

Faculty of Science



Principles of Biochemistry BIC1B01/BIC01B1

January Examination

DATE

SESSION 08h30 – 11h30

EKSAMINAR

Dr. I. Mwaba

MODERATOR

Dr G. Koorsen

TIME 3 HOURS

MARKS 80

The use of calculator is allowed.

QUESTION 1**[10 MARKS]**

- 1.1 Use a diagram of a hydration shell to show how NaCl will react with water. (3)
- 1.2 Draw a linear hydrogen bond between 2 water molecules. (2)
- 1.3 Describe how you would prepare 250 mL of a 0.1 M phosphate buffer at pH 6.5 using disodium and monosodium phosphate salts. You may use the following information in your answer: (5)
- $pK_a(H_2PO_4^-) = 7.2$; $M(NaH_2PO_4) = 119.98 \text{ g/mol}$; $M(Na_2HPO_4) = 141.96 \text{ g/mol}$

QUESTION 2**[25 MARKS]**

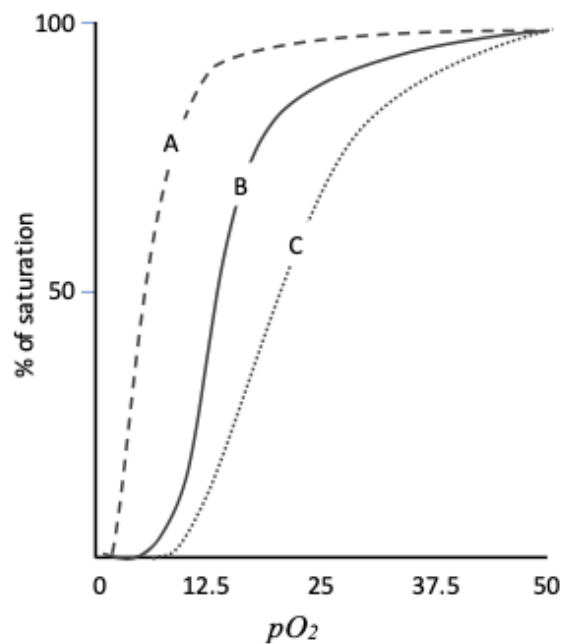
- 2.1 Draw the structures of a tripeptide **LVI**. (8)
- 2.1.1 Indicate and name on the drawing, the bonds that define the different torsion angles. (2)
- 2.2 Below is a table of the pK_a of various amino acids. Using the information provided in this table to answer the following questions

Amino acid	pK_{a1}	pK_{a2}	pK_{a3}
Glycine	2.34	9.60	---
Alanine	2.34	9.69	---
Valine	2.32	9.62	---
Leucine	2.36	9.60	---
Isoleucine	2.36	9.60	---
Methionine	2.28	9.21	---
Proline	1.99	10.60	---
Phenylalanine	1.83	9.13	---
Tryptophan	2.83	9.39	---
Asparagine	2.02	8.80	---
Glutamine	2.17	9.13	---
Serine	2.21	9.15	---
Threonine	2.09	9.10	---
Tyrosine	2.20	9.11	---
Cysteine	1.96	8.18	---
Aspartic acid	1.88	9.60	3.65
Glutamic acid	2.19	9.67	4.25
Lysine	2.18	8.95	10.53
Arginine	2.17	9.04	12.48
Histidine	1.82	9.17	6.00

- 2.2.1 Draw a fully labeled titration curve of histidine. (3)
- 2.2.2 Indicate on the titration curve, the position of all pKas for histidine. (1)
- 2.2.3 Calculate the pI of histidine. (2)

2.3 Is the statement “*Myosin cannot be regulated by cooperativity*” true or false? Justify your answer. (3)

2.4 Below is the oxygen binding curves of different oxygen binding proteins.



2.5 Which of the 3 depicted curves represent:

- 2.5.1 Adult hemoglobin. (2)
- 2.5.2 Fetal hemoglobin. (2)
- 2.5.3 Myoglobin. (2)

Justify your answers

QUESTION 3

[15 MARKS]

- 3.1 Is denaturation of DNA a reversible process? *Justify your answer.* (3)
- 3.2 What is epigenetics. (2)
- 3.3 What is the role of topoisomerases? (1)
- 3.4 What is the difference between topoisomerase I and topoisomerase II. (2)
- 3.5 Explain how weak Van der Waals interactions can stabilize DNA double helix. (2)

- 3.6 What does the term “polycistronic mRNA” mean? (2)
- 3.7 State the role played by the following classes/types of RNA.
- 3.7.1 tRNA (1)
 - 3.7.2 Ribosomal RNA. (1)
 - 3.7.3 Small nuclear RNA (1)
 - 3.7.4 miRNA (1)

QUESTION 4

[15 MARKS]

- 4.1 Draw the structure of Cholesterol and label its rings. (5)
- 4.2 Which of the following fatty acids are saturated? (1)
- A. $C_{18}H_{34}O_2$ B. $C_{18}H_{32}O_2$ C. $C_{20}H_{32}O_2$ D. $C_{18}H_{30}O_2$
- 4.3 How can one distinguish a saturated fatty acid from a unsaturated fatty acid, simply by looking at its chemical formula? (2)
- 4.4 What does the term ‘amphipatic’ mean? (1)
- 4.5 Describe the role played by the following lipids
- 4.5.1 Waxes. (2)
 - 4.5.2 Triglycerides or fats. (2)
 - 4.5.3 Phospholipids. (2)

QUESTION 5

[15 MARKS]

- 5.1 Define "reducing sugar." (2)
- 5.2 Explain why sucrose is not a reducing sugar, even though both glucose and fructose are. (3)
- 5.3 Draw the structure (Fischer Projection) of simple aldo-pentose sugar. (2)
- 5.4 Glycogen, starch and cellulose are all made of glucose molecules strung together. What makes these structures different? (4)
- 5.5 How does the cyclization of sugars introduce a new chiral center? Use a detailed diagram of glucose to answer the question. (4)