INTI INTERNATIONAL UNIVERSITY

FOUNDATION IN SCIENCE (CFSI)
BIO1203: BIOLOGY 1
FINAL EXAMINATION: MAY 2014 SESSION

Instructions: This paper consists of **FIVE (5)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Question 1

(a) (i) State the **FOUR (4)** kingdoms of the Eukarya domain and give **ONE (1)** example of each kingdom.

(4 marks)

(ii) What is the difference between the discovery science and hypothesis-based science?

(2 marks)

(iii) Use key terms provided to show the general process of the scientific method.

Hypothesis	Observation	Question
Conclusion	Prediction	Experiment or observation

(1 mark)

(b) Water is the only common substance found naturally in all three common states of matter and it is essential for all life on Earth. The unique properties of water and its abundance make possible for life to thrive on Earth.

(i) Water is polar molecule. Briefly explain this statement.

(2 marks)

(ii) How does water moderate temperature?

(4 marks)

(c) Table 1.1 contains statements about four molecules.
Complete the table by indicating with a tick (✓) or a cross (×) whether the statements apply to haemoglobin, DNA, phospholipids or antibodies.
You should put a tick or a cross in each box of the table. Copy the table in the answer sheet.

Table 1.1

Statement	Haemoglobin	DNA	Phospholipids	Antibodies
Contains iron				
Contains phosphate				
Able to replicate				
Hydrogen bonds stabilize the molecule				
Contains nitrogen				

(5 marks)

(d) Table 1.2 shows the observation in an experiment to identify the unknown substances.
Identify the compound in solution A and B.

Table 1.2

Solution	**Benedict's test**	**Iodine test**
Distilled water	Blue	Brown
A	Greenish	Brown
B	Blue	Dark blue

(2 marks)

(e) Describe the structure of starch.

(5 marks)

Question 2

(a) Fig. 2.1 shows an animal cell.

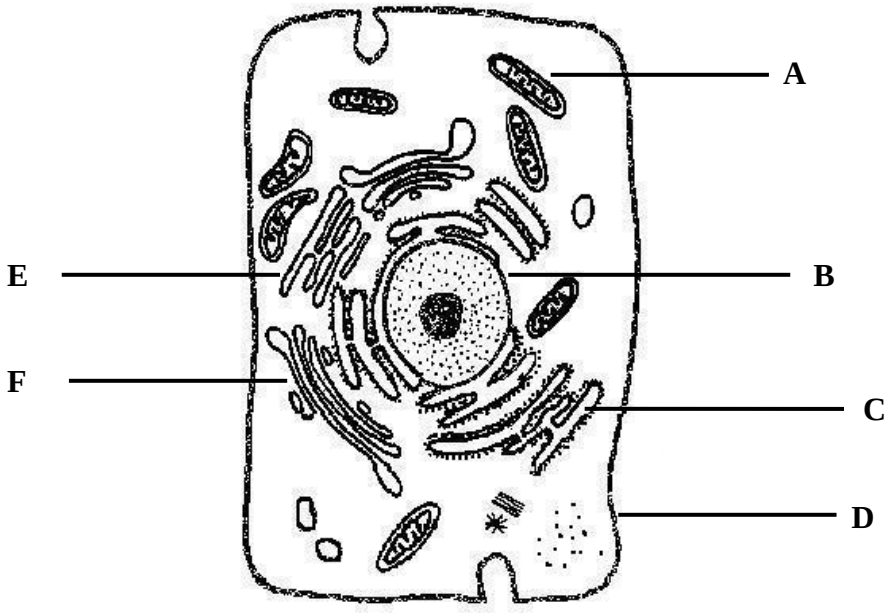

Fig. 2.1

Identify structures A, B, C, D, E, and F. State **ONE (1)** function for each structure respectively.

(9 marks)

(b) Fig. 2.2 shows an inhibition of an enzyme.

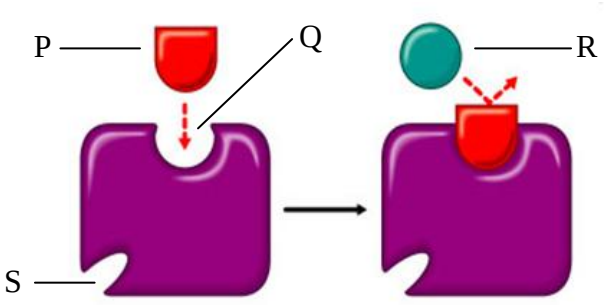

Fig. 2.2

(i) Identify the structures labeled P, Q, R and S.

(4 marks)

(ii) Which type of inhibition is shown in the diagram above? Briefly explain your answer.

(4 marks)

(c) Fig. 2.3 shows a part of a cell surface membrane.

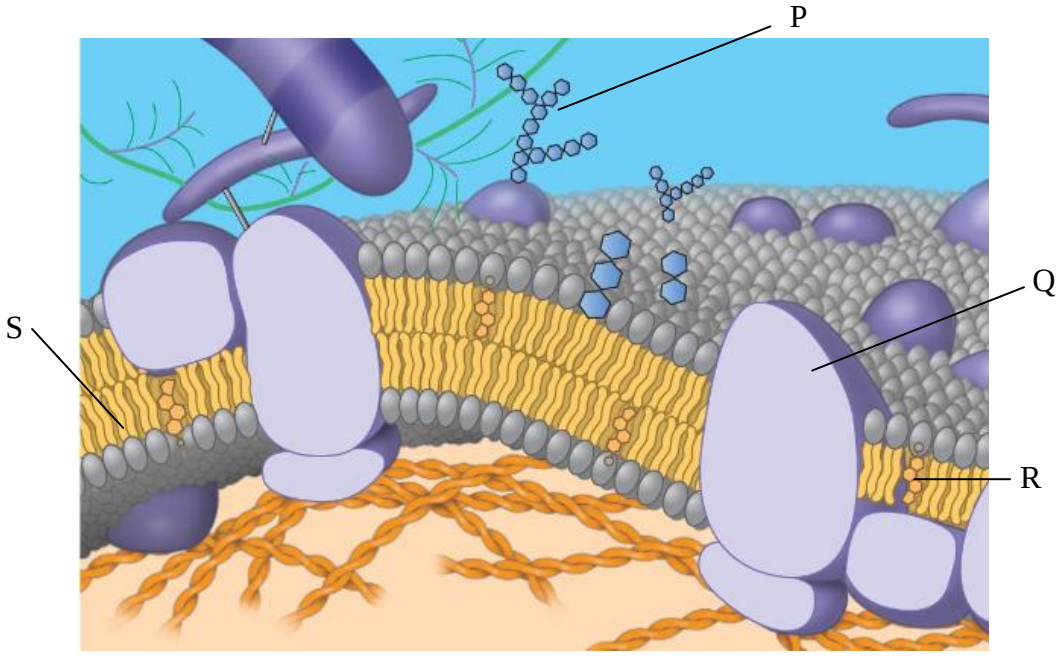

Fig. 2.3

Identify structures labeled P, Q, R and S and state **ONE (1)** function of each structure respectively.

(8 marks)

Question 3

(a) Fig. 3.1 shows the linked reaction and Krebs cycle stages in the cellular metabolic pathway.

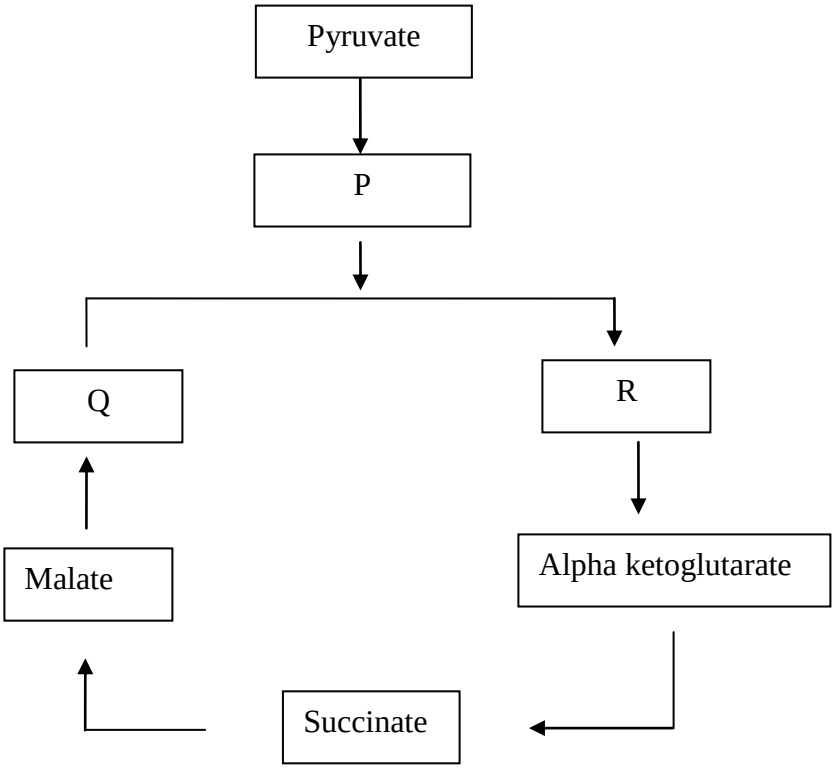

Fig. 3.1

(i) Identify P, Q and R.

(3 marks)

(ii) Where does the conversion of P to Q take place?

(1 mark)

(iii) How many CO_2 molecules are released during the Krebs cycle (excluding the link reaction phase) if only **ONE (1)** molecule of pyruvate enters the Krebs cycle?

(1 mark)

(iv) What happens to the NADH that is produced during the Krebs cycle?

(2 marks)

(b) Only substrate-level phosphorylation is possible in the absence of oxygen.
Explain why oxidative phosphorylation is not possible in the absence of oxygen.

(5 marks)

(c) Fig. 3.2 shows the light-dependent reaction of photosynthesis.

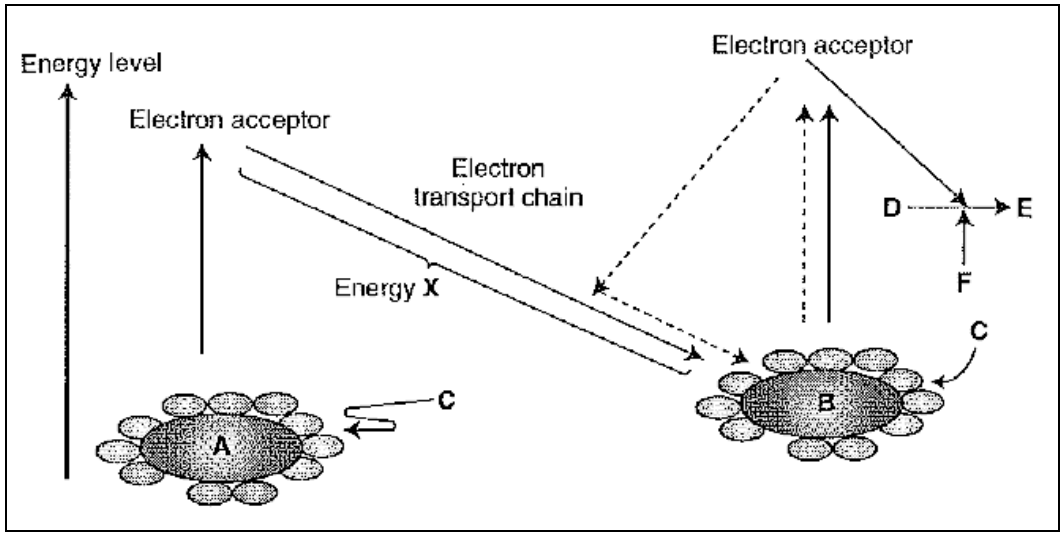

Fig. 3.2

(i) Identify A, B, C, D, E and F in the diagram above.

(3 marks)

(ii) In a chloroplast, where can you find structures A and B?

(1 mark)

(iii) Name the primary pigment that is found in each structure of A and B.

(2 marks)

(iv) State the function of C.

(2 marks)

(v) Explain the function of energy X produced by electron transport chain.

(2 marks)

(vi) List **THREE (3)** roles of the thylakoid membrane in photosynthesis.

(3 marks)

Question 4

(a) The summer squash plant produces fruits that are either white or yellow in colour and are either shaped like a disc or a sphere. The dominant phenotypes are white and disc shaped fruits. Using the symbols **A** for white, **a** for yellow, **B** for disc and **b** for sphere, draw a Punnett square to show the genotypes and phenotypes of **all** offspring if a white and disc-shaped fruit plant, heterozygous for both genes, is self-fertilised. Include fraction of each phenotype.

(8 marks)

(b) Cystic fibrosis (CF) is caused by a recessive mutation, b, on an autosome.
Draw a genetic diagram to show, for parents with genotypes BbXX and BbXY, the probability of having a daughter who suffers from CF.
In your genetic diagram, show the genotypes of the gametes and the genotypes and phenotypes of the offspring.

(6 marks)

(c) Fig. 4.1 below shows the life cycle of a tiger.

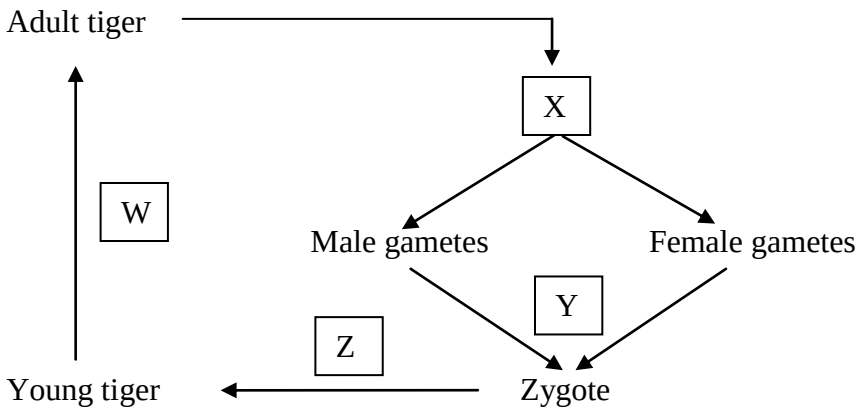

Fig. 4.1

(i) Identify the stage(s) where meiosis occurs.

(1 mark)

(ii) Identify the stage(s) where mitosis occurs.

(1 mark)

(iii) DNA replication occurs in the cells during interphase before the cells divide by mitosis. Briefly explain the importance of DNA replication that occurs before mitosis.

(3 marks)

(iv) State **TWO (2)** importance of mitosis in life cycle of this tiger.

(2 marks)

(d) Fig. 4.2 shows the results of an animal cell that has undergone meiosis II.

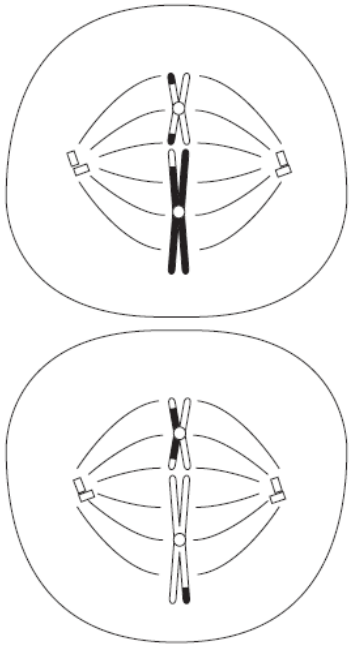

Fig. 4.2

(i) Which stage of meiosis II is shown in Fig. 4.2?

(1 mark)

(ii) State the stage that comes after the stage mentioned in (i).

(1 mark)

(iii) Describe what has happened to the following organelles before the start of meiosis.
(a) the nuclear membrane

(1 mark)

(b) the centrioles

(1 mark)

Question 5

(a) Fig. 5.1 below shows part of a molecule of deoxyribonucleic acid (DNA).

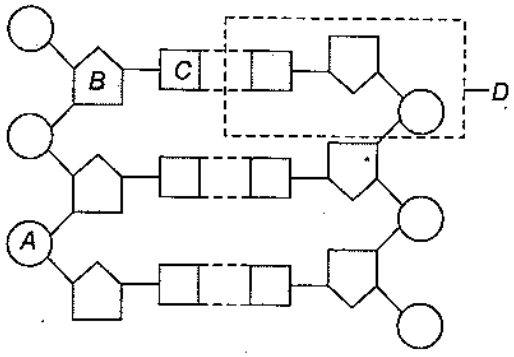

Fig. 5.1

(i) Name the structures labeled A, B, C, and D.

(2 marks)

(ii) An analysis of a molecule of DNA showed that thymine accounted for 8 % of the content of the nitrogenous bases. Calculate the percentage of cytosine in the molecule. Show your working.

(2 marks)

(b) The letters below represent part of a DNA sequence for a gene encodes for a certain protein necessary for blood to clot.

3'- CCT TAC GAA CGA CCC GAG CTT ATT GCG GAA- 5'

(i) Write the nucleotide sequence of the other strand of DNA.

(1 mark)

(ii) Transcribe the DNA sequence mentioned in (i) into RNA.

(1 mark)

(iii) The table below shows the codons and the specified acid amino. Write the sequence of amino acids that is produced by the translation of the RNA mentioned in (ii).

Three-letter codons of messenger RNA, and the amino acids specified by the codons			
AAU, AAC – Asparagine	CAU, CAC – Histidine	GAU, GAC – Asparatic acid	UAU, UAC – Tyrosine
AAA, AAG – Lysine	CAA, CAG – Glutamine	GAA, GAG – Glutamic acid	UAA, UAG – Stop
ACU, ACC, ACA, ACG – Threonine	CCU, CCC, CCA, CCG – Proline	GCU, GCC, GCA, GCG – Alanine	UCU, UCC, UCA, UCG – Serine
AGU, AGC – Serine AGA, AGG – Arginine	CGU, CGC, CGA, CGG – Arginine	GGU, GGC, GGA, GGG – Glycine	UGU, UGC – Cysteine UGA – Stop UGG – Leucine
AUU, AUC, AUA – Isoleucine AUG – Methionine	CUU, CUC, CUA, CUG – Leucine	GUU, GUC, GUA, GUG – Valine	UUU, UUC – Phenylalanine UUA, UUG – Leucine

(1 mark)

(c) Fig. 5.2 shows the stages involved in the polymerase chain reaction.

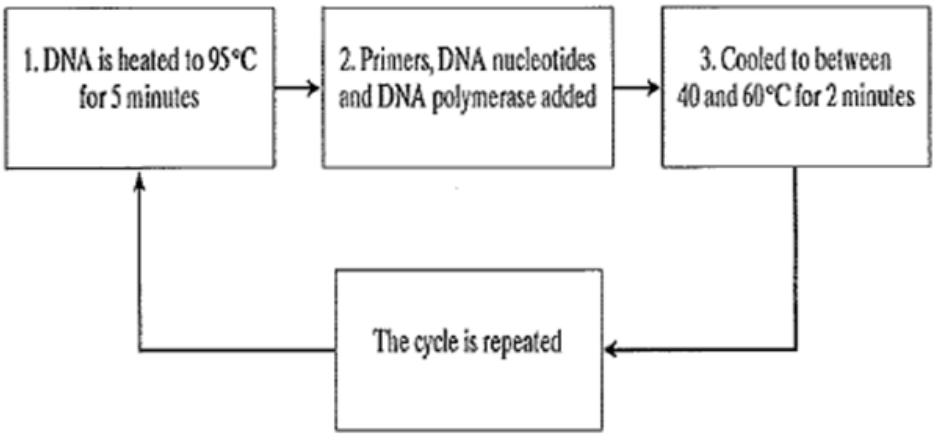

Fig. 5.2

(i) Why DNA is heated to 95 ^{o}C?

(1 mark)

(ii) What is the role of DNA polymerase and a primer in the process?

(2 marks)

(iii) How many DNA molecules will be produced from **ONE (1)** DNA molecule after 5 cycles?

(1 mark)

(d) Fig. 5.3 shows some of the steps involved in the production of bacteria capable of synthesising human insulin.

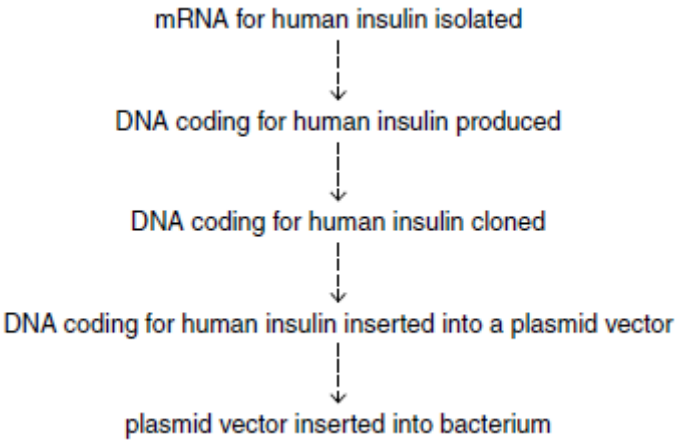

Fig. 5.3

State the role of each of the following enzymes in the production of bacteria capable of synthesizing human insulin,

(i) reverse transcriptase
(ii) restriction enzymes
(iii) DNA ligase

(3 marks)

(e) Fig. 5.4 shows the gene regulation and the expression of a *lac* operon when lactose is present.

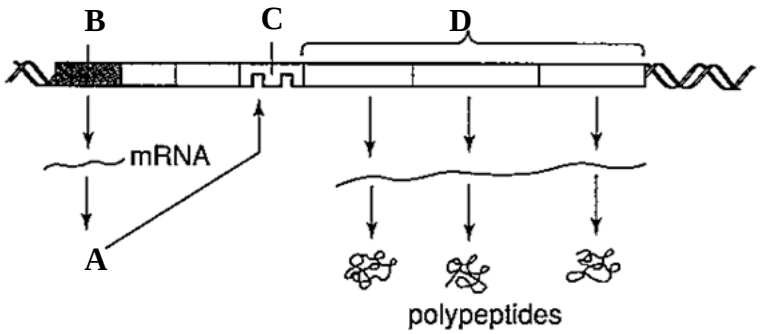

Fig. 5.4

(i) Identify the substances labeled A, B, C and D.

(4 marks)

(ii) Explain how *lac* operon works when lactose is absent.

(3 marks)

(f) There is much controversy throughout the world regarding the use of genetically modified (GM) crops.

(i) Suggest **TWO (2)** advantages of growing GM rice with an enhanced vitamin A content.

(2 marks)

(ii) Suggest **TWO (2)** disadvantages of growing GM crops.

(2 marks)

-THE END-

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