INTI INTERNATIONAL UNIVERSITY

FOUNDATION IN SCIENCE (CFSI)
BIO1203: BIOLOGY 1
FINAL EXAMINATION: FEBRUARY 2016 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) List **FIVE (5)** characteristics of living things.

(5 marks)

(b) Fig. 1.1 shows the reaction of triglyceride formation.

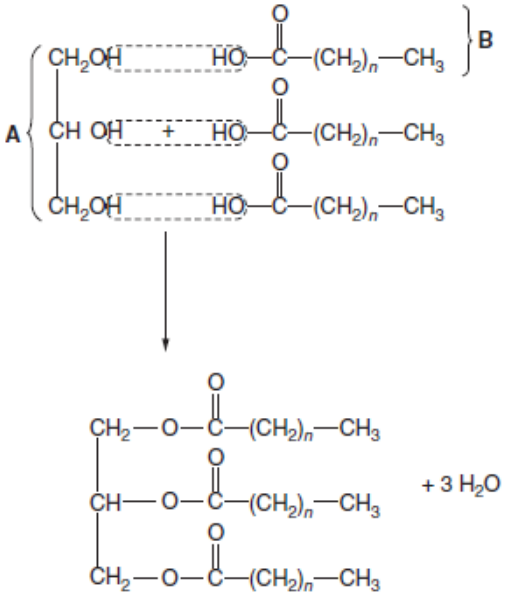



**Fig. 1.1**

(i) Name the molecules A and B.

(2 marks)

(ii) State the above reaction (**Fig. 1.1**)

(1 mark)

(iii) Animals and plants store triglycerides as energy reserves. Briefly explain the advantage of storing triglycerides as energy reserves rather than carbohydrates, such as starch.

(2 marks)

(c) Copy and complete the table by indicating with a tick (✓) which **one** of the properties of water is responsible for each role. You should put only **ONE (1)** tick (✓) in each row.

**Table 1. Roles of water in living organisms**

| Roles of water | Properties of water | | | |
|---|---|---|---|---|
| | High specific heat capacity | Strong cohesive forces between water molecules | High heat of vaporization | Solvent for polar molecules and ions |
| Transport medium in blood plasma and phloem | | | | |
| Surface for small insects to walk on | | | | |
| Major component of sweat used in heat loss | | | | |
| Transpiration pull in xylem | | | | |
| Preventing wide variations body temperature | | | | |

(5 marks)

(d) Fig. 1.2 shows an electron micrograph of two adjacent cells in a leaf.

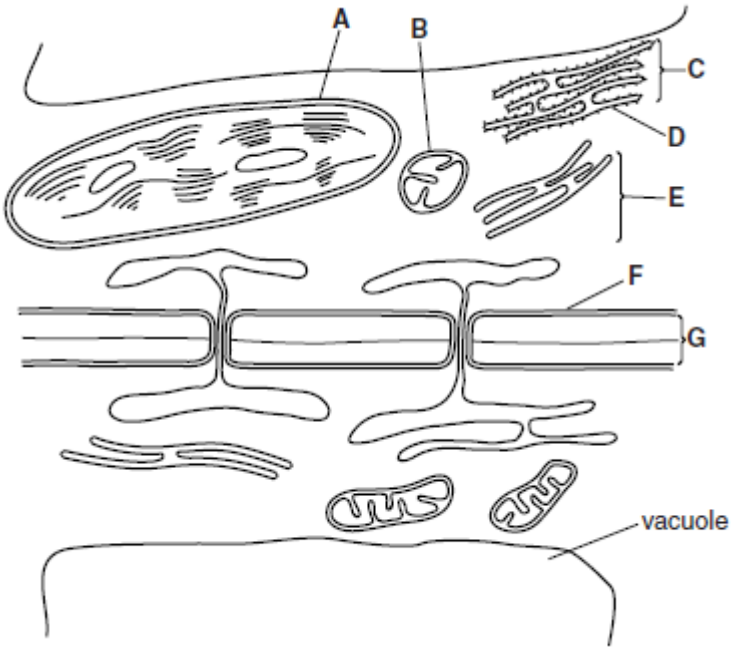



**Fig. 1.2**

(i) Briefly describe why the internal details of structures A and B are only visible when using the electron microscope and not when using the light microscope.

(2 marks)

(ii) Identify structures C, D and E.

(3 marks)

(iii) State **THREE (3)** roles of vacuoles in plant cells.

(3 marks)

(iv) State **TWO (2)** differences between the structures in a prokaryotic cell compared to those in Fig. 1.2.

(2 marks)

**Question 2**

(a) Fig. 2.1 shows a portion of a plasma membrane.

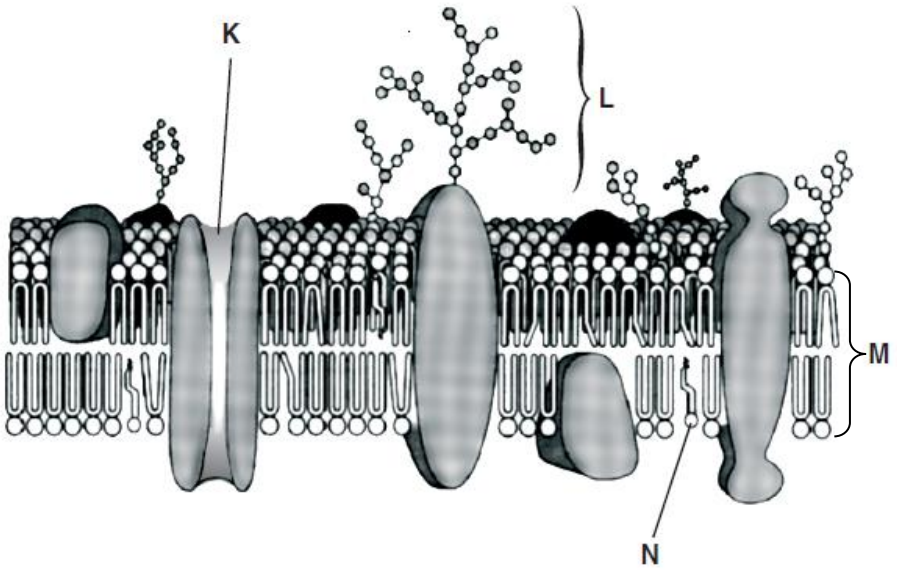



**Fig. 2.1**

(i) Identify structures K, L, M and N.

(4 marks)

(ii) Describe **THREE (3)** features which influence the ability of a substance to pass through a cell membrane.

(6 marks)

(iii) Give **TWO (2)** reasons why transport of substances across a membrane is important to a cell.

(2 marks)

(b) A student investigated the effect of substrate concentration on the activity of sucrase.
Six test-tubes were set up each containing 10 $cm^3$ of different concentrations of sucrose solutions. The test-tubes were left in a water bath at 30 °C for ten minutes.
After ten minutes, 5 $cm^3$ of a sucrase solution at 30 °C was added to each test-tube and the reaction mixtures were stirred.
After a further five minutes, same volume of Benedict's solution added to each test-tube. The student recorded the time when a green colour first became visible in each test-tube. After five minutes, the temperature of the water-bath was raised to above 85 °C. The concentrations used and the student's results are shown in Table 2.

**Table 2**

| Concentration of sucrose / g $dm^{-3}$ | Time taken for green colour to appear / s |
|---|---|
| 5 | 278 |
| 10 | 145 |
| 15 | 95 |
| 20 | 75 |
| 50 | 47 |
| 100 | 46 |

(i) Explain why the temperature of the water-bath was raised to above 85 °C.

(2 marks)

(ii) Copy Fig. 2.2 to sketch a graph to show the effect of substrate concentration on the rate of hydrolysis of sucrose by sucrase.

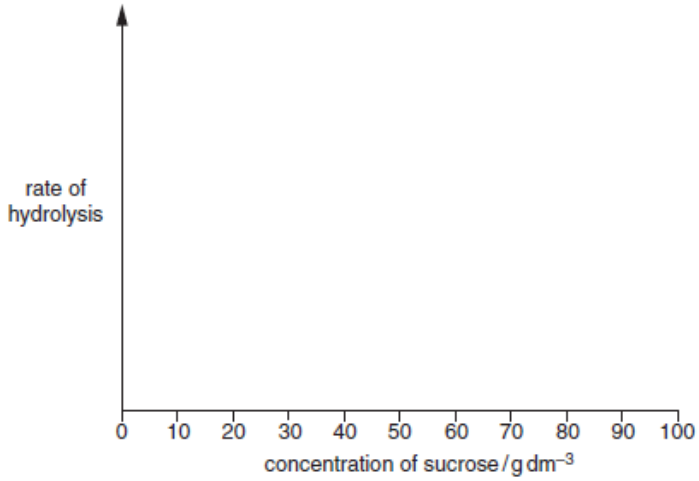



**Fig. 2.2**

(2 marks)

(iii) With reference to the Table 2, describe and explain the effect of increasing substrate concentration on the rate of hydrolysis of sucrose by sucrase.

(5 marks)

(c) Each transport mechanism across cell surface membranes has a characteristic set of features. In each of the boxes in **Fig. 2.3**, state one example of a transport mechanism that matches the pathway shown.

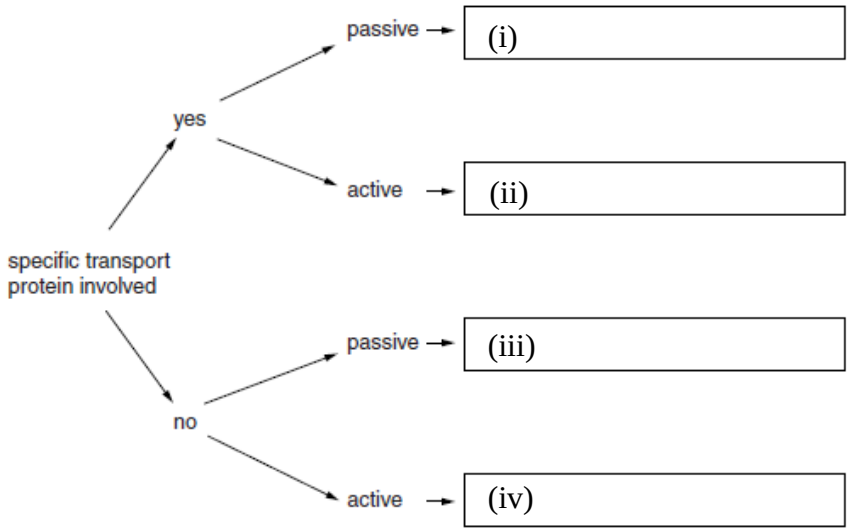



**Fig. 2.3**

(4 marks)

**Question 3**

(a) Fig. 3.1 is an electron micrograph of a mitochondrion. **TWO (2)** stages of respiration occur in mitochondria.

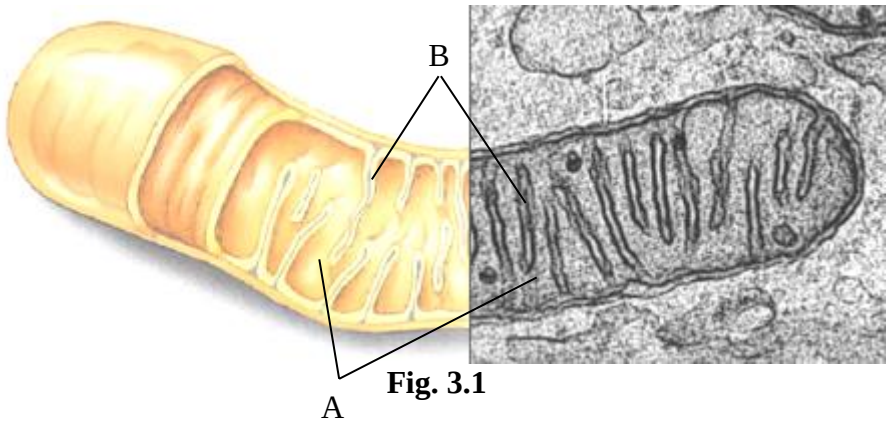



**Fig. 3.1**

(i) Copy and complete Table 3 by naming the structures labeled A and B. State which of the stages of respiration occur in each.

**Table 3**

| | Name of structure | Stage of respiration |
|---|---|---|
| A | | |
| B | | |

(4 marks)

(ii) Suggest **TWO (2)** ways how the structure of a mitochondrion is adapted to carry out the stages stated in (i).

(2 marks)

(iii) List **THREE (3)** roles of $NAD^+$ in aerobic respiration.

(3 marks)

(iv) State **TWO (2)** differences between photophosphorylation and oxidative phosphorylation.

(2 marks)

(b) Copy and complete the table below by filling items (i) to (x) to show the differences between light-dependent and light-independent reactions in photosynthesis.

| | Light-dependent reactions | Light-independent reactions |
|---|---|---|
| Site | (i) | (ii) |
| Starting material (s) | (iii) | (iv) |
| ATP& NADPH | (v) | (vi) |
| End product(s) | (vii) | (viii) |
| Light Energy | (ix) | (x) |

(5 marks)

(c) Fig. 3.2 shows the part of the light-independent reaction that occurs in a type of cell in $C_4$ plants.

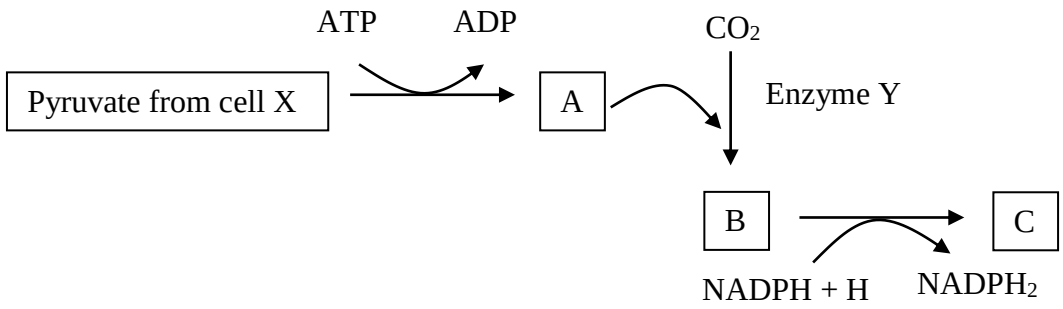



**Fig. 3.2**

(i) Identify substances A, B and enzyme Y.

(3 marks)

(ii) What is the advantage of using enzyme Y by $C_4$ plants in regards to atmospheric $CO_2$ concentration?

(2 marks)

(d) Fig. 3.3 shows the stages of Calvin cycle.

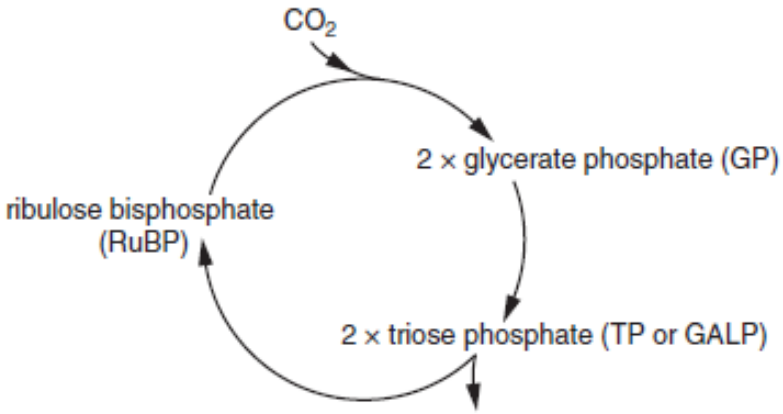



**Fig. 3.3**

(i) State the name of the five carbon molecule in the cycle.

(1 mark)

(ii) What is the enzyme that fixes carbon dioxide?

(1 mark)

(iii) State where in the chloroplast the Calvin cycle occurs.

(1 mark)

(iv) State the name of another compound that is produced in the light-dependent stage of photosynthesis that is used in the Calvin cycle.

(1 mark)

**Question 4**

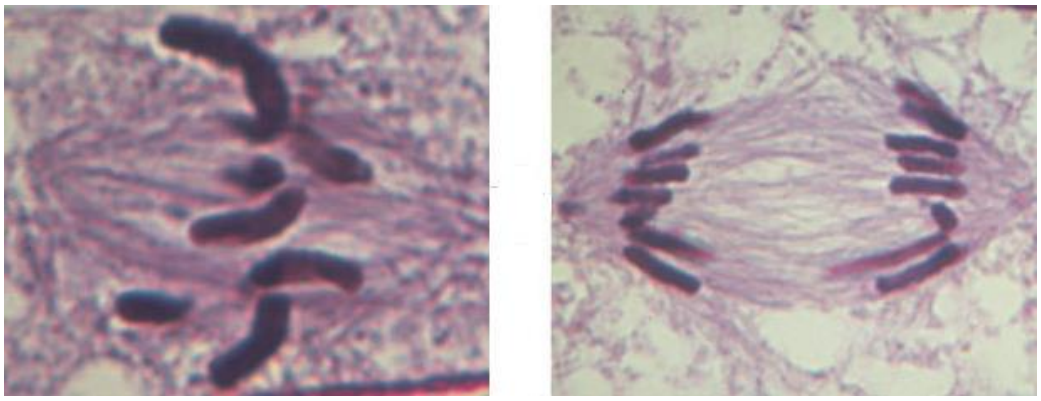
(a) In mice there are several alleles of the gene that controls the intensity of pigmentation of the fur. The alleles are listed below in order of dominance with **C** as the most dominant.
**C** = full colour
$\mathbf{C^{ch}}$ = chinchilla
$\mathbf{C^{h}}$ = himalayan
$\mathbf{C^{p}}$ = platinum
$\mathbf{C^{a}}$ = albino
The gene for eye colour has two alleles. The allele for black eyes, **B**, is dominant, while the allele for red eyes, **b**, is recessive.
A mouse with full colour and black eyes was crossed with a himalayan mouse with black eyes. One of the offspring was albino with red eyes.
Using the symbols above, draw a Punnett square to show the genotypes and fraction phenotypes of the offspring of this cross.

(9 marks)

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

(6 marks)

(c) Fig. 4.1 shows **TWO (2)** stages of mitosis in a cell from a root tip of *Allium cepa*.



**D** **E**

**Fig. 4.1**

(i) Identify stage **D** and stage **E**. Describe what happens to the chromosomes in stage **D** and stage **E** respectively.

(4 marks)

(ii) State **TWO (2)** importance of mitosis in life cycle of *Allium cepa*.

(2 marks)

(d) List **TWO (2)** differences between mitosis and meiosis.

(2 marks)

**Question 5**

(a) Explain the regulation of *trp* (tryptophan) operon when *trp* is present and absent in prokaryotic cells.

(8 marks)

(b) State **ONE (1)** role of each of the following enzymes in gene cloning.

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

(3 marks)

(c) Fig. 5.1 shows the stages involved in the polymerase chain reaction.

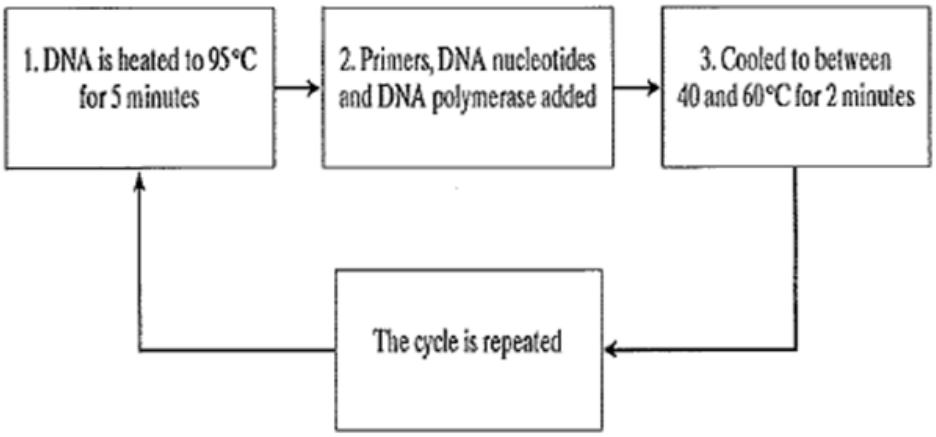



**Fig. 5.1**

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

(1 mark)

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

(1 mark)

(d) Fig. 5.2 shows structure of a DNA molecule.

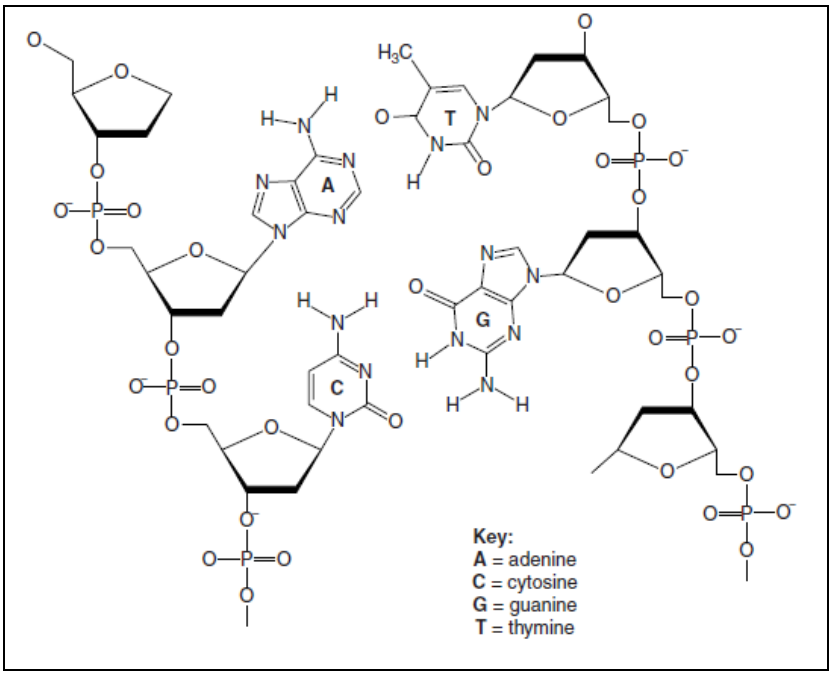



**Fig. 5.2**

(i) Name the bonding between two base pairs shown.

(1 mark)

(ii) State **TWO (2)** importance of the bonding mentioned in (i) in DNA structure.

(2 marks)

(e) Switching genes on and off allows proteins to be synthesized only when required. Processes P and Q occur when a gene is switched on, as shown in Fig. 5.3.

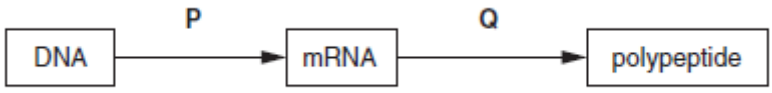



**Fig. 5.3**

(i) Name processes P and Q.

(2 marks)

(ii) Name the organelle that required in Process Q.

(1 mark)

(f) Fig. 5.4 shows a section of mRNA with the sequences of three codons.

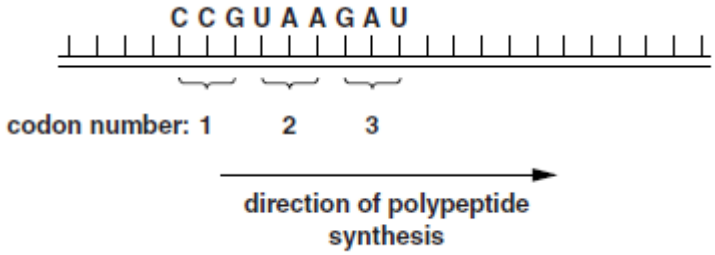



**Fig. 5.4**

(i) State the base sequences of the tRNA anticodon complementary to **codon 1 and 2**.
(2 marks)

(ii) State the base sequences of the DNA sequence which coded for **codon 3**.
(1 mark)

(g) Haemoglobin is a globular protein that shows quaternary structure. It is composed of two types of polypeptide, known as α and β globin. Fig. 5.5 shows part of the base sequence of the mRNA that codes for the first ten amino acids of β globin. Table 5 shows some of the codons and the amino acids for which they code.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 5’ | GUG | CAC | ACG | UCG | AAG | GAG | CUU | CAC | CCU | GCC | 3’ |

**Fig. 5.5**

**Table 5**

| amino acid | abbreviation | codons | | | | | |
|---|---|---|---|---|---|---|---|
| alanine | ala | GCA | GCC | GCG | GCU | | |
| glutamic acid | glu | GAA | GAG | | | | |
| histidine | his | CAC | CAU | | | | |
| leucine | leu | UUA | UUG | CUA | CUC | CUG | CUU |
| lysine | lys | AAA | AAG | | | | |
| proline | pro | CCA | CCC | CCG | CCU | | |
| serine | ser | UCA | UCC | UCG | UCU | AGC | AGU |
| threonine | thr | ACA | ACC | ACG | ACU | | |
| valine | val | GUA | GUC | GUG | GUU | | |

Use the information in Table 5 to complete the sequence of amino acids at the beginning of β globin using the first three letters of each amino acid. Some of them have been done for you.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| val | his | | | | glu | | | | ala |

(3 marks)

**-THE END-**