Faculty of Science



Principles of Biochemistry BIC1B01/BIC01B1 Examination

DATE

12 NOVEMBER 2018

SESSION 08h30 - 11h30

EKSAMINAR

Dr. G. Koorsen

MODERATOR

Dr I. Mwaba

TIME

3 HOURS

MARKS

80

Please read the following instructions carefully:

- Answer all the questions in the examination book provided.
- The use of a calculator is allowed.

Question 1 (9)

Consider the following Table and answer the questions that follow:

Acid	HA	A	Ka
Pyruvic acid	CH₃COCOOH	CH ₃ C—COO°	3.16×10^{-3}
Formic acid	HCOOH	HCOO-	1.78×10^{-4}
Lactic acid	СП₃СНОНСООН	CH ₈ CH—HCOO ⁻	1.38×10^{-4}
Benzoic acid	G_6H_5COOH	G ₆ H ₅ COO~	6.46×10^{-5}
Acetic acid	CH ₃ COOH	CH*COO-	1.76×10^{-6}
Ammonium ion	ZH44	NH_3	5.6×10^{-10}
Oxalic acid (1)	ноос-соон	HOOC-COO°	5.9×10^{-2}
Oxalic acid (2)	HOOC-COO	~()()()~	6.4×10^{-5}
Mafonic acid (1)	HOOC—CH ₀ —COOH	HOOC-CH ₂ -COO	1.49×10^{-3}
Malonic acid (2)	HOOCCH ₂ COO	°OOCCH ₉ COO°	2.03×102^{-6}
Malic acid (1)	HOOCCH ₂ CHOHCOOH	HOOC-CH,-CHOH-GOOT	3.98×10^{-4}
Malic acid (2)	HOOC—CH ₂ —CHOH—COO"	"OOC—CH ₂ —CHOH—COO"	5.5×10^{-6}
Succinic acid (1)	HOOC-CH,-CH,O-OOH	HOOCCH ₃ CH ₃ COO ⁻	6.17×10^{-5}
Succinic acid (2)	HOOCCH ₂ COO"	TOOC—CH ₂ —CH ₂ —COOT	2.3×10^{-6}
Carbonic acid (1)	H_0CO_8	HGO _s =	4.3×10^{-7}
Carbonic acid (2)	HCO ₃ ⁻	$CO_3^{\frac{n}{2}}$	5.6×10^{-11}
Citric acid (1)	HOOC—CH ₂ —C(OH) (COOH) OCH ₂ —COOH	HOOC—CH ₂ —C(OH) (COOH) —CH ₂ —COO ⁻	8.14×10^{-4}
Citric acid (2)	HOOC—CH ₂ —C(OH) (COOH) OCH ₂ —COO ⁺	"OOC—CH ₂ —C(OH) (COOH) —CH ₂ —COO"	1.78 × 10 ⁻¹⁵
Cirric acid (3)	TOOC—CH2—C(OH) (COOH) OCH2—COOT	CH ₂ —COO"	3.9×10^{-6}
Phosphoric acid (1)	$\mathrm{H_{3}PO_{4}}$	H ₂ PO ⁻ 4	7.25×10^{-3}
Phosphoric acid (2)	$H_2PO_4^-$	HPO ₄ 2-	6.31×10^{-8}
Phosphoric acid (3)	$\mathrm{HPO_4^{2-}}$	PO ⁴ 3-	3.98×10^{-13}

- 1.1. Which two weak acids listed in the Table are triprotic? (2)
- 1.2. How would you prepare 100 mL of a 0.2 M HOOC-CH₂-COO⁻-OOC-CH₂-COO⁻ buffer at pH 6.0? The buffer should be prepared from monosodium malonate $M(NaOOC-CH_2-COO) = 126.04$ g/mol and disodium malonate $M(Na_2OOC-CH_2-COO) = 148.03$ g/mol. (7)

Question 2 (11)

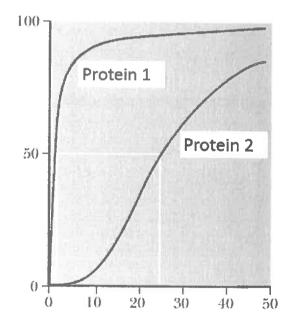
- 2.1. Draw the structure of the amino acid isoleucine and label all the chiral carbon atoms with a star (*). (5)
- 2.2. Draw the structure of the amino acid tryptophan, and label all the functional groups. (6)

Question 3 (11)

- 3.1. Give the dissociation reaction for the amino acid aspartic acid. (6) $pKa(\alpha\text{-COOH}) = 2.09$; $pKa(\alpha\text{-NH}_3^+) = 9.82$; pKa(R) = 3.86
- 3.2. What is the net charge of aspartic acid at pH 10? (1)
- 3.3. Give an example of two cyclic peptide hormones, that are very similar in primary structure, but with different functions. Give the names and the functions of the two hormones. (4)

Question 4 (16)

- 4.1. Describe how pH-mediated change in the quarternary structure of hemoglobin explain the Bohr effect. (12)
- 4.2. The following diagram shows the binding curves of two oxygen binding proteins. Consider the curves carefully and answer the question that follow:



Compare protein 1 and protein 2 in terms of the cooperativity of binding and motivate your answer. (4)

Question 5 (15)

Compare the composition of ribosomes in prokaryotes and eukaryotes. (15)

Question 6 (5)

- 6.1. Draw the structure of the fatty acid that can be denoted by the following notation: $16:1-\Delta^9$. (3)
- 6.2. What is the definition of a wax? Give an example. (2)

Question 7 (6)

- 7.1. Draw the structures of the following monosaccharides:
- 7.1.1. α-D-glucopyranose (3)
- 7.1.2. α -D-fructofuranose (3)

Question 8 (7)

- 8.1. What disaccharides are made of the following monosaccharides?
- 8.1.1. galactose- β -1,4-glucose (1)
- 8.1.2. glucose- α -1,4-glucose (1)
- 8.1.3. glucose-β-1,4-glucose (1)
- 8.1.4. glucose- α -1,2-fructose (1)
- 8.2. What are the cellular functions of:
- 8.2.1. heparin (1)
- 8.2.2. condroitin sulphates (1)
- 8.2.3. hyaluronate (1)

TOTAL [80]