

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

INSTITUTE OF BIOMEDICAL ENGINEERING

ENGINEERING SCIENCE PROGRAMME
OPTION 5bme, BIOMEDICAL ENGINEERING

FINAL EXAMINATION BME 395S: BIOSYSTEM II
APRIL 25, 1997 09:30 TO 12:00

EXAMINER: PROFESSOR P.Y. WANG

[ANSWER ANY 8 QUESTIONS; FULL MARK FOR @ QUESTION IS 12.5%]

(1) At the isoelectric pH, the apparent electrophoretic mobility of glycine is observed to be 3.61 cm. Give and explain the reasons for the mobility. How can it be corrected?

(2) A heptapeptide yields no van Slyke nitrogen, but is readily degradable by the Edelman reaction. After the reaction, the purified polypeptide product is treated with chymotrypsin to give equimolar amount of 3 aminoacids and a peptide which can be further broken down completely by pepsin. Propose A structure for the heptapeptide and show precisely the location of the Edelman Degradation.

★ (3) With examples, formulas and equations where applicable, show the differences and similarities between the actions of an enzyme and co-enzyme with respect to the active sites.

(4) 3,5-Dihydroxy-3-methyl-pentanoic acid, labelled at the α -carbon atom by radioactive ^{14}C , is subjected to β -elimination, followed by decarboxylation and then pyrophosphorylated. The resulting product is incubated at an optimal concentration for 4 days with a culture of an eukaryotic cell. Describe an isolative procedure for the esterified form of the most likely polycyclic compounds, and circle the locations of the ^{14}C labels thereon.

★ (5) Draw the 8 structures of D-aldohexose, and with formulas and equations where applicable identify: (a) chemically and (b) biochemically, the structure of D-glucose.

★ (6) With appropriate formulas and equations, show 3 occasions where the action of isomerases is important in sustaining the anaerobic glycolytic process.

(7) A Balb/c mouse, body weight 27 g, has been injected with human red blood cells/Group A. Describe a procedure to: (a) anesthetize the mouse, (b) splenectomize, (c) close the incisions properly, (d) prepare and select hybridoma, (e) draw 0.75 ml of blood, 7 days after surgery. What are the results of testing the antibodies derived from (d) and (e) with: (i) the antigen and (ii) human T lymphocytes?

(8) Outline the protein synthesis process in sensitized mouse B lymphocytes. Sketch and describe a procedure to show that the proteins released therefrom are polyclonal antibodies. Explain clearly the reasons for the diversity.

(9) If the aminoacid sequence of the human insulin A-Chain is known, describe the principle of constructing the gene for its synthesis in E. coli K12(trp-). With equations and formulas where applicable, complete the biotechnological synthesis of human insulin.

(10) Sketch the structure of porcine proinsulin, and with equations and formulas, show how it can be converted into human insulin on an industrial scale.
