FINAL
Alternative Assessment

(COVER PAGE)

Session	:	**April 2020**
Programme	:	Foundation in Science (CFSI)
Course	:	**BIO1203: Biology 1**
Date of Examination	:	7 August 2020 (Friday)
Time	:	9:00am – 11:30am Reading Time : Nil
Duration	:	2 hours + 30 minutes (uploading time)
Special Instructions	:	

This paper consists of **FOUR (4)** questions. Answer **ALL FOUR (4)** questions.
All questions carry equal marks.

Materials permitted :

Nil

Materials provided :

Nil

Examiner(s)	:	**Dr. Khor Soo Ping**
Chief Moderator	:	Ms. Ooi Saik Huey

*This paper consists of **14** printed pages, including the cover page.*

FOUNDATION IN SCIENCE (CFSI)
BIO1203: BIOLOGY 1
FINAL ALTERNATIVE ASSESSMENT: APRIL 2020 SESSION

Instructions: This paper consists of **FOUR (4)** questions. Answer **ALL FOUR (4)** questions. All questions carry equal marks.

Question 1

(a) A plant scientist wants to investigate if different concentrations of nutrients in fertilizer will affect the rate of crop production in a green house. The crops were watered daily and maintained in green house controlled at a standard temperature and humidity.

(i) Define the meaning of control variable in an experiment.

(1 mark)

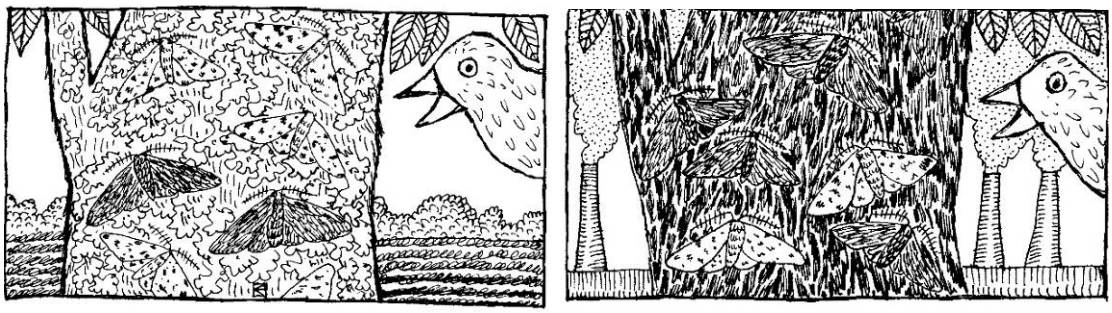
(ii) Identify dependent and independent variables in this experiment.

(2 marks)

(b) A hypothesis is said to be testable and falsifiable. Explain what does it mean for a hypothesis to be "falsifiable"?

(1 mark)

(c) Figure Q1(c) shows the picture of before and after industrial revolution. Before the industrial revolution in England, pollution level is considerably lower and the peppered moths that possess lighter coloration find it easier to camouflage on the trees of the English forests. Industrial revolution began in the middle of the eighteenth-century. Since then, factories were being built, and they ran by burning coal for fuel. As a result, dark smoke covered the surrounding countryside. Trees that had been light in colour now were dark and bare. Today, more than 90% of the peppered- moths are dark in colour. Using the above example, explain the concept of **natural selection.**



Before industrial revolution After industrial revolution

Figure Q1(c)

(4 marks)

(d) Figure Q1(d) shows a diagram of two water molecules linked by a hydrogen bond.

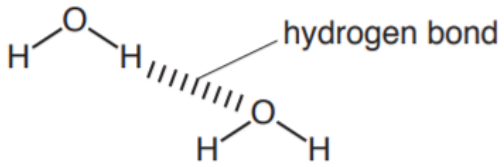


Figure Q1(d)

(i) Name the type of bond that forms between hydrogen and oxygen atom within the same water molecules.

(1 mark)

(ii) Describe how water molecules are held together by hydrogen bonds.

(3 marks)

(iii) Which property of water explains why water cluster into spherical beads on the waxy surface of leaves after it rains. Elaborate your answer.

(2 marks)

(e) Figure Q1(e) shows a part of cellulose molecule.

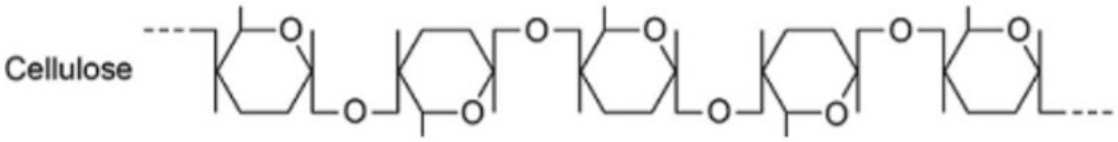


Figure Q1(e)

(i) Based on Figure Q1(e), how do you justify that cellulose is a polymer.

(1 mark)

(ii) Give one example of polysaccharide presents in animal cells that has the same function of cellulose in plant.

(1 mark)

(f) Figure Q1(f) shows the amino acid cysteine, which is a basic building block for protein.

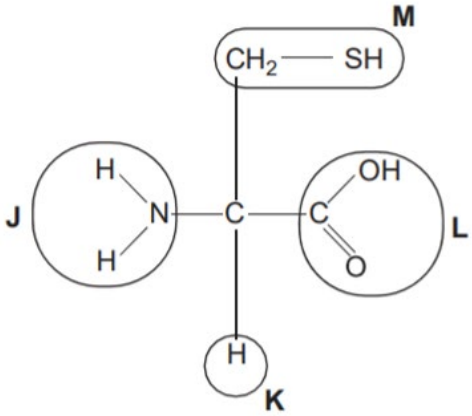


Figure Q1(f)

(i) Name and identify the letters **J** and **L** in Figure Q1(f) which represents the functional group of cysteine.

(2 marks)

(ii) The primary structure of a protein consists of a chain of amino acids. Name the bond that forms between two amino acids and describe how a second amino acid would bond to cysteine in forming the primary structure of a protein.

(4 marks)

(iii) Describe in details how tertiary structure of a protein molecule is formed.

(3 marks)

Question 2

(a) Figure Q2(a)i is a diagram of a eukaryotic cell showing the organelles involved in the production and secretion of an extracellular protein. The rough endoplasmic reticulum (RER) is shown enlarged at the side of the diagram.

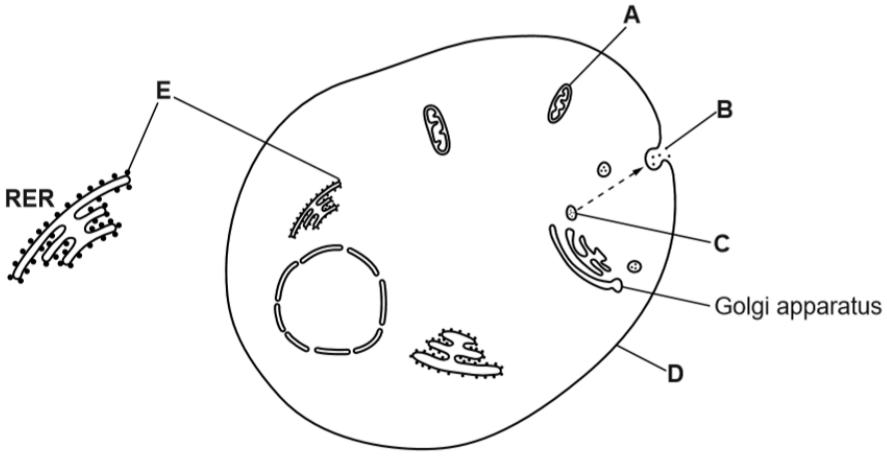


Figure Q2(a)i

(i) Describe in detail the flow of endomembrane system and its components that are responsible for protein production until secretion process from a eukaryotic cell.

(3 marks)

(ii) Name the process by which the protein is secreted from the cell at **B**.

(1 mark)

(iii) Describe the structure of a phospholipid and how the structures contribute to its role in cell membrane.

(4 marks)

(iv) Figure Q2(a)ii below shows the enlarged diagram of organelle A using electron microscope. Organelle A produce ATP which is a source of energy. Write the equation for this process.

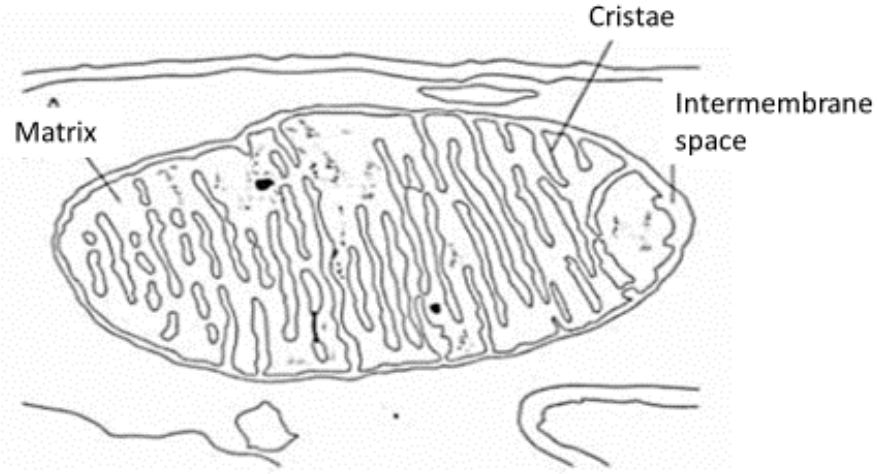


Figure Q2(a)ii

(1 mark)

(v) Substance X is a three-carbon molecule produced from glycolysis stage of cellular respiration. Substance X enters organelle A from the cytoplasm for ATP production What is substance X?

(1 mark)

(vi) In organelle A, substance X is converted to a two-carbon substance. Describe this process.

(3 marks)

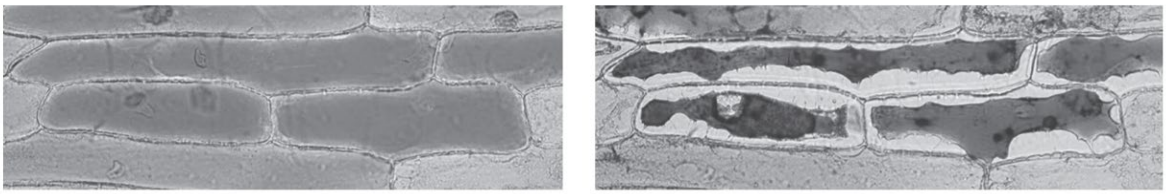
(vii) Water is a waste product of aerobic respiration. Describe how water is formed at the end of aerobic respiration.

(2 marks)

(viii) Describe the fate of substance X if substance X does not proceed to organelle A during anaerobic respiration. Explain the importance of this reaction.

(2 marks)

(b) Figure Q2(b)i shows the epidermis of an onion placed in distilled water and concentrated salt solution. The cells were then photographed under a microscope.



cells in distilled water | cells in salt solution

Figure Q2(b)i

(i) Osmosis is the mechanism that results in the appearance of the onion cells in Figure Q2(b)i. Explain this mechanism.

(1 mark)

(ii) Describe and explain what you have observed from both the onion cells placed in distilled water and concentrated solution.

(4 marks)

(iii) In a separate experiment, red blood cells were also placed in both distilled water and salt solution for one hour and viewed under microscope. Figure Q2(b)ii shows the process of how fresh red blood cells changed over time in one of the liquids tested. Based on the observation, which liquid is most likely the red blood cells were incubated?

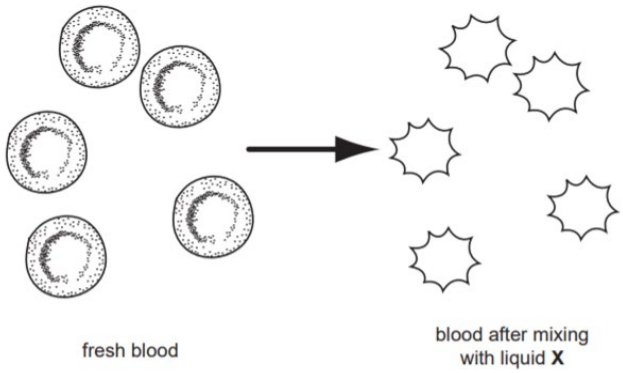


Figure Q2(b)ii

(1 mark)

(iv) If red blood cells are placed in distilled water and examined under microscope no cells are seen. Explain why no red blood cells would be seen, unlike onion cells.

(2 marks)

Question 3

(a) Figure Q3(a) below shows some of the steps in photosynthesis.

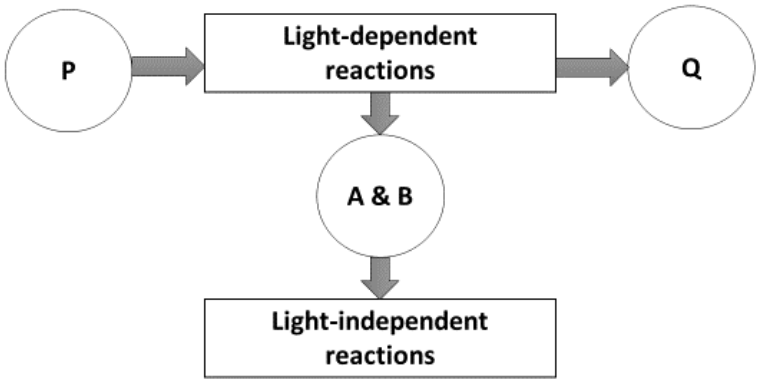


Figure Q3(a)

(i) Q is a by-product of light-independent reactions. Identify molecule P.

(1 mark)

(ii) Molecule P plays an important part in photosynthesis. Describe its role in light-dependent reactions.

(2 marks)

(iii) Describe precisely how molecules A and B are produced in the light-dependent reaction of photosynthesis when light hits the photosystem.

(5 marks)

(b) Mosquitoes contain cells with a diploid number (2n) of six. Figure Q3(b) shows a cell from a male mosquito at one of the meiosis stages.

P

Figure Q3(b)

(i) Describe **TWO (2)** events in stage P that does not occur in mitosis division.

(2 marks)

(ii) Interphase was formerly known as a 'resting stage'. Justify why the term 'resting stage' is an incorrect description for cells in interphase.

(1 mark)

(iii) State the stage of meiosis where single chromosome line up on the equator.

(1 mark)

(c) The pedigree diagram Figure Q3(c) below shows the inheritance of galactosemia in a family. Galactosemia is not a sex-linked disorder.
The normal allele is represented by **G** and the defective recessive allele is represented by **g**.

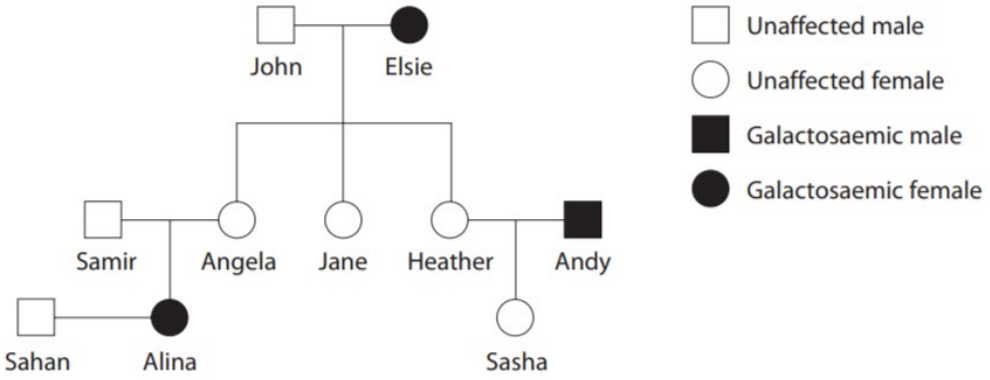


Figure Q3(c)

(i) Based on your understanding of gene inheritance, what is the criteria for galactosemic phenotype to be expressed?

(1 mark)

(ii) If John is heterozygous for galactosemia, what is Jane's genotype?

(1 mark)

(iii) Explain why Alina is affected by galactosemia disorder.

(2 marks)

(d) Figure Q3(d) shows the karyotype from a body cell of a person. This person has a rare condition that affects their chromosome numbers.

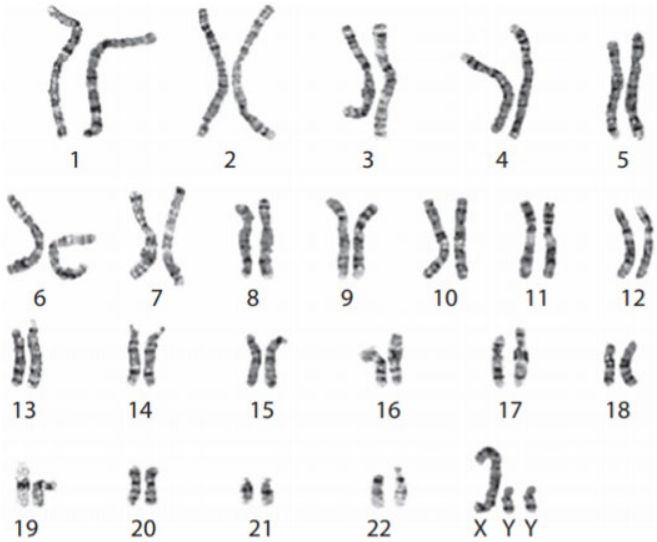


Figure Q3(d)

(i) State the sex of the person based on the karyotype shown.

(1 mark)

(ii) Demonstrate how the karyotype shown in Figure Q3(d) could be produced.

(2 marks)

(e) True breeding fruit flies with grey bodies and long wings were crossed with fruit flies with black bodies and short wings. All the F1 generation are heterozygous with grey bodies and long wings.

The heterozygous F1 offspring were crossed with flies homozygous for black body and short wings. Figure Q3(e) below shows the results of this cross.

GgNn crossed with **ggnn**

	Grey body, long wings	**Black body, short wings**	**Grey body, short wings**	**Black body, long wings**
Number of offspring	975	963	186	194

Figure Q3(e)

Keywords:
G - dominant allele for grey body; **g-** recessive allele for black body
N - dominant allele for long wings; **n** - recessive allele for short wings.

(i) Based on Figure Q3(e), results demonstrated that the data recorded of this cross is not the predicted phenotypic ratio following Mendel's law of inheritance. Explain from the aspect of gene linkage why the above results were obtained.

(2 marks)

(ii) If the cross followed Mendel's law of inheritance, what ratio of genotypes and phenotypes would have expected to obtain in the offspring crossed between heterozygous grey body and long wings, and homozygous for black body and short wings? Show your working.

(4 marks)

Question 4

(a) Hemoglobin is a type of protein found in red blood cell and it is important for oxygen transportation. The mutation in hemoglobin gene may lead to a genetic disease called sickle cell anemia. The DNA sequences below show the normal gene sequence codes for normal red blood cell and different types of mutation in hemoglobin gene. Figure Q4(a) below shows the normal and mutated gene sequence for haemoglobin gene and its respective amino acids sequence.

CAC	GTG	GAC	TGA	GGA	CTC	CTC	Normal gene
val	his	leu	thr	pro	glu	glu	
CAC	GTG	GAC	TGA	GGA	CAC	CTC	Mutation 1
val	his	leu	thr	pro	val	glu	
CAC	GTG	GAC	TGA	GGA	CAT	CCT	Mutation 2
val	his	leu	thr	pro	val	gly	
CAC	GTG	GAC	TGA	GGA	CCC	TCA	Mutation 3
val	his	leu	thr	pro	gly	ser	

Figure Q4(a)

(i) Based on the above example, describe how mutation in hemoglobin gene leads to sickle cell anemia.

(1 mark)

(ii) Name mutation 1, 2 and 3 shown in Figure Q4(a).

(3 marks)

(iii) Explain why mutation 2 and 3 resulted in a more harmful consequences in terms of polypeptide production.

(1 mark)

(iv) Describe how polypeptide chain of hemoglobin protein is produced from its mRNA sequence in cytoplasm.

(4 marks)

(b) Figure Q4(b) shows the diagram of DNA replication.

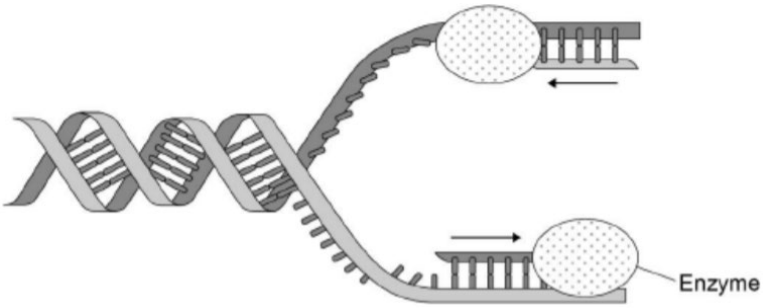


Figure Q4(b)

(i) Name and explain the function of the enzyme.

(2 marks)

(ii) Explain why DNA replication follows a semi conservative model.

(2 marks)

(iii) To identify tissue traces from a crime scene, DNA from the tissue is 'replicated' to get enough samples for further analysis. What biotechnological technique resembles DNA replication?

(1 mark)

(c) Restriction enzymes cuts DNA into fragments at specific site determined by the sequence of bases. Figure Q4(c) shows the base sequences cut by three different restriction enzymes.

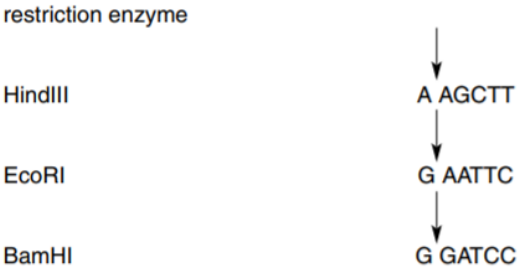


Figure Q4(c)

(i)

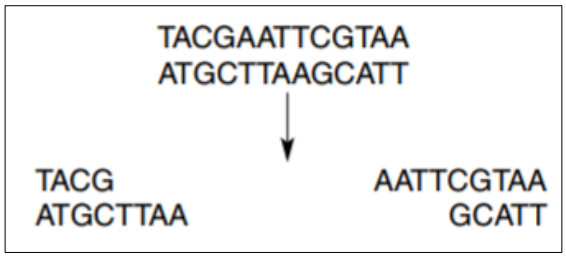


Figure Q4(c)i

The DNA section above is cut by one of the enzymes in Figure Q4(c). Which restriction enzyme is being used to cut the above DNA section in Figure Q4(c)i?

(1 mark)

(ii) Name the unpaired single stranded regions of the DNA fragments after the section of DNA has been cut by restriction enzyme.

(1 mark)

(d) People who suffer from Type 1 Diabetes do not produce insulin and must inject it daily. This insulin is created through genetic engineering techniques involving bacterial vectors and enzymes. Previously, insulin was extracted from animals such as pigs.

(i) Explain how recombinant plasmid containing human insulin gene can be produced.

(3 marks)

(ii) What are the **TWO (2)** main reasons why insulin production industry has switched to using gene cloning technique rather than directly extract from animal?

(2 marks)

(iii) Gene expression, the turning on and off of genes, can help organisms respond to environmental changes. Insulin gene expression in response to high blood glucose levels is important for maintaining glucose homeostasis. Suggest and explain **TWO (2)** ways how insulin gene expression can be controlled in response to glucose levels after transcription level.

(4 marks)

~ The End ~