

Protein synthesis

Question Paper 2

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Nucleic acids and protein synthesis
Sub Topic	Protein synthesis
Booklet	Theory
Paper Type	Question Paper 2

Time Allowed : 66 minutes

Score : / 55

Percentage : /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

- 1 A molecule of messenger RNA (mRNA) was produced during the transcription of a gene. Part of the template sequence of DNA was ATGC.

Fig. 3.1 shows the part of the molecule of messenger RNA corresponding to that sequence of four bases.

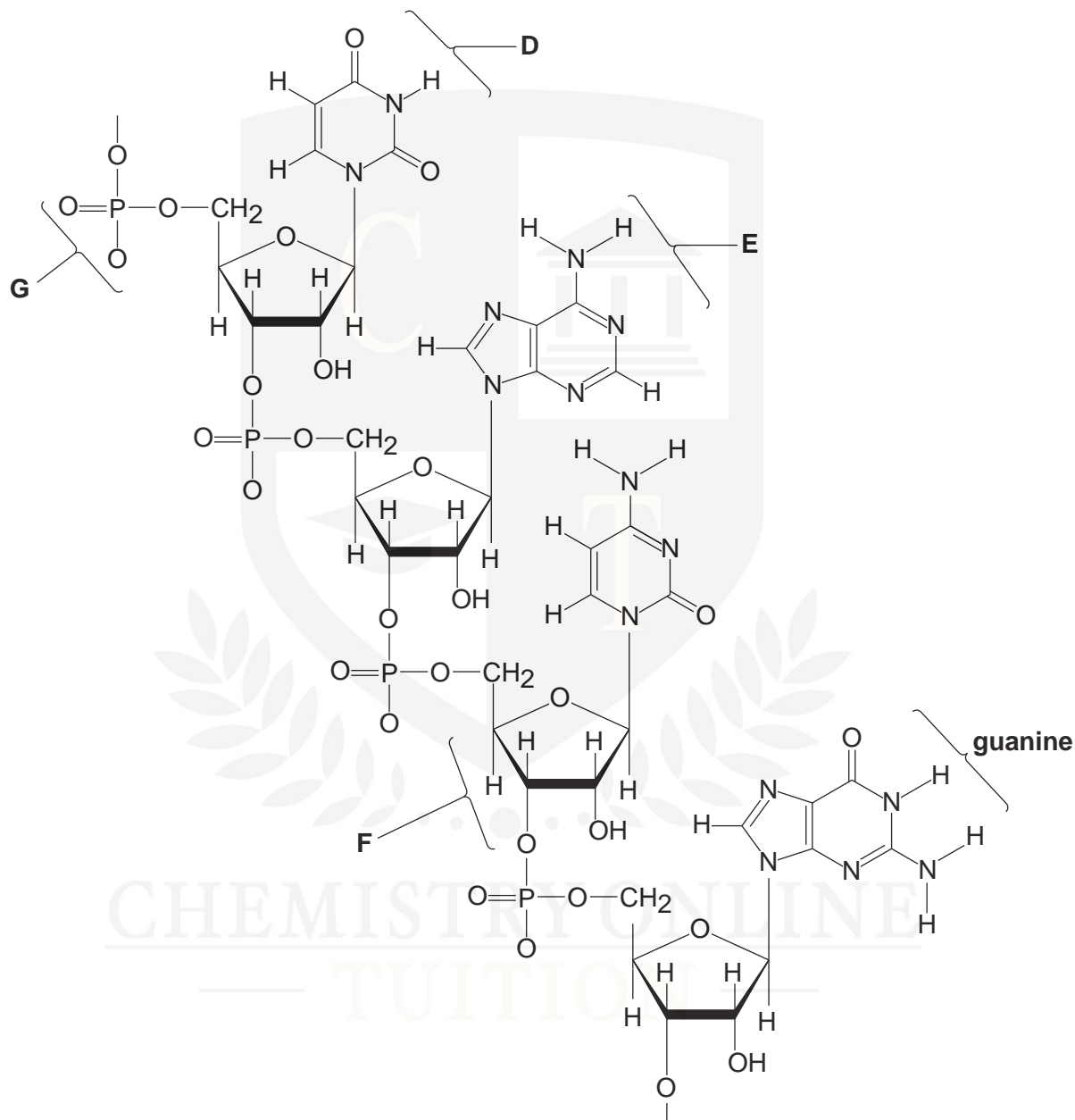


Fig. 3.1

- (a) Name the parts of the mRNA molecule shown in Fig. 3.1 labelled **D**, **E**, **F** and **G**.

D

E

F

(b) Complete the table to show **three** ways in which mRNA differs from DNA.

	mRNA	DNA
1		
2		
3		

[3]

(c) Describe the role of mRNA after it leaves the nucleus and enters the cytoplasm of a eukaryotic cell.



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 — TUITION —

 [4]

[Total: 11]

2 Catalase is an enzyme with a molecular structure composed of four identical sub-units.

Fig. 4.1 is a diagram that shows how catalase is produced in cells.

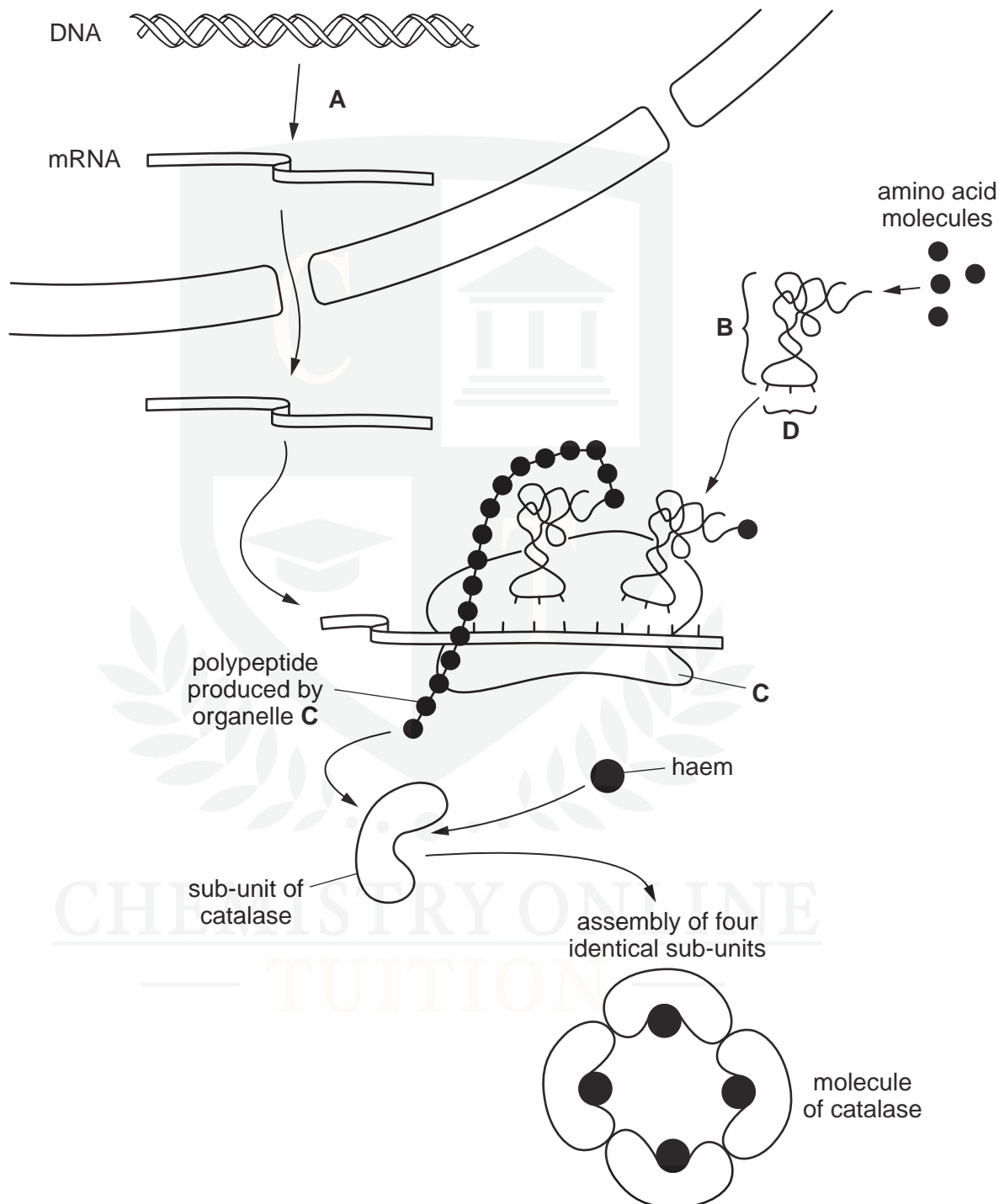


Fig. 4.1

(a) With reference to Fig. 4.1,

(i) name

process **A**

molecule **B**

structure **C**

sequence of bases **D** [4]

(ii) state two ways in which the structure of catalase is similar to the structure of haemoglobin and one way in which it differs

structural similarities

1.

2. [2]

structural difference

..... [1]

(iii) State why it is possible for a catalase molecule to bind to four substrate molecules at the same time.

..... [1]

(b) The enzyme amylase catalyses the following reaction:



The progress of this reaction may be followed by measuring either the starch concentration or the maltose concentration at intervals of time.

State which chemicals you would use to detect the disappearance of the substrate and the appearance of the product, in order to follow the progress of the reaction.

disappearance of substrate

.....

appearance of product

..... [2]

[Total: 10]

- 3 Collagen is found in the extracellular matrix of muscles, tendons, ligaments and bones. Fibroblast cells in these tissues make collagen by synthesising polypeptides that form molecules with a triple helix shape. These are secreted from fibroblasts into the extracellular matrix where enzymes assemble them into collagen fibres.

Fig. 4.1 is a diagram summarising these events.

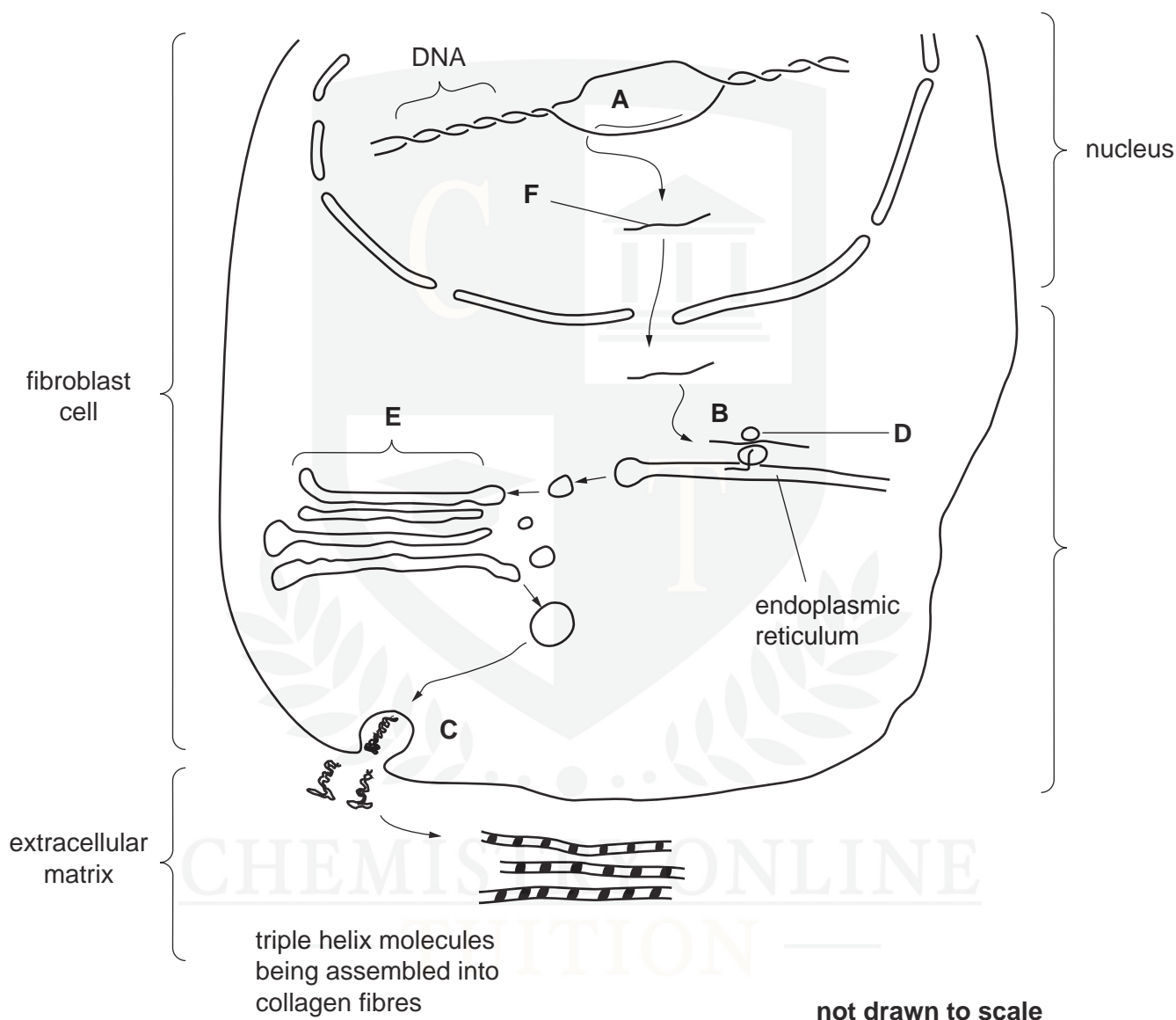


Fig. 4.1

(a) (i) Name the processes occurring at A, B and C.

A

B

C [3]

(ii) Name structures **D** and **E**.

D

E [2]

(iii) Name molecule **F**.

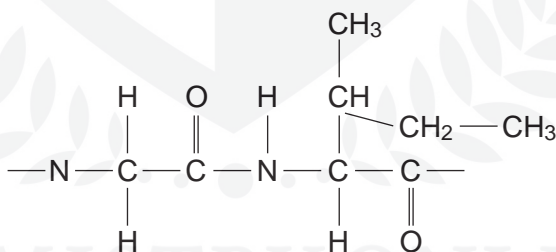
F [1]

Collagen is continuously broken down in the extracellular matrix by the enzyme collagenase, which catalyses the hydrolysis of the peptide bond between the amino acids glycine and isoleucine.

(b) Suggest how collagenase is only able to act on the peptide bond between glycine and isoleucine and not on peptide bonds between any other amino acids.

.....
.....
.....
..... [2]

(c) Draw a diagram below to show how the peptide bond between glycine and isoleucine is broken by hydrolysis including the product or products.



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— TUITION —

- 4 There are many types of amino acids, but only twenty that are polymerised to make polypeptides and proteins in animals.

(a) Name the type of chemical reaction that occurs when two amino acids form a dipeptide.

..... [1]

(b) Fig. 3.1 shows two amino acids, glycine and valine. Use the space below to make a drawing to show what happens when these two molecules join together to form a dipeptide.

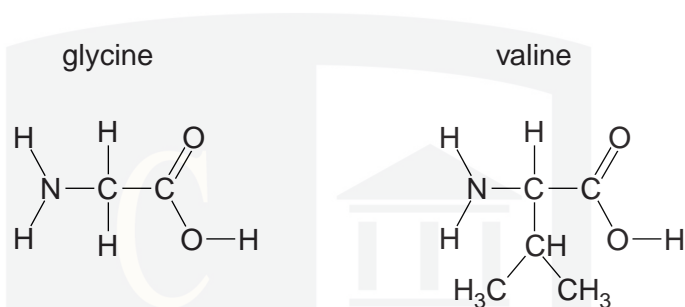


Fig. 3.1

[4]

- (c) Angiotensinogen is an inactive protein molecule. When blood pressure decreases, part of angiotensinogen is removed to form a short polypeptide, angiotensin that stimulates an increase in blood pressure.

Fig. 3.2 shows the base sequence within the gene for angiotensinogen that codes for this short polypeptide, the RNA codons and the primary structure of angiotensin.

DNA base sequence	CTA	GCA	CAA	ATG	TAG	GTG	GGG	.....
RNA codons	.....	CGU	.....	UAC	AUC	CAC	CCC	UUC
polypeptide primary structure	Asp	Arg	Val	Tyr	Ile	His	Pro	Phe

Fig. 3.2

- (i) Complete Fig. 3.2 to show the missing DNA triplet and the RNA codons. [1]
- (ii) State the full name of the type of RNA shown in Fig. 3.2.

..... [1]

Table 3.1 shows the blood pressure in the right ventricle and in the pulmonary artery of a person who is in good health.

Table 3.1

phase of cardiac cycle	blood pressure / kPa	
	right ventricle	pulmonary artery
Ventricular systole	3.33	3.33
Ventricular diastole	0.67	1.33

- (d) Use the information in Table 3.1 to explain why the blood pressure in the pulmonary artery is the same as the pressure in the right ventricle during systole, but higher during diastole.

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- (e) People with long-term chronic obstructive pulmonary disease (COPD) usually have blood which is poorly oxygenated during its passage through the lungs. This leads to a constriction of blood vessels in the lungs.

Suggest the likely effect of this on the heart.

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..... [2]

- (f) Describe the signs and symptoms of COPD that help doctors make an early diagnosis of this condition.

.....

.....

.....

.....

..... [2]

[Total: 14]

CHEMISTRY ONLINE
— TUITION —

- 5 Table 5.1 shows the triplets of bases on the template polynucleotide of DNA for some amino acids.

Table 5.1

amino acid		DNA triplets
glutamic acid	(glu)	CTT CTC
histidine	(his)	GTA GTG
leucine	(leu)	GAA GAG GAT GAC
proline	(pro)	GGA GGG GGT GGC
threonine	(thr)	TGA TGG TGT TGC
valine	(val)	CAA CAG CAT CAC

Fig. 5.1 shows the base sequences in DNA and mRNA for the first seven amino acids of the β chain of haemoglobin.

DNA	CAC	.....	GAC	TGA	GGA	CTC	CTC
mRNA	GUG	CAC	CUG	.....	CCU	GAG	GAG
β chain	val	his	.....	thr	pro	glu	glu

Fig. 5.1

- (a) (i) Use Table 5.1 to complete Fig. 5.1. [3]

- (ii) State the term used to describe the sequence of amino acids in a polypeptide.

.....[1]

- Explain how a single change in the DNA triplet for the sixth amino acid of the gene coding for the β chain leads to the production of a different amino acid sequence.

[Total: 9]