UNIVERSITY OF JOHANNESBURG

FACULTY	: Science
DEPARTMENT	: Biotechnology and Food Technology
CAMPUS	: DFC
MODULE	: BTN1GB1 Fundamental Genetics
SEMESTER	: Second
EXAM	: **Final Exam 2019**

DATE	: 18 November 2019	**SESSION**	: 8:30am
ASSESSOR(S)	: DR MH Serepa-Dlamini		
MODERATOR	: Mr L Alagiozoglou		
DURATION	: 2 Hours	**MARKS**	: 100

NUMBER OF PAGES: 9 PAGES

INSTRUCTIONS:

1. Number your answers clearly.
2. Answer SECTION A on the MCQ card and SECTION B in the booklet.
3. It is in your best interest to write clearly and legibly.
4. Submit the question with your answer book.
5. All the Best.

SECTION A

Question 1

- Answer the following questions on the allocated MCQ card.
- The mark allocation is ONE mark per question.

1. MicroRNAs and small interfering RNAs both function similarly in "silencing" genes. What are two ways in which they may act?
    A. inhibit RNA splicing and bind to complementary DNA sequences to prevent transcription
    B. cut up mRNAs using the Dicer enzyme and bind to complementary mRNA sequences to prevent translation
    C. cut up mRNAs using the Dicer enzyme and bind to complementary DNA sequences to prevent transcription
    D. degrade mRNA and bind to complementary mRNA sequences to prevent translation
    E. degrade mRNA and inhibit RNA splicing
2. Reverse transcription, carried out by retroviruses, is the process by which _____.
    A. DNA information is copied into RNA
    B. RNA information is copied into DNA
    C. RNA information is "read" to form a protein molecule
    D. DNA is duplicated
    E. information is copied from a protein molecule into RNA
3. In genetic engineering, "sticky end" refers to _____.
    A. a technique for finding a gene of interest within a nucleus without destroying the cell
    B. the ability of plasmids to stick to a bacterial cell wall and thus be taken up into the bacterium
    C. short bits of single-stranded DNA left at the end of DNA molecules cut by restriction enzymes
    D. the site on mRNA that sticks to the DNA during transcription e. none of the above

4. In recombinant methods, the term "vector" refers to _____.
    A. the enzyme that cuts DNA into restriction fragments
    B. the sticky ends of a DNA fragment
    C. an RFLP marker
    D. a plasmid or other agent used to transfer DNA into a living cell
    E. a DNA probe used to locate a particular gene
5. The term "RFLP" stands for _____.
    A. restriction fragment length polymorphism
    B. reverse fragment ligated polymerization
    C. really fast ligation protocol
    D. restriction fragment ligation procedure
    E. RNA fragment length pool
6. Which of the following RNAs can induce gene silencing?
    A. miRNA
    B. snoRNA
    C. ssRNA
    D. ncRNA
7. Translation occurs in the
    A. nucleus
    B. cytoplasm
    C. nucleolus
    D. lysosome
    E. mitochondria
8. The enzyme involved in amino acid activation is
    A. ATP synthetase
    B. aminoacyl tRNA synthetase
    C. aminoacyl mRNA synthetase
    D. aminoacyl rRNA synthetase
9. During translation, the role of enzyme peptidyl transferase is
    A. transfer of phosphate group
    B. amino acid activation
    C. peptide bond formation between adjacent amino acids
    D. binding of ribosome subunits to mRNA
    E. Movement of tRNA from P to A site
10. Which of the energy rich molecules is required for initiation of translation
    A. ATP
    B. GTP
    C. CTP
    D. AMP
    E. cAMP

11. During translation, the ______ site within the ribosome hold the growing amino acid chain while the ________ site holds the next amino acid to be added to the chain.
    A. A, P
    B. P, A
    C. A, B
    D. B, A
    E. P, E
12. Which of the following is an example of the degeneracy of the genetic code?
    A. a given amino acid has more than one codon
    B. each codon specifies more than one amino acid
    C. the first two bases specify the amino acid
    D. the genetic code is not degenerate
    E. the last base specifies the amino acid
13. The amino acid sequence of a polypeptide chain comprises the ____ structure of the protein.
    A. primary
    B. secondary
    C. tertiary
    D. quaternary
14. Which statement describes the correct order of events in translation elongation?
    A. The ternary complex binds to the A site, EF-Tu leaves, peptidyl transferase forms a peptide bond, EF-G hydrolyzes ATP to translocate the peptidyl tRNA to the P site, tRNA leaves the E site.
    B. The ternary complex binds to the P site, EF-Tu leaves, peptidyl transferase forms a peptide bond, EF-G hydrolyzes GTP to translocate the aminoacyltRNA to the A site, tRNA leaves the E site.
    C. The ternary complex binds to the A site, EF-G leaves, peptidyl transferase forms a peptide bond, EF-Tu hydrolyzes GTP to translocate the peptidyl tRNA to the P site, tRNA leaves the E site.
    D. The ternary complex binds to the P site, EF-Tu leaves, peptidyl transferase forms a peptide bond, EF-G hydrolyzes ATP to translocate the peptidyl tRNA to the A site, tRNA leaves the E site.
    E. The ternary complex binds to the A site, EF-Tu leaves, peptidyl transferase forms a peptide bond, EF-G hydrolyzes GTP to translocate the peptidyl tRNA to the P site, tRNA leaves the E site.

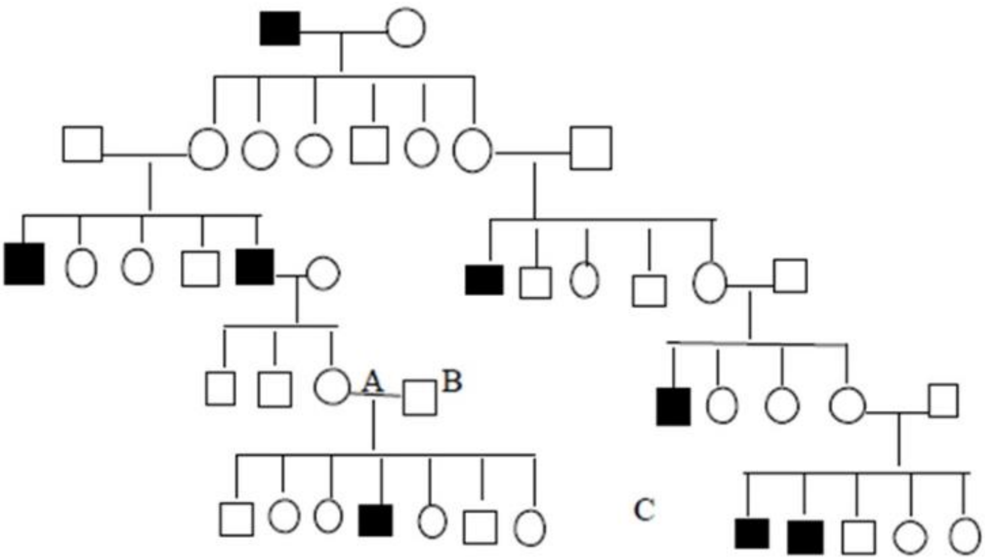
15. What sequence on the template strand of DNA corresponds to the first amino acid inserted into a protein?
    A. TAC
    B. UAA
    C. UAG
    D. AUG
16. How many nucleotides are needed to code for a protein with 450 amino acids?
    A. 1350
    B. 450
    C. 300
    D. 150
17. The standard or housekeeping sigma factor used most often by *Escherichia coli* RNA polymerase under normal growth conditions is called sigma ___.
    A. 70
    B. 32
    C. S
    D. E
18. In __________ ribosomes can attach to the mRNA and begin translation even though transcription has not been completed.
    A. prokaryotes
    B. eukaryotes
    C. fungi
    D. protozoa and some plants
    E. none of the above
19. The Pribnow box of *Escherichia coli*
    A. is centered approximately 35 bp upstream of the start site of transcription.
    B. is centered between 7 and 13 bp upstream of the start codon.
    C. is centered approximately 10 bp upstream of the start site of transcription.
    D. is located at the site of addition of poly (A) in eukaryotic mRNAs.
20. In a dihybrid cross, AaBb x AaBb, what fraction of the offspring will be homozygous for both recessive traits?
    A. 1/16
    B. 1/8
    C. 3/16
    D. 1/4
    E. ¾

21. A phenotypic ratio of 3:1 in the offspring of a mating of two organisms heterozygous for a single trait is expected when
    A. the alleles segregate during meiosis
    B. each allele contains two mutations
    C. the alleles are identical
    D. the alleles are incompletely dominant
22. A pea plant is heterozygous for both seed shape and seed colour. S is the allele for the dominant, spherical shape characteristic; s is the allele for the recessive, dented shape characteristic. Y is the allele for the dominant, yellow colour characteristic; y is the allele for the recessive, green colour characteristic. What will be the distribution of these two alleles in this plant's gametes?
    A. 50% of gametes are Sy; 50% of gametes are sY
    B. 25% of gametes are SY; 25% of gametes are Sy
       25% of gametes are sY; 25% of gametes are sy
    C. 50% of gametes are sy; 50% of gametes are SY
    D. 100% of the gametes are SsYy
       50% of gametes are SsYy; 50% of gametes are SSYY

SECTION B

Question 1

1.1 Research has shown that a particular eye defect is represented in a family pedigree as follows:



a) On the basis of this data, which of the following mechanisms of inheritance are POSSIBLE, explain why? autosomal dominant,autosomal recessive, sex-linked dominant, sex-linked recessive, Y-linked. (2)

b) What is the most PROBABLE mechanism of inheritance? (2)

c) What is the genotype of female A? (1)

d) What is the genotype of male B? (1)

e) What is the probability that a child from marriage C will show this eye defect? (1)

f) How many generations are shown in the pedigree? (1)

1.2 In pea plants, the stem length may result in a tall (T) or dwarf (t), plant seeds may be round (R) or wrinkled (r) and yellow (Y) or green (y). Draw a punnet square and indicate what proportion of the offspring in the following crosses would be expected to be wrinkled?

a) TtYYRr x ttYYrr (24)

Student name:___________

Student Number:__________

Question 2

2.1 You would like to use PCR to amplify (make many copies of) the boxed section of the DNA sequence below:

5´ ACGACCGATAGACGACGTAGGACTTACTTACTTACGTAGGCA 3´

3´ TGCTGGCTATCTGCTGCATCCTGAATGAATGAATGCATCCGT 5´

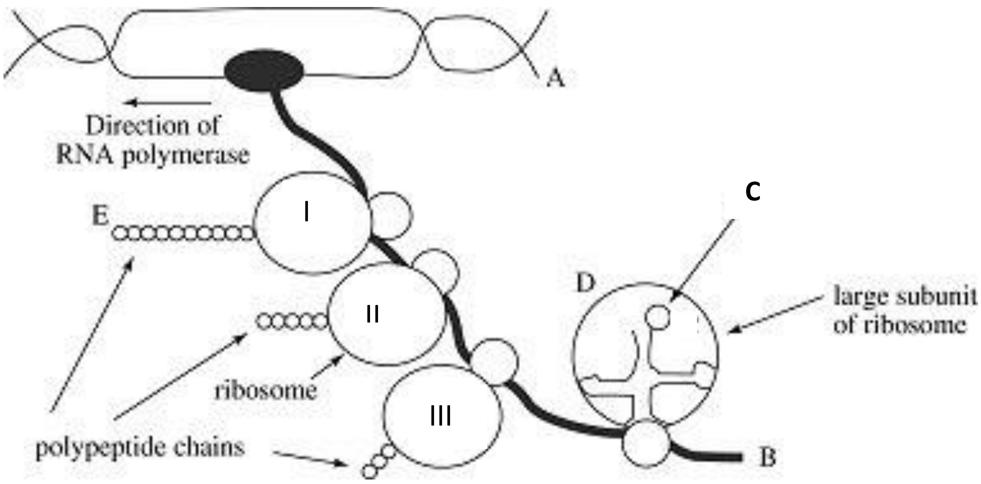
You ask your lab partner to order a pair of primers that can be used in the PCR reaction. The sequences of the primers he orders are: Primer #1: 5´ ATAGAC 3´ Primer #2: 5´ ACTTAC 3´

a) Oops! Looks like you shouldn't have trusted your lab partner on this one. Which of the two primers is wrong, and why won't it work, support your answer by indicating annealing of the correct primer to the strands? (5)

b) Outline the steps of PCR and briefly explain each step. (15)

Question 3

3.1 The drawing below represents a simultaneous transcription in bacteria. Answer the questions that follow, the direction of RNA pol is given by the arrow.



a) The letter B is nearest to which end of which molecule? (2)

b) Which end of the polypeptide chain is near to the letter E? (1)

c) Which ribosome began translation first? (1)

d) What type of RNA is within the large ribosomal subunit? (1)

e) What is the size of the large ribosomal subunit? (1)
f) Which subunit of the ribosome initiates translation? (1)
g) The letter A is next to which end of which molecule? (2)
h) What does the letter C represent? (1)

Question 4

4.1 The following DNA template strand was utilized in a Sanger sequencing experiment, 5` AATTGCGTCAGTCGTA 3`. Using the technique behind Sanger sequencing:

a) Write down the ALL the fragments which will result from the tube with ddGTP. (3)
b) Write down the sequence of the larger fragment from the answer in a). (1)
c) Indicate all the fragments from the experiment on a gel drawing, provide accurate illustrations with labels and indicate the reading of the bands from the 5` to 3`. (10)
d) Where does the primer anneal on the above strand and why? (2)