Voice of the Genome -1

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 -1

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

Q1.

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

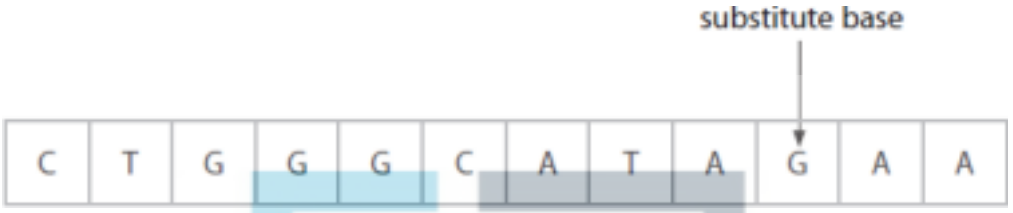
(Total for question = 3 marks)

Q2.

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.

One of the most common mutations causing thalassaemia is the substitution of one adenine base with guanine. The diagram shows the location of the mutation in part of the DNA strand coding for four amino acids.



Explain why this mutation affects the function of the haemoglobin molecule. (3)

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(Total for question = 3 marks)

Q3.

The consistency of the mucus is determined by the movement of water, by osmosis, from the cells lining the bronchi.

Explain how the partial permeability of the surface membrane of the cells lining the bronchi allows osmosis to take place.

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Q4.

All cells have a cell surface membrane.

Cell surface membranes regulate the movement of substances into and out of cells. (i) Which of the following describes the movement of water by osmosis? **(1)**

☐	**A**	against a solute concentration gradient	through a fully permeable membrane
☐	**B**	against a solute concentration gradient	through a partially permeable membrane
☐	**C**	down a solute concentration gradient	through a fully permeable membrane
☐	**D**	down a solute concentration gradient	through a partially permeable membrane

(ii) The concentration of potassium ions inside an animal cell is many times higher than the concentration of potassium ions in the extracellular fluid.

Which mechanism is responsible for the uptake of potassium ions by this animal cell? (1)

- **A** active transport
- **B** exocytosis
- **C** osmosis
- **D** passive diffusion

(iii) Glucose enters cells by facilitated diffusion.

Which part of the cell surface membrane allows facilitated diffusion of glucose? (1)

- A cholesterol
- B glycolipid
- C phospholipid
- D protein

(Total for question = 3 marks)

Q5.

Peat bogs are formed over millions of years from the remains of plants and animals.

Waterlogging and acidic conditions prevent the decomposition of plants and animals in peat bogs.

The photograph shows peat being cut from a peat bog.

(i) State how the age of the layers in a peat bog can be determined.

(1)

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(Source: © Reimar/Shutterstock)

(ii) Explain why the conditions in peat bogs prevent decomposition.

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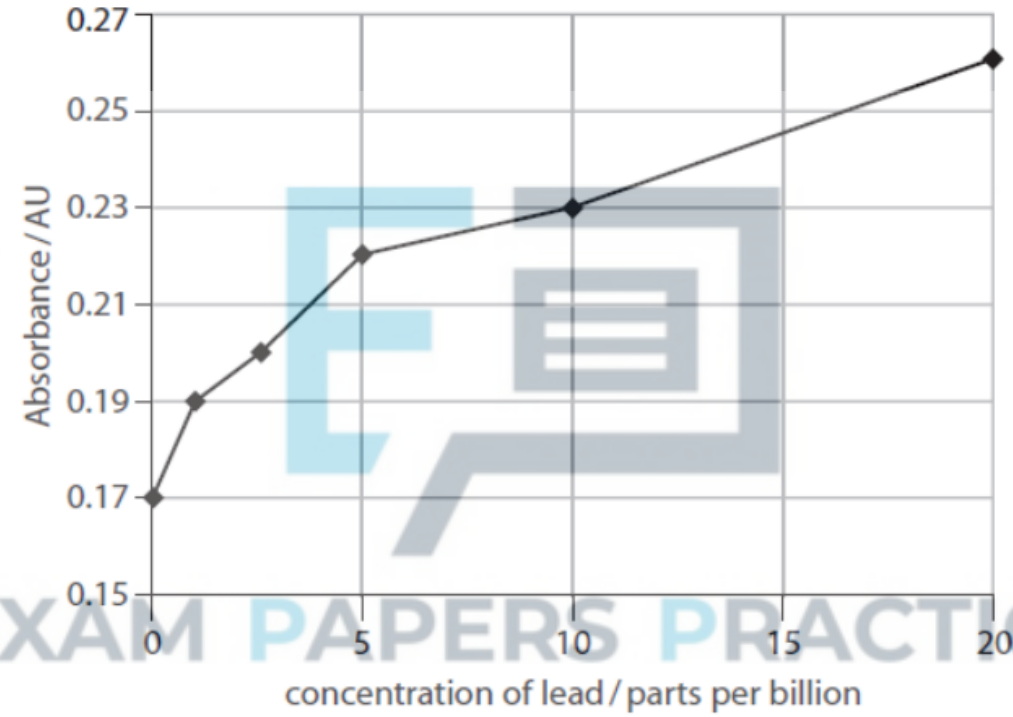
(Total for question = 4 marks)

Q6.

Lead is a toxic metal that can affect the structure of proteins. Lead affects protein in a similar way to changing pH.

Beetroot vacuoles contain a pigment. The absorbance of a solution is proportional to the concentration of the pigment in the solution.

The graph shows the results of a scientific investigation to study the effect of increasing lead concentration on the permeability of the membranes of beetroot cells.



(a) State the name of the membrane that surrounds the vacuole in beetroot cells.

(1)

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(b) Calculate the difference in percentage increase in absorbance between the lead concentration of 0-10 parts per billion and 10-20 parts per billion.

(3)

Answer ..... %

(c) (i) Explain the effect of lead on membrane permeability in beetroot cells. **(2)**

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(ii) Devise an investigation to determine whether pH has a similar effect to lead on the permeability of the membranes of beetroot cells.

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(Total for question = 10 marks)

Q7.

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.

Explain why this mutation may prevent the enzyme involved in the production of haem from functioning correctly.

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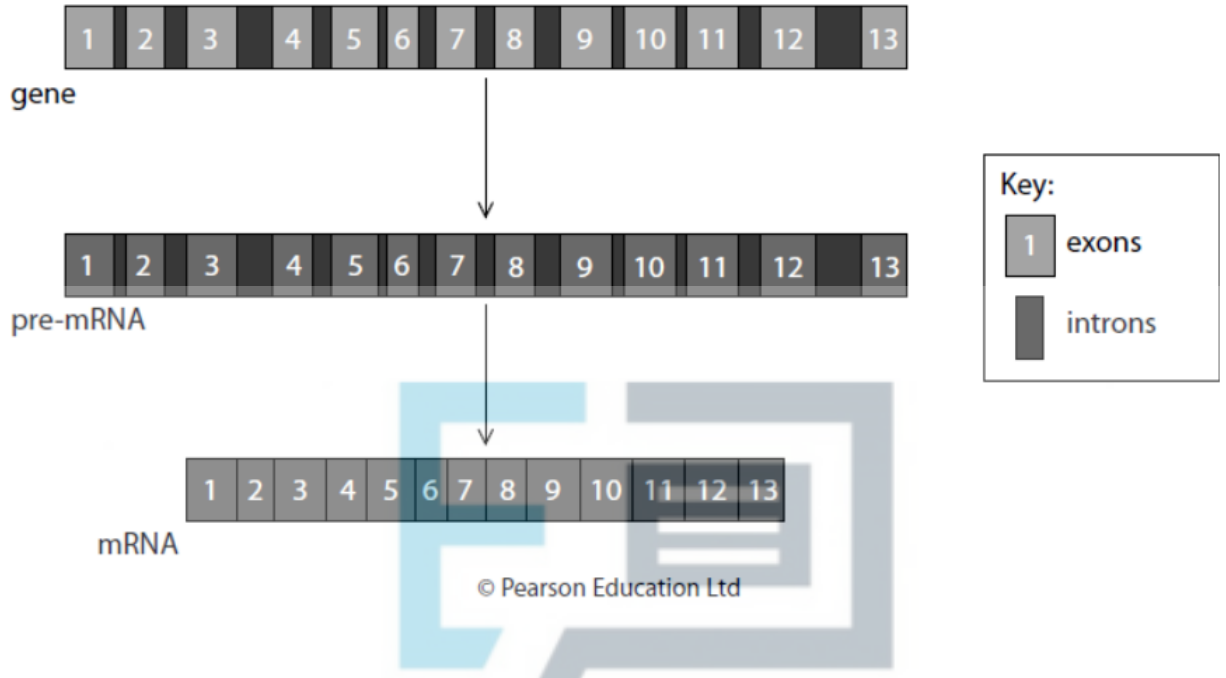
(Total for question = 4 marks)

Q8.

A central idea in biology is that DNA codes for the synthesis of proteins from amino acids. The instructions for making proteins are in the form of mRNA.

The diagram shows two stages in the production of mRNA.



(a) Explain how this molecule of mRNA is produced.

(4)

(Total for question = 4 marks)

Q9.

The scientific article you have studied is adapted from 'How Performance-Enhancing Drugs Work.'

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

(a) (i) The population of the UK is 63 182 000 of which 49 182 000 are adults (paragraph 13).

Calculate the number of adults who have asthma.

(2)

Answer .....

(ii) People with asthma sometimes have difficulty breathing (paragraph 13). Explain how beta-2 agonists may help to relieve their symptoms.

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(iii) Explain how beta-2 agonists can increase the heart rate (paragraph 13).

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(b) Explain how human growth hormone (HGH) is able to stimulate cells to secrete IGF-1 (paragraphs 20 and 21).

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(c) Explain why it is difficult to identify athletes who are using banned substances such as HGH (paragraphs 17, 20 and 22).

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(d) Explain one benefit of using substances developed from perfluorocarbons (PFCs) to treat patients with breathing difficulties (paragraphs 30 and 31).

(2)

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(e) Local anaesthetics mask pain by binding to protein channels in the membranes of neurones (paragraph 38).

Explain how binding to protein channels will prevent pain being sensed by the pain centre of the brain.

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(f) Explain why diuretics are a prescribed drug for high blood pressure (paragraph 43).

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(g) A test for the T/E ratio can help to identify athletes who have injected testosterone into their body (paragraph 45).

Explain the limitation of this test.

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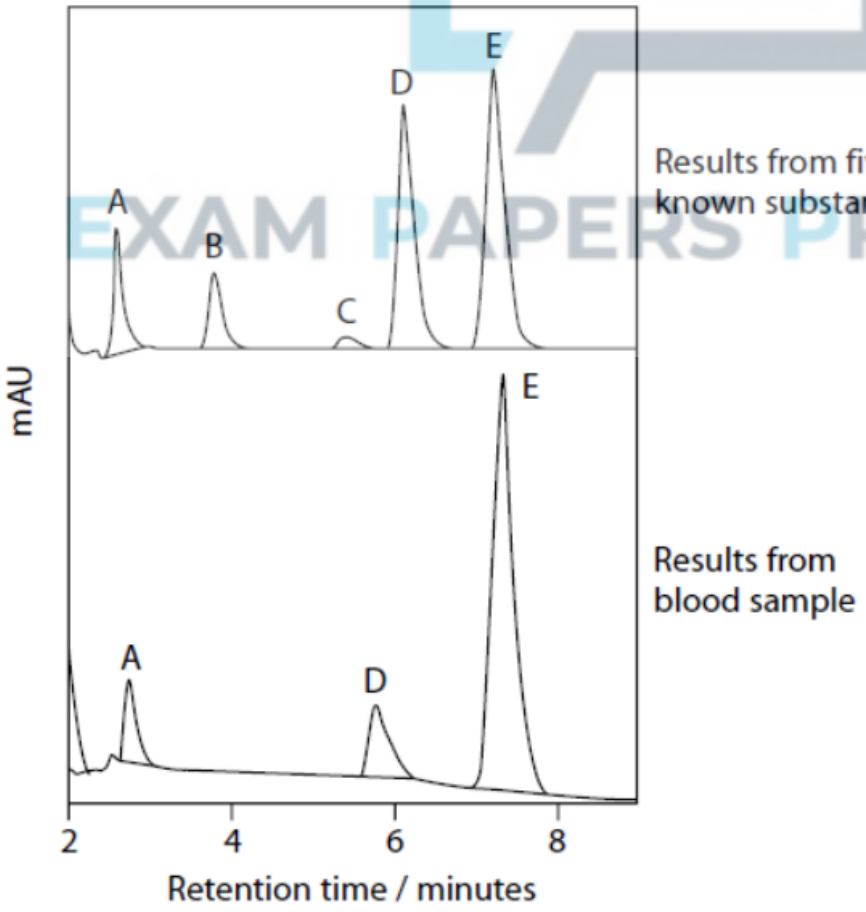
(h) Gas chromatography (GC) can be used to detect athletes who have taken banned drugs (paragraph 48).

The chromatogram shows the GC results for five known banned substances, A, B, C, D and E.



Explain why the peak for drug E is different from the peak for drug A (paragraph 48).

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(i) Explain how the blood passport may result in more effective monitoring of athletes (paragraph 51).

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(j) Comment on the ethical viewpoints for and against the use of performance-enhancing drugs by athletes.

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(Total for question = 33 marks)

Q10.

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 ☒.

In the lungs, oxygen moves from the alveoli into red blood cells.

(i) How many times does an oxygen molecule cross a cell surface membrane to move from the centre of an alveolus to the centre of a red blood cell?

(1)

☐ **A** 2

☐ **B** 3

☐ **C** 4

☐ **D** 5

(ii) Oxygen enters the red blood cell by

(1)

☐ **A** active transport

☐ **B** diffusion

☐ **C** facilitated diffusion

☐ **D** osmosis

(Total for question = 2 marks)

Q11.

Penicillin is an antibiotic. It was discovered in 1928. Since then many antibiotics have been identified and are widely used in the treatment of bacterial infections.

Scientists have recently discovered a new class of antibiotics that bind to ribosomes. (i) Explain why these antibiotics could affect the production of proteins in bacteria. **(3)**

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(ii) These new antibiotics attach to a site on the ribosome not affected by any known antibiotics.

Deduce why these new antibiotics might be used to treat bacteria that are resistant to other antibiotics.

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* (iii) Scientists have isolated these new antibiotics and tested their effectiveness against bacteria that are resistant to other types of antibiotic.

Devise a laboratory procedure to compare the effectiveness of penicillin with one of the new antibiotics.

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(Total for question = 11 marks)

Q12.

(i) Many of the proteins synthesised become extracellular enzymes.

Describe what happens to these proteins following the process of translation until they are released from the cell.

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(ii) Cells in people with these diseases produce incorrectly folded enzyme molecules.

Explain why enzymes that are incorrectly folded cannot carry out their function. **(3)**

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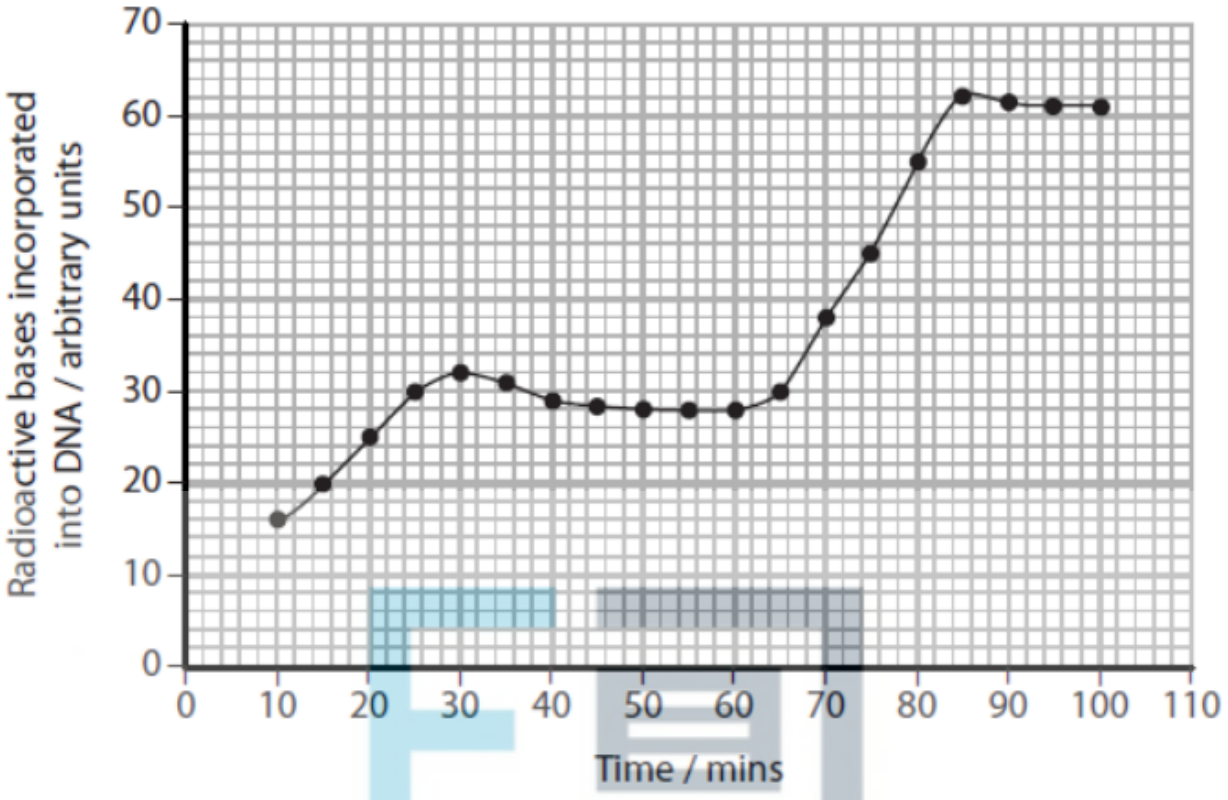
(Total for question = 6 marks)

Q13.

DNA synthesis in bacterial cell cultures has been investigated.

In an experiment, a mixture of radioactive bases was added to a culture of dividing bacteria. The results are shown in the graph.



(i) Calculate the fastest rate of uptake of bases by these bacteria.

(2)

Answer .....

(ii) Deduce how many times the bacteria in the culture have divided during this experiment. **(2)**

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(iii) Explain why the experiment would be improved if all the bases were provided but only the thymine was radioactive.

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(Total for question = 6 marks)

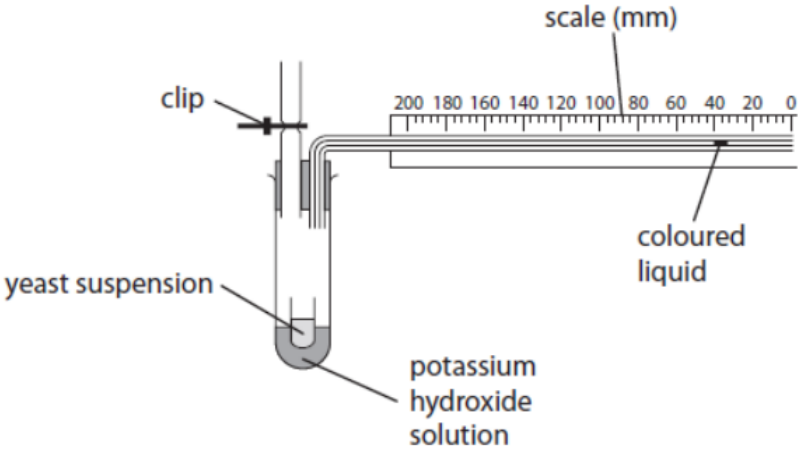
Q14.

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

Mitochondria are the sites of aerobic respiration in yeast cells.

It has been stated that if the temperature of yeast is raised by 10 °C, the rate of respiration will double.

The diagram shows some apparatus that can be used to measure the rate of respiration in yeast.



Devise an investigation using this apparatus to determine whether an increase of 10 °C doubles the rate of respiration in yeast.

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(Total for question = 4 marks)

Q15.

All cells have a cell surface membrane.

Some epithelial cells in the lungs secrete mucus. If the mucus is too 'sticky', it cannot be easily removed from the lungs.

Other epithelial cells in the lungs contain CFTR proteins in their cell surface membranes.

(i) Describe the role of the CFTR protein in ensuring that the mucus produced in the lungs has the right consistency.

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(ii) The table shows part of the gene that codes for the CFTR protein and the corresponding amino acid sequence. Each amino acid is represented by a single letter.

Part of the CFTR gene	ATTAAAGAAAATATCATCTTTGGTGTTTCCTAT										
Amino acid sequence	I	K	E	N	I	I	F	G	V	S	Y

Explain how the information in the table demonstrates the nature of the genetic code.

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(Total for question = 6 marks)

Q16.

There are a number of reactions that regularly occur in cells.

* Another reaction that regularly occurs in cells is phosphorylation.

Phosphorylation plays a significant role in a wide range of cellular processes. Over a quarter of a million scientific articles have been written on this subject.

Using your knowledge of biology, discuss the roles of phosphorylation in cells. **(9)**

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Q17.

Trypsin is an enzyme found in many groups of living organisms.

Trypsin specifically acts on a polypeptide to form amino acids.

State the type of chemical reaction catalysed by trypsin.

(1)

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(Total for question = 1 mark)

Q18.

Enzymes control biochemical pathways.

Phosphofructokinase is an enzyme involved in controlling the rate of glycolysis. State what is meant by the term enzyme.

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(Total for question = 2 marks)

Q19.

Collagen is a fibrous protein.

Explain how the structure of collagen is related to its function.

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Q20.

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 extracellular matrix contains collagen.

(i) Describe the structure of collagen.

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(ii) Give a function for collagen in the blood-gas barrier.

(1)

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(Total for question = 4 marks)

Q21.

Hereditary spherocytosis is a condition that affects red blood cells.

This inherited condition is caused by a gene mutation that affects the shape of the cell surface membrane.

Describe the structure of the cell surface membrane.

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(Total for question = 3 marks)

Q22.

Global warming can affect abiotic factors that determine the distribution of organisms. The presence of sodium chloride in soil is an abiotic factor that affects the germination of seeds.

The effects of sodium chloride solution and gibberellin on the germination of rice seeds have been investigated.

Gibberellin regulates developmental processes in plants.

Gibberellins can activate the gene for amylase in rice seeds.

Amylase is an enzyme that hydrolyses starch in the rice seeds.

Devise an investigation to demonstrate the effect of gibberellin on amylase activity in rice seeds treated with sodium chloride.

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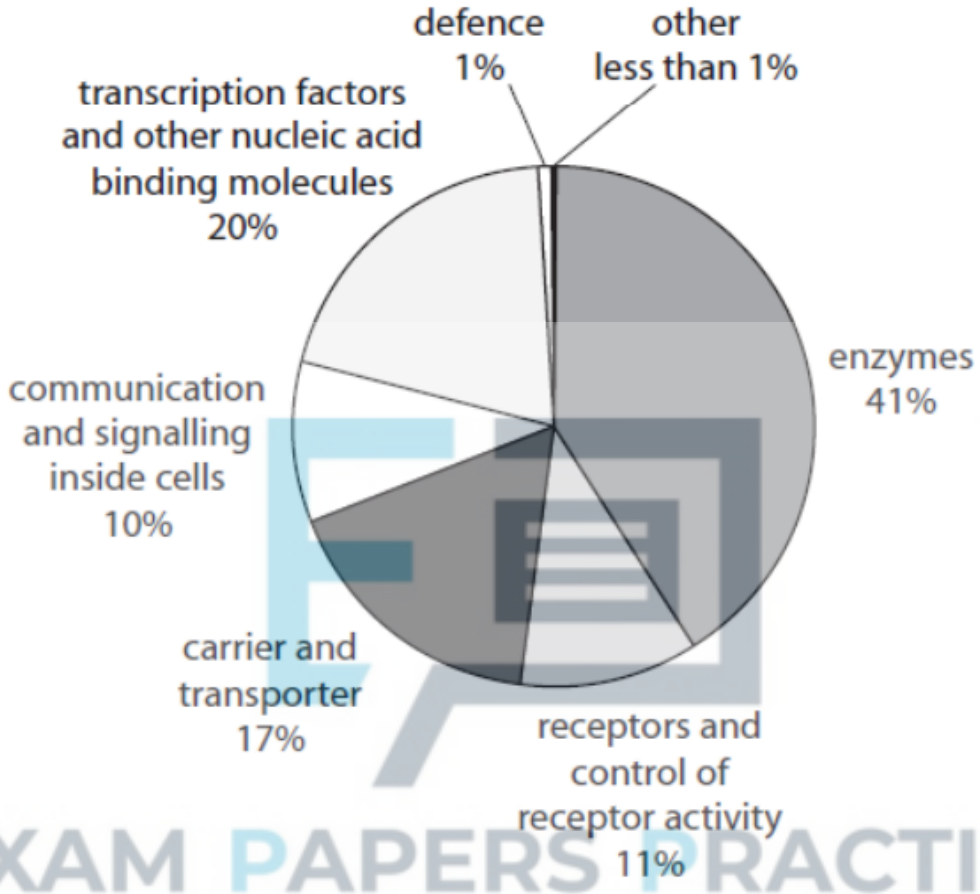
(Total for question = 4 marks)

Q23.

* The human genome codes for approximately 20 000 different proteins.
The pie chart shows the proportion of proteins carrying out different functions.



The 20 amino acids used to make proteins can be classified according to the properties of their side chains (R groups).

Table 1 shows the number of amino acids with these properties.

Property of the side chain group	Number of amino acids with the property
Non-polar	9
Polar, uncharged	6
Negatively charged	3
Positively charged	2

Table 1

Table 2 shows three amino acids, used to synthesise proteins, that have unique properties.

Amino acid	Comment on structure
Cysteine	The side chain contains a thiol group (-S-H) that is chemically reactive.
Glycine	The side chain is a hydrogen atom which is much smaller than any other side chain. This allows tight coiling of polypeptide chains.
Proline	The side chain forms a peptide bond with the nitrogen in the amino group. This makes a polypeptide chain more rigid.

Table 2

Discuss the importance of the amino acid side chain to the structure, function and location of proteins.

(9)

(Total for question = 9 marks)

Q24.

The inheritance of coat colour in mice has been investigated.

Some scientists crossed mice that had yellow coats. The offspring had either yellow coats or non-yellow coats.

(i) Explain how the scientists knew which allele for coat colour was recessive. **(2)**

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(ii) The crosses led to a total of 1599 offspring being produced.

Predict the number of yellow and non-yellow offspring produced. **(2)**

Offspring with a yellow coat	Offspring with a non-yellow coat

(iii) The table shows the actual number of offspring with each coat colour.

Offspring with a yellow coat	Offspring with a non-yellow coat
1064	535

Explain why there are differences between the predicted and actual numbers of these mice.

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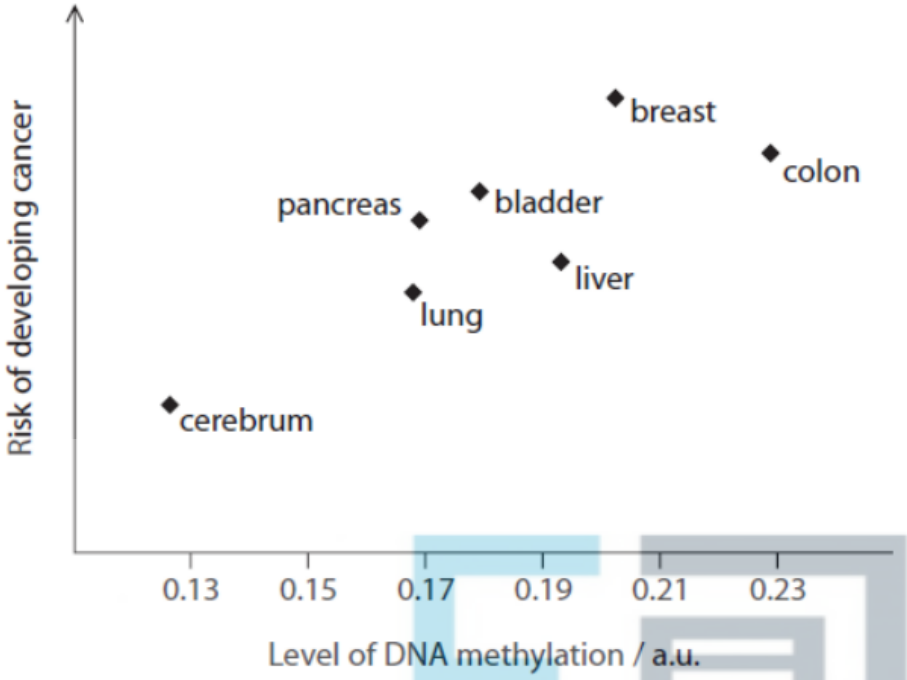
(Total for question = 7 marks)

Q25.

There is a link between the methylation of certain regions of DNA and the risk of developing cancer.

The graph shows the relationship between the level of methylation of these regions of DNA and the risk of developing cancer in different parts of the body by the age of 70.



(i) Draw a line of best fit on the graph to identify any correlation between the independent variable and the dependent variable.

(1)

(ii) An investigation studied the effect of age on the mean level of DNA methylation. In this investigation, the null hypothesis was rejected at the 5% significance level.

Explain what is meant by the phrase: the null hypothesis was rejected at the 5% significance level for this investigation.

(2)

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*(iii) Scientists have found that a high level of succinate leads to the inhibition of an enzyme called TET.

The function of TET is to remove methyl groups from DNA.

Explain how a mutation in the gene for succinate dehydrogenase can increase the risk of developing cancer.

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(Total for question = 9 marks)