UNIVERSITY OF TORONTO

FACULTY OF APPLIED SCIENCE AND ENGINEERING

FINAL EXAMINATION, DECEMBER 1998

Fourth Year - Programs, 5bm(c), 5bm(e)

BME495F - MOLECULAR AND CELLULAR BIOLOGY

Exam Type: A

Examiners - P.Y. Wang
A.M. Dolan

(ANSWER ANY 20 QUESTIONS: Each Question = 5%)

(1) Explain briefly the functions of Golgi complex, mitochondrion, microfilament, and icosahedral capsid.

(2) Describe briefly the main events in the growth stage of an eucaryote cell, and sketch the phases of its mitosis.

Describe the differences in the culture methods for eucaryotes and phages.

Describe the procedures and explain clearly the principles of detecting a labeled protein by beta and gamma counting.

Explain clearly with sketches where applicable, how does one visualize: (a) DNA on SDS-PAGE, (b) antibody in serum. What is a plaque forming assay?

A pentapeptide is not susceptible to the action of trypsin, and a solution of chymotrypsin releases only Tyr and a tetrapeptide. However, pepsin will digest the pentapeptide completely, and the amino acids are identified as Tyr, Leu, and Arg. What is the structure of this pentapeptide?

With chemical equations and sketches, show the mechanism of enzyme action of chymotrypsin, and explain clearly how N-tosyl-L-phenylalanyl-chloromethyl ketone can be used to locate its active site.

What is the main structural feature common to estrogen and corticosteroid? Name the steroid which is not pharmacologically active, and describe briefly 2 of its major functions in the biological systems.

Which epimer of a hexose can be used as a carbon source for lipids through the action of coenzymes? Carbons derived from how many molecules of this epimer are required to biosynthesize a molecule of squalene?

(10) Explain briefly the principle of elucidating the structure of complex polysaccharides. Apply this principle to distinguish the chemical structural difference between lactose and allolactose.

(11) With 1 example in each case, illustrate with formulas and biochemical equations, the importance of enzymic isomerization and beta-elimination in sustaining the anaerobic glycolysis process.

(12) With chemical equations and formulas, show 1 most important similarity and 1 major difference between the sequencing of a tripeptide and a trinucleotide.

(13) Give an example of specific reaction which will: (a) break the A unit in DNA or RNA, (b) Join T to C as in "Gene Machine".

(14) Explain clearly the reasons for the choice of cell, the use of Con A, and the need for Colcemid in the procedure to visualize human chromosomes.

(15) Explain clearly with sketches, the functions of Dna A protein and Pol I in the replication of bacterial dsDNA.

(16) Describe with sketches, 1 major similarity and 1 important difference in the action of telomerase and reverse transcriptase.

(17) Why is the sigma factor so important in the transcription of bacterial RNA? What are the consequences, if this factor is absent? What is the function of rho factor?

(18) Explain clearly with sketches how the lactose operon can be turned on in E. coli.

(19) Briefly describe the role of EF-Tu and EF-G factors in rRNA peptide synthesis.

(20) Explain briefly with sketches, the functions of EF 1, IF 2 and EF 3 in translation.

(21) Describe briefly the important characteristics and functions of 4 types of RNA.

(22) Briefly outline the scheme used to decode the mRNA codons.

(23) Briefly describe the principle of gene mapping in E. coli.

(24) Explain clearly with sketches, why bacterial genes near the tail end of the chromosome can still be mapped by conjugation, even though contact through pilus may break off much earlier before complete chromosome transfer.

(25) Explain clearly when E. coli (F^+) conjugates with E. coli (F^-), why there is no transfer of donor chromosome. If the F plasmid is transferred, why the donor does not become F^-.

(26) Describe briefly with sketches how the RNA primer is removed at the termination of replication in: (a) procaryotes, and (b) eucaryotes.

(27) Explain clearly why ampicillin and IPTG are used in the screening of transformed E. coli K12 cells for rDNA luciferase.

(28) Describe an experimental procedure to insert the luc gene into a plasmid vector.

(29) Draw the basic structure of an immunoglobulin and label its various parts. Explain clearly the source of antibody diversity.

(30) How can antibody-producing beta-lymphocytes be immortalized? Explain the principle of cell selection for monoclonal antibody.