or diagram.
  - Explain the specific characteristics of the peptide bond.
  - Define the following concepts or terms and use them to describe and interpret the conduct of enzymes, substrates, inhibitors and activators.
    - Active site
    - Activation energy
    - Allosteric
    - Direct Linear graphic representation
    - Enzyme substrate complex
    - Catalysis
    - Kinetic parameters
    - Lineweaver-Burke graphic representation
    - Michaelis-Menten graphic representation
    - Reaction rate
    - Regulation
    - Rate constant
    - Specificity
    - Saturation kinetics
  - Deduce the dependence of enzyme mechanisms on functional groups in the active site and predict the type of interaction depending on the specific example.
  - Explain the concept of catalysis and why enzymes meet the requirement and indicate what enzyme specificity derives from.
  - Know the factors possibly involved in enzyme regulation and apply them to or identify them in a given example.
  - Explain the interplay between enzymes and activation energy.
  - Given a specific enzyme mechanism, explain the steps involved.
  - Use the appropriate formulae to determine the kinetic parameters of an enzyme-catalysed reaction.
  - Explain the influence of effectors (activating and inhibitory) and use the appropriate formulae to calculate the kinetic parameters involved under the given conditions.
  - Write down the kinetic characteristics of allosteric enzymes and apply them in given examples.
  - Classify enzyme reactions according to the six main classes of enzymes and the international numbering system.
- **With regard to vitamins, coenzymes & cofactors**
  - Assign coenzymes to a reaction based on the type of reaction involved.
  - Recognise the active section of a coenzyme in a sketch or diagram, describe its function and distinguish between the active and inactive form.
  - Describe the differences and similarities between coenzymes, prosthetic groups and cofactors.
  - Discuss the relationship between the symptoms of a vitamin deficiency and the involvement of a coenzyme in specific reactions.
- **With regard to carbohydrates**
  - Apply the following concepts connection with carbohydrates.
    - Mutarotation
    - Ring closure
    - Reducing
    - Non-reducing
  - Discuss the role ring closure in monosaccharides has on mutarotation, D-, L, α- & β-configuration and the reducing characteristics.
  - Discuss the role that equatorial and axial groups have on the stability of the chair and boat conformations in monosaccharides.

- **With regard to lipids and Biological membranes**
  - Define, and where applicable recognise the following concepts in a given structure and discuss its implications in membranes.
    - Amphipathic
    - Asymmetry
    - Gel like solid
    - Lateral diffusion
    - Lipid double layer
    - Membrane fluidity
    - Non-covalent cooperative structure
    - Transition temperature
    - Transverse diffusion
    - Two dimensional fluid
    - Vesicle formation and fusion
    - Liquid crystalline condition
  - Predict the influence changes to individual lipid components will have on the fluidity and melting point of biological membranes.
  - Relate the rate of diffusion in lipid membranes to the membrane composition and the chemical characteristics of the diffusing molecule.
  - Name different types of transport or identify them from graphic representations and explain the principles, which each one is based on.
- **Use all the formulae that follow as well as their variations.**

(1) $$\mathrm{pH} = \mathrm{pKa} + \log \frac{[\mathrm{Conjugate\ base}]}{[\mathrm{Conjugate\ acid}]}$$

(2) $$\mathrm{pH} = -\log [\mathrm{H}^+]$$

(3) $$\mathrm{pK_a} = -\log \mathrm{K_a}$$

If $\mathrm{HA} \longleftrightarrow H^{1+} + A^{1-}$ *then*

(4) $$K_a = \frac{[H^{1+}][A^{1-}]}{[HA]} \text{ and therefore } pH = \frac{K_a[HA]}{[A^{1-}]}$$

If the concentration of $\mathrm{HA} = \mathrm{c}$, then

(5) $$\mathrm{K_a} = \frac{x^2}{(c-x)}$$

(6) $$\text{Then the concentration of } \mathrm{A^{1-}} = \mathrm{H^{1+}} = x = \frac{K_a \pm \sqrt{(K_a)^2 - 4(1)(K_a)}(c)}{2(1)}$$

(7) $$\chi_A = \frac{[A]/[HA]}{1 + [A]/[HA]}$$

(8) $$\chi_A = \frac{1}{1 + [A]/[HA]}$$

(9) $$[a]_\lambda^\tau = \frac{(A^\circ)(100)}{(l)(c)}$$

If $P + L \longleftrightarrow P\mathrm{L}$ then

(10) $$\mathrm{K_b} = \frac{[\mathrm{PL}]}{[P][L]}$$

If $PL \longleftrightarrow \mathrm{P} + \mathrm{L}$ then

(11) $$\mathrm{K_d} = \frac{[P][\mathrm{L}]}{[PL]}$$

(12) $$\mathrm{K_d} = \frac{1}{\mathrm{K_b}}$$

(13) $$\mathrm{Y} = \frac{[\mathrm{PL}]}{[\mathrm{P}]+[PL]} = \frac{[\mathrm{PL}]}{[\mathrm{P}]_{tot}}$$

(14) $$\mathrm{Y} = \frac{[\mathrm{L}]}{\mathrm{K_d} + [\mathrm{L}]}$$

(15) $$\mathrm{Y} = \frac{\mathrm{K_b}\,[\mathrm{L}]}{1 + [\mathrm{L}]\mathrm{K_b}}$$

(16) $$\mathrm{Y} = \frac{[\mathrm{L}] \diagup \mathrm{K_d}}{1 + [\mathrm{L}]\mathrm{K_d}}$$

(17) $$\frac{1}{\mathrm{Y}} = \frac{\mathrm{K_d}}{[\mathrm{L}]_{\mathrm{tot}} + 1}$$

(18) $$\mathrm{B} = \frac{(\text{Number of moles of L})_{\text{bound}}}{(\text{Number of moles of P})_{total}} = \frac{\mathrm{n}[\mathrm{L}]}{\mathrm{Kd} + [\mathrm{L}]}$$

(19) $$\frac{1}{\mathrm{B}} = \frac{\mathrm{K_d}}{\mathrm{n}[\mathrm{L}]} + \frac{1}{\mathrm{n}}$$

(20) $\Delta \mathrm{G}^{\#} = \text{Free energy of activation (Activation energy)}$

(21) $\Delta G^{\#} = G_{\text{transition state}} + G_{\text{substrate}}$

If $\mathrm{A} + \mathrm{B} \rightarrow \mathrm{C} + \mathrm{D}$ then

(22) $\mathrm{v} = \frac{-\mathrm{d}[\mathrm{A}]}{dt}$ is the reaction rate in terms of a decrease in the concentration of A

If $\mathrm{A} + \mathrm{B} \rightarrow \mathrm{C} + \mathrm{D}$ then

$$\mathrm{v} = \frac{-\mathrm{d}[\mathrm{A}]}{dt} = \frac{-d[B]}{dt} = \frac{d[C]}{dt} = \frac{d[D]}{dt}$$

For the reaction $\mathrm{A} + 2\mathrm{B} \rightarrow$ PRODUCTS

(23) $$\mathrm{v} = \frac{-\mathrm{d}[\mathrm{A}]}{dt} = \frac{-1}{2}\frac{d[B]}{dt}$$

For the reaction $\mathrm{A} + 2\mathrm{B} \xrightarrow{\mathrm{k}}$ PRODUCTS

(24) $\mathrm{v} = k[A][B]^2$ waar k = snelheidskonstante

For the enzyme reaction $\mathrm{E} + \mathrm{S} \underset{\mathrm{k_{-1}}}{\overset{\mathrm{k_1}}{\rightleftarrows}} ES \xrightarrow{k_2} E + P$

(25) $$\mathrm{K_s} = \frac{[E][S]}{[ES]} = \frac{k_{-1}}{k_1}$$

(26) $[\mathrm{ES}] = \dfrac{[E]_{tot}[S]}{K_s + [S]}$

(27) At equilibrium $\mathrm{K_s} = \dfrac{[E][S]}{[ES]}$ and at the steady state $\mathrm{K_m} = \dfrac{[E][S]}{[ES]}$

(28) At equilibrium $\mathrm{K_s} = \dfrac{k_{-1}}{k_1}$ and at the steady state $\mathrm{K_m} = \dfrac{k_{-1} + k_2}{k_1}$

(29) At the steady state $[\mathrm{ES}] = \dfrac{[E]_{tot}[S]}{K_m + [S]}$

(30) For the enzyme reaction in 24 the rate is given by $\mathrm{v} = \dfrac{\mathrm{d}[\mathrm{P}]}{dt} = k_2[ES]$ or by $\mathrm{v} = \dfrac{k_2[E]_{tot}[S]}{K_m + [S]}$

(31) For the enzyme reaction in 24 the maximum reaction rate is given by $\mathrm{V_{max}} = \mathrm{k_2}[\mathrm{E}]_{\mathrm{tot}}$

(32) Therefore the reaction rate is $\mathrm{v} = \dfrac{V_{\max}[S]}{K_m + [S]}$ also written as $\mathrm{v_0} = \dfrac{V_{\max}[S]_0}{K_m + [S]_0}$

(33) $\dfrac{1}{\mathrm{v}_0} = \dfrac{K_m}{V_{\max}} \dfrac{1}{[S]_0} + \dfrac{1}{V_{\max}}$

(34) $\mathrm{K_m^{app}} = K_m \left(1 + \dfrac{[I]}{K_i}\right)$

(35) $\mathrm{K_m^{app}} = \dfrac{K_m}{\left(1 + \dfrac{[I]}{K_i}\right)}$

(36) $\mathrm{v_0} = \dfrac{V_{\max}[S]_0}{K_m^{app} + [S]_0}$

❑ Word list for Biochemistry 214 (Themes A to J)

♦ *214 Theme A: The living cell*

214 Tema A: Die lewende sel	214 Theme A: The living cell
differensiële sentrifugering	differential centrifugation
eukariote	eukaryotes
homogenisering	homogenisation
meiose	meiosis
merkerensieme	marker enzymes
mikrosomale fraksie	microsomal fraction
mitose	mitosis
organel	organelle
ploïdie	ploidy
prokariote	prokaryotes
Selwande	cell walls
sitoplasma	cytoplasm
sitosol	cytosol
subsellulêre fraksionering	sub-cellular fractionation

♦ *214 Theme B: Molecular evolution*

214 Tema B: Molekulêre evolusie	214 Theme B: Molecular evolution
biologiese evolusie	biological evolution
chemise evolusie	chemical evolution
divergente evolusie	divergent evolution
eenheidsevolutionêre periode	unit evolutionary period
fetale hemoglobien	fetal haemoglobin
filogenetiese boom	phylogenetic tree
geenduplikasie	gene duplication
globienproteïene	globin proteins
hemoglobin	haemoglobin
hiperveranderlik	hyper variable
homoloë proteïene	homologous proteins
konserwatief gesubstitueerd	conservatively substituted
konvergente evolusie	convergent evolution
mioglobien	myoglobin
neurale drywing	neural drift
oksiderende atmosfeer	oxidising atmosphere
onveranderlike residu	invariant residue
PAM-eenheid	PAM-units
prebiotiese era	prebiotic era
puntmutasies	point mutations
reduserende atmosfeer	reducing atmosphere
repliserende entiteite	replicating entities
RNA-wêreld	RNA-world
yster-protoporfirien IX	iron-protoporphyrine IX

♦

- ***214 Theme C: Bio molecules***

214 Tema C: Biomolekule	214 Theme C: Bio molecules
amfipaties	amphipathic
diëlektriese konstante	dielectric constant
diëlektriese medium	dielectric medium
dipool	dipole
dipoolmoment	dipole moment
dispersiekragte (London-kragte)	dispersion forces (London-forces)
dubbellaag vesikels	double layered vesicles
elektronegatiwiteit	electronegativity
funksionele groep	functional groups
heterogene polimeer	heterogeneous polymer
hidratering	Hydration
hidrateringskil	hydration layer
hidrofilies	hydrophilic
hidrofobies	hydrophobic
hidrolise	hydrolysis
homogene polimeer	homogenous polymer
ioniese binding	Ionic bonds
klatraatstruktuur	clathrate structures
kovalente binding	covalent bonding
kovalente radius	covalent radius
misel	micelle
monolaag	Mono layer
monomeer	monomer
nie-kovalente binding	non-covalent bond
nie-polêre binding	non-polar bond
polariseerbaarheid	Polarisability
polêre binding	Polar bond
polimeer	Polymer
sp^3-gehibridiseerde koolstof	sp^3-hybridised carbon
Van der Waalskontakafstand	Van der Waal's contact distance
Van der Waalskragte	Van der Waal's forces
Van der Waalsradius	Van der Waal's radius
waterstofbinding	hydrogen bonds
waterstofbindingsakseptor	hydrogen bond acceptor
waterstofbindingsdonor	hydrogen bond donor

- ***214 Theme D: Nucleic acids***

214 Tema D: Nukleïensure	214 Theme D: Nucleic Acids
annelering (tempering)	annealing
antikodon	anticodon
bakteriofaag	bacteriophage
chromatien	chromatin
chromosoom	chromosome
denaturering	denaturation
deoksiribonukleïensuur (DNA)	deoxyribonucleic acid (DNA)
ekspressie van genetiese informasie	expression of genetic information
endonukleases	endonucleases
fosfodiësterbinding	phospho-diester bonds
geen	gene
genetiese kode	genetic code

214 Tema D: Nukleïensure	214 Theme D: Nucleic Acids
genoom	genome
haarnaaldlusse	hairpin loops
hibrieddubbelhelikse	hybrid double helixes
hiperchromiese effect	hyperchromic effect
histoon	histone
klonering	cloning
kodon	codon
komplementariteit	complementarity
koöperatiewe denaturering	cooperative denaturation
leesraam	reading frame
mRNA	mRNA
mutasie	mutation
N-basis	N-base
nukleosied	nucleoside
nukleosoom	nucleosome
nukleotied	nucleotide
oligonukleotied	oligonucleotide
omgekeerde transkripsie	reverse transcription
pirimidien	pyrimidine
plasmied	plasmid
polimerase ensieme	polymerase enzymes
polinukleotied	polynucleotide
primêre strukture van nukleïensure	nucleic acid primary structures
purien	purine
renaturering	renaturation
replikasie	replication
ribonukleïensuur (RNA)	ribonucleic acid (RNA)
ribosome	ribosome
rRNA	rRNA
sekondêre strukture van nukleïensure	nucleic acid secondary structures
semi-konserwatiewe replikasie	semi-conservative replication
sirkulêre DNA	circular DNA
smeltingstemperatuur (T_m)	melting temperature (T_m)
superdraaiing	super coiling
topoisomerases	topoisomerases
topoisomere	topoisomers
toutomerie	tautomery
transkripsie	transcription
translasie	translation
tRNA	tRNA

- ***214 Theme E: Proteins***

214 Tema E: Proteïene	214 Theme E: Proteins
A-lokus	A-locus
amfiproties	amphiprotic
amfoliet/poliamfoliet	ampholyte / polyampholyte
aminogroep	amino-group
aminosuurresidu/aminoasielresidu	amino acid residue / aminoacyl residue
aminoterminaal/N-terminaal	amino-terminal / N-terminal
asimmetries/chirale C-atoom	asymmetric / chiral C-atom

214 Tema E: Proteïene	214 Theme E: Proteins
bydraende struktuur	contributory structure
denaturasie/ontvouing	denaturation/unfolding
domein	domain
eenvoudige proteïen	simple protein
elektroliet	electrolyte
enantiomere	enantiomer
gedraaide β-plate	coiled β-sheet
gekonjugeerde proteïen	conjugated protein
globulêre proteïen	globular protein
heliksbundels	helix bundles
hidrofobiese effek	hydrophobic effect
hidropatie, hidrofobies, hidrofilies	hydropathy, hydrophobic, hydrophilic
insouting	salting in
isoelektriese punt (pI)	isoelectric point (pI)
karboksielgroep	carboxyl group
karboksielterminaal/C-terminaal	carboxyl-terminal / C-terminal
konfigurasie	configuration
konformasie	conformation
koöperatief	cooperative
kwaternêre struktuur	quaternary structure
oligopeptied	oligopeptide
onreëlmatig gestruktureerde streek	irregularly structured region
peptied, dipeptied, tripeptied, ens.	peptide bond / amide bond
peptiedbinding/amiedbinding	peptide, dipeptide, tripeptide, etc.
P-lokus	P-locus
polipeptied	polypeptide
post-translasionele modifikasie	post-translational modification
primêre struktuur	primary structure
prostetiese groep	prosthetic group
resonanshibried	resonance hybrid
resonansstabilisering	resonance stabilisation
resonansstrukture	resonance structure
sekondêre struktuur	secondary structure
subeenheid	subunit
suurdissosiasiekonstante (K_a, pK_a)	acid dissociation constant (K_a, pK_a)
tersiêre struktuur	tertiary structure
uitsouting	salting out
veselagtige proteïen	fibrous protein
willekeurige renaturasie/willekeurige vouing	voluntary renaturation/voluntary folding
zwitterioon/iso-elektriese spesie	zwitterion / isoelectric specie
α-aminosuur	α-amino acid
α-heliks	α-helix
β-draai	β-turn
β-plaat	β-sheet
β-spiraal	β-coil
β-vaatjies	β-barrels

♦

- ***214 Theme F: Binding of ligands to proteins***

214 Tema F: Binding van ligande aan proteïene	214 Theme F: Binding of ligands to proteins
affiniteit	affinity
allosteriese effect	allosteric effect
bindingsetel	binding site
bindingskonstante (K_b)	Binding constant (K_b)
dissosiasiekonstante (K_d)	dissociation constants (K_d)
geïnduseerde passing	induced fit
hiperboliese bindingkurwe	hyperbolic binding curve
komplementariteit	complementarity
koöperatiewe binding (positief en negatief)	cooperative binding (positive and negative)
ligand	ligand
ligand bindingskonstante (K_b)	ligand binding constants (K_b)
proteïen-ligand kompleks	protein-ligand complex
sigmoïdale bindingskurwe	sigmoidal binding curve
slot-en-sleutel binding	lock-and-key binding
versadiging	saturation

- ***214 Theme G: Enzymes***

214 Tema G: Ensieme	214 Theme G: Enzymes
aktiewe setel/katalitiese setel	active site/catalytic site
aktiveerder	activation energy
aktiveringsenergie	activator
allosterie	allostery
allosteriese effektor	allosteric effector
allosteriese ensiem	allosteric enzyme
allosteriese setel	allosteric site
bestendige toestand	steady state
effektor	effector
elementêre stap	elementary step
ensiem	enzyme
ensiem-substraat kompleks	enzyme-substrate complex
heterotropiese allosteriese interaksie	heterotropic allosteric interaction
homotropiese allosteriese interaksie	homotropic allosteric interaction
inhibisiekonstante (K_i)	inhibition constants (K_i)
inhibitor	inhibitor
katalis	Catalyst
kofaktor/koënsiem	cofactor/coenzyme
kompeterende inhibitor	competitive inhibitor
kovalente katalise	covalent catalysis
maksimum reaksiesnelheid (V_{max})	maximum reaction velocity (V_{max})
Michaelis konstante (K_m)	Michaelis constant (K_m)
monovalente allosteriese ensiem	monovalent allosteric enzyme
omkeerbare inhibisie	reversible inhibition
omsettingsgetal (k_{cat})	conversion number (k_{cat})
onomkeerbare inhibisie	irreversible inhibition
oorgangstoestand	transition state
polivalente allosteriese ensiem	polyvalent allosteric enzyme
reaksiemeganisme	reaction mechanism
reaksiesnelheid (v)	reaction rate (v)
snelheidskonstante (k)	rate constant (k)
snelheidsvergelyking	rate equation

214 Tema G: Ensieme	214 Theme G: Enzymes
substraat	substrate
substraatdissosiasiekonstante (K_s)	substrate dissociation constants (K_s)
suur-basis katalise	acid-base catalysis
terugvoerinhibisie	feedback inhibition
versadigingskinetika	saturation kinetics

- ***214 Theme H: Vitamins, coenzymes & cofactors***

214 Tema H: Vitamiene, koënsiem & kofaktore	214 Theme h: Vitamins, coenzymes & cofactors
aminering/deaminering/transaminering	amination/deamination/transamination
chemiese aktivering	chemical activation
dehidrogenase	dehydrogenase
groepsoordrag	group transfer
hidrolise	hydrolysis
karboksilering/dekarboksilering	carboxylation/decarboxylation
koënsiem	coenzyme
kofaktor	cofactor
mono-oksigenase	mono-oxygenase
oksidase	oxidase
oksidasie/reduksie	oxidation/reduction
prostetiese groep	prosthetic group
reduseerekwivalent	reducing equivalent
vitamien	vitamin

- ***214 Theme I: Carbohydrates***

214 Tema I: Koolhidrate	214 Theme I: Carbohydrates
aldehiedgroep	aldehyde group
aldose	aldose
anomeer	anomer
asetaal/hemi-asetaal	acetal/hemi-acetal
disakkaried(e)	disaccharide(s)
enantiomeer	enantiomer
furaan	furan
glikaan	glycan
glukaan	glucan
heteropolimeer	heteropolymer
homopolimeer	homopolymer
isomeer	isomer
ketaal/hemi-ketaal	ketal/hemi-ketal
ketogroep	keto group
ketose	ketose
konformasionele isomeer	conformational isomer
koolhidraat/sakkaried	carbohydrate/saccharide
monosakkaried(e)	monosaccharide(s)
mutarotasie	mutarotation
N-glikosidiese binding	N-glycosidic bond
O-glikosidiese binding	O-glycosidic bond
oligosakkaried	oligosaccharide
piraan	pyran
polisakkaried(e)	polysaccharide(s)
stereoisomerisme	stereoisomerism
toutomerisasie	tautomerisation

- ***214 Theme J: Lipids, membranes & cellular transport***

214 Tema J: Lipiede, membrane & sellulêre transport	214 Theme J: Lipids, membranes & cellular transport
adiposiete/vetselle	adipocytes/fat cells
aktiewe transport	active transport
amfipatiese verbinding	amphipathic compound
detergent	detergent
diffusie	diffusion
dubbellipiedlaag	double lipid layer
emulsie	emulsion
vetsuur	fatty acid
gefasiliteerde transport	facilitated transport
gliserolruggraat	glycerol backbone
hidrofobiese verbinding	hydrophobic compound
integrale membraanproteïen	integral membrane protein
lipied	lipid
liposoom	liposome
vloeistofmosaïek model	fluid mosaic model
misel	micelle
olie	oil
passiewe transport	passive transport
periferale membraanproteïen	peripheral membrane protein
saponifikasie	sapponification
seep	soap
selmembraan	cell membrane
vesikels	vesicles
Vet	fat

- **Program for Biochemistry 214**