**FINAL**
Alternative Assessment

(COVER PAGE)

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| Session | : | **August 2020** |
| Programme | : | Foundation in Science (CFSI) |
| Course | : | **BIO1203: Biology 1** |
| Date of Examination | : | 17 December 2020 (Thursday) |
| 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 **13** printed pages, including the cover page.*

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

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

**Question 1**

(a) Charles Darwin's book "On the origin of species" published in 1859 proposed a mechanism for evolution called natural selection. Describe the process of natural selection.

(4 marks)

(b) *Halobacterium salinarum* is a member of the Archaea. It is an aquatic, motile microorganism that respires aerobically and actively seeks out locations where oxygen is present.

(i) Archaea is a taxonomic grouping called a domain. Name the other **TWO (2)** domains.

(1 mark)

(ii) List **TWO (2)** common characteristics that are shared between archaea and another 2 domains.

(2 marks)

(c) 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 a polar molecule. Explain the chemical properties of water that makes it a polar molecule.

(2 marks)

(ii) Explain why ice is less dense than water at 0°C and how do aquatic organisms benefit from this phenomenon?

(3 marks)

(d) Explain why cell is known as structural and functional unit of life.

(2 marks)

(e) Proteins are macromolecules that are made up of many amino acids. Figure Q1(e) shows two amino acid monomers joined by a peptide bond to form a dipeptide.

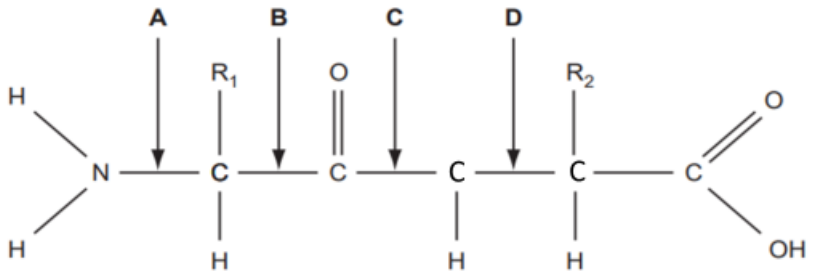


Figure Q1(e)

(i) Based on Figure Q1(e), which of the following alphabet **A**, **B**, **C** and **D**, shows the peptide bond?

(1 mark)

(ii) What is represented by $R_1$ and $R_2$ as shown in Figure Q1(e)?

(1 mark)

(iii) Name **ONE (1)** element in the molecule shown in Figure Q1(e) that would **NOT** be found in carbohydrates.

(1 mark)

(iv) Describe how the amino acids react together to form a dipeptide.

(3 marks)

(f) Figure Q1(f) shows the rice plant, which is a type of grass and reproduces by producing grains. The rice grains are full of starch. Starch is a carbohydrate and made up of repeating units of small building blocks.

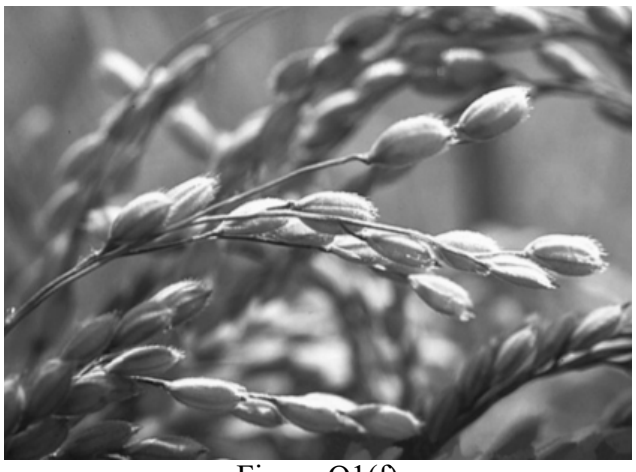

Figure Q1(f)

(i) Name the scientific monomer of carbohydrate.

(1 mark)

(ii) Cellulose is also a carbohydrate molecule found in rice plants. Describe the difference between starch and cellulose in terms of function in the rice plants.

(2 marks)

(g) State **TWO (2)** structural differences between a DNA and RNA molecule.

(2 marks)

**Question 2**

(a) Insulin is a protein produced by beta cells in the pancreas. Insulin is synthesized on ribosomes, then modified and packaged in vesicles. It is stored in these vesicles until it is secreted. Figure Q2(a) below shows the organelles involved in this process of modifying and packaging the insulin in vesicles.

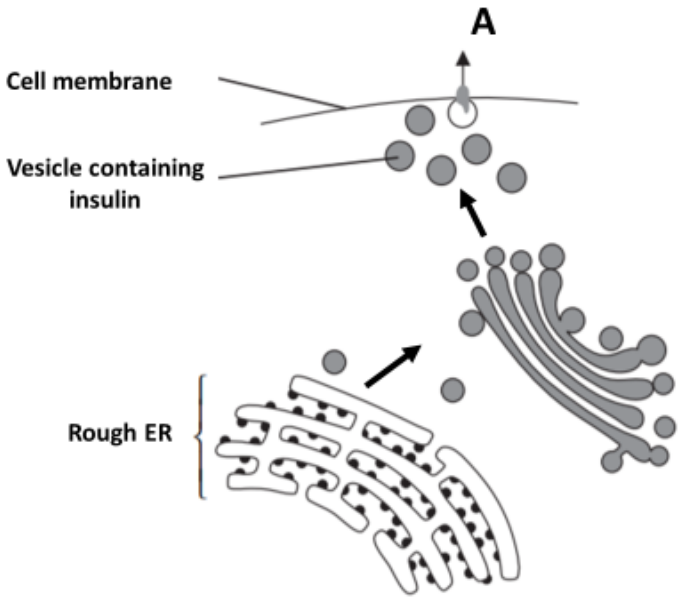


Figure Q2(a)

(i) Using the information given in Figure Q2(a), describe how insulin is modified, packaged and secreted by the cell.

(3 marks)

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

(1 mark)

(iii) Adjacent cells communicate, interact, and adhere through specialized junctions between them. State any **ONE (1)** type of intercellular cell junction in animal cells and explain its function.

(2 marks)

(b) Figure Q2(b) shows an enzyme-catalyzed reaction.

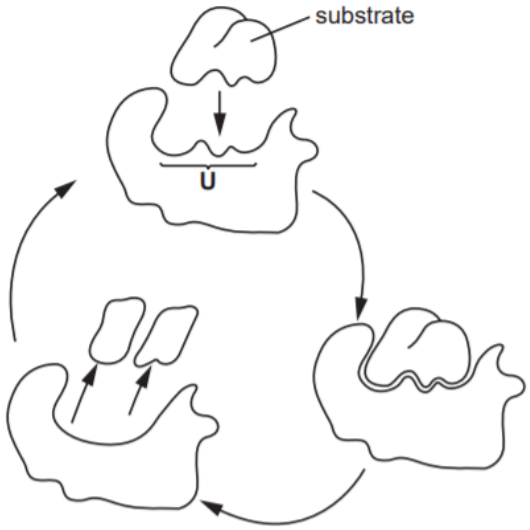


Figure Q2(b)

(i) Name the part of the enzyme labelled **U**.

(1 mark)

(ii) Describe how competitive inhibitor and noncompetitive inhibitor affect enzyme activities in a cell.

(2 marks)

(c) Figure Q2(c) below represents the section of a cell plasma membrane.

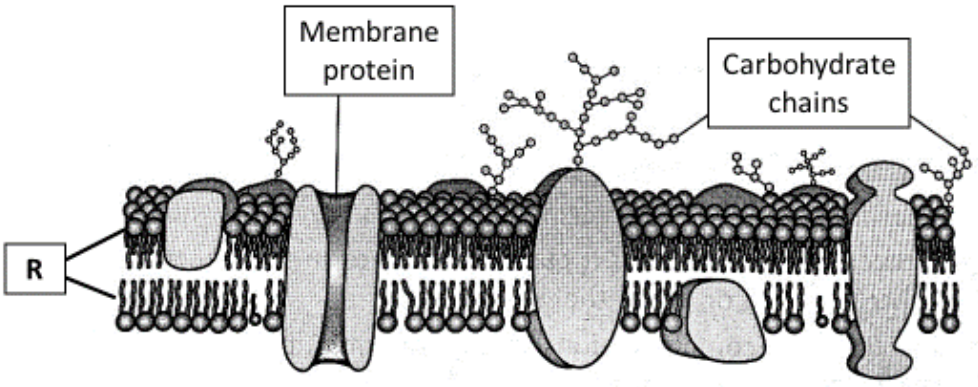


Figure Q2(c)

(i) What is the name of the membrane protein in Figure Q2(c)?

(1 mark)

(ii) Many substances are said to be actively transported across membrane protein. Explain what is meant by 'active transport'.

(2 marks)

(iii) Figure Q2(c)(iii) shows a diagram of the molecular structure of **R**. What is structure **R**?

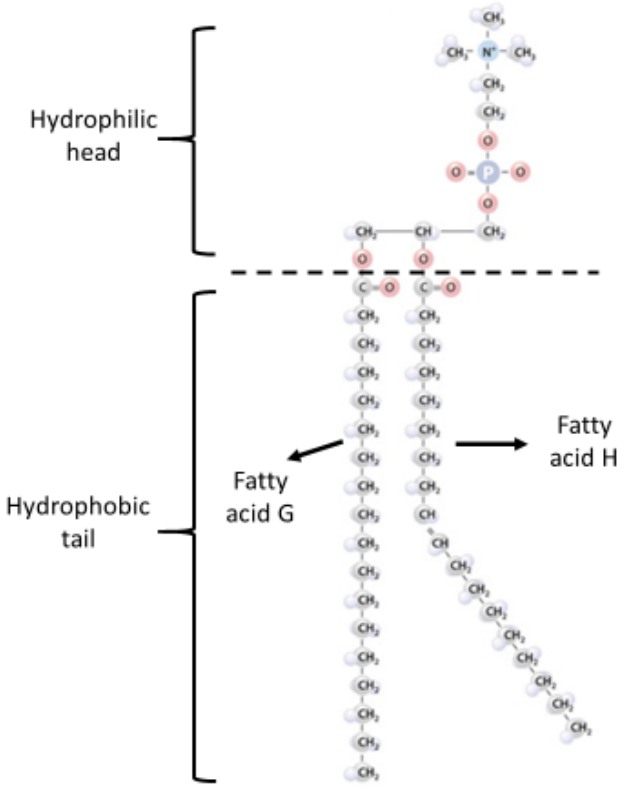


Figure Q2(c)(iii)

(1 mark)

(iv) With reference to diagram Figure Q2(c)(iii), which fatty acid is unsaturated fatty acid? Explain your answer.

(2 marks)

(v) How the structure of fatty acids in molecule **R** contribute to its role in cell membrane?

(1 mark)

(d) When there is insufficient oxygen for aerobic respiration, animal cells and yeast perform anaerobic respiration. Figure Q2(d) shows the anaerobic respiration of yeast during bread making process.

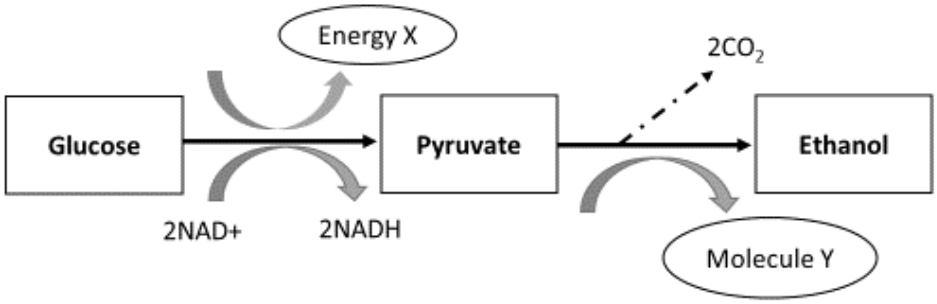


Figure Q2(d)

(i) State the energy **X** and molecule **Y**.

(2 marks)

(ii) Give the reaction that converts glucose to pyruvate.

(1 mark)

(iii) Briefly describe how animal cells harvest energy under anaerobic condition.

(2 marks)

(e) Figure Q2(e) represents stages of aerobic respiration that take place in a mitrochondria.

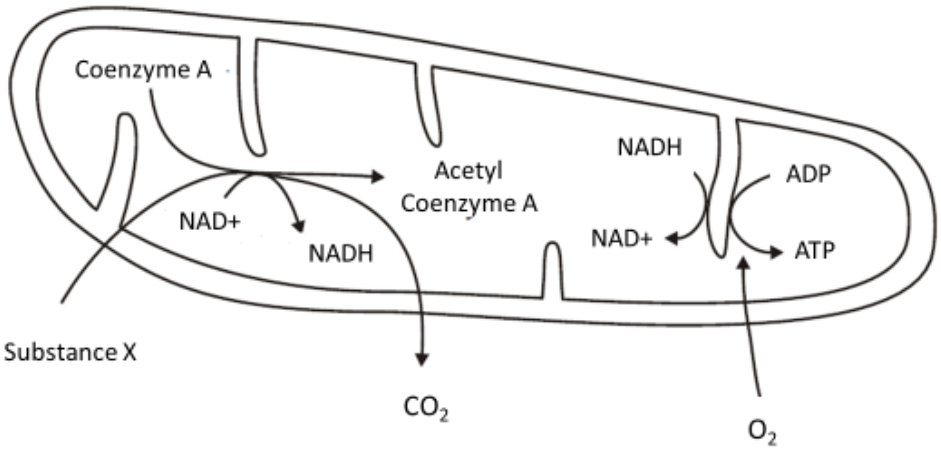


Figure Q2(e)

(i) Name substance **X**.

(1 mark)

(ii) Explain why oxygen is needed for the production of ATP on the cristae of the mitochondria.

(3 marks)

**Question 3**

(a) Figure Q3(a) below shows some steps of the light-independent reaction in photosynthesis.

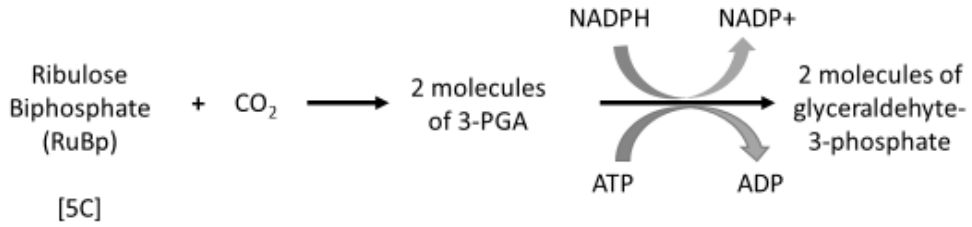


Figure Q3(a)

(i) How many carbon atoms are there in one molecule of glyceraldehyte-3-phosphate?

(1 mark)

(ii) Name the enzyme that catalyze the reaction of RuBp and $CO_2$.

(1 mark)

(iii) What is the function of ATP and NADPH in the reaction shown in Figure Q3(a)?

(2 marks)

(iv) The photolysis of water is an important part of the process of photosynthesis. Outline what happen to the hydrogen ion, electrons and oxygen atom after water splits in conjunction with photolysis.

(3 marks)

(b) Figure Q3(b) shows a diagram of a duplicated chromosome found in one of the stages of cell division.

Figure Q3(b)

(i) State precisely the stage of cell division where this event could be observed.

(1 mark)

(ii) Explain why this event in Figure Q3(b) leads to significant genetic variation of the cells produced.

(2 marks)

(iii) Other than the event in Figure Q3(b), give **ONE (1)** way in which cell division allows the production of genetically different cells.

(1 mark)

(iv) During interphase, the genetic material is copied. State **TWO (2)** other events that occur during interphase.

(2 marks)

(c) The pedigree diagram in Figure Q3(c) shows the inheritance of cystic fibrosis in a family. Cystic fibrosis is not a sex-linked disorder.

The normal allele is represented by **A** and the defective recessive allele is represented by **a**.

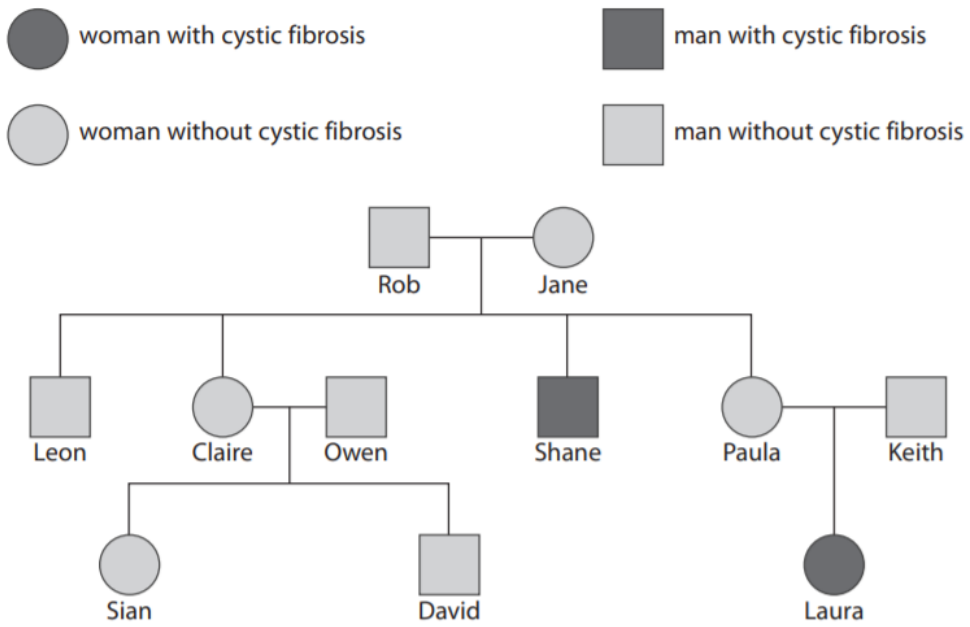


Figure Q3(c)

(i) Write the possible genotypes for Paula and Keith. Explain why.

(4 marks)

(ii) Paula and Keith decided to have a second child. What is the percentage probability that their second child will be a carrier of the cystic fibrosis allele? Show your working.

(4 marks)

(d) In Drosophila, the genes for wing length and eye colour are sex-linked. Long wings and red eyes are dominant over vestigial wings and white eyes.

What is meant by

(i) Gene?

(1 mark)

(ii) Sex-linked gene?

(1 mark)

(iii) When heterozygous Drosophila flies for length of wing and eye colour were crossed with flies with vestigial wing and white eyes, the F1 offspring obtained were as follows:

| | |
|---|---|
| Long wings, white eyes | = 13 |
| Long wings, red eyes | = 42 |
| Vestigial wings, white eyes | = 41 |
| Vestigial wings, red eyes | = 12 |

Calculate the recombination frequency.

(2 marks)

**Question 4**

(a) Hemoglobin is a type of protein found in red blood cell and it is important for oxygen transportation. The diagram below shows the production of hemoglobin protein in a eukaryotic cell.

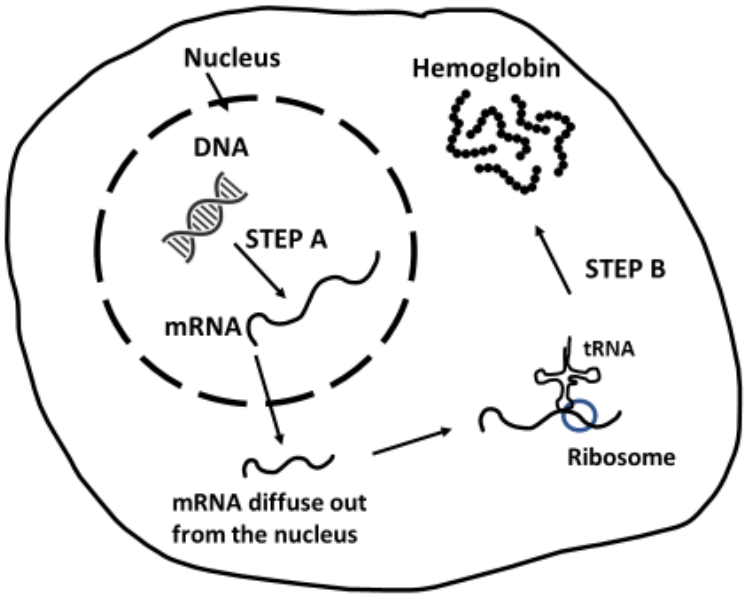


Figure Q4(a)

(i) Name and describe the **THREE (3)** main processes in step A.

(4 marks)

(ii) What is the function of tRNA in step B?

(1 mark)

(iii) A part of the amino acid sequence of normal hemoglobin and sickle-cell hemoglobin is shown below:

Hb normal – thr – pro – glu – glu
Hb sickle cell – thr – pro – val – glu

The mRNA codon for these amino acids are:

Glutamine (glu) – GAA
Proline (pro) – CCU
Threonine (thr) – ACU
Valine (val) – GUA

Write the anticodons on tRNA molecules for the synthesis of sickle cell hemoglobin.

(1 mark)

(iv) State the type of mutation in Q4(iii) which led to the production of sickle cell hemoglobin.

(1 mark)

(v) A geneticist isolates the hemoglobin mRNA for research study. Upon comparison, the mRNA is found to contain 1,000 fewer bases than the DNA sequence. Explain why is this happening?

(2 marks)

(vi) Describe **TWO (2)** mechanisms on how microRNA (miRNA) can control mRNA translation and gene expression in cytosol.

(2 marks)

(b) Figure Q4(b) shows the gene cloning process of human insulin gene.

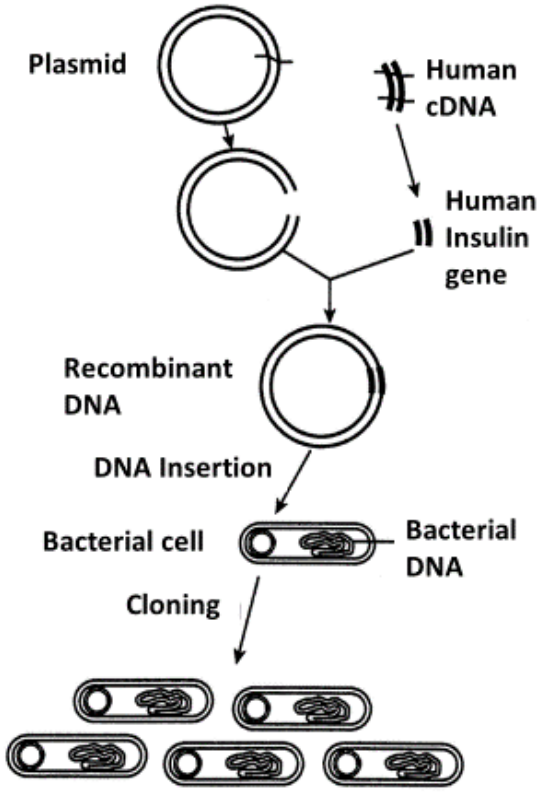


Figure Q4(b)

(i) Name the enzyme that used to cut the plasmid DNA.

(1 mark)

(ii) Describe in details how does human insulin gene is inserted to the plasmid DNA.

(3 marks)

(iii) List **TWO (2)** advantages of treating diabetes with human insulin produced by genetic engineering.

(2 marks)

(iv) Human cDNA can be produced from mRNA by using a specific enzyme. Name the enzyme.

(1 mark)

(v) Explain why the human cDNA is used to be inserted into the bacterial plasmid instead of the original DNA in the cloning process.

(2 marks)

(c) Figure Q4(c) shows the *lac* operon when lactose is absent.

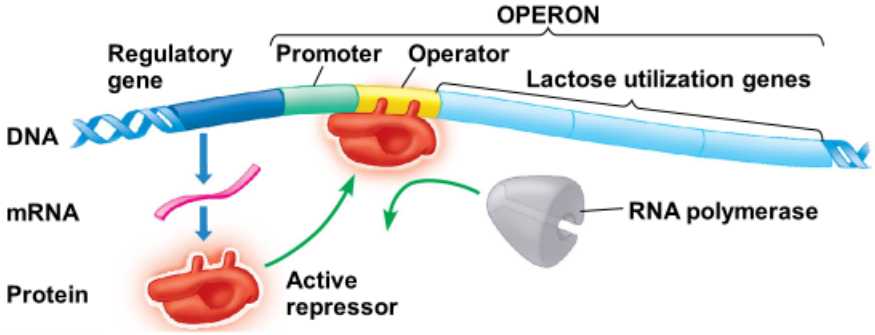


Figure Q4(c)

(i) Based on the information given in the Figure Q4(c), explain why lactose utilization gene is unable to be transcripted.

(3 marks)

(ii) What will happen to the active repressor during the presence of lactose?

(2 marks)

**~ The End ~**

*BIO1203(f)/august 2020/formatted*