

## Voice of the Genome -4

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Date: \_\_\_\_\_

Time:

Total Marks Available:

Total Marks Archived:

Level: Edexcel A level Biology

Subject: Biology

Exam Board: Pearson Edexcel Level 3 GCE AS and A level Biology A (Salters-Nuffield) and also Pearsons Edexcel AS and A Level Biology B (9BI0) - Is however suitable for use by AS and A level Biology Students of other Boards

Topic: Voice of the Genome -4

Type: Topic Questions

To be used by all students preparing for Edexcel AS and A level Biology A and Biology B - Students of other Boards may also find this useful



## Questions

Q1.

Explain why the phospholipids are arranged in two layers in a cell surface membrane.

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**(Total for question = 3 marks)**



Q2.

Describe how thicker mucus would affect gas exchange across the walls of the alveoli.

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Q3.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

Farmers use fertilisers to increase the growth of crops such as wheat.

(i) Fertilisers contain phosphate ion compounds.

Plants need phosphate in order to synthesise

(1)

- A both cellulose and phospholipids
- B both phospholipids and polysaccharides
- C both polynucleotides and phospholipids
- D both polynucleotides and polysaccharides



(ii) After the grain is harvested, farmers plough the stems (straw) from wheat plants into the soil.

This improves the quality of the soil. These stems contain polysaccharides.

Explain how microorganisms in the soil break down the stems.

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(Total for question = 4 marks)

Q4.

Emphysema is a condition that causes changes to the tissues in the lungs.

In an investigation, the surface area for gas exchange and the volume of the lungs of three groups of individuals were determined. The results are shown in the table.

Measurement	Individuals without emphysema	Individuals with mild emphysema	Individuals with severe emphysema
Mean surface area for gas exchange / m <sup>2</sup>	118 ± 11	97 ± 8	30 ± 5
Mean total lung volume / cm <sup>3</sup>	4772 ± 223	6232 ± 410	6725 ± 384
Mean surface area for gas exchange : volume ratio	247.3 : 1		44.6 : 1



Fick's law of diffusion can be used to calculate a value for the effectiveness of the uptake of oxygen by the lungs.

This value can be calculated using the equation

$$\text{value} = \frac{\text{surface area} \times \text{concentration difference}}{\text{diffusion distance}}$$

The diffusion distance in alveoli is 0.5  $\mu\text{m}$ .

The mean oxygen concentration in alveoli is 14 kPa and in the capillaries is 5 kPa. The calculated value for healthy individuals is 2124.

(i) Calculate the value for individuals with severe emphysema.

(2)

Answer .....

(ii) Calculate the percentage difference between the value for individuals with severe emphysema and the value for individuals without emphysema.

(2)

Answer .....

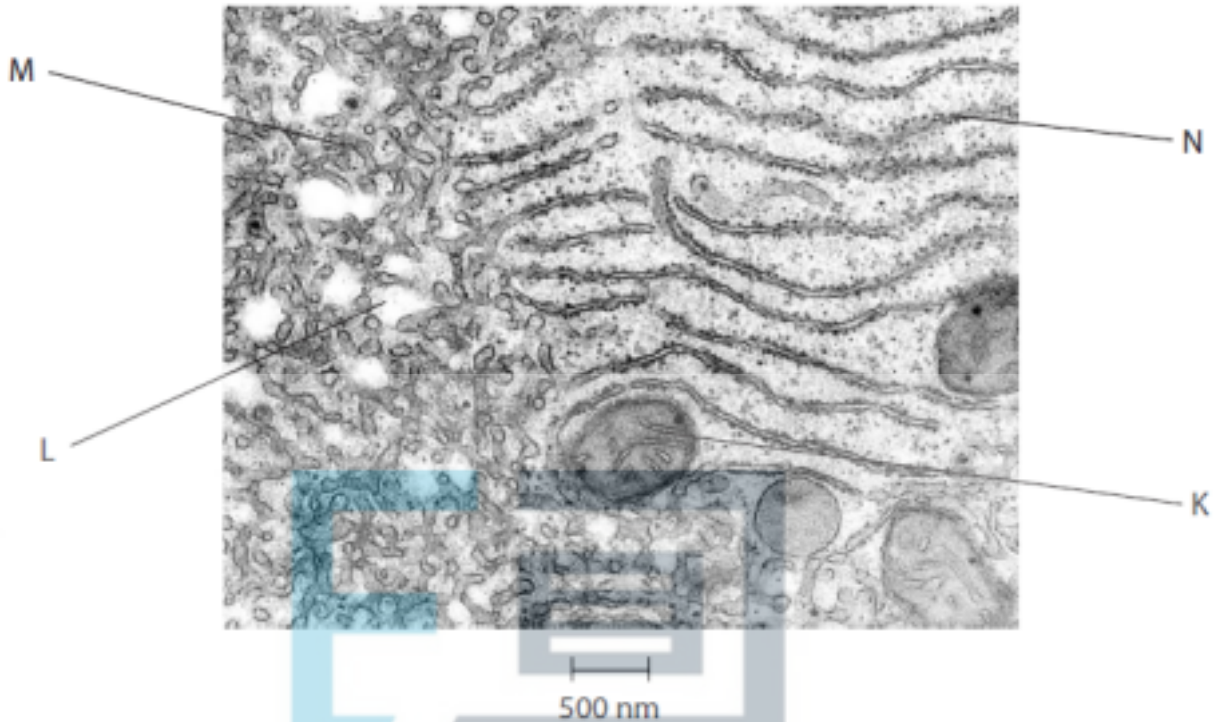
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**(Total for question = 4 marks)**

Q5.

Liver cells synthesise and export a variety of proteins.

The image is a transmission electron micrograph of part of a liver cell.



(i) Which of the following structures is involved in respiration?

(1)

- A K
- B L
- C M
- D N

(ii) Which of the following structures is involved in synthesising lipids?

(1)

- A K
- B L
- C M
- D N

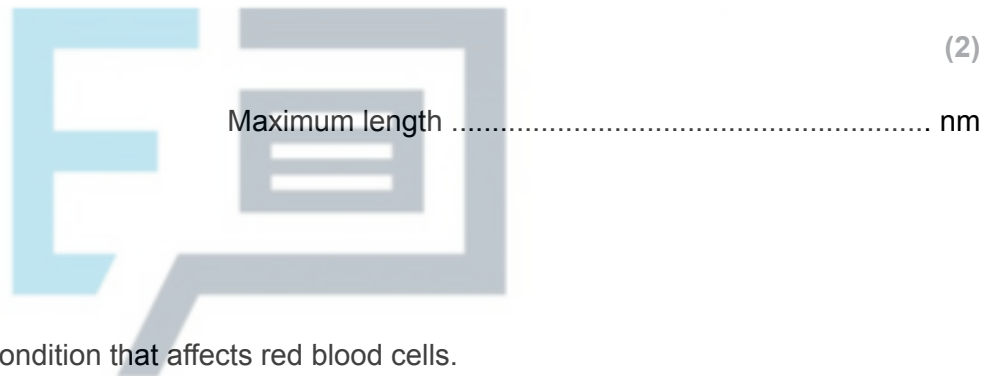
(iii) The site of synthesis of proteins to be released by exocytosis is

(1)

- A K
- B L
- C M
- D N

(iv) Calculate the maximum width of the structure labelled K.

(2)



Q6.

Hereditary spherocytosis is a condition that affects red blood cells.

The red blood cells of individuals with spherocytosis are spherical instead of having a biconcave disc shape.

Explain the effect of spherocytosis on the uptake of oxygen by red blood cells. (3)

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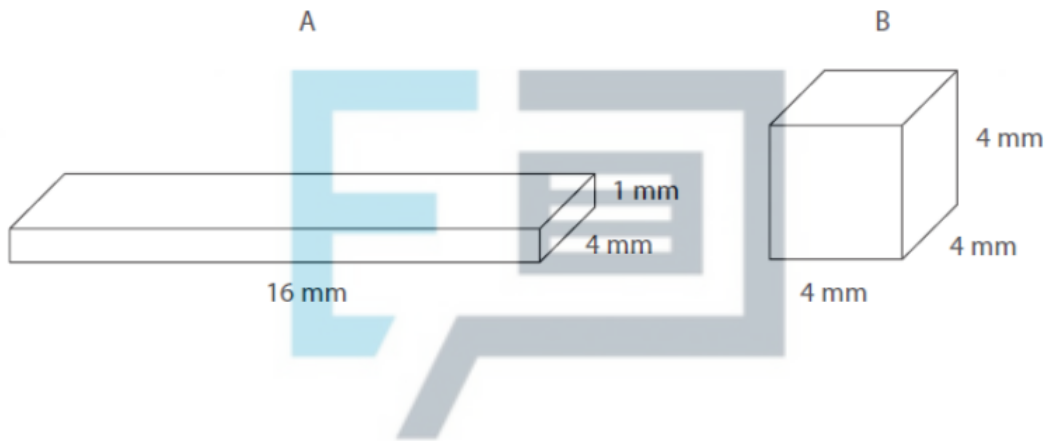
Q7.

Scientists can use models to explain the need for a circulation system in animals.

The shapes in the diagram represent two different animals that live in water. The figures represent the height, width and breadth of the animals.

Determine why animal A does not need a circulation system but animal B does.

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**(Total for question = 4 marks)**





Q8.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

Thalassaemia is a recessive genetic disorder that affects the production of haemoglobin. It is caused by a gene mutation.

Scientists are developing methods to repair gene mutations such as the one that causes thalassaemia.

A gene mutation can be a change in a single base in the

(1)

- A DNA that codes for a different amino acid
- B DNA that codes for a different monosaccharide
- C RNA that codes for a different amino acid
- D RNA that codes for a different monosaccharide

(Total for question = 1 mark)

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Q9.

Porphyria is a life-threatening genetic disease. It is caused by a mutation in the gene coding for an enzyme involved in the production of haem.

In people with porphyria, haem cannot be produced.

A new technique known as gene silencing has been developed to treat this disease.

Molecules known as small interfering RNA (siRNA) combine with mRNA to prevent translation.

Deduce how siRNA may be used to prevent the development of porphyria.



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**(Total for question = 4 marks)**



Q10. The sequence of bases in DNA determines the sequence of amino acids in a polypeptide.

The table below shows the genetic code for each amino acid.

TTT	Phe	TCT	Ser	TAT	Tyr	TGT	Cys
TTC		TCC		TAA		TGC	
TTA	Leu	TCA	Pro	TAG	Stop	TGA	Stop
TTG		TCG		TGG		Trp	
CTT	leu	CCT	Pro	CAT	His	CGT	Arg
CTC		CCC		CAC		CGC	
CTA		CCA		CAA	CGA		
CTG		CCG		CAG	CGG		
ATT	Ile	ACT	Thr	AAT	Asn	AGT	Ser
ATC		ACC		AAC		AGC	
ATA	Met	ACA	Ala	AAA	Lys	AGA	Arg
ATG		ACG		AAG		AGG	
GTT	Val	GCT	Ala	GAT	Asp	GGT	Gly
GTC		GCC		GAC		GGC	
GTA		GCA		GAA	GGA		
GTG		GCG		GAG	GGG		

(a) The diagram below shows the DNA base sequence coding for part of a polypeptide.

A	T	G	G	G	C	A	T	T
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(i) Using the information in the table, state the order of amino acids for this part of the polypeptide.

(1)

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(ii) Explain what is meant by the term **non-overlapping genetic code**.

(1)

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(b) (i) Explain why there are **three** bases in each of the codes shown in the table.

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(ii) Suggest an advantage for most amino acids having more than one code. Give an explanation for your answer.

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(c) Explain the role of the base sequences TAA, TAG and TGA.

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(d) Explain how the amino acids are joined together in a polypeptide.

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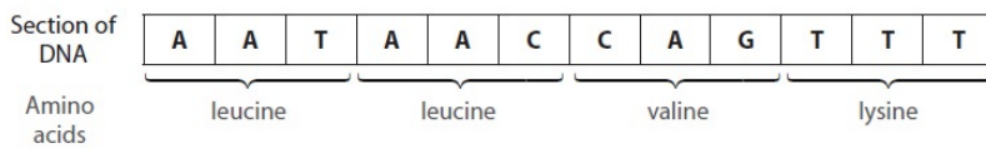
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**(Total for Question = 13 marks)**

Q11. The diagram below shows the base sequence on a short section of DNA consisting of 12 mononucleotides. This base sequence contains the genetic code for a short section in the primary structure of a polypeptide.



(a) Name each of the bases represented by the letters, **A**, **C**, **G** and **T** in the diagram. (1)

- A**.....
- C**.....
- G**.....
- T**.....

(b) Using the sequence shown in the diagram, explain the meaning of each of the following terms.

(i) Triplet code

(2)

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(ii) Non-overlapping

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(iii) Degenerate

(2)



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(c) Place a cross  in the box next to the names of the two components, other than the bases, that form part of each mononucleotide in this sequence.

(1)

- A** deoxyribose and nitrate
- B** deoxyribose and phosphate
- C** ribose and nitrate
- D** ribose and phosphate



\*(d) Transcription of this section of DNA forms a complementary strand of mRNA. Describe how translation of this mRNA synthesises part of a polypeptide molecule.

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(Total for Question = 13 marks)

Q12.

Some people have a disorder that reduces their ability to produce an enzyme required to break down glycogen. This enzyme is glycogen phosphorylase.

The symptoms of this disorder include muscle weakness and lack of stamina when exercising.

(i) Explain why a low concentration of this enzyme would cause the symptoms described.

(3)





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(ii) Devise an experiment to investigate the effect of glycogen phosphorylase concentration on the breakdown of glycogen.

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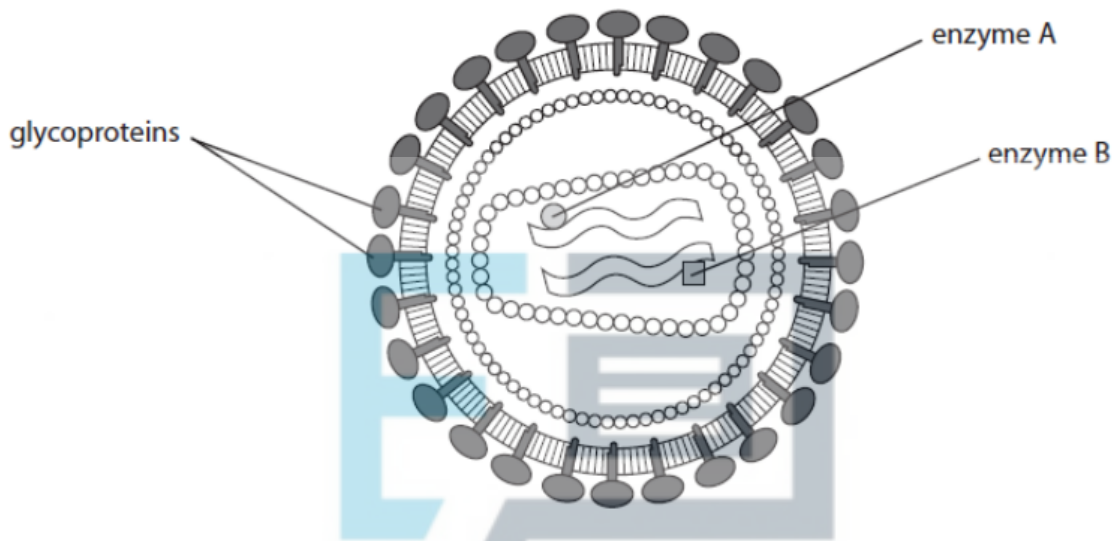
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Q13.

Anti-viral drugs have been developed to treat patients infected with Human Immunodeficiency Virus (HIV).

The diagram below shows the structure of HIV.



(a) A glycoprotein has a carbohydrate attached to a protein molecule.  
Describe the three-dimensional structure of a glycoprotein.

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(b) Some anti-viral drugs prevent HIV entering the host cells.

Suggest how these anti-viral drugs could prevent HIV entering the host cells.

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\* (c) Describe how the enzymes shown in the diagram are involved in HIV infection.

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EXAM PAPERS PRACTICE

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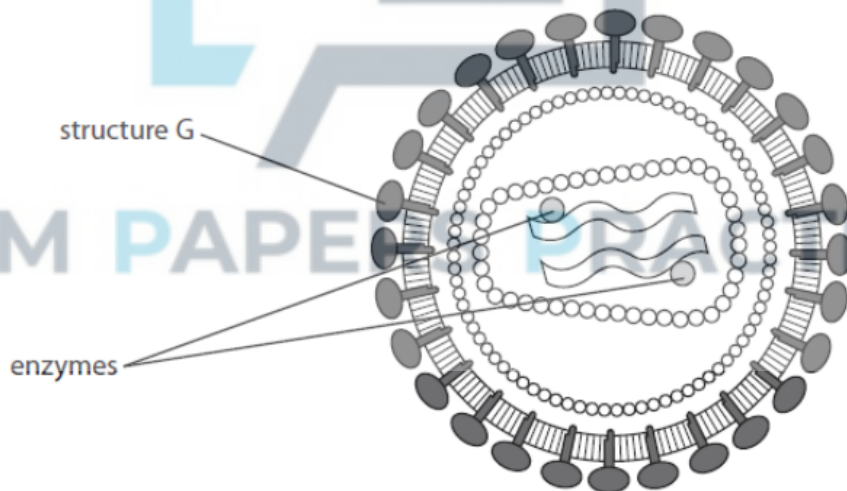
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(Total for question = 11 marks)

Q14.

Anti-viral drugs have been developed to treat patients infected with Human Immunodeficiency Virus (HIV).

The diagram below shows the structure of HIV.



(a) Explain how **structure G** enables HIV to infect human cells.

(3)

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(b) Some anti-viral drugs used to treat patients infected with HIV are inhibitors of enzymes found within HIV.

(i) Describe the structure of an enzyme.

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\*(ii) Suggest how these anti-viral drugs would work in the treatment of patients infected with HIV.

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(Total for question = 11 marks)

Q15.

Wasps are insects that live in groups.

One species of wasp (*Vespula germanica*) has been shown to knock its body repeatedly against a hard surface. This signals the presence and quality of food to other wasps.

When threatened by another animal, it may use its stinger to inject a venom to protect itself.



bugguide.net

The stinger injects a venom that contains the enzyme phospholipase. This enzyme hydrolyses phospholipids, releasing fatty acids.



**EXAM PAPERS PRACTICE**

Describe how the structure of phospholipase allows it to hydrolyse phospholipids.

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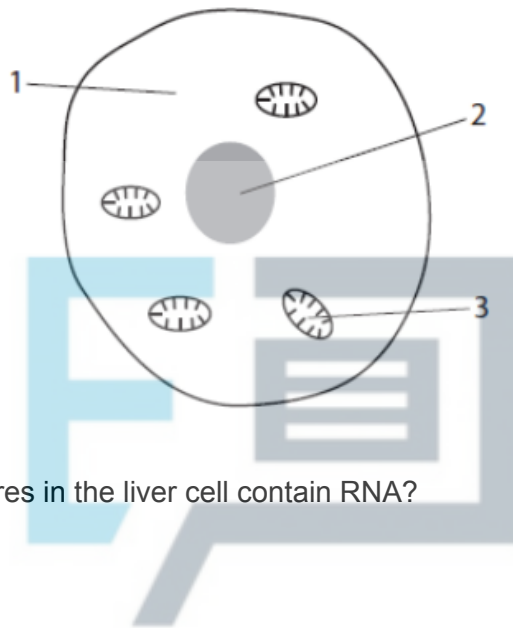
**(Total for question = 4 marks)**



Q16.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

The diagram shows some of the features of a human liver cell.



(i) Which of the labelled features in the liver cell contain RNA?

(1)

- A 1 only
- B 1 and 3 only
- C 2 and 3 only
- D 1, 2 and 3

(ii) Cells produce lactate during anaerobic respiration. Lactate travels in the blood to the liver. Liver cells can absorb lactate from the blood.

Deduce what happens to the lactate in these cells.

(2)





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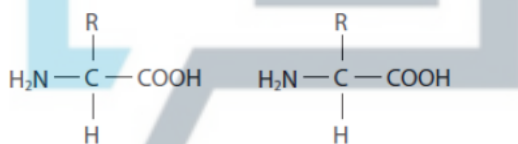
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(iii) During protein synthesis, two amino acids are joined together to form a dipeptide.

The diagram shows two identical amino acids.

Complete the diagram to show how the dipeptide is formed from these two amino acids. (2)



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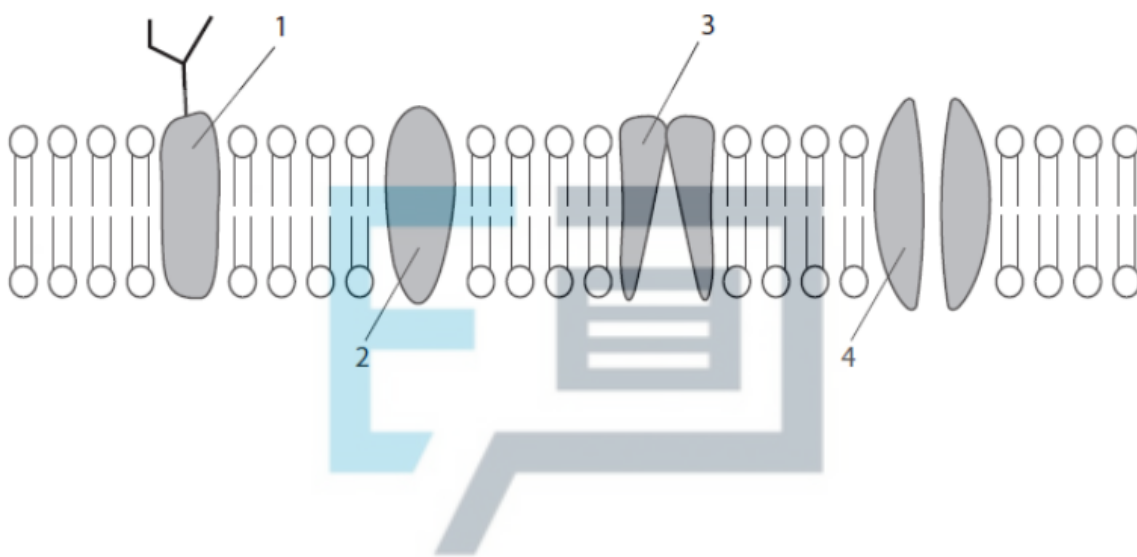
(Total for question = 5 marks)

Q17.

Answer the questions with a cross in the boxes you think are correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

The structure of the cell surface membrane can be described by the fluid mosaic model.

The diagram shows the fluid mosaic model of the cell surface membrane.



(i) Which of the shaded structures transport charged molecules or ions across the membrane?

- A 1 and 2 only
- B 3 and 4 only
- C 1, 2 and 3 only
- D 1, 2, 3 and 4

(1)

(ii) Which of the shaded structures contain both hydrophilic regions and hydrophobic regions? (1)

- A 1 and 2 only
- B 3 and 4 only
- C 1, 2 and 3 only
- D 1, 2, 3 and 4

(iii) A student measured the width of the phospholipid bilayer shown on the diagram as 2.5 cm. The actual size of this bilayer is 5 nm.

What is the approximate magnification of the diagram?

(1)

- A  $\times$  5000
- B  $\times$  50 000
- C  $\times$  500 000
- D  $\times$  5 000 000



(Total for question = 3 marks)

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Q18.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

Cystic fibrosis can be caused by a number of different mutations in the CFTR gene.

(i) A gene contains a number of base pairs. Of the base pairs in this gene, 50% are adenine and thymine.

Q = the number of base pairs in this gene.

Which of the following shows the total number of hydrogen bonds (H bonds) present in this gene?

(1)



**A** 2.0 × Q

**B** 2.5 × Q

**C** 4.0 × Q

**D** 5.0 × Q

(ii) Explain why different mutations in the CFTR gene can lead to differences in the severity of the symptoms of cystic fibrosis.

(2)

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**(Total for question = 3 marks)**



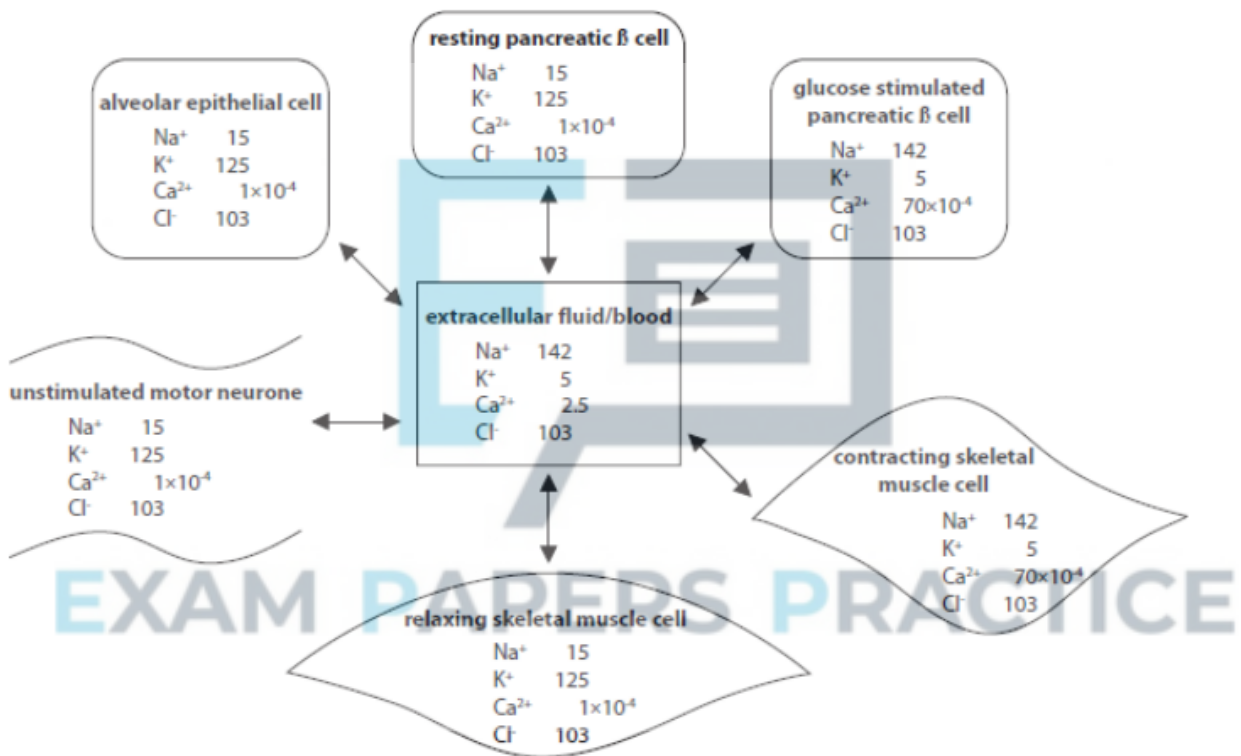
Q19.

\*Cells use ions in many different processes.

Ion transport across cell membranes is a fundamental property of all living cells.

The diagram shows some typical ion concentrations in healthy human cells and in the extracellular fluid.

All values are in  $\text{mmol dm}^{-3}$ .



The tables show information about the human genome and types of transport channel in humans.



Some information about the human genome	
Number of genes in the human genome	approximately 20 000
Number of genes coding for membrane proteins	approximately 5 400
Number of genes coding for proteins involved in the transport of ions across cell membranes	more than 350
Number of diseases associated with mutations in genes involved in the transport of ions across cell membranes	more than 28
Organs and systems in which ion channel mutations cause disease	central nervous system, heart, lungs, pancreas and skeletal muscle

Type of transport channel	Number of each type of transport channel
Voltage gated ion channels	147
Chloride channels	17
Active transport	81

Discuss the importance of ion transport across membranes in human health and disease.

**(Total for question = 9 marks)**

Q20.

Glycolysis is inhibited by acidic conditions.

Devise an investigation to determine the effect of acidic conditions on the initial rate of reaction of phosphofructokinase.

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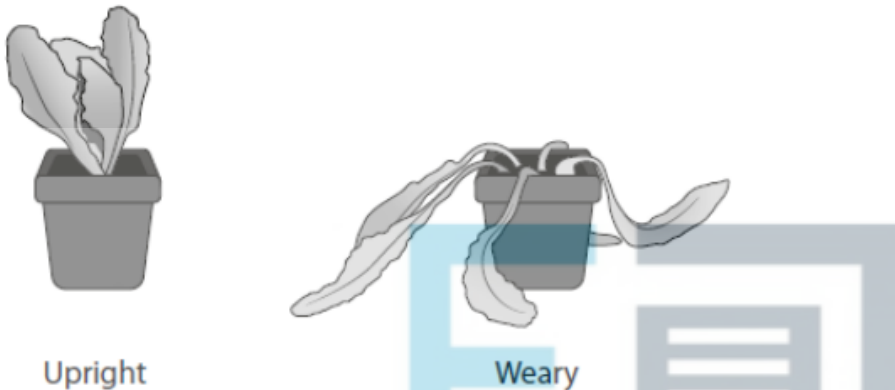
(Total for question = 4 marks)

Q21.

Lettuce plants usually grow upright. This is the 'upright' phenotype.

In one variety of lettuce the stem of the lettuce grows along the ground. This is the 'weary' phenotype.

These two phenotypes are shown in the diagram.



Inheritance of the weary phenotype has been investigated.

Scientists crossed weary lettuce plants with upright lettuce plants.  
The  $F_1$  generation produced from this cross were all upright.

In the second cross, two of the  $F_1$  lettuce plants were crossed with each other to produce the  $F_2$  generation.

The phenotypes of the  $F_2$  generation and the results of a statistical test are shown in the table.





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Number of offspring with weary phenotype	Number of offspring with upright phenotype	Chi-squared ( $\chi^2$ )
159	414	2.31

Degrees of freedom	Probability		
	0.01	0.05	0.1
1	2.71	3.84	6.64
2	4.61	5.99	9.21
3	6.25	7.82	11.35
4	7.78	9.49	13.28

Justify the conclusion that the weary phenotype was inherited as a recessive trait.

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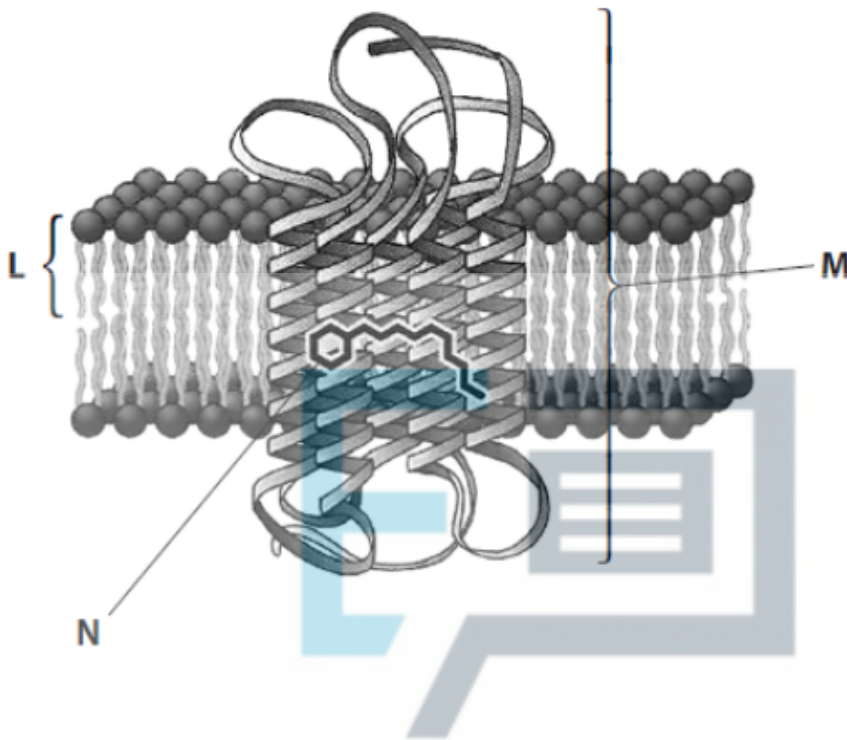
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**(Total for question = 3 marks)**



Q22.

The diagram shows part of the membrane of the outer segment of a rod cell.



(a) Which of the following is the part labelled **L**?

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(1)

- A** fatty acid tail
- B** phosphate head
- C** phospholipid
- D** phospholipid bilayer

(b) (i) Give the name of the visual pigment labelled **M**.

(1)

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(ii) Give the name of the light-absorbing part of the visual pigment labelled **N**.

(1)

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(c) Describe how the absorption of light by the part labelled **N** results in an action potential in the optic nerve.

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EXAM PAPERS PRACTICE

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**(Total for question = 6 marks)**

Q23.

Malaria is a disease that kills more than 400 000 people every year.

It is caused by *Plasmodium*, a single-celled organism that lives in the blood.

*Plasmodium* is transmitted by mosquitoes.

Malaria can be controlled by killing the mosquitoes that transmit the disease. Scientists are genetically modifying *Metarhizium pingshaense*, a fungus that infects mosquitoes.

The genetically modified (GM) fungus contains a gene from a species of spider. This gene codes for a protein that kills mosquitoes.

(i) The GM fungus transcribes and translates the gene for this protein.

Describe the primary structure of a protein.

(2)



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(ii) The primary structure of this protein is then converted into a tertiary structure and modified by organelles in the cell.

Describe the role of the organelles involved in these processes.

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(Total for question = 7 marks)

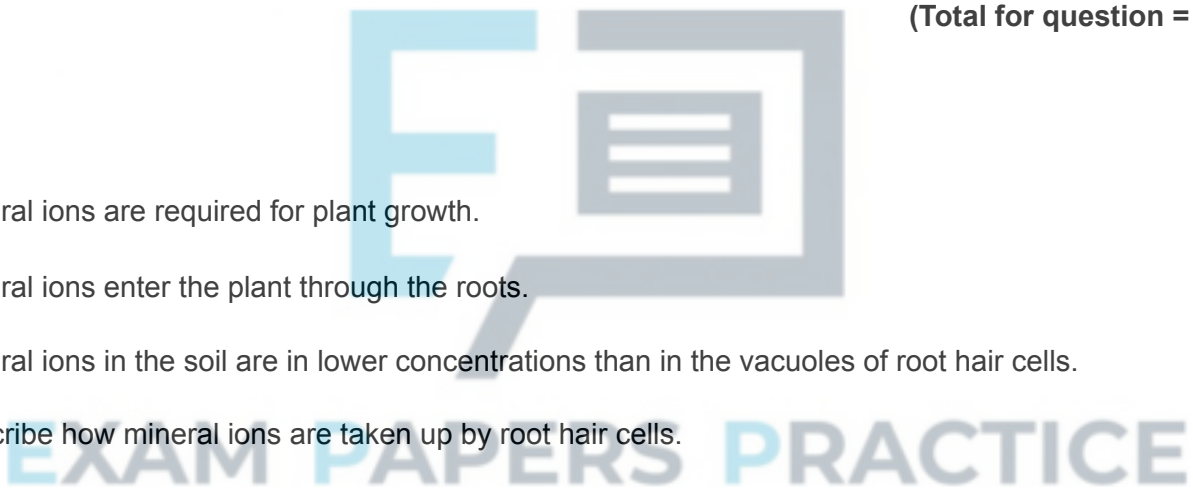
Q24.

Mineral ions are required for plant growth.

Mineral ions enter the plant through the roots.

Mineral ions in the soil are in lower concentrations than in the vacuoles of root hair cells.

Describe how mineral ions are taken up by root hair cells.



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(Total for question = 3 marks)



Q25.

Mineral ions are required for plant growth.

(i) Nitrate ions are required for the synthesis of

(1)

- A amino acids
- B cellulose
- C starch
- D sucrose

(ii) Phosphate ions are required for the synthesis of

(1)

- A cellulose
- B chlorophyll
- C nucleic acids
- D sucrose

(iii) Magnesium ions are present in the structure of

(1)

- A amino acids
- B cellulose
- C chlorophyll
- D starch

(Total for question = 3 marks)