



FACULTY OF SCIENCE

DEPARTMENT OF BOTANY AND PLANT BIOTECHNOLOGY

LSFT0A3

LIFE SCIENCE 3A FET

APK CAMPUS

JUNE EXAM

6 JUNE 2019

DATE:	6 JUNE 2019
SESSION:	8:30-11:30
ASSESSOR:	MS J. WILLIAMSON
INTERNAL MODERATOR:	DR. H. BYTH-ILLING
EXTERNAL MODERATOR:	PROF. G. LAUTENBACH
DURATION:	3 HOURS
TOTAL MARKS:	150

NUMBER OF PAGES: 13 PAGES

Please read the following instructions carefully

1. Answer all the questions in the question paper
2. Answer ALL of the questions in the test book.
3. Work neatly.
4. Read your questions carefully.
5. Good Luck

QUESTION 1**[18]**

Choose the best answer to complete the statement or answers the question. Only write down the correct letter next to the appropriate question number.

- 1.1 Imagine a genetic counsellor working with a couple who have just had a child who is suffering from Tay-Sachs disease. Neither parent has Tay-Sachs, nor does anyone in their families. Which of the following statements should this counsellor make to this couple?
- A. "Because no one in either of your families has Tay-Sachs, you are not likely to have another baby with Tay-Sachs. You can safely have another child."
 - B. "Because you have had one (1) child with Tay-Sachs, you must each carry the allele. Any child you have has a 50% chance of having the disease."
 - C. "Because you have had one (1) child with Tay-Sachs, you must each carry the allele. Any child you have has a 25% chance of having the disease."
 - D. "Because you have had one (1) child with Tay-Sachs, you must both carry the allele. However, since the chance of having an affected child is 25%, you may safely have three more children without worrying about having another child with Tay-Sachs."
 - E. "You must both be tested to see who is a carrier of the Tay-Sachs allele."
- 1.2 Most genes have many more than two (2) alleles. However, which of the following is also true?
- A. At least one (1) allele for a gene always produces a dominant phenotype.
 - B. Most of the alleles will never be found in a live-born organism.
 - C. All of the alleles but one (1) will produce harmful effects if homozygous.
 - D. There may still be only two (2) phenotypes for the trait.
 - E. More than two (2) alleles in a genotype is lethal.
- 1.3 Cystic fibrosis affects the lungs, the pancreas, the digestive system, and other organs, resulting in symptoms ranging from breathing difficulties to recurrent infections. Which of the following terms best describes this?
- A. Incomplete dominance

- B. Multiple alleles
- C. Pleiotropy
- D. Epistasis
- 1.4 Diploidy is first re-established following _____
- A. fertilization.
- B. gastrulation.
- C. parthenogenesis.
- D. organogenesis.
- E. ovulation.
- 1.5 Genetic mutations in asexually reproducing organisms lead to more evolutionary changes than do genetic mutations in sexually reproducing ones because _____
- A. asexually reproducing organisms, but not sexually reproducing organisms, pass all mutations to their offspring.
- B. asexually reproducing organisms devote more time and energy to the process of reproduction than do sexually reproducing organisms.
- C. sexually reproducing organisms can produce more offspring in a given time than can sexually reproducing organisms.
- D. more genetic variation is present in organisms that reproduce asexually than is present in those that reproduce sexually.
- E. asexually reproducing organisms have more dominant genes than organisms that reproduce sexually.
- 1.6 Fertilization of an egg without activation is like _____
- A. placing the key in the ignition of a car but not starting the engine.
- B. resting during halftime of a basketball game.

- C. preparing a pie from scratch and baking it in the oven.
- D. walking to the cafeteria and eating lunch.
- E. dropping a rock off a cliff and watching it land in the valley below.
- 1.7 The primary function of the corpus luteum is to _____
- A. nourish and protect the egg cell.
- B. produce prolactin in the alveoli.
- C. maintain progesterone and oestrogen synthesis after ovulation has occurred.
- D. stimulate the development of the mammary glands.
- E. support pregnancy in the second and third trimesters.
- 1.8 Which hypothalamic hormone triggers the secretion of FSH?
- A. Luteinizing hormone (LH)
- B. Follicle-stimulating hormone (FSH)
- C. Progesterone
- D. Human chorionic gonadotropin (HCG)
- E. Gonadotropin-releasing hormone (GnRH)
- 1.9 A woman in the final week of pregnancy who is given an injection of oxytocin would likely_____
- A. undergo the loss of oxytocin receptors from her uterine smooth muscle cells.
- B. stop secreting prostaglandins from the placenta.
- C. undergo vigorous contractions of her uterine muscles.
- D. increase the synthesis and secretion of progesterone.
- E. be prevented from lactation.

- 1.10 In his transformation experiments, what did Griffith observe?
- A. Mutant mice were resistant to bacterial infections.
 - B. Mixing a heat-killed pathogenic strain of bacteria with a living non-pathogenic strain can convert some of the living cells into the pathogenic form.
 - C. Mixing a heat-killed non-pathogenic strain of bacteria with a living pathogenic strain makes the pathogenic strain non-pathogenic.
 - D. Infecting mice with non-pathogenic strains of bacteria makes them resistant to pathogenic strains.
 - E. Mice infected with a pathogenic strain of bacteria can spread the infection to other mice.
- 1.11 A biochemist isolates and purifies various molecules needed for DNA replication. When she adds some DNA, replication occurs, but each DNA molecule consists of a normal strand paired with numerous separate segments of DNA a few hundred nucleotides long. What has she probably left out of the mixture?
- A. DNA polymerase
 - B. DNA ligase
 - C. Nucleotides
 - D. Okazaki fragments
 - E. Primase
- 1.12 What is meant by the description "antiparallel" regarding the strands that make up DNA?
- A. The twisting nature of DNA creates nonparallel strands.
 - B. The 5' to 3' direction of one strand runs counter to the 5' to 3' direction of the other strand.
 - C. Base pairings create unequal spacing between the two DNA strands.
 - D. One (1) strand is positively charged and the other is negatively charged.

- E. One (1) strand contains only purines and the other contains only pyrimidines.
- 1.13 As a ribosome translocates along an mRNA molecule by one codon, which of the following occurs?
- A. The tRNA that was in the A site moves into the P site.
- B. The tRNA that was in the P site moves into the A site.
- C. The tRNA that was in the A site moves to the E site and is released.
- D. The tRNA that was in the A site departs from the ribosome via a tunnel.
- E. The polypeptide enters the E site.
- 1.14 A part of an mRNA molecule with the following sequence is being read by a ribosome: 5' CCG-ACG 3' (mRNA). The following charged transfer RNA molecules (with their anticodons shown in the 3' to 5' direction) are available. Two of them can correctly match the mRNA so that a dipeptide can form.

tRNA Anticodon	Amino Acid
GGC	Proline
CGU	Alanine
UGC	Threonine
CCG	Glycine
ACG	Cysteine
CGG	Alanine

The dipeptide that will form will be _____

- A. cysteine-alanine.
- B. proline-threonine.
- C. glycine-cysteine.
- D. alanine-alanine.
- E. threonine-glycine

- 1.15 What type of bonding is responsible for maintaining the shape of the tRNA molecule?
- A. Covalent bonding between sulphur atoms.
 - B. Ionic bonding between phosphates.
 - C. Hydrogen bonding between base pairs.
 - D. Van der Waals interactions between hydrogen atoms.
 - E. Peptide bonding between amino acids.
- 1.16 A cell divides to produce two (2) daughter cells that are genetically different.
- A. The statement is true for mitosis only.
 - B. The statement is true for meiosis I only.
 - C. The statement is true for meiosis II only.
 - D. The statement is true for mitosis and meiosis I.
 - E. The statement is true for mitosis and meiosis II.
- 1.17 If an organism is diploid and a certain gene found in the organism has 18 known alleles (variants), then any given organism of that species can/must have which of the following?
- A. At most, two (2) alleles for that gene.
 - B. Up to 18 chromosomes with that gene.
 - C. Up to 18 genes for that trait.
 - D. A haploid number of 9 chromosomes.
 - E. Up to, but not more than, 18 different traits.
- 1.18 A tetrad includes which of the following sets of DNA strands?
- A. Two (2) single-stranded chromosomes that have synapsed.
 - B. Two (2) sets of sister chromatids that have synapsed.

- C. Four (4) sets of sister chromatids.
- D. Four (4) sets of unique chromosomes.
- E. Eight (8) sets of sister chromatids.

QUESTION 2**[18]**

Give the correct biological term for each of the following definitions. Only write down the correct term next to the appropriate question number.

- 2.1 The external appearance of the gene.
- 2.2 Different alternatives of a gene.
- 2.3 The relations between successive generations.
- 2.4 The type of embryonic development found in rabbits.
- 2.5 The embryonic membrane that disposes of waste products during amniote development.
- 2.6 The type of cleavage whereby the egg does not divide completely.
- 2.7 An invasive technique in which amniotic fluid are obtained for genetic analysis.
- 2.8 The outer layer of the blastocyst.
- 2.9 The cessation of ovulation and menstruation.
- 2.10 Proteins responsible for the first level of DNA packing in chromatin.
- 2.11 Long strand of DNA which codes for a specific characteristic.
- 2.12 The specific type of sugar found in DNA.
- 2.13 The starting codon of protein synthesis.
- 2.14 The structure that bonds with the stop codon during the termination process of transcription.
- 2.15 The structure which helps to bond mRNA to protein of the ribosome.

- 2.16 Sex chromosomes.
- 2.17 The failure of chromosomes or chromatids to separate normally during meiosis.
- 2.18 Phenomenon where more than two (2) chromosome sets are found in each somatic cell.
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QUESTION 3**[19]**

- 3.1 Wolves are sometimes observed to have black coats and blue eyes. Assume that these traits are controlled by single locus genes and are located on different chromosomes. Assume further that normal coat colour (N) is dominant to black (n) and brown eyes (B) are dominant to blue (b). Suppose the alpha male and alpha female of a pack (these are the dominant individuals who do most of the breeding) are black with blue eyes and normal coloured with brown eyes, respectively. The female is also heterozygous for both traits. How many of the offspring (assume 16) living in the pack will have each of the following genotypes? (Show ALL the detail of the cross) (17)
- 3.2 Briefly name and describe the two (2) laws Mendel formulated after completing a few crosses using pea plants. (4 x ½ = 2)
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QUESTION 4**[19]**

- 4.1 What are the potential advantages of genetic recombination? (3)
- 4.2 Embryonic development of a frog after fertilization involves three (3) processes. Name these processes and draw and label a cross section of the structure, which forms at the end of the second process. (11)
- 4.3 Name and discuss the process, which sets up a fast block to polyspermy. (5)
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QUESTION 5**[19]**

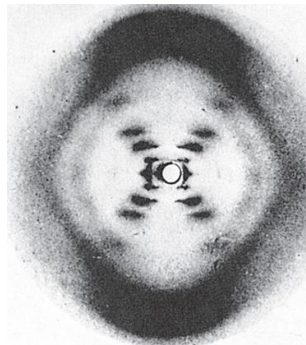
- 5.1 Draw a flow diagram to explain the unique hormonal control of the testes. (11)

- 5.2 What are the differences between the production of male gametes and the production of female gametes? (5)
- 5.3 Describe the structure of the testes. (2 x ½ = 1)
- 5.4 Explain how temperature change effect the production of sperm and functioning of the testes? (4 x ½ = 2)

QUESTION 6

[19]

- 6.1 Study the image below and answer the questions that follow.



- 6.1.1 Identify the image above. (1)
- 6.1.2 Who first produced this image? (1)
- 6.1.3 What features did Watson and Crick deduce from this image to develop a model of this structure in the image? (3)
- 6.1.4 Draw and label an uncoiled version of the structure in the image. Make sure you draw the shapes accurately and include all necessary bonds. (10 x ½ = 5)

6.2 Study the photo of a specific molecular machine below and answer the questions that follow



6.2.1 What is the machine in the photo above called? (No abbreviations) (1)

6.2.2 What is this machine used for? (1)

6.2.3 Briefly explain how this machine works. (4)

6.3 Discuss each of the following terms to clarify what it is and what it is used for.

6.3.1 DNA polymerase III (1)

6.3.2 Nuclease (1)

6.3.3 Pseudogenes (1)

QUESTION 7
[19]

7.1 Use the table below to answer the following questions

		Second Base				
		U	C	A	G	
First Base	U	UUU } Phe UUC } UUA } Leu UUG }	UCU } Ser UCC } UCA } UCG }	UAU } Tyr UAC } UAA Stop UAG Stop	UGU } Cys UGC } UGA Stop UGG Trp	Third Base
	C	CUU } Leu CUC } CUA } CUG }	CCU } Pro CCC } CCA } CCG }	CAU } His CAC } CAA } Gln CAG }	CGU } Arg CGC } CGA } CGG }	
	A	AUU } Ile AUC } AUA } AUG Met or Start	ACU } Thr ACC } ACA } ACG }	AAU } Asn AAC } AAA } Lys AAG }	AGU } Ser AGC } AGA } Arg AGG }	
	G	GUU } Val GUC } GUA } GUG }	GCU } Ala GCC } GCA } GCG }	GAU } Asp GAC } GAA } Glu GAG }	GGU } Gly GGC } GGA } GGG }	

7.1.1 Determine the amino acid sequence of the following: (6)

Coding DNA strand: CCT CTT ATG CCT TTT AAC CCG TAG CGT AAA

7.1.2 Determine the tRNA sequence of the following: (4 X ½ = 2)

Template strand: CCC TAC CCA ATA ACT AAA

7.2 Protein synthesis consist of two (2) processes. Name these two (2) processes. Where in the cell does each one (1) occur? Each process is subdivided into three (3) phases.

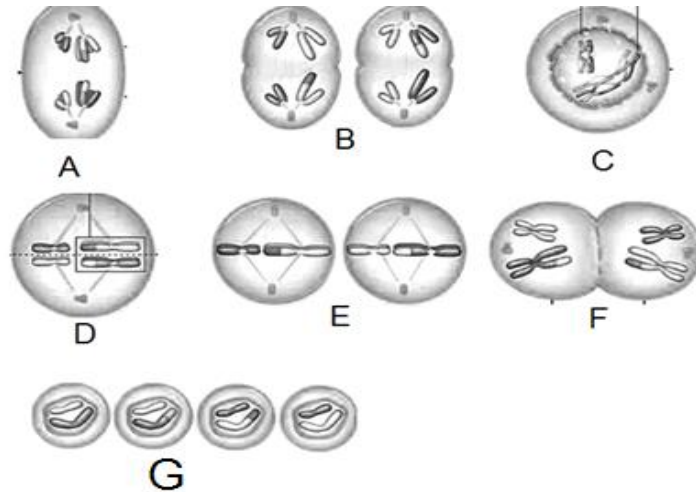
Briefly discuss the first phase of the first process. (10)

7.3 What is meant by RNA modification? (2 x ½ = 1)

QUESTION 5

[19]

8.1 Study the diagrams below and answer the questions that follow.



8.1.1 Identify the phases of meiosis in each of the diagrams below. (7)

8.1.2 During which phase (include name and diagram letter) are genes exchanged? What is this process called and why is it important? (3)

8.2 Why is meiosis important? (2)

8.3 Why do sex chromosome abnormalities tend to be less severe than autosome abnormalities? (2)

8.4 Discuss the term karyotype. (5)

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