AS 8

PROTEIN SYNTHESIS

QUESTIONSHEET 1

Do not write in margin

Read through the following account of protein synthesis and then fill in the spaces with the most appropriate word or words.

Messenger RNA formed by ..... from the nuclear DNA passes through pores in the ..... and attaches to ..... on the .... amino acids are brought to the mRNA by the molecules of ..... which attach to the ..... of the mRNA by their ..... . Adjacent amino acids then join together by ..... to form a ..... . This is released and passes to the ..... where it associates with other similar molecules to make protein.

[11]

TOTAL / 11

QUESTIONSHEET 2

The table below relates to certain features of messenger RNA and transfer RNA. If a feature is correct mark the box with a tick (✓) and if a feature is incorrect mark the box with a cross (✗).

Feature	mRNA	tRNA
Contains anticodons		
May contain several genes/alleles		
Can associate with any amino acid		
Contains uracil instead of thymine		
A short molecule 70-90 nucleotides long.		

[5]

TOTAL /5

QUESTIONSHEET 3

With reference to the genetic code, explain the meaning of the terms:

(a) codon.

.....

.....

.....

[2]

(b) degenerate code.

.....

.....

.....

[2]

(c) non overlapping code.

.....

.....

.....

[2]

(d) gene.

.....

.....

.....

[2]

(e) chain termination codon.

.....

.....

.....

[2]

TOTAL / 10

QUESTIONSHEET 4

The table below shows some of the 64 available codons and their associated amino acids.

Codon	Amino acid
AGG	arginine
CAG	glutamine
GGG	glycine
GGU	glycine
GUU	valine
UUA	leucine
UCA	serine
UUU	phenylalanine

(a) The diagram below shows the coding strand of a length of DNA with its bases indicated.

A G T C C C A A A T DNA

(i) Identify each of the four bases:

A. ..... C. ..... G. ..... T. .....
[1]

(ii) Write down the base sequence of a length of messenger RNA that would be transcribed from this DNA.

_____ mRNA [1]

(iii) In all known life forms on Earth the code is non-overlapping. Explain what is meant by the term 'non-overlapping'.

.....
[1]

(iv) State the sequence of amino acids which would result from the DNA sequence in (a).

..... [1]

(v) An organism from another planet might have an overlapping code. Write down the sequence of amino acids which would be assembled in this case.

..... [1]

(b) Explain why glycine has two codons in the above table.

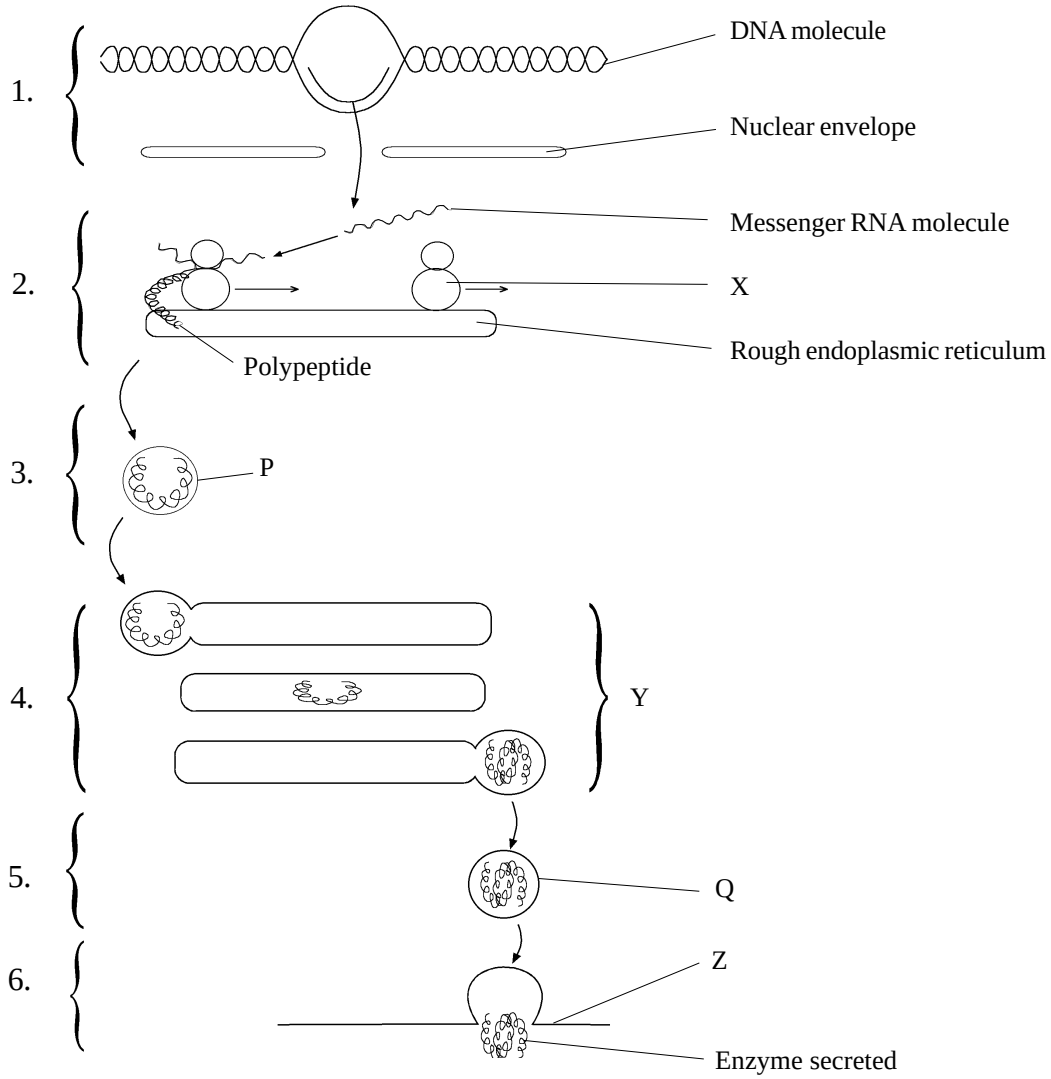
.....

.....
[2]

TOTAL / 7

QUESTIONSHEET 5

The diagram below shows some of the stages involved in the secretion of an enzyme by a stomach cell. The stages are labelled 1 to 6.



(a) (i) Name the processes occuring in stages 1, 2, 4 and 6.

1: ..... [1]

2: ..... [1]

4: ..... [1]

6: ..... [1]

(ii) Name the structures labelled X, Y and Z.

X: . ..... [1]

Y: . ..... [1]

Z: ..... [1]

(Continued...)

Do not write in margin

(iii) Distinguish between vesicles P and Q and their contents.

P & Q: .....

.....

Contents: .....

.....

[3]

(b) What parts are played by (i) peptide synthetase, and (ii) transfer RNA in polypeptide synthesis?

(i) peptide synthetase: .....

.....

[1]

(ii) tRNA: .....

.....

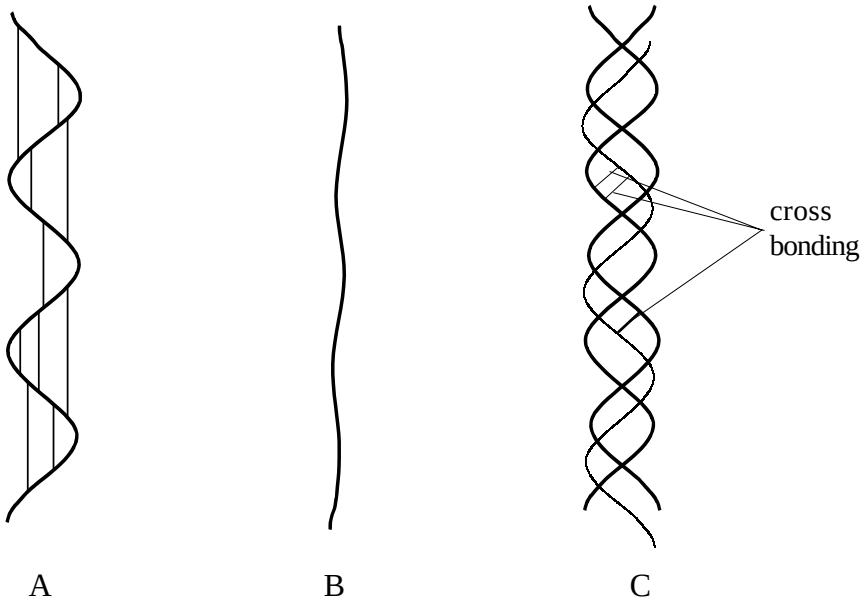
.....

.....

[3]

TOTAL / 14

The drawings represent different three dimensional structures of a protein.



A B C

(a) (i) Indicate whether A, B and C are primary, secondary, tertiary or quaternary structures.

A: ..... B: ..... C: .....

[3]

(ii) Name two types of bond involved in cross bonding.

1 .....

2 .....

[2]

(iii) Is this protein a fibrous or a globular protein? Give a reason for your answer.

Type .....

Reason .....

[2]

(*Continued....*)

Do not write in margin

(b) Distinguish between each of the following pairs.

(i) Primary structure and secondary structure of a protein.

.....

.....

.....

.....

[4]

(ii) Tertiary structure and quaternary structure of a protein.

.....

.....

.....

.....

[4]

TOTAL / 15

QUESTIONSHEET 7

Do not write in margin

Explain the roles of the following in protein synthesis.

(a) ATP.

.....

.....

.....

[2]

(b) Peptide bonds.

.....

.....

.....

[2]

(c) Hydrogen and sulphur bonds.

.....

.....

.....

.....

[2]

(d) Complimentary bases.

.....

.....

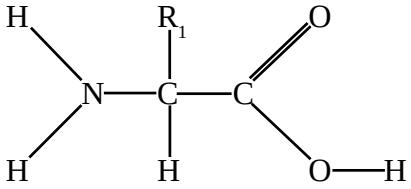
.....

[2]

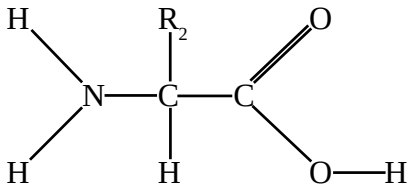
TOTAL / 8

QUESTIONSHEET 8

The diagrams below show the structural formulae of two amino acids, X and Y.



Amino acid X



Amino acid Y

(a) (i) Name two elements other than carbon, oxygen or hydrogen which could be present in the groups R_1 and R_2.

1: .....

2: ..... [2]

(ii) Name a reactive chemical group, other than an acid or amine group, which could be present in R_1 or R_2.

..... [1]

(b) During polypeptide synthesis amino acids X and Y could become linked.

(i) In the space below draw the structural formula of the dipeptide produced. Label the type of bond formed and indicate the byproduct formed.

[4]

(ii) Where in the eukaryotic cell are the primary, secondary and tertiary structures of a protein assembled?

..... [1]

(iii) Where in a eukaryotic cell is the quaternary structure of a protein mainly assembled?

..... [1]

(c) How may groups R1 and R2 be involved in the formation of the secondary, tertiary or quaternary structures of a protein?

.....

.....

.....

..... [3]

TOTAL / 12

QUESTIONSHEET 9

(a) In which cells are the following proteins synthesised?

1. insulin: .....
2. pepsin: .....
3. haemoglobin: .....
4. antibodies: .....
5. somatotropin: .....

[5]

(b) Which of the above proteins are manufactured by genetic engineering?

.....

[1]

(c) Protein synthesis may be switched on and off by the action of a regulator gene. Some proteins are synthesised continuously throughout life and some are only synthesised occasionally in response to a specific stimulus.

(i) How does the regulator gene act to switch protein synthesis on or off?

.....

.....

.....

.....

[3]

(ii) Name a protein from the list in (a) which is only produced occasionally in response to a specific stimulus.

.....

[1]

(iii) Suggest a specific stimulus which would cause synthesis of this protein.

.....

[1]

(iv) Haemoglobin synthesis is sometimes deficient. Suggest a cause for this.

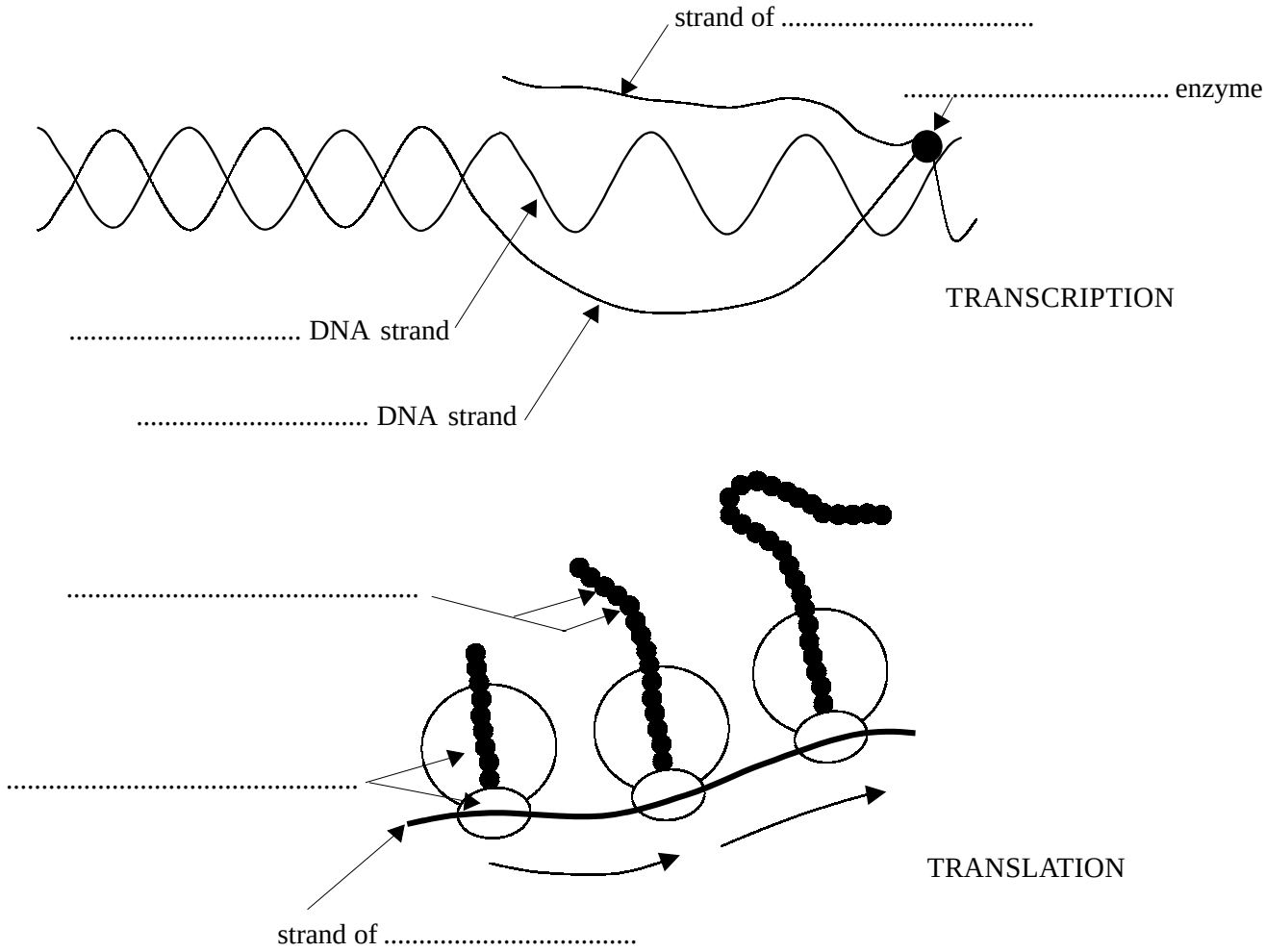
.....

[1]

TOTAL / 12

QUESTIONSHEET 10

The diagrams illustrate the processes of transcription and translation in a eukaryotic cell.



(a) Complete the labelling of the diagrams.

[7]

(b) Briefly describe each of the following processes which occur during polypeptide synthesis in eukaryotic cell.

(i) Transcription.

.....

.....

.....

.....

.....

.....

[5]

(*Continued....*)

Do not write in margin

(ii) Formation of tRNA-amino acid complexes.

.....

.....

.....

[2]

(iii) Translation.

.....

.....

.....

.....

.....

.....

[6]

TOTAL /20

QUESTIONSHEET 11

Complete the following statements by filling in the spaces with the most appropriate word or words.

(a) DNA contains the bases adenine, cytosine, guanine and ..... , but RNA contains the bases ..... .

[2]

(b) Amino acids are joined by ..... to form the primary structure of the polypeptide. Polypeptides are joined by ..... and ..... to form the quaternary structure of the protein.

[3]

(c) The function of the ribosome is to anchor the ..... so that its ..... can be recognised and paired with the complimentary ..... on the ..... .

[4]

(d) One function of the Golgi body is to receive the synthesised ..... from the rough endoplasmic reticulum, and to join them with other ..... to make proteins, or with ..... to make lipoproteins or with ..... to make glycoproteins.

[4]

TOTAL / 13

PROTEIN SYNTHESIS

QUESTIONSHEET 12

(a) Suggest explanations for each of the following:

(i) During polypeptide synthesis a ribosome accommodates two transfer RNA molecules at a time.

.....

.....

.....

.....

[2]

(ii) A ribosome contains enzymes such as peptide synthetase (peptidyl transferase).

.....

.....

.....

.....

[2]

(iii) For polypeptide synthesis to occur, amino acids must first react with ATP.

.....

.....

.....

.....

[2]

(iv) The genetic code possesses stop-go (chain termination) codons.

.....

.....

.....

.....

[2]

TOTAL / 8

QUESTIONSHEET 13

(a) For polypeptide synthesis animals can use ready made amino acids obtained through the diet. Plants, however, have to synthesise their own amino acids using an available nitrogen source.

Outline the steps involved when a flowering plant, such as a daisy, manufactures its required amino acids.

.....

.....

.....

.....

.....

.....

[4]

(b) How would the process of obtaining amino acids differ from the daisy in a plant of the family Papilionaceae (Leguminoseae)?

.....

.....

.....

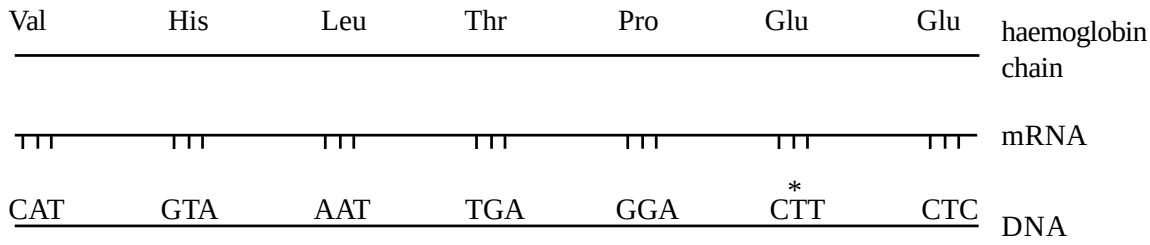
[2]

TOTAL / 6

PROTEIN SYNTHESIS

QUESTIONSHEET 14

The diagram below shows the sequence of amino acids in part of a haemoglobin molecule. This sequence of amino acids was determined by the specified genetic code on the DNA which, in turn, determined the base sequence of the messenger RNA during transcription. The mRNA sequence was translated to form the amino acid chain of the haemoglobin.



Key:
Val = valine
His = histidine
Leu = leucine
Thr = threonine
Pro = proline
Glu = glutamic acid

(a) Write in the complimentary base sequence on the mRNA strand on the diagram.

[2]

(b) In what way does the code in the diagram show redundancy (degeneracy)?

.....

.....

[2]

(c) (i) If the base marked * was substituted with A, how would the haemoglobin chain be different?

.....

[1]

(ii) This mutation produces an abnormal form of haemoglobin called haemoglobin S. What condition is associated with this abnormality.

.....

[1]

(iii) In what ways might the haemoglobin S be abnormal?

.....

.....

.....

[2]

TOTAL / 8

QUESTIONSHEET 15

Name one cell organelle associated with high levels of the following enzymes. Describe the function of the enzyme within the organelle.

(a) DNA polymerase.

Name: .....

Function: .....

.....

.....

[2]

(b) RNA polymerase.

Name: .....

Function: .....

.....

.....

[2]

(c) Cytochrome oxidase.

Name: .....

Function: .....

.....

.....

[2]

(d) Peptide synthetase (Peptidyl transferase).

Name: .....

Function: .....

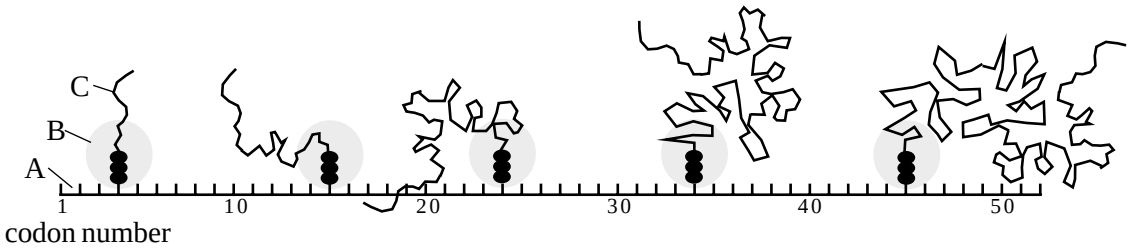
.....

[2]

TOTAL /8

Figure 1 shows part of the sequence of events in the assembly of the enzyme lysozyme which consists of 129 amino acids.

Fig 1



(a) Identify structures A, B, C.

A: .....

B: .....

C: .....

[3]

(b) State how the alpha-helix portion of the molecule is held together.

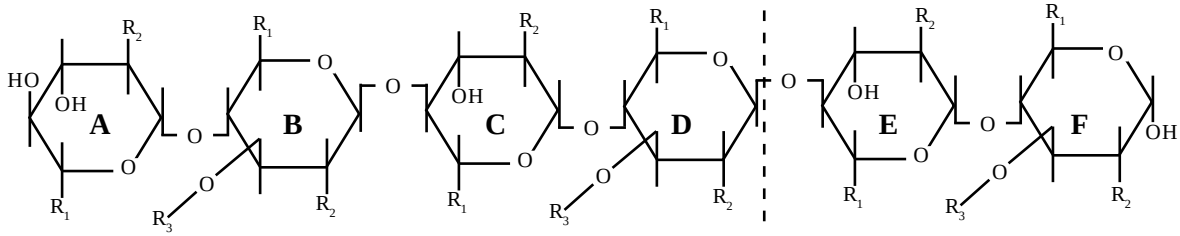
.....

.....

[2]

Lysozyme is capable of splitting a polysaccharide found in the bacterial cell wall. Figure 2 shows the structure of this polysaccharide. The dotted line shows one of the points at which lysozyme splits the molecule.

Fig 2



(c) Mark on the diagram another point where lysozyme could split the molecule.

[1]

(d) Explain the significance of the assembly process shown in Figure 1 to the activity of lysozyme shown in Figure 2.

.....

.....

.....

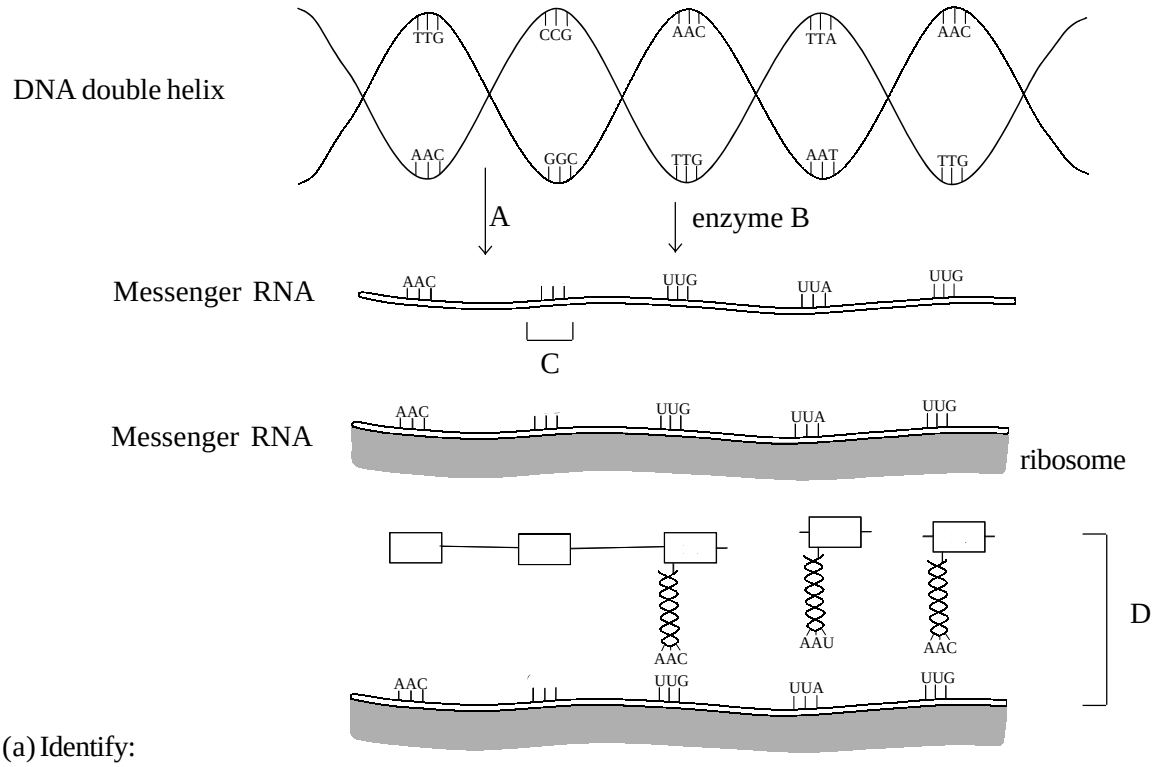
.....

[4]

TOTAL / 10

QUESTIONSHEET 17

The diagram shows some of the stages in the synthesis of proteins



(a) Identify:

(i) process A.

..... [1]

(ii) enzyme B.

..... [1]

(iii) sequence C.

..... [1]

(iv) process D.

..... [1]

(b) State two reasons why ATP is required for this process.

.....

..... [2]

(c) State three ways in which DNA differs structurally from RNA.

.....

.....

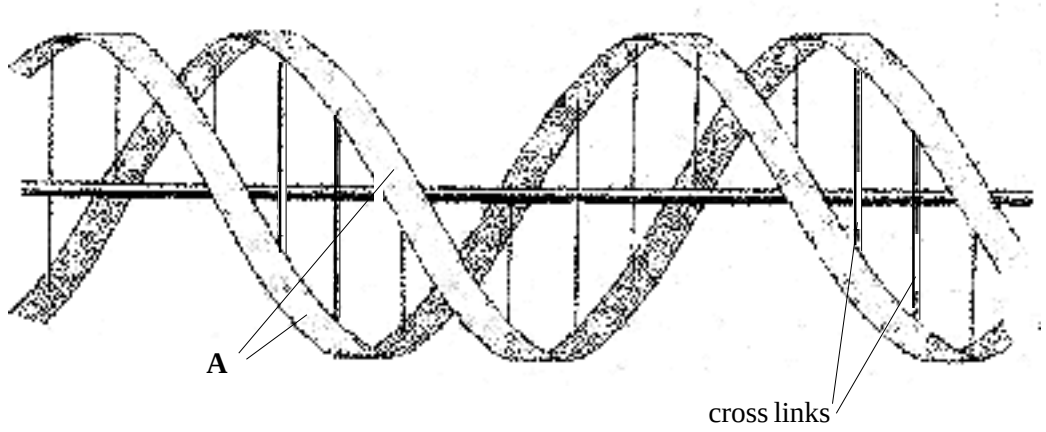
..... [3]

TOTAL / 9

PROTEIN SYNTHESIS

QUESTIONSHEET 18

The drawing below represents the structure of a DNA molecule. The rod along the centre is not part of the molecule but is included to show a three dimensional perspective.



(a) (i) Describe the chemical structure of chains A.

.....

.....

.....

..... [3]

(ii) Describe the chemical nature of the cross links which hold strands A together.

.....

.....

.....

.....

..... [4]

(b) Describe the nature of the genetic code on DNA.

.....

.....

.....

.....

.....

.....

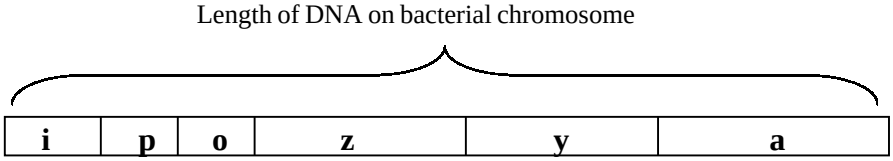
..... [6]

TOTAL / 13

QUESTIONSHEET 19

Do not write in margin

The diagram below shows the 'lac operon' which is a control system of gene expression regulating lactose metabolism in the bacterium E. coli.



Genes **z**, **y** and **a** control the synthesis of the enzymes which are responsible for the metabolism of lactose in the bacterial cell. Gene **i** is a regulator gene controlling the expression of genes z, y and a. **p** is the promotor region to which RNA polymerase attaches during transcription of DNA to mRNA. **o** is the operator site to which the repressor protein can attach.

In the presence of lactose the bacteria can produce the enzymes to metabolise lactose . If the bacteria are subcultured onto a lactose free substrate they cease to produce the enzymes for metabolising lactose, within three minutes.

(a) Describe how the lac operon system works to repress the formation of the lactose metabolising enzymes.

.....

.....

.....

.....

..... [4]

(b) Describe how the lac operon can be switched on in order to synthesize the lactose metabolising enzymes.

.....

.....

.....

.....

..... [4]

(c) Oncogenes are genes which operate to initiate the cancer process. State two different agents which might induce the oncogenes into activity.

1. ..... 2. ..... [2]

TOTAL / 10

PROTEIN SYNTHESIS

QUESTIONSHEET 20

(a) Read through the following account of DNA replication and then complete it by filling in the spaces with the most appropriate word or words.

During DNA replication the enzyme ..... binds to the DNA double ..... This makes the DNA ..... and breaks the ..... bonds between the nucleotides. These nucleotides are bound together at ..... . The base adenine binds with ..... and ..... binds with guanine. Free nucleotides found in the ..... bind with the exposed bases producing two strands of DNA. The process is said to be ..... because in both of the two DNA strands produced, one sequence of nucleotides is new and the other is from the ..... DNA. [10]

(b) (i) When a sample of DNA was chemically analysed it was found that 36% of the bases were adenine. What were the percentages of the other bases? Explain your anserws.

.....

.....

.....

..... [4]

(ii) Is it possible to forecast the percentages of bases that would be present in the messenger RNA transcribed from this DNA? Explain your answer.

.....

.....

..... [2]

TOTAL / 16