



EXAM PAPERS PRACTICE

Voice of the Genome -2

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 -2

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.

At the start of fertilisation, many sperm cells will surround the ovum.

Fertilisation begins with the acrosome reaction.

(i) Which of the following describes the acrosome reaction?

(1)

- A the ovum releases enzymes that digest the egg cell membrane
- B the ovum releases enzymes that digest the zona pellucida
- C the sperm cell releases enzymes that digest the egg cell membrane
- D the sperm cell releases enzymes that digest the zona pellucida

(ii) Which of the following statements describes the genetic content of a sperm cell? (1)

	Each sperm cell will contain	Different sperm cells will contain
<input type="checkbox"/> A	one copy of each gene	different alleles of some genes
<input type="checkbox"/> B	one copy of each gene	the same alleles for all genes
<input type="checkbox"/> C	two copies of each gene	different alleles of some genes
<input type="checkbox"/> D	two copies of each gene	the same alleles for all genes

(Total for question = 2 marks)

Q2.

Yeast is a single-celled organism that can respire aerobically.

Mitochondria are the sites of aerobic respiration in yeast cells.

(i) Name two molecules needed for aerobic respiration that can move into the mitochondria. (2)

1

2

(ii) The outer mitochondrial membrane is not permeable to hydrogen ions (H^+). Explain the importance of this feature of the membrane.

(4)



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(Total for question = 6 marks)



Q3.

The scientific article you have studied is adapted from *Scientific American*.

Use the information from the scientific article and your own knowledge to answer the following question.

"Why is aging, smoking or radiation exposure associated with cancer?" (paragraph 8). Explain why "These things cause mutations".

(3)

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(Total for question = 3 marks)

Q4.

(i) Muscle contains actin and myosin protein fibres.

Which of the following describes the primary structure of a protein?

(1)

- A amino acids joined by hydrogen bonds
- B amino acids joined by ester bonds
- C amino acids joined by peptide bonds
- D amino acids joined by phosphodiester bonds



(ii) Describe the structure of an amino acid.

(3)

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Q5.

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 .

Moving a limb involves the interaction of muscles, tendons and ligaments.

Tendons and ligaments are important structures in elbow and knee joints.

(i) Which of the following identifies the structures that join bones to bones in an elbow joint?

(1)



- A ligaments only
- B ligaments and tendons
- C tendons only
- D neither ligaments nor tendons

(ii) One type of joint injury is a torn ligament. This may be treated by adding a piece of tendon to the ligament. This is because after a period of time, the tendon tissue changes and responds in the same way as a ligament.

Which of the rows in the table correctly describe the changes in this piece of tendon?

(1)

Row	Piece of tendon shows a change in its	The change is
1	genotype	an anatomical adaptation
2	genotype	a physiological adaptation
3	phenotype	an anatomical adaptation
4	phenotype	a physiological adaptation

- A row 1 only
- B row 3 only
- C rows 1 and 2
- D rows 3 and 4

*(iii) The photograph shows athletes competing in the modern triathlon.



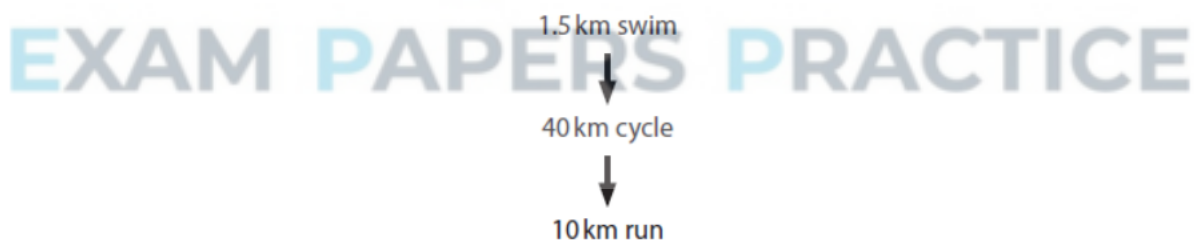
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The modern triathlon involves three sports: swimming, cycling and running.

An investigation was carried out to compare the level of demand on the body of these three sports during a triathlon.

The investigation involved 12 athletes who were all males of the same age.

Each athlete carried out the triathlon as shown in the flow diagram. There was no rest period between each sport.



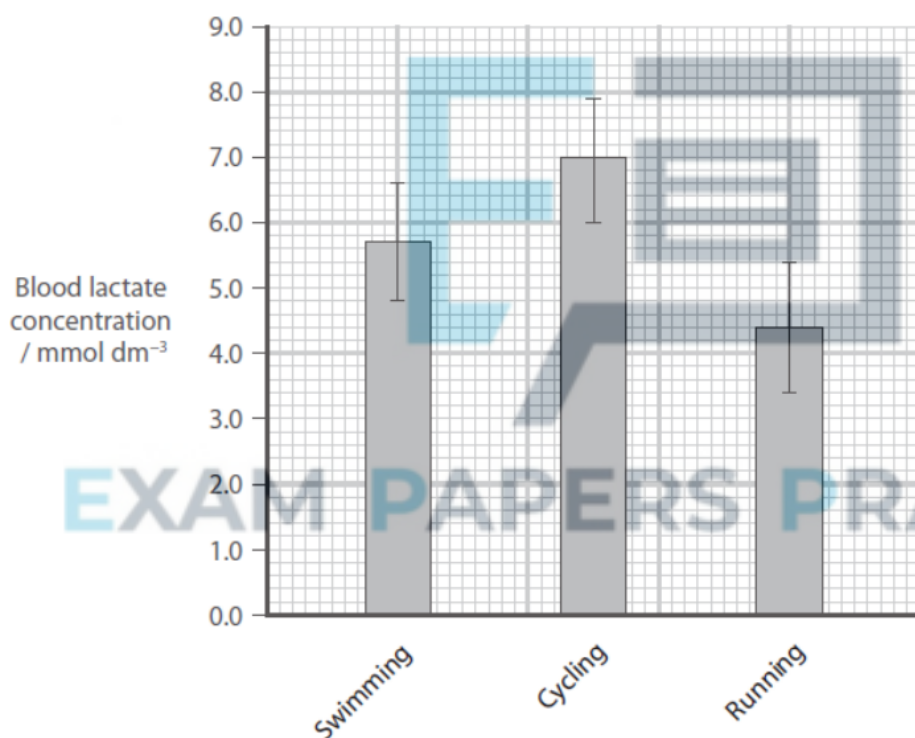
The heart rate for each athlete was measured as they completed each sport.

The mean heart rate for each sport was then calculated and is shown in the table.



Sport	Mean heart rate / bpm
Swimming	163
Cycling	165
Running	159

The blood lactate level for each athlete was also measured as they completed each sport. Means for lactate level after each sport were calculated.



The results are shown in the graph.

It was concluded that cycling was the most demanding of the three triathlon sports. This was followed by swimming and then running.

Evaluate the validity of this conclusion.

(6)

(Total for question = 8 marks)



Q6.

The structure of the cell surface membrane can be explained using the fluid mosaic model.

This model suggests that there are a variety of different proteins and glycoproteins present in a phospholipid bilayer.

* The ratio of lipid to protein in a cell surface membrane is approximately 1:1.

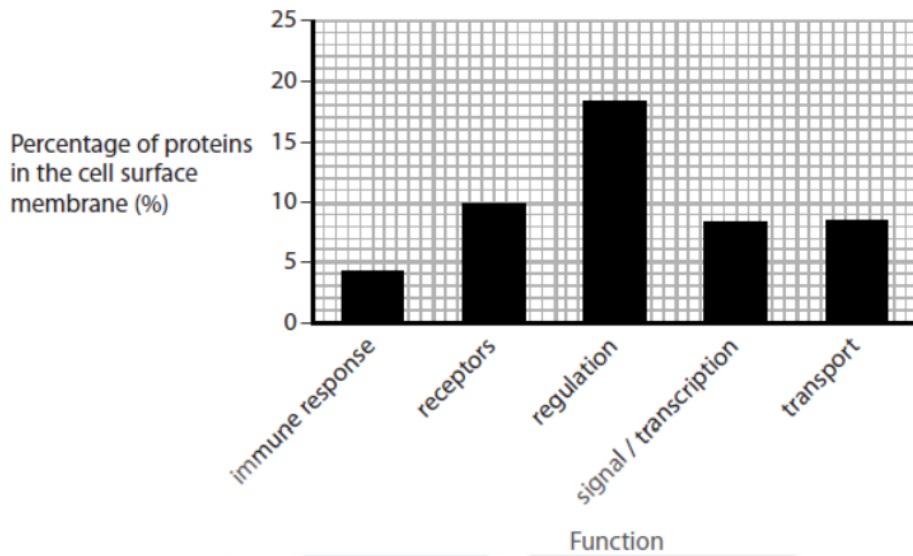
Scientists have studied the proteins present within human cells. Proteins in a cell are found in several locations.

Location within a cell	Percentage of total protein present (%)
cell surface membrane	68.2
cytoplasm	1.4
endoplasmic reticulum / Golgi apparatus	1.4
nucleus	14.5
other	14.5

The table shows the percentage of protein found in some locations in a cell.

The proteins within the cell surface membrane were further analysed for their function.

The graph shows some of the results of this analysis.



Analyse the data to evaluate the following statement.

'The variety of different proteins present in the cell surface membrane makes them more important than the phospholipid bilayer to the functioning of that cell.'

(9)

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(Total for question = 9 marks)

Q7.

Tuberculosis (TB) is an infectious disease caused by mycobacteria.

Individuals infected with *M. tuberculosis* can be treated with antibiotics.

Antibiotic	Mechanism of action
Isoniazid	Inhibits the synthesis of a fatty acid needed to make bacterial cell walls
Rifampicin	Inhibits bacterial RNA polymerase
Streptomycin	Binds to bacterial ribosomes to prevent the binding of tRNA
Pyrazinamide	Not yet known, but not the same mechanisms as the other three antibiotics

Four of the antibiotics used to treat TB are shown in the table.

In one clinical trial lasting six months, the effect of treating TB with these antibiotics was investigated.

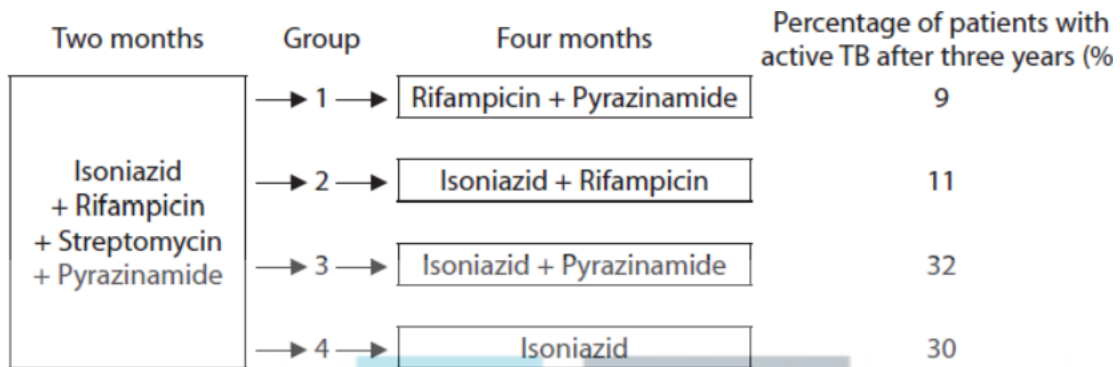
All patients were treated with all four antibiotics for two months. Then they were treated with different pairs of antibiotics or isoniazid alone for a further four months.



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All patients were free of any signs of active TB at the end of the clinical trial.

The design of the trial and the percentage of these patients with TB three years after the trial ended are shown in the diagram.



Analyse the data to comment on the effectiveness of these antibiotics for the treatment of TB.

(6)

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(Total for question = 6 marks)

Q8.

Tissues of the human body have different stem cell populations.

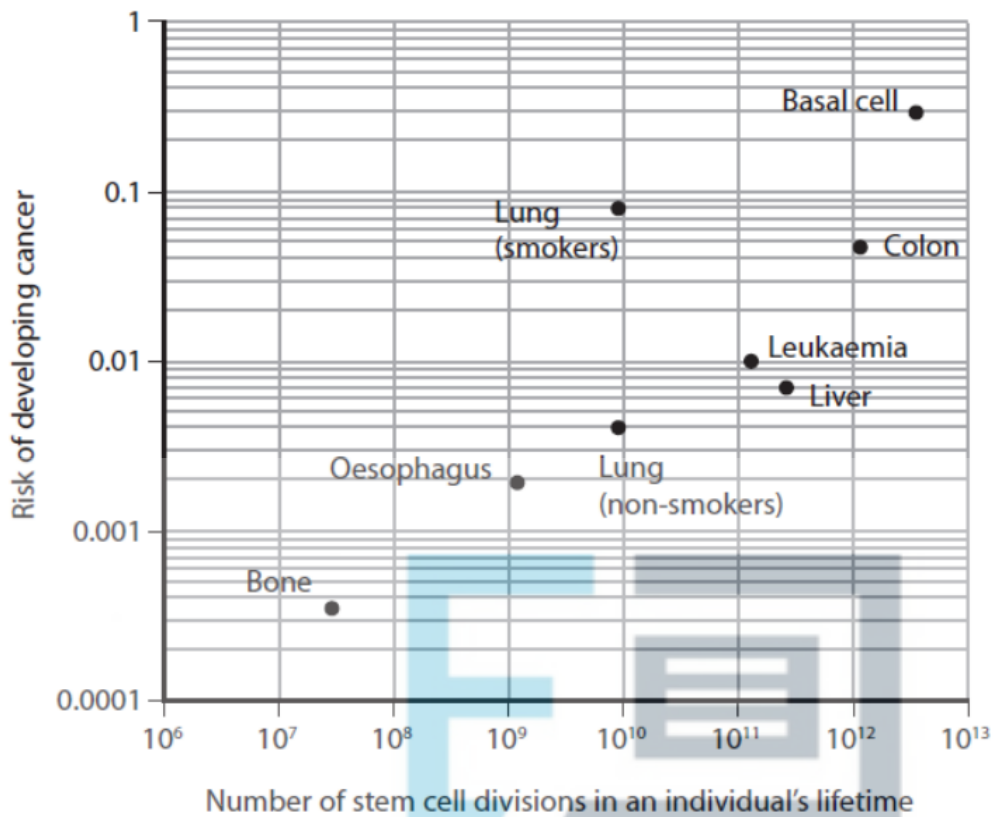
These stem cells divide to replace and renew cells in these tissues.

Scientists have observed a relationship between the number of times a stem cell population divides in a tissue and the risk of developing cancer in that tissue.

This relationship is shown in the graph.



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(i) The correlation coefficient for the data is 0.937.

The table shows some critical values for this correlation coefficient.

Critical values for the correlation coefficient	
n	p = 0.05
4	1.00
5	0.90
6	0.83
7	0.71
8	0.64
9	0.60
10	0.56

Which of the following correctly describes the correlation?

(1)

- A non-significant and positive
- B non-significant and negative
- C significant and positive
- D significant and negative

(ii) Explain the relationship between the number of stem cell divisions and the risk of developing cancer.

(2)

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(iii) The graph shows that the risk of developing lung cancer is greater in a cigarette smoker compared to a non-smoker.

Calculate how many times greater.

(2)

Answer

(iv) Explain why cigarette smokers have a higher risk of developing lung cancer than non-smokers.

(2)



Q9.

*Genetic testing can be used to identify individuals who have genetic disorders such as Batten disease.

The table shows examples of some types of genetic screening and examples of where they may be used.

Type of screening	Method	Example
Blood test to identify risk of a disease	DNA from a blood sample is examined	Identifying presence of BRCA1 and BRCA2 mutations where there is a family history of breast cancer
Blood test to identify carriers of a genetic disease	DNA from a blood sample is examined	Establishing if a person is heterozygous for a recessive condition such as cystic fibrosis (CF)
Amniocentesis	Fetal DNA from amniotic fluid is tested	Identifying genetic disorders in the fetus
Chorionic villus sampling (CVS)	Fetal DNA from placental tissue is tested	Identifying genetic disorders in the fetus
Non-invasive prenatal diagnosis (NIPD)	Analysis of fetal DNA fragments from blood samples from the mother	Identification of chromosomal disorders and a small number of single gene disorders in the fetus
Pre-implantation genetic diagnosis (PGD)	Combined with IVF to test embryo at 8-cell stage	Ensures only embryos without a genetic disorder such as CF are implanted



Q10.

All known organisms can be placed into one of the three domains of life.

The table shows some information about the three different domains.

Feature	Archaea	Bacteria	Eukaryota
DNA is circular	Yes	Yes	No
DNA is single-stranded	No	No
Growth inhibited by the antibiotic streptomycin	No	Yes	No
Name of the link between fatty acids and glycerol in lipids	Ether	Ester	Ester
Presence of cell wall	Some	Yes
Methionine required for starting protein synthesis	Yes	No	Yes
Transcription factors required for transcription	Yes	No	Yes

Complete the table to show the features in Bacteria and in Eukaryota.

(2)

(Total for question = 2 marks)

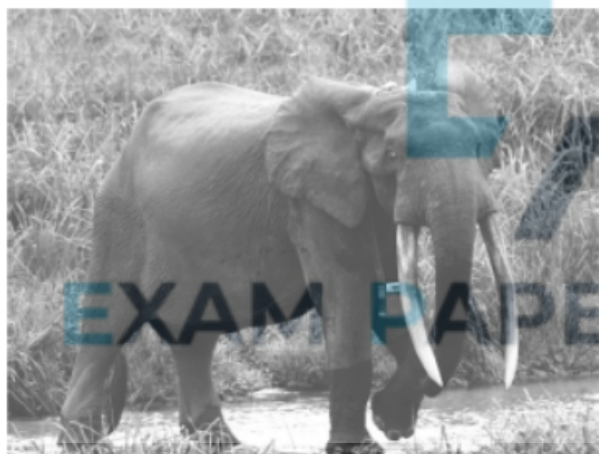


Q11.

Scientists have studied behavioural, anatomical and genetic variation in elephants. The table shows some information about two populations of African elephants.

Population	Location	Feeding behaviour	Anatomical differences
Forest elephant	tropical forest of central and West Africa	feeds on leaves and fruits of high-growing plants such as shrubs and trees	<ul style="list-style-type: none">• lower jaw longer and narrower• tusks straighter and downward facing• overall a much smaller size
Savannah elephant	African savannah	feeds on grass and leaves of low-growing shrubs	<ul style="list-style-type: none">• lower jaw shorter and wider• tusks more curved and upward facing• overall a larger size

The photographs show elephants from the two populations.



Forest elephant



Savannah elephant

DNA samples were collected from these two populations of elephants.

One of the genes showing variation was the GBA gene. The table shows the frequency of the alleles of the GBA gene in the two populations.



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GBA allele	Frequency of allele in the elephant population	
	Savannah elephant	Forest elephant
J	0.05	0.43
K	0.00	0.57
L	0.95	0.00

(i) State what is meant by the term **allele**.

(1)

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(ii) Use the Hardy-Weinberg equation to show that more than 50% of the forest elephant population are homozygous for the GBA gene.

(3)

Answer

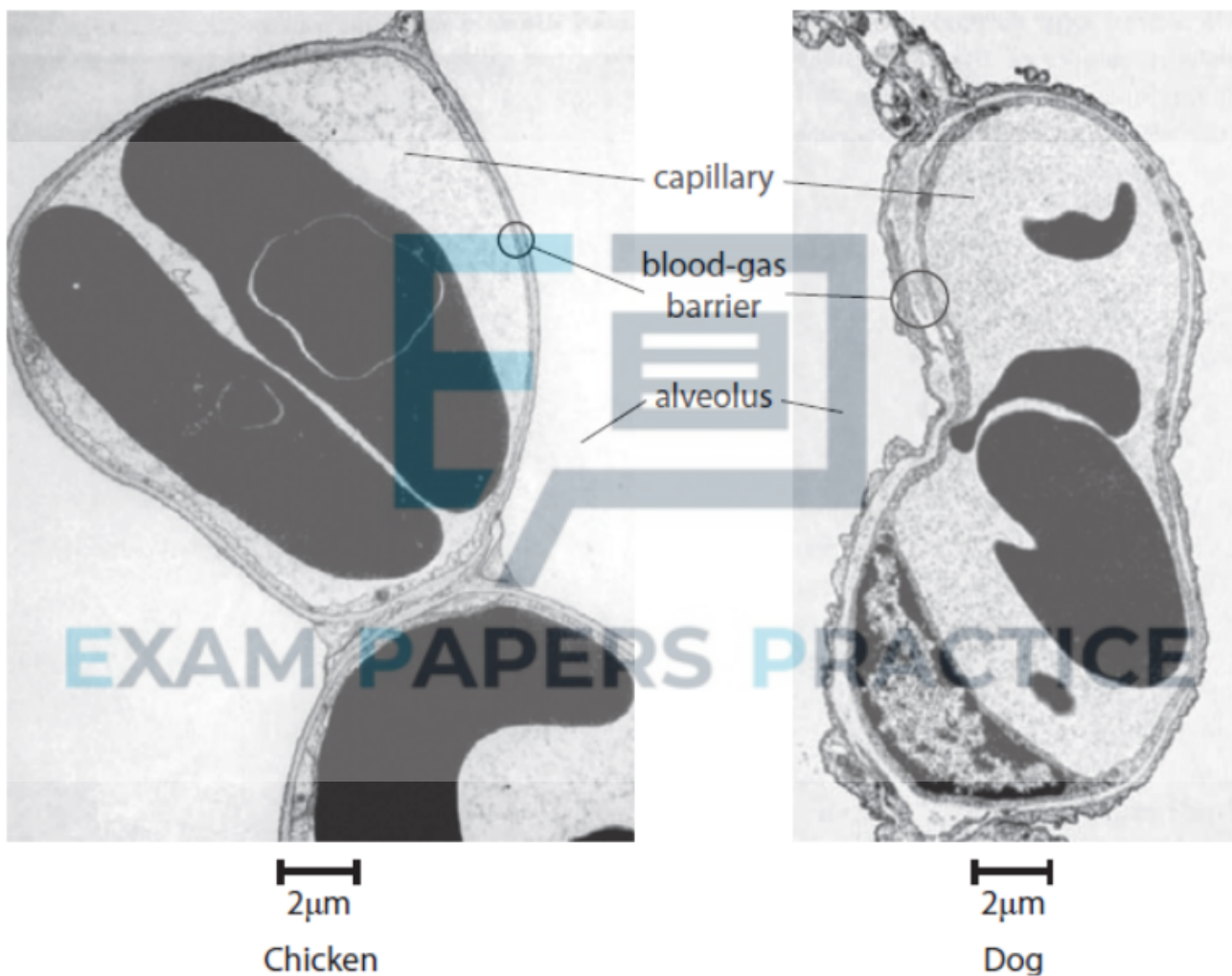
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Q12.

In birds and mammals, gas exchange takes place between the blood in the capillaries and the air in the alveoli.

There are three layers between the blood and the air in the alveoli: the capillary wall, a layer of extracellular matrix and the alveolar wall. This is called the blood-gas barrier.



The electron micrographs show the blood-gas barriers for a chicken and a dog.

Explain how the blood-gas barrier of the chicken is adapted to give more efficient gas exchange than the blood-gas barrier of the dog.

(3)



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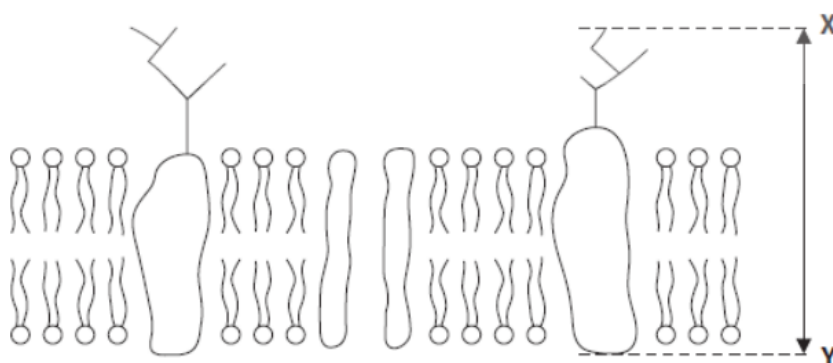
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(Total for question = 3 marks)

Q13.

The structure of the cell surface membrane can be explained using the fluid mosaic model. This model suggests that there are a variety of different proteins and glycoproteins present in a phospholipid bilayer.

The drawing shows the cell surface membrane of a liver cell. The drawing has a magnification of 5×10^6 .



Calculate the actual length of the glycoprotein between points X and Y.
Give your answer with an appropriate unit.

(2)



Answer

(Total for question = 2 marks)

Q14.

During the development of the mammalian heart, there is a hole between the left ventricle and the right ventricle.

This hole usually becomes sealed before the mammal is born. If it is not sealed, the mammal will become easily tired due to a lack of energy.

Explain why a mammal born with a hole between the two ventricles will have these symptoms. (3)

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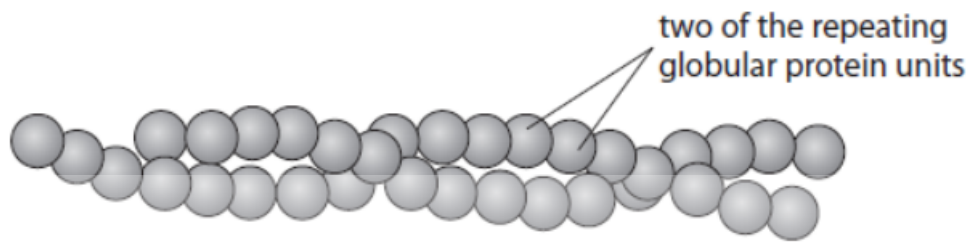
(Total for question = 3 marks)



Q15.

Actin and collagen are both proteins.

The diagram shows two filaments of actin from a muscle fibre. Each filament is a polymer of repeating globular protein units.



Compare and contrast the structures of an actin filament and collagen.

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(Total for question = 3 marks)

Q16.

Glucosaminoglycans (GAGs) are the by-products of chemical reactions inside cells. GAGs are broken down by enzymes inside lysosomes in cells.

Mucopolysaccharidosis type I (MPS I) is a genetic condition that results in the build-up of GAGs inside cells.

MPS I affects the production of enzyme G that breaks down GAGs inside lysosomes.

Enzymes work by

(1)

- A** increasing the activation energy of a reaction
- B** lowering the activation energy of a reaction
- C** providing energy to the reactants
- D** removing energy from the products

(Total for question = 1 mark)

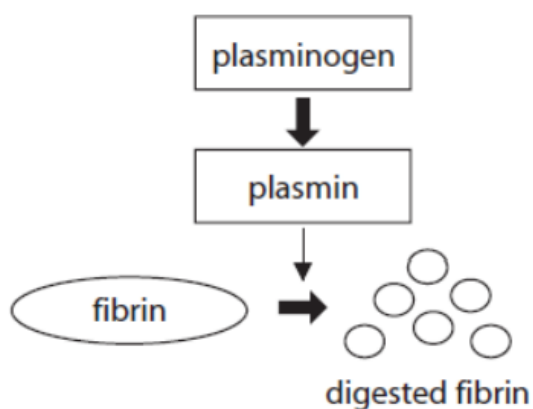
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Q17.

Beetroot cells contain the pigment betalain.

When beetroot cells are placed in alcohol, the concentration of betalain in the cells changes. Explain why alcohol affects the concentration of betalain in these cells.

(3)



Pharmaceutical companies have developed drugs that inhibit the activity of plasmin. One of these drugs, tranexamic acid, is used in surgery to reduce blood loss.

The active site of the plasmin enzyme binds to the amino acid lysine on the fibrin protein molecule.

Plasmin binds to part of the fibrin molecule in order to break down the fibrin. The diagrams show the structure of lysine in the fibrin polypeptide and the structure of tranexamic acid.



Deduce why tranexamic acid prevents plasmin breaking down fibrin.

(3)



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(ii) Describe the role of tRNA in the production of leptin.

(3)



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(iii) Describe how the primary structure of leptin enables it to be soluble in water.

(3)



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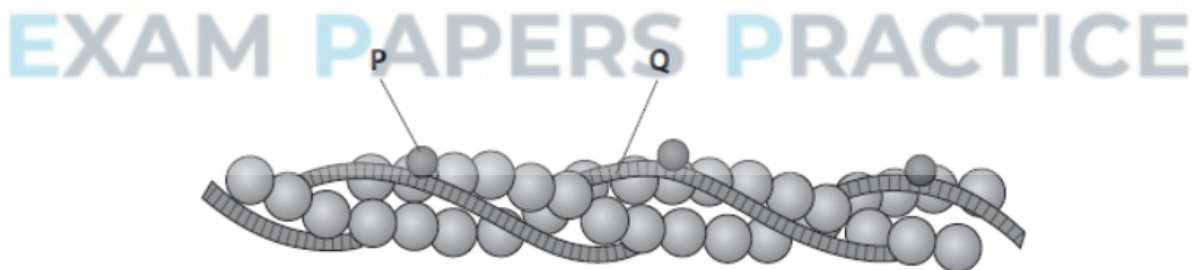
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(Total for question = 2 marks)

Q22.

The diagram shows actin and other components (P and Q) of a thin filament in a myofibril.



(i) Describe the interaction between P and Q that allows muscle contraction.

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(ii) The thick filament in a myofibril contains myosin. The myosin head contains the enzyme ATPase. Explain the importance of the primary structure for the functioning of this enzyme.

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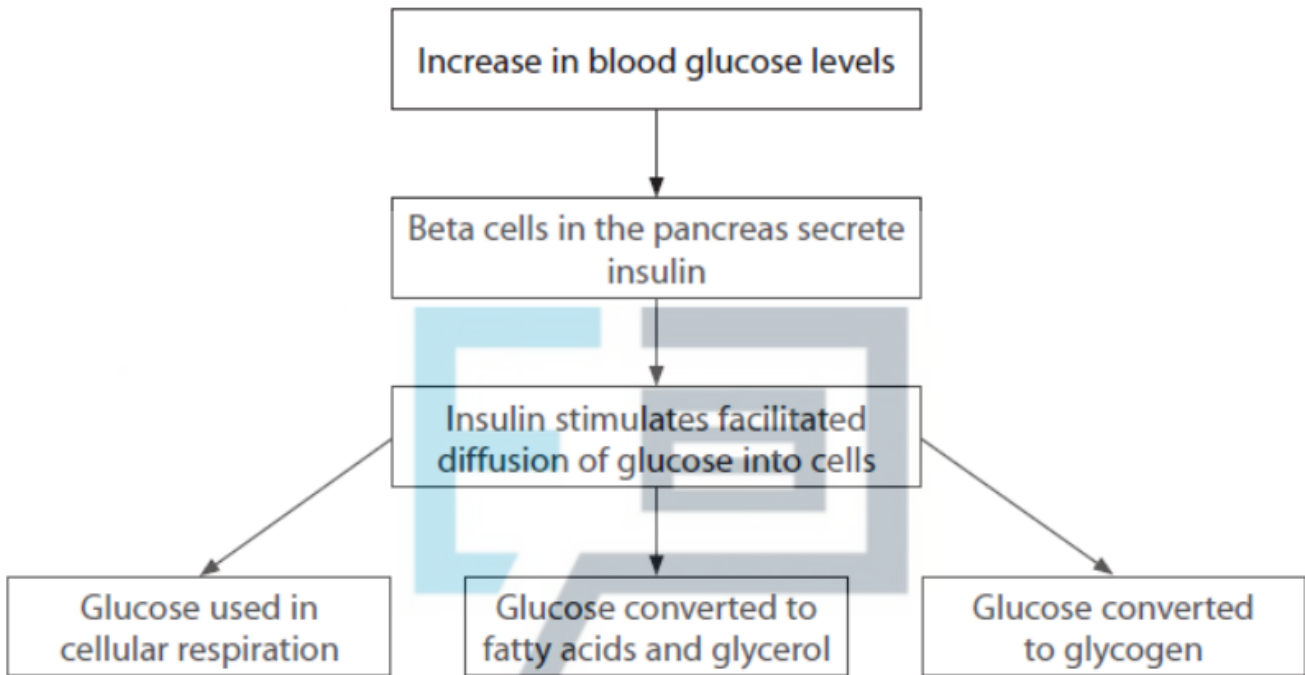
(Total for question = 5 marks)



Q23.

The internal conditions within the body are maintained by homeostatic mechanisms. The regulation of blood glucose involves homeostatic mechanisms.

The diagram shows part of the sequence of events when there is an increase in blood glucose levels.



(i) Describe how glucose moves into cells by facilitated diffusion.

(2)

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(ii) Explain how the structure of glycogen allows it to be an energy store.

(3)

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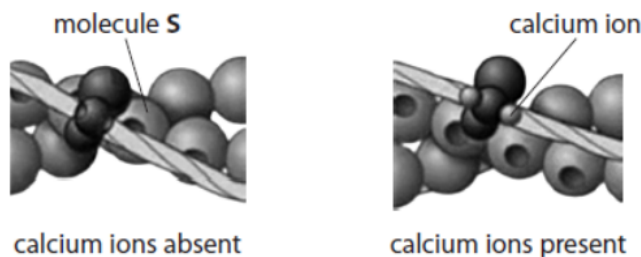
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(Total for question = 5 marks)

Q24.

Muscle cells contain myofibrils. The diagrams show the arrangement of some of the molecules present in a myofibril when calcium ions are absent and when they are present.



Describe how the concentration of calcium ions around the myofibrils is controlled.

(3)



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(Total for question = 3 marks)

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Q25.

The scientific article you have studied is adapted from several sources.

Use the information from the scientific article and your own knowledge to answer the following questions.

'The hunger system is mediated by hormones from the gut and from fat cells' (paragraph 6). Describe how these fat cells could release hormones.

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(Total for question = 2 marks)

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