INTI INTERNATIONAL UNIVERSITY

FOUNDATION IN SCIENCE (CFSI)
BIO1203: BIOLOGY 1
FINAL EXAMINATION: JANUARY 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) Fig. 1.1 shows a part of a cell surface membrane.

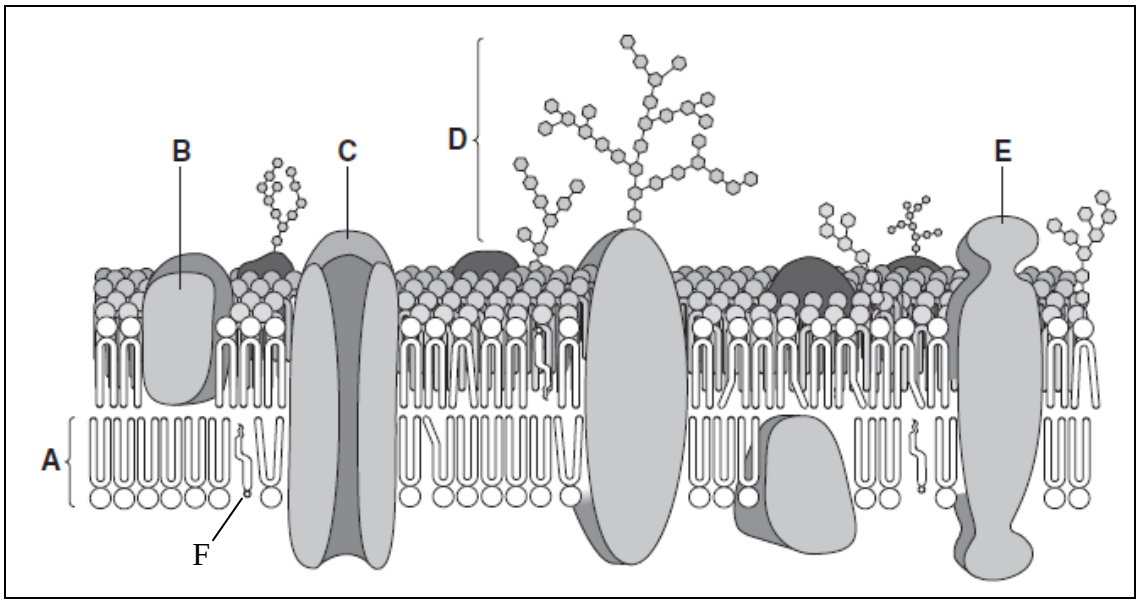


Fig. 1.1

(i) Identify structures labeled A, C, D and F and state **ONE (1)** function of each structure respectively.

(8 marks)

(ii) Explain how proteins are held in the membrane.

(3 marks)

(iii) Structure B is a protein composed of 398 amino acids.
Calculate the minimum number of nucleotide base pairs required in the gene coding for this protein. Show your working.

(1 mark)

(b) Sucrase is the enzyme that catalyses the hydrolysis of sucrose. A student investigated the effect of substrate concentration on the activity of this enzyme.
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, the temperature of the water-bath was raised to above 85 °C and the same volume of Benedict's solution added to each test-tube in turn. The student recorded the time when a green colour first became visible in each test-tube.
The concentrations used and the student's results are shown in Table 1.1.

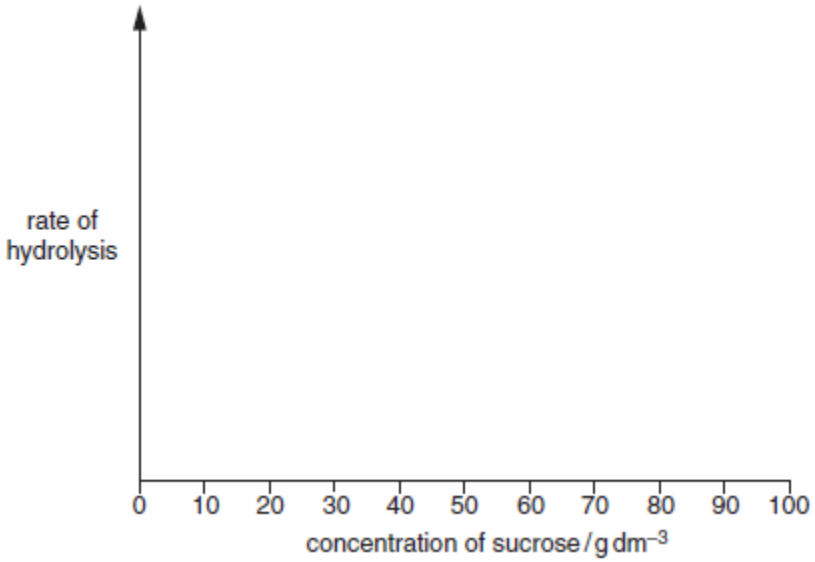
Table 1.1

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 the axes below to sketch a graph to show the effect of substrate concentration on the rate of hydrolysis of sucrose by sucrase.

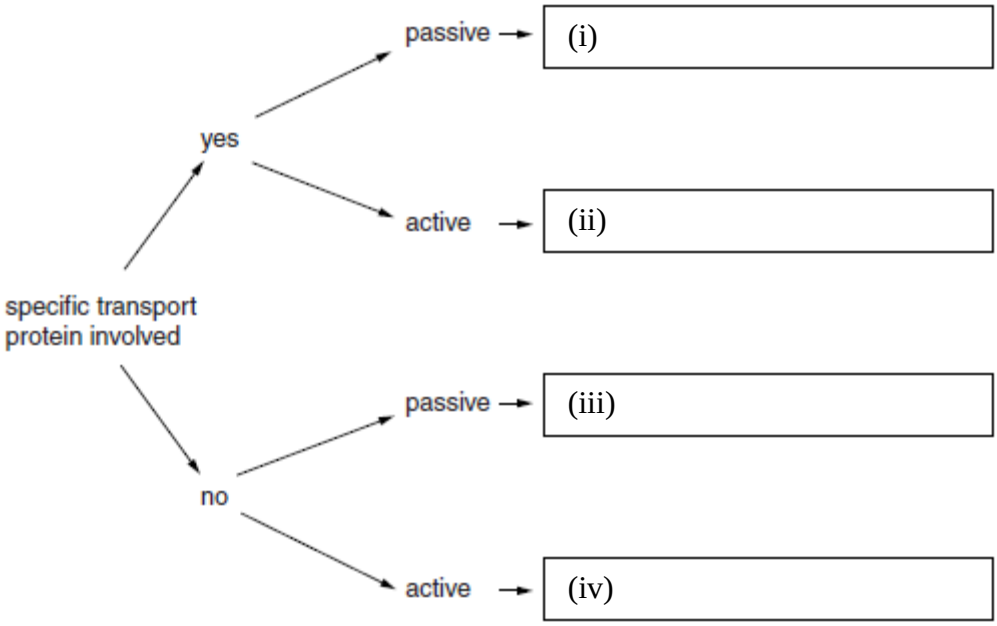


(2 marks)

(iii) With reference to the student's results, 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 below, state one example of a transport mechanism that matches the pathway shown.



(4 marks)

Question 2

(a) Table 2.1 below includes statements about the roles of water

- in living organisms
- as an environment for living organisms.

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 2.1

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)

(b) Briefly explain the mechanism of evolution suggested by Darwin.

(5 marks)

(c) Fig. 2.1 shows the reaction to form triglycerides.

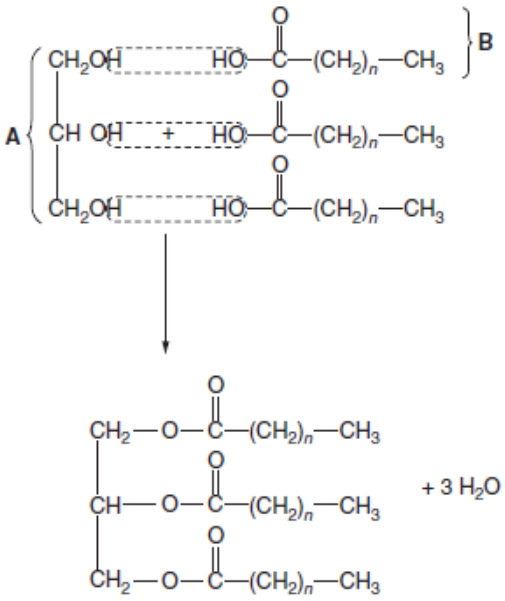


Fig. 2.1

(i) Name the molecules labeled A and B.

(2 marks)

(ii) State the name of the reaction shown.

(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)

(d) Fig. 2.2 shows a drawing made from an electron micrograph of two adjacent cells in a leaf.

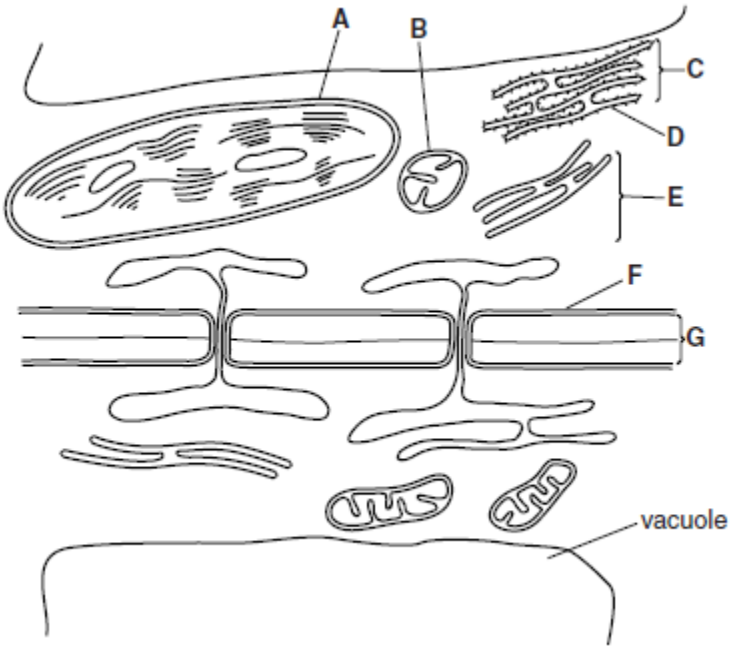


Fig. 2.2

(i) Structures A and B are both visible using the light microscope, but the internal detail of these organelles shown in Fig. 2.2 is only visible using the electron microscope. Briefly explain 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 the structures labeled C, D and E.

(3 marks)

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

(3 marks)

(iv) State **TWO (2)** ways in which the structure of a prokaryotic cell differs from that shown in Fig. 2.2.

(2 marks)

Question 3

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

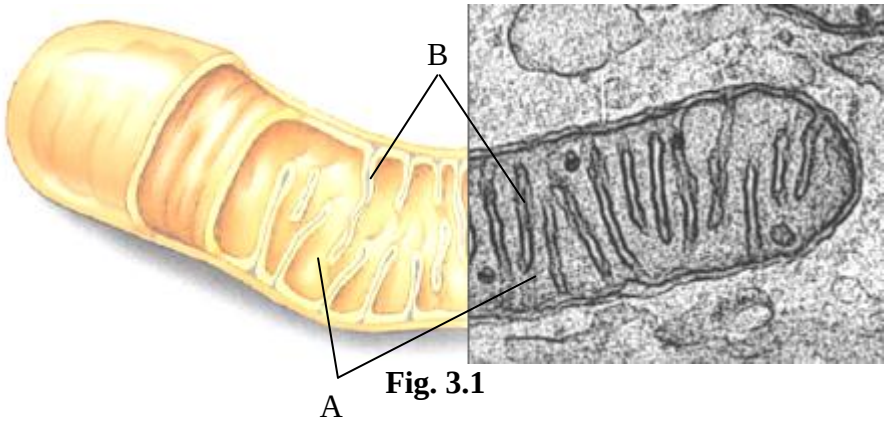


Fig. 3.1

(i) Copy and complete the table below by naming the structures labeled A and B and stating which of the stages of respiration occur in each.

	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 **TWO (2)** stages stated in (i).

(2 marks)

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

(3 marks)

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

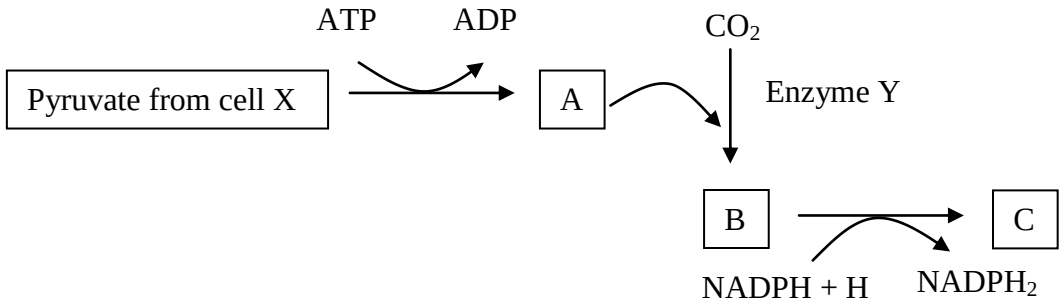
(2 marks)

(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) Diagram below shows the part of the light-independent reaction that occurs in a type of cell in C_4 plants.



(i) Identify substances labeled 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. 3.2 shows the stages of Calvin cycle.

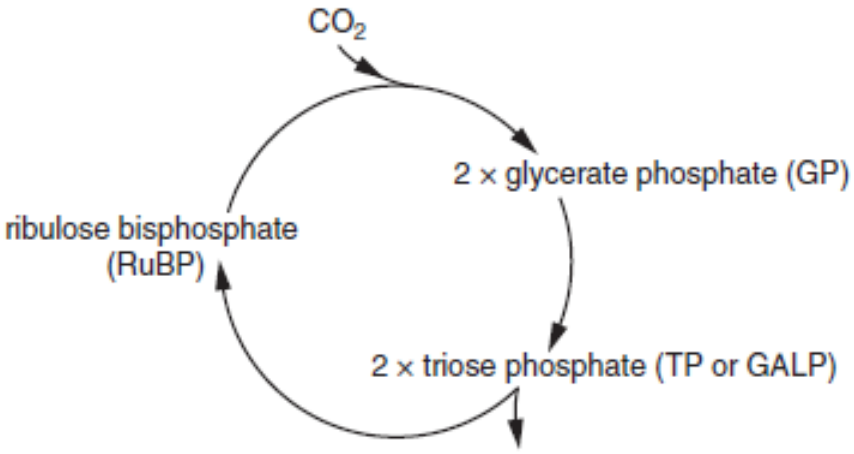


Fig. 3.2

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

(1 mark)

(ii) State the name of 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

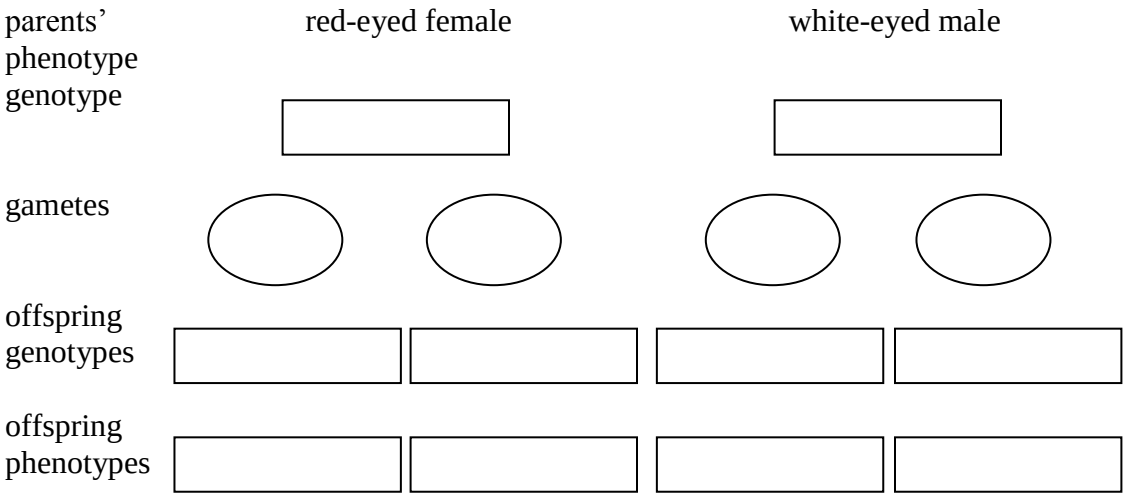
(a) The fruit fly, *Drosophila melanogaster*, has many phenotypic variations and has been used in experiments to demonstrate the principles of inheritance.
The majority of fruit flies have red eyes but there is a variant with white eyes.
Fig. 4.1 shows the red-eyed which is dominant trait and white-eyed variants of the fruit fly.

Red-eyed **White-eyed**

Fig. 4.1

The gene for eye colour is located on the **X chromosome**.
Using suitable symbols, draw a genetic diagram to show the possible offspring of a cross between a heterozygous red-eyed female fruit fly with a white-eyed male fruit fly.

key to symbols:……..; ……..

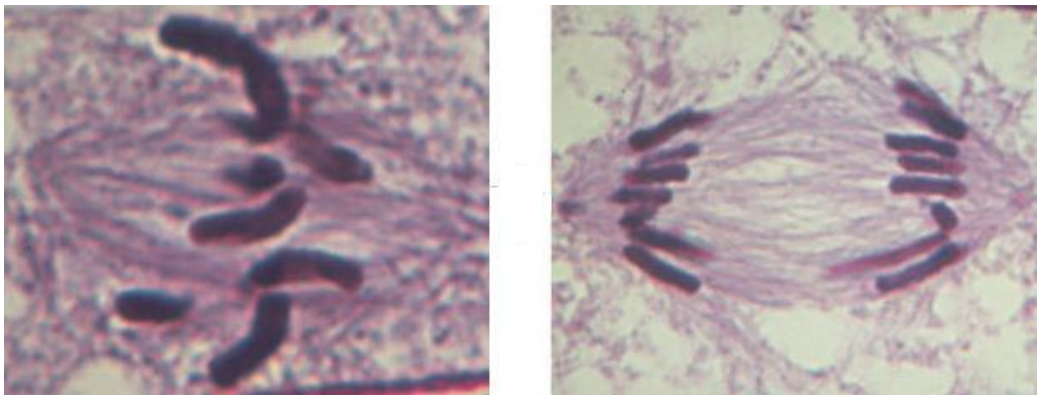


(8 marks)

(b) Incomplete dominance is observed in the inheritance of hypercholesterolemia. Jane and Steven are both heterozygous for this characteristic and both have elevated levels of cholesterol. Their daughter Susan has a cholesterol level six times higher than normal; she is apparently homozygous, **hh**. What fraction of Jane and Steven's children are likely to have elevated but not extreme levels of cholesterol, like their parents? If Jane and Steven have one more child, what is the probability that the child will suffer from the more serious form of hypercholesterolemia seen in Susan?

(5 marks)

(c) Fig. 4.2 shows **TWO (2)** stages of mitosis in a cell from a root tip of *Allium cepa*.



D **E**

Fig. 4.2

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

(4 marks)

(ii) Describe the events that occur within a cell after the stage **E** in **Fig. 4.2** to allow the formation of **TWO (2)** cells.

(3 marks)

(iii) State **THREE (3)** importance of mitosis in life cycle of *Allium cepa*.

(3 marks)

(iv) State **TWO (2)** differences between mitosis and meiosis.

(2 marks)

Question 5

(a) Fig. 5.1shows the stages involved in making recombinant human insulin by using genetically modified bacteria.

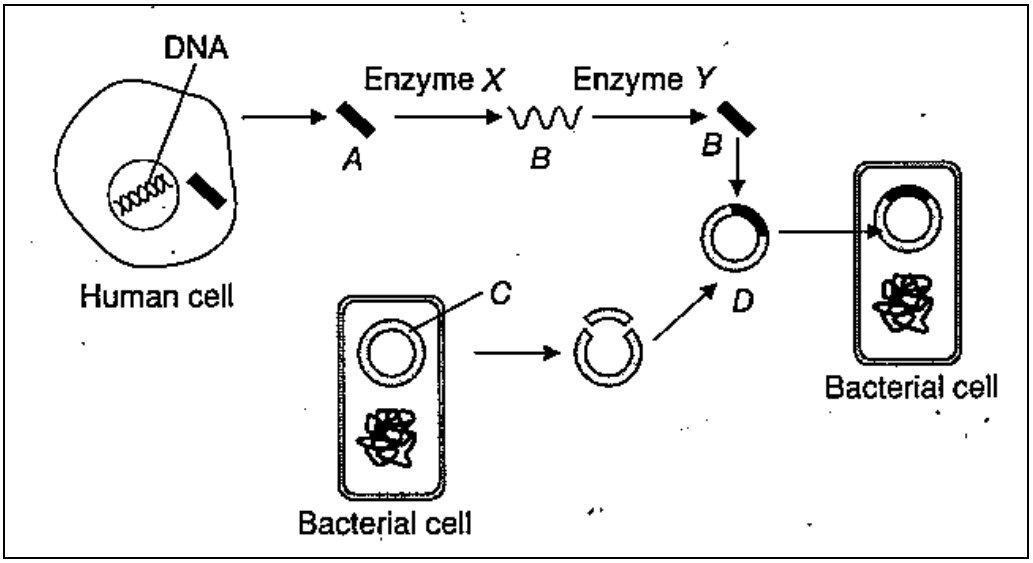


Fig. 5.1

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

(4 marks)

(ii) Name the enzymes X and Y.

(2 marks)

(iii) At present, human insulin used for treating diabetes mellitus can be produced through genetic engineering. State **THREE (3)** advantages of using such insulin.

(3 marks)

(iv) Explain why, instead of the original DNA, human cDNA is used to combine with bacterial plasmids in some cloning processes.

(3 marks)

(b) The two strands of a DNA molecule are held together by hydrogen bonds between complementary base pairs. Explain **THREE (3)** importance of hydrogen bonding between the two strands of DNA for it to carry out its functions.

(3 marks)

(c) Catalase is an enzyme with a molecular structure composed of four identical sub-units. Fig. 5.2 is a diagram that shows how catalase is produced in cells.

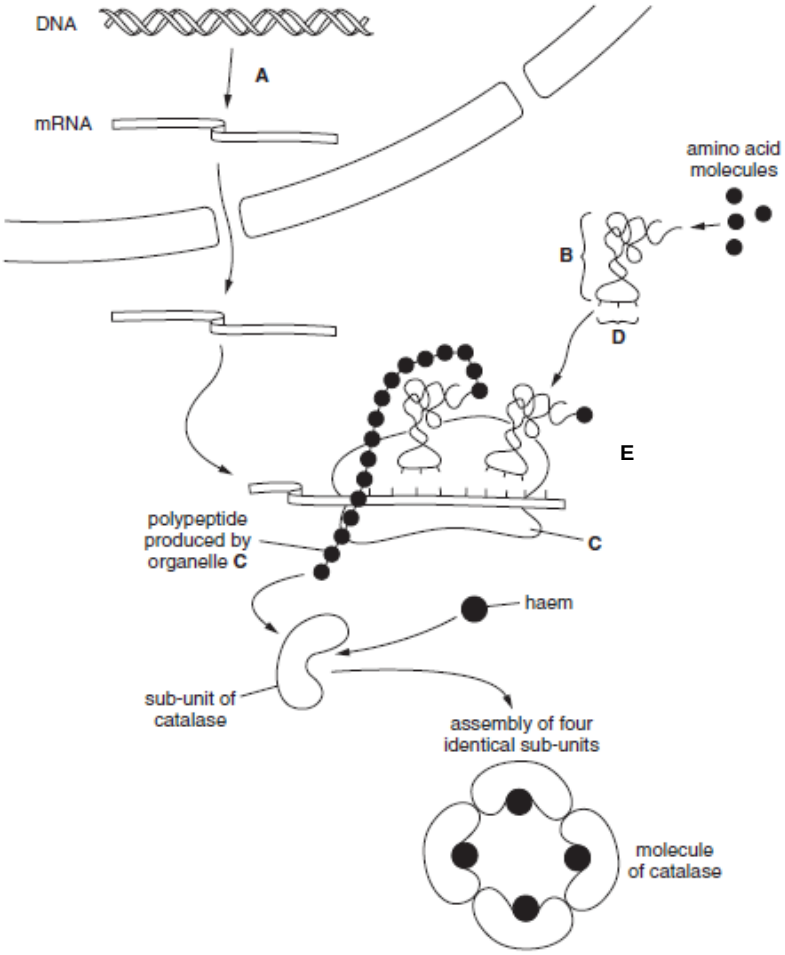


Fig. 5.2

(i) Identify process A, molecule B, structure C and sequence of bases D.

(4 marks)

(ii) State **THREE (3)** differences between process A and E.

(3 marks)

(d) The diagram below shows the base sequence of an mRNA.

AUG AAA UAU UCG UUA UAU UAC GUC

If AUG on the mRNA is the **first codon** produced through transcription ,

(i) Write the base sequence on the corresponding DNA strand where this mRNA is produced by process **A** as mentioned in question **5(c)**. Include the **5'** and **3'** on the strand.

(1 mark)

(ii) Copy and label the **5'** and **3'** end of the mRNA strand shown in the diagram above.
(1 mark)

(iii) Identify the polypeptide chain produced by the mRNA in (d). Refer to the table below.

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 Gln	CGA Arg	A
	CUG Leu	CCG Pro	CAG Gln	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

(1 mark)

-THE END-

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