



(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR**

FOURTH YEAR FIRST SEMESTER EXAMINATIONS

**FOR THE DEGREE
OF
BACHELOR OF SCIENCE MEDICAL BIOTECHNOLOGY
SPECIAL/SUPPLEMENTARY EXAM**

COURSE CODE: BMB 421

**COURSE TITLE: GENE EXPRESSION SYSTEMS AND
SEQUENCING**

DATE: 15th October 2020

TIME: 11.00 AM - 1.00 PM

INSTRUCTIONS TO CANDIDATES

This paper is divided into three sections, **A B** and **C**, carrying respectively: Multiple Choice Questions (**MCQs**), Short Answer Questions (**SAQs**) and Long Answer Questions (**LAQs**).

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

SECTION A: MULTIPLE CHOICE QUESTIONS (20 MARKS)

- When scientists were attempting to determine the features of the genetic code, Crick and co-workers found that when three base additions or three base deletions occurred in a single gene, the wild type phenotype was sometimes restored. This observation supported the hypothesis that
 - The code is triplet.
 - AUG is the initiating triplet.
 - The code is overlapping.
 - There are three amino acids per base.
- In 1964, Nirenberg and Leder used the triplet binding assay to determine specific codon assignments. A complex of which of the following components was trapped on the nitrocellulose filter?
 - Ribosomes and DNA
 - Free tRNAs
 - Charged tRNA, RNA triplet, and ribosome
 - Uncharged tRNAs and ribosomes
- Which of the following is true?
 - Every amino acid is coded for by a single codon.
 - There are more amino acids than there are codons.
 - Every codon codes for an amino acid.
 - Each codon in a gene codes for no more than one single amino acid.
- The genetic code is “degenerate” because
 - There are more codons than amino acids.
 - There are more amino acids than codons.
 - Different organisms use different codons to encode the same amino acid.
 - Some codons specify more than one amino acid.
- What is the name given to the three bases in a messenger RNA that bind to the anticodon of tRNA to specify an amino acid placement in a protein?
 - Protein
 - Anti-anticodon
 - Cistron
 - Codon
- When studying the initiation of transcription, one often finds consensus sequences located in the region of the DNA where RNA polymerase(s) bind. Which are common consensus sequences?
 - CAAT, TATA
 - GGTTC, TTAT
 - TTTTAAAA, GGGGCCCC
 - Any trinucleotide repeat
- An intron is a section of
 - Protein that is clipped out post-translationally.
 - RNA that is removed during RNA processing.
 - DNA that is removed during DNA processing.
 - Transfer RNA that binds to the anticodon.
- Three posttranscriptional modifications often seen in the maturation of mRNA in eukaryotes are
 - 5'-capping, 3'-poly (A) tail addition, splicing

- B. 3'-capping, 5'-poly (A) tail addition, splicing
 - C. Removal of exons, insertion of introns, capping
 - D. 5'-poly (A) tail addition, insertion of introns, capping
9. What is the initiator triplet in both prokaryotes and eukaryotes and what is the amino acid coded for by this triplet?
- A. UAA, no amino acid coded.
 - B. UAA, methionine.
 - C. AUG, arginine.
 - D. AUG, methionine.
10. Which type of RNA molecule carries an amino acid to the ribosome?
- A. tRNA
 - B. rRNA
 - C. mRNA
 - D. siRNA
11. The term "peptidyl transferase" relates to
- A. Base additions during mRNA synthesis.
 - B. Peptide bond formation during protein synthesis.
 - C. Elongation factors binding to the large ribosomal subunit.
 - D. 5' capping of mRNA.
12. By their experimentation using the *Neurospora* fungus, Beadle and Tatum were able to propose the hypothesis that:
- A. Prototrophs will grow only if provided with nutritional supplements.
 - B. Several different enzymes may be involved in the same step in a biochemical pathway.
 - C. The role of a specific gene is to produce a specific enzyme.
 - D. More than one codon can specify a given amino acid.
13. What is the term which refers to a contiguous set of bacterial genes which are under coordinate control?
- A. Lysogen.
 - B. Prototroph.
 - C. Operon.
 - D. Allosteric.
14. Which term most appropriately refers to a *trans* acting regulatory factor?
- A. Translation
 - B. RNA processing
 - C. DNA binding protein
 - D. Helicase activation
15. The *lac* operon
- A. Is under negative and positive control.
 - B. Is under positive control *only*.
 - C. Is normally expressed constitutively.
 - D. Is an example of tissue-specific expression?
16. What is the function of cAMP in regulation of the *lac* operon?
- A. Activates a repressor protein
 - B. Activates an activator protein
 - C. Inactivates a repressor protein
 - D. Inactivates an activator protein

17. When a repressor binds to an operator, what process is affected?
- Transcription of the operon is prevented.
 - DNA replication of the operon is prevented.
 - mRNA made from the operon cannot be translated.
 - Protein made from the operon does not function.
18. A mutant *E. coli* strain, grown under conditions that normally induce the *lac* operon, produces high amount of β -galactosidase. What is a possible genotype of the cells? (*I* = *lac* repressor gene; *Z*, *Y*, *A* = *lac* operon structural genes; *P* = *lac* promoter; *O* = *lac* operator)
- lacI*⁺ *lacP*⁺ *lacO*⁺ *lacZ*⁻ *lacY*⁺ *lacA*⁺
 - lacI*⁺ *lacP*⁺ *lacO*^c *lacZ*⁺ *lacY*⁺ *lacA*⁺
 - lacI*⁻ *lacP*⁺ *lacO*⁺ *lacZ*⁻ *lacY*⁺ *lacA*⁺
 - lacI*⁺ *lacP*⁻ *lacO*⁺ *lacZ*⁺ *lacY*⁺ *lacA*⁺
19. Consider a bacterial strain that has a mutant *lac* operator region that cannot bind repressor. If you were to introduce into this strain a wild type operator region on an F' element, the cell would
- Synthesize lactose.
 - Display inducible expression of the *lac* operon.
 - Display constitutive expression of the *lac* operon.
 - Probably not catabolize lactose.
20. With regards to the *trp* operon,
- Tryptophan is an inducer.
 - Tryptophan is a co-repressor.
 - Attenuation can halt replication.
 - None of the above.

SECTION B: SHORT ANSWER QUESTIONS (40 MARKS)

- Give a detailed structure of a gene. [8 Marks]
- List any four eukaryotic promoter elements. [4 Marks]
 - Differentiate between splicing and alternative splicing. [4 Marks]
- Compare and contrast Rho dependent and independent termination. [8 Marks]
- Describe the structures of tRNA and rRNA. [8 Marks]
- Describe bisulfite sequencing. [4 Marks]
 - Which factors control gene expression? [4 Marks]

SECTION C: LONG ANSWER QUESTIONS (40 MARKS)

- With the aid of chemical structures, describe the mechanism of chemical cleavage sequencing method invented by A. Maxam and W. Gilbert. [20 Marks]
- Discuss the Sanger dideoxy-sequencing technique. [20 Marks]
- Give a detailed account of transcription stating the differences between prokaryotic and eukaryotic transcription. [20 Marks]