

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

RESIT/SPECIAL EXAMINATION

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN
BIOCHEMISTRY

BIOC 207/201: PHYSICAL BIOCHEMISTRY

STREAMS: BSC BIOC

TIME: 2 HOURS

DAY/DATE: TUESDAY 10/08/2021

2.30 P.M – 4.30 P.M.

INSTRUCTIONS:

- Answer Question One and any other Two Questions
- Do not write on the question paper

Question One (30 marks)

Constants

ΔG° for fructose-1-phosphate hydrolysis = -16KJmol^{-1} , $R=8.315\times 10^{-3}\text{KJmol}^{-1}\text{K}$, $T=25^{\circ}\text{C}$

Question One (30 marks)

- Explain the relevance of the first and second laws of thermodynamics to biological systems. (5 marks)
 - ΔG is a valuable criterion in determining whether a reaction can occur spontaneously or not, explain the various fates associated with it. (6 marks)
 - In rat erythrocytes the concentration of ATP, ADP and P_i are 3.25, 1.25 and 2.65 mM respectively, calculate the actual free energy of hydrolysis (ΔG_p) of ATP in the erythrocyte cell at standard pH and temperature (4 marks)
 - Explain why ΔG for favorable processes is always a negative value. (5 marks)
- e. ATP is usually hydrolysed in cells according to the equation $\text{ATP} \rightleftharpoons \text{ADP} + \text{P}_i$. Given that $[\text{ATP}] = 2\times 10^{-7}\text{M}$, $[\text{ADP}] = 2.65\times 10^{-1}\text{M}$ and $[\text{P}_i] = 2\times 10^{-1}\text{M}$, calculate:

- i. The equilibrium constant. (5 marks)
- ii. ΔG^0 for ATP hydrolysis. (5 marks)

Question Two (20 marks)

- a) Describe the bioilluminescence cycle as observed in the fire fly. (10 marks)
- b) The processes that feed phosphate into ATP/ADP cycle fall mainly within four groups. Explain these processes. (10 marks)

Question Two (20 marks)

- a) Phosphorylated compounds have large free energies of hydrolysis due to product stabilization. Describe the hydrolysis of phosphoenol pyruvate and 1,3 bisphosphoglycerate indicating how the products are stabilized relative to reactants. (10 marks)
- b) Describe the nucleophilic displacement reactions of ATP. (10 marks)

Question Three (20 marks)

- a) Explain the role of myokinase in the production of AMP during muscle contraction. (10 marks)

- b) An enzymatic hydrolysis of Fructose-1-Phosphate,



was allowed to proceed to equilibrium at 25°C. The original concentration of Fructose-1-Phosphate was 1.2M, but when the system had reached equilibrium the concentration of Fructose-1-Phosphate was only $7.52 \times 10^{-5}\text{M}$. Calculate the equilibrium constant for this reaction and the free energy of hydrolysis of Fructose-1-Phosphate. (10 marks)
