FACULTY OF SCIENCE

DEPARTMENT BOTANY AND PLANT BIOTECHNOLOGY

LS3AFET / LSFT0A3

LIFE SCIENCE 3A FET

APK CAMPUS

SEMESTER TEST (UNITS: 1-3)

18 MARCH 2016

DATE:	**18 MARCH 2016**
SESSION:	**9H40-11H15**
ASSESSOR:	**MS J. WILLIAMSON**
INTERNAL MODERATOR:	**DR. A. NEL**
EXTERNAL MODERATOR:	**PROF. J. DE BEER**
DURATION:	**1½ HOURS**
TOTAL MARKS:	**90**

NUMBER OF PAGES: 11 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 **[15]**

Choose the alternative that best completes the statement or answers the question. Only write down the correct letter next to the appropriate question number.

1.1 Who conducted the X-ray diffraction studies that were key to the discovery of the structure of DNA?

A. Griffith
B. **Franklin**
C. Meselson and Stahl
D. Chargaff
E. McClintock

1.2 Which of the following results from Griffith's experiment is an example of transformation?

A. Mouse dies after being injected with living S cells.
B. Mouse is healthy after being injected with living R cells.
C. Mouse is healthy after being injected with heat-killed S cells.
D. Mouse dies after being injected with a mixture of heat-killed S and living R cells.
E. In blood samples from the mouse in D, living S cells were found.

1.3 Tables like the one shown here are useful for organizing sets of data representing a common set of values (in this case, percentages of A, G, C, and T) for a number of different samples (in this case, species).

Source of DNA	Adenine	Guanine	Cytosine	Thymine
Sea urchin	32.8%	17.7%	17.3%	32.1%
Salmon	29.7	20.8	20.4	29.1

Data from several papers by Chargaff: for example, E. Chargaff et al., Composition of the desoxypentose nucleic acids of four genera of sea-urchin, *Journal of Biological Chemistry* 195:155–160 (1952).

Does the distribution of bases in sea urchin DNA and salmon DNA follow Chargaff's rules?

A. Yes, because the %A + %T is greater than the %G + %C in both species.
B. No, because %A + %T does not equal %G + %Cin both species.

C. <u>Yes, because the %A approximately equals the %T and the %G approximately equals the %C in both species.</u>

D. No, because %A is higher than %T and %G is higher than %C in both species.

1.4 Place the steps in a cycle of PCR (Polymerase Chain Reaction) in the correct order:

1. Annealing—Cool to allow primers to form hydrogen bonds with ends of target sequence
2. Extension—DNA polymerase adds nucleotides to the 3′ end of each primer
3. Denaturation—Heat briefly to separate DNA strands

A. **<u>3-1-2</u>**

B. 3-2-1

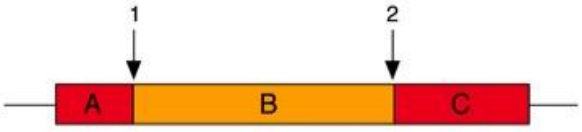
C. 1-2-3

D. 2-3-1

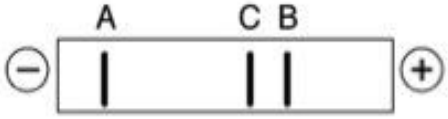
E. 1-3-2

F. 2-1-3

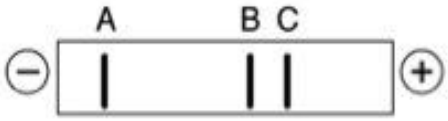
1.5 This segment of DNA is cut at restriction sites 1 and 2, which creates restriction fragments A, B, and C. Which of the following electrophoretic gels represents the separation of these fragments?



A.


B.


C.


D.


1.6 From the following list, which is the first event in translation in eukaryotes?

A. Elongation of the polypeptide.

B. Base pairing of activated methionine-tRNA to AUG of the messenger RNA.

C. The larger ribosomal subunit binds to smaller ribosomal subunits.

D. Covalent bonding between the first two amino acids.

E. The small subunit of the ribosome recognizes and attaches to the 5' cap of mRNA.

1.7 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.

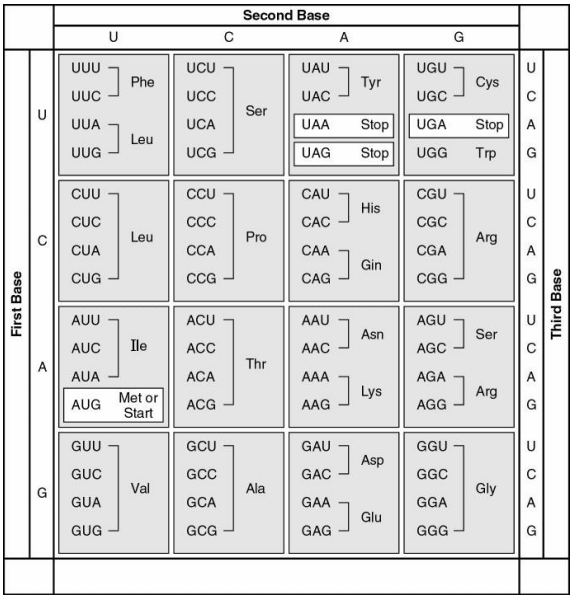
B. The tRNA that was in the P site moves into the A site.

C. The tRNA that was in the A site moves to the E site and is released.

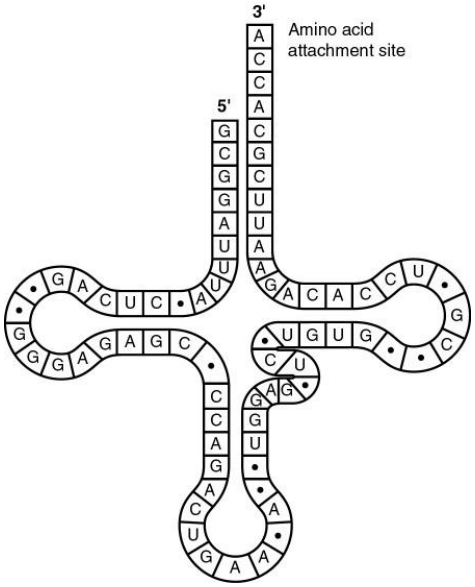
D. The tRNA that was in the A site departs from the ribosome via a tunnel.

E. The polypeptide enters the E site.

1.8 Study the diagram and table below and answer the question that follows.



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



Which amino acid will be picked up by the RNA in the diagram?

A. Glu

B. Gin

C. Thr

D. Leu

E. Ile

1.9 A peptide has the sequence NH_2-phe-pro-lys-gly-phe-pro-COOH. Which of the following sequences in the coding strand of the DNA could code for this peptide?

A. 3' UUU-CCC-AAA-GGG-UUU-CCC

B. 3' AUG-AAA-GGG-TTT-CCC-AAA-GGG

C. 5' TTT-CCC-AAA-GGG-TTT-CCC

D. 5' GGG-AAA-TTT-AAA-CCC-ACT-GGG

E. 5' ACT-TAC-CAT-AAA-CAT-TAC-UGA

1.10 Which of the following terms does not pertain to translation?

A. Anticodon.

B. tRNA

C. Aminoacyl-tRNA synthetase.

D. Polypeptide.

E. Rrna.

F. DNA.

1.11 Fertilization is to the zygote as meiosis is to which of the following?

A. Mitosis

B. Diploid

C. Chromosome

D. Replication

E. Gamete

1.12 Privet shrubs and humans each have a diploid number of 46 chromosomes per cell. Why are the two (2) species so dissimilar?

A. Privet chromosomes undergo only mitosis.

B. Privet chromosomes are shaped differently.

C. Human chromosomes have genes grouped together differently.

D. The two (2) species have appreciably different genes.

E. Privets do not have sex chromosomes.

1.13 Diploid cells may undergo either mitosis or meiosis. Haploid cells may undergo mitosis (for certain species) but not meiosis because _____

A. The sister chromatids cannot separate.

B. The synaptonemal complex is too strong.

C. Crossing over has occurred.

D. Cohesins are no longer present.

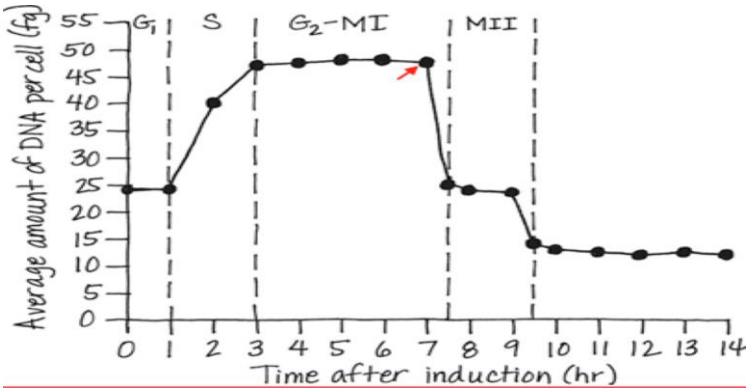
E. **homologous chromosomes cannot pair.**

1.14 What allows sister chromatids to separate in which phase of meiosis?

A. Release of cohesin along sister chromatid arms in anaphase I.
B. Crossing over of chromatids in prophase I.
C. Celease of cohesin at centromeres in anaphase I.
D. **Release of cohesin at centromeres in anaphase II.**
E. Crossing over of homologs in prophase I.

1.15 A graph with labels indicating the different phases of the meiotic cell cycle (MI = meiosis I; MII = meiosis II) is shown to the right, based on the data from the table. Think carefully about the point on the graph where the line at the highest value begins to slope downward, indicated by the arrow.

What specific point of meiosis does this "corner" represent?



A. Metaphase I
B. Prophase II
C. Cytokinesis
D. Anaphase I

QUESTION 2 **[15]**

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 self-replicating genetic structure of cells containing the cellular DNA that bears in its nucleotide sequence the linear array of genes. **Chromosome**

2.2 Structure used to make transgenic bacteria. **Recombinant DNA**

2.3 The enzyme which cuts out & replaces damaged stretches of DNA during proof reading after DNA replication. **Nuclease**

2.4 Proteins that are responsible for the first level of DNA arrangement. **Histones**

2.5 The enzyme responsible for the unwinding of a DNA molecule. **Helicase**

2.6 The nucleotide unique to RNA. **Uracil**

2.7 The base triplet found on an m-RNA. **Codon**

2.8 The starting codon of protein synthesis. **AUG**

2.9 The location of mRNA in the cell. **Nucleus**

2.10 The part of the sugar molecule of RNA which binds with the nitrogenous base. **C1**

2.11 The reversal of a chromosome segment. **Inversion**

2.12 Organisms with more than two (2) chromosome sets. **Polyploidy**.

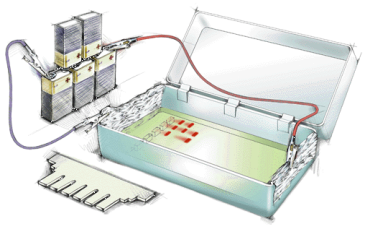
2.13 Disease caused by XXY chromosomes. **Klinefelter syndrome**

2.14 The failure of chromosomes or chromatids to separate normally during meiosis. **Non-disjunction**

2.15 An ordered display of magnified images of an individual's chromosomes arranged in pairs. **Karyotype**

QUESTION 3 **[20]**

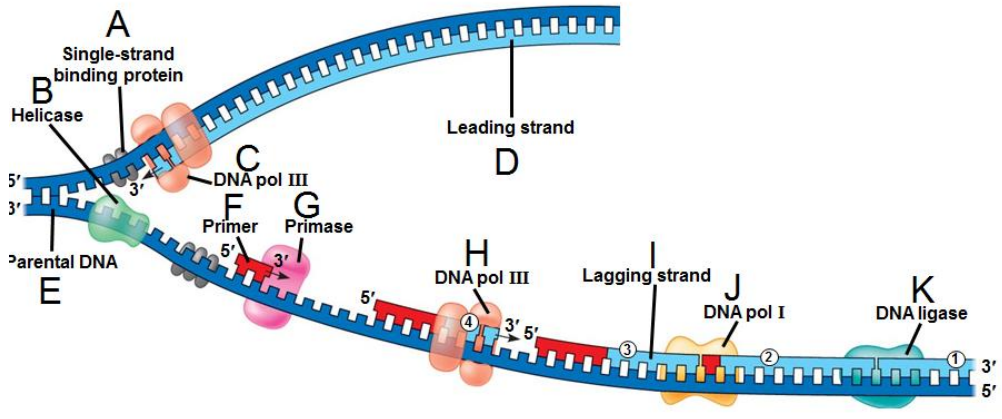
3.1 The apparatus below is used as part of a very important forensic technique. Name and discuss this forensic technique, include the use of the apparatus below. (8)



- **Gel electrophoresis apparatus**
- **Sample of DNA is cut into fragmentsby means of restriction enzymes.**
- **Negative charged electrode at one end of a rectangular flat piece of gel and a positive electrode is placed at the other end.**
- **The DNA is placed at the negative end of the gel and starts to move to the positive end.**
- **Smaller fragments move faster than the larger ones. Separation occurs on the basis of size.**
- **DNA is then pressed flat against the gel and transferred to filter paper.**
- **Radioactive probes bind to special DNA fragments.**
- **X-rays are taken of the filter paper. The DNA probes show up as dark bands on the film.**
- **The pattern of these bands is the DNA fingerprint.**

3.2 The diagram below illustrates an important process needed to precede mitosis. Name this process and label A – K. (12)

DNA replication



QUESTION 4 **[20]**

4.1 Protein synthesis is a very important process which takes place in each somatic cell of a human. It can be divided into two (2) distinct stages. Name each stage and state where each occurs in the cell. Briefly discuss the events of the first stage. (20)

- **Transcription (1) and Translation (1)**
- **Transcription – in nucleus**
- **Translation – in cytoplasm**
- **The 3 stages of transcription:**
- **(1) Initiation**
- **(2) Elongation**
- **(3) Termination**
- **Initiation: 1. RNA-polymerase attaches to the beginning of the DNA code called the promotor**
- **It unwinds the DNA molecule and breaks the weak hydrogen bonds between the complementary strands – a "bubble forms"**
- **The one strand now acts as a template for the formation of the mRNA strand.**
- **Elongation: Free nucleotides in the nucleus bonds to the complementary bases of the DNA template strand. (Uracil replaces Thymine in mRNA)**
- **More free nucleotides bond to their complementary bases, to elongate the mRNA strand, until the entire code has been transcribed.**
- **The DNA parts already transcribed rewound.**
- **Termination: The mRNA will detach from the DNA template.**
- **The RNA polymerase detaches and starts all over again at a different location where needed.**
- **Now the pre-mRNA strand has to undergo a modification and RNA splicing before it can leave the nucleus.**
- **Each end of a pre-mRNA molecule is modified in a particular way: 5' end receives a modified nucleotide 5' cap**
- **3' end gets a poly-A tail**
- **RNA splicing removes introns (non-coding RNA) &**
- **joins exons (coding RNA),**
- **creating an mRNA molecule with a continuous coding sequence.**
- **RNA splicing is carried out by spliceosomes.**

QUESTION 5 **[20]**

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

Diagram A ***Diagram B***

5.1.1 Name the phase of meiosis in diagram A and diagram B respectively. (2)

- **Diagram A - Metaphse II**
- **Diagram B - Metaphase I**

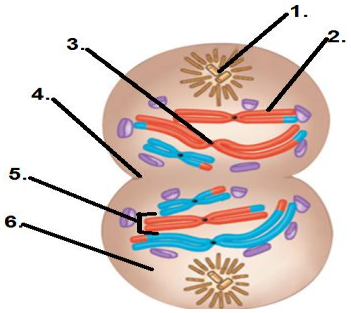
5.1.2 What is the main difference between the phase in diagram A and the phase in diagram B? (2)

- **Diagram A: Single chromosomes attach to single spindle fibres**
- **Diagram B: Homologous chromosome pairs attach to one spindle fibre.**

5.2 How do Mitosis differ from Meiosis with regard to the second and fourth phases? Tabulate your answer. (6)

Mitosis	Meiosis I	Meiosis II
Prophase: Homologous chromosome pairs form and lie randomly in the nucleus	**Prophase I: Homologous chromosome pairs form and lie next to one another**	**Prophase II: Single chromosomes form (there are no homologous chromosomes)**
Anaphase: Daughter chromosomes move to opposite poles	**Anaphase I: Duplicated chromosomes move to opposite poles**	**Anaphase II: Daughter chromosomes move to opposite poles**

5.3 Study the diagram below and answer the questions that follow.



5.3.1 The diagram show one (1) of the phases in the process used to make gametes. Name this process. (1)

Meiosis I

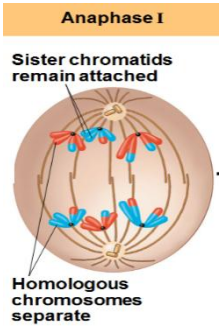
5.3.2 Which phase is represented by the diagram above? (1)

Telophase I

5.3.3 Label structures 1 – 6. (6 x ½ = 3)

1. **– Centrioli**
2. **– Chromatid**
3. **– Centromere**
4. **– cleavage furrow**
5. **- chromosome**
6. **– cytoplasm**

5.3.4 Name, draw and label a diagram to represent the phase that precedes the phase in the diagram. (5)



Heading: (1)

Labels (3)

3 chromosomes up/3 down (1)

---

ooooOOOooo