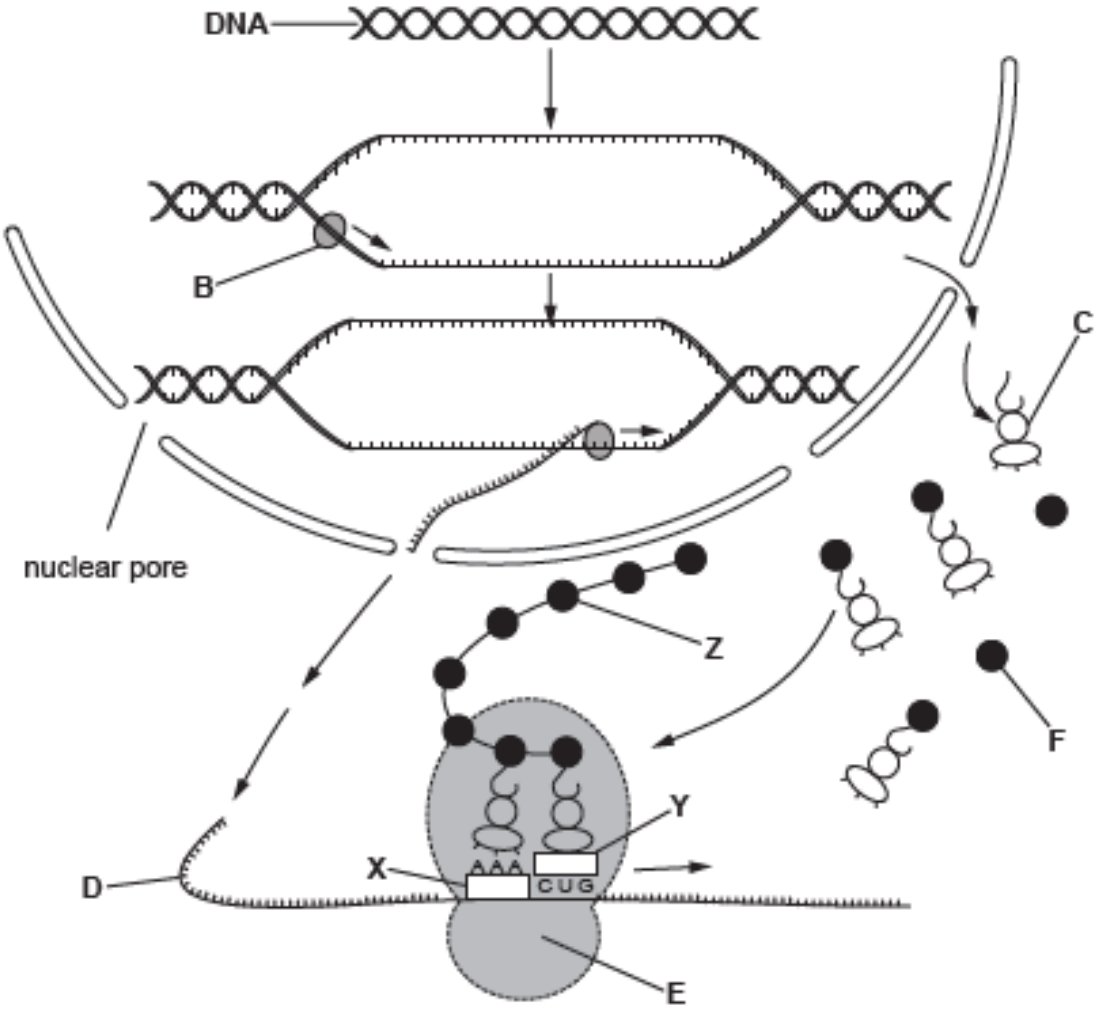
GCE AS Level Biology

S21-B400U10-1

Assessment Resource 4

Basic Biochemistry and Cell Organisation Resource D

1. The diagram below summarises the process of protein synthesis which involves both DNA and RNA.



(a) Use some of the letters from the diagram to identify the following molecules involved in protein synthesis. [1]

mRNA .....

tRNA .....

rRNA .....

(b) (i) The structures labelled **X** and **Y** on the diagram are sequences of bases. Complete the table below. [2]

Base Sequence	Name of the sequence	Bases in the sequence
X	.....	.....
Y	.....	.....

(ii) Describe and explain how a change in the base sequence of **X** could affect the primary structure of molecule **Z**. [3]

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(c) It was originally proposed that **one gene** carried the code for **one enzyme**. This was revised to become the **one gene – one protein** hypothesis. It is now known as, the **one gene – one polypeptide** hypothesis.

Using your knowledge of protein structure and function explain why the two previous versions of this hypothesis are no longer accepted. [2]

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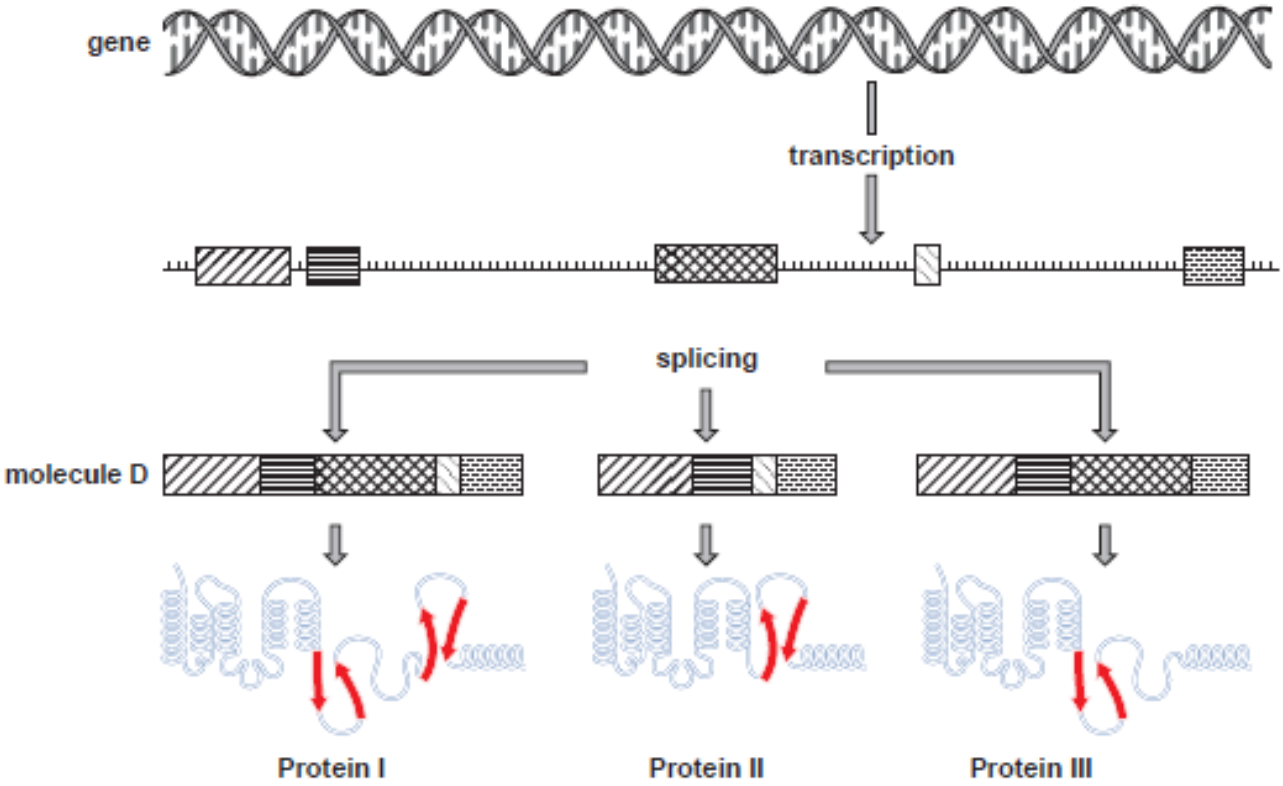
In the 1960s, it was estimated that the human genome contained more than 2000000 genes. Analysis has since shown that much of the genome is made up of non-coding regions and that the coding regions contain about 20000 genes that code for polypeptides. However, over 1000000 different polypeptides are produced by our cells.

The diagram below shows how different proteins can be produced from the same gene.



(d) Describe the process of transcription. [3]

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(e) (i) State the names given to the: [1]

coding regions .....

non-coding regions .....

(ii) With reference to the gene shown in the diagram and your own knowledge of protein synthesis, explain how **different** proteins can be produced from a single gene. [3]

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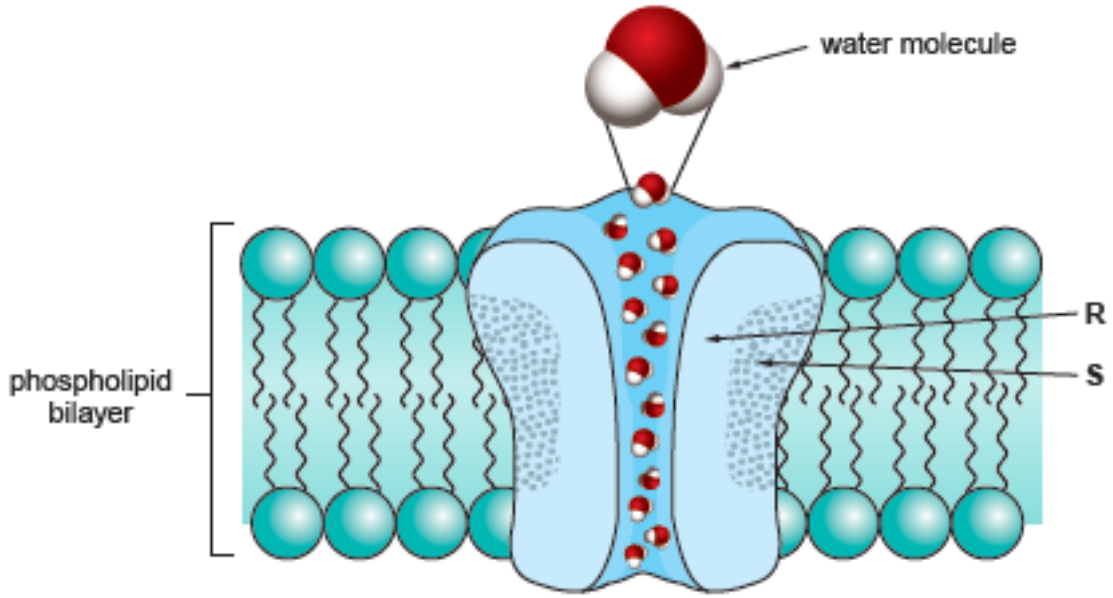
2. The presence of aquaporin proteins in cell membranes speed up the movement of water molecules by osmosis. The diagram below shows water molecules travelling through an aquaporin in the plasma membrane of a cell.



(a) (i) Explain why water molecules cannot easily diffuse through the phospholipid bilayer. [1]

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(ii) Identify which region of the aquaporin molecule labelled **R** and **S** is non-polar. Explain how you arrived at your answer. [1]

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(b) Water passes from one plant cell to another down a water potential gradient.
Water potential is affected by two opposing forces, pressure potential (ψ_p) and solute potential (ψ_s).

$$\Psi_{cell} = \Psi_p + \Psi_s$$

A practical was carried out to determine the water potential of red onion cells by placing red onion tissue in different concentrations of sucrose solution and observing them under a microscope. The total number of cells in the field of view was counted together with the number of plasmolysed cells. The percentage of plasmolysed cells was then calculated for each concentration of sucrose solution.

The results are shown in the table.

Concentration of sucrose solution /mol dm^{-3}	Solute potential /kPa	Plasmolysed cells /%
0.1	−269	2
0.2	−526	12
0.3	−790	18
0.4	−1052	36
0.5	−1322	56
0.6	−1596	70
0.7	−1882	81
0.8	−2180	98
0.9	−2580	100

(i) Explain why the water potential of the cell can be assumed to be equal to the solute potential of the solution that causes 50 % plasmolysis. [1]

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(ii) Use the results in the table to estimate a value for the water potential of the onion tissue. [1]

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(iii) Outline how the data in the table could be used to determine a more accurate estimate of the onion tissue water potential. [2]

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(iv) State how the procedure could be modified to improve reliability and accuracy. [2]

Reliability .....

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Accuracy .....

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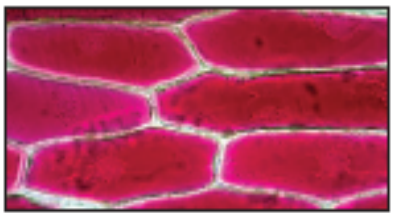
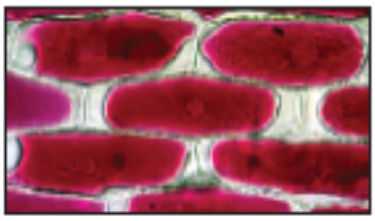
Photographs of some of the cells from the red onion tissue used in the investigation are shown below.

S



T



(v) State the terms used to describe the cells above. [1]

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T .....

(vi) Red onion tissue was placed in a solution with a solute potential of −1800 kPa. After 30 minutes, the cells appeared like those shown in **T** above. Explain this observation. [2]

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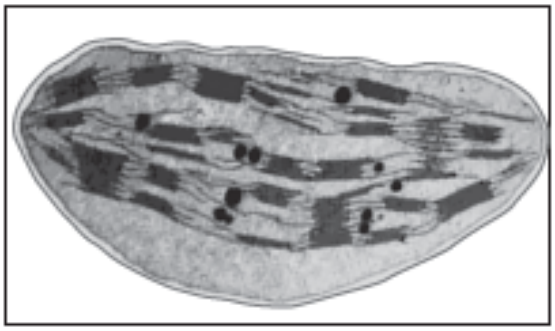
3. A symbiotic relationship is the interaction between two different species living in close physical association to the advantage of both.

In 1967, Lynn Margulis proposed the theory of endosymbiosis and suggested that mitochondria and chloroplasts evolved from free-living prokaryotes that were taken into other prokaryotic cells by endocytosis to form the first eukaryotic cells.

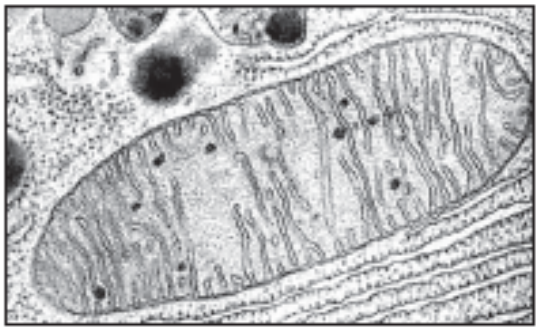
The electron micrographs below show the detailed structure of a chloroplast and a mitochondrion.

Chloroplast



1 µm

Mitochondrion



0.5 µm

Compare the structures of mitochondria and chloroplasts to prokaryotes.

Describe and explain how the double membrane observed in both organelles was formed, and how this supports the theory of endosymbiosis.

Suggest the advantages of this symbiotic relationship to the mitochondria, the chloroplasts and the newly formed eukaryotic cell. [9 QER]

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END OF PAPER