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GCE

Edexcel Advanced Subsidiary GCE in Biology (Salters-Nuffield) (8048)

For examination from 2006

Edexcel Advanced GCE in Biology (Salters-Nuffield) (9048)

For examination from 2007

April 2005

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Sample assessment material

Edexcel AS/A GCE in
Biology (Salters-Nuffield) (8048/9048)

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Acknowledgements

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Publications code UA016189

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Introduction

The specimen papers and mark schemes in this publication are to support the GCE in Biology (Salters-Nuffield) specification, available from September 2006. The specimen papers and mark schemes in this publication, with the exception of Unit Test 6132/01, were used for the pilot specification in the June 2004 examination series.

Unit tests

Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	1	3	1	/	0	1	Signature	

Paper Reference(s)

6131/01

Edexcel GCE

Biology (Salters-Nuffield)

Advanced Subsidiary

Unit Test 1

Time: 1 hour 15 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
Total	

Materials required for examination
Ruler

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, the paper reference, your surname and initials, and your signature.
The paper reference is shown above. Check that you have the correct question paper.
Answer ALL SEVEN questions in the spaces provided in this booklet.
If you need to use additional answer sheets, attach them loosely but securely inside this booklet.
Show all the steps in any calculations and state the units. Calculators may be used.
Include diagrams in your answers where these are helpful.

Information for Candidates

The marks for individual questions and parts of questions are shown in round brackets: e.g. (**2**).
The total mark for this question paper is 60.

Advice to Candidates

You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, taking account of your use of grammar, punctuation and spelling.

Leave blank

Answer ALL questions in the spaces provided

1. The diagrams below show a pig (a mammal) and a flatworm (a small pond animal).

× 0.05

× 5

(a) Explain why a pig has a heart and circulatory system whereas a flatworm does not.

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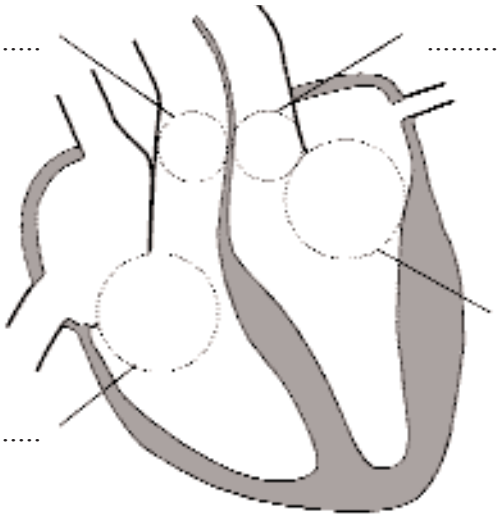
(2)

Leave blank

(b) The diagram below shows a cross-section of a mammalian heart. The positions of the valves are shown by the four circles.



(i) On the diagram, indicate whether each valve is open or closed during ventricular systole (contraction of the ventricles) by writing 'open' or 'closed' on the lines provided. Do not draw the valves.

(2)

(ii) Indicate the position of the sino-atrial node (pacemaker) by drawing a cross on the diagram.

(1)

(iii) State the role of the sino-atrial node.

.....

.....

(1)

(c) Suggest **two** advantages of the coronary artery branching directly off the aorta.

1. .....

.....

2. .....

.....

(2) **Q1**

(Total 8 marks)

Leave blank

2. (a) The table below summarises four processes by which molecules can pass across membranes.

Complete each box in the table with a ✓ if the statement is correct or a ✗ if the statement is incorrect.

Process	Requires energy from respiration (ATP)	Requires a concentration gradient
Passive diffusion		
Facilitated diffusion		
Osmosis		
Active transport		

(4)

(b) Explain how the structure of the lung makes it effective for gaseous exchange by diffusion.

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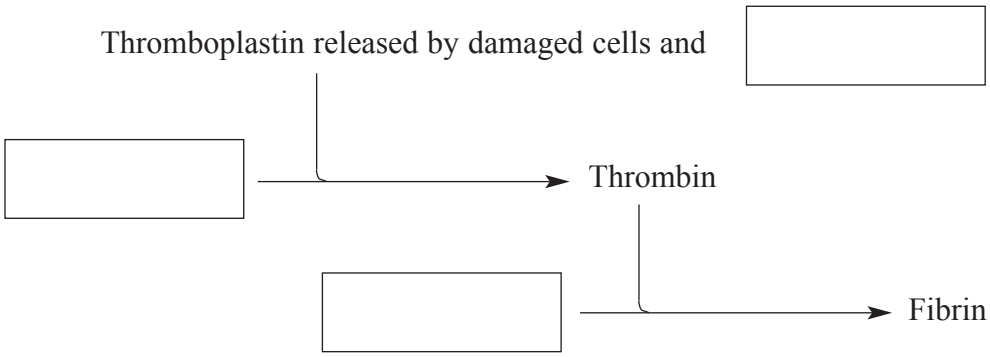
(4) **Q2**

(Total 8 marks)

Leave blank

3. (a) The diagram below summarises some of the steps involved in blood clotting. Complete the diagram by writing in the missing words in the boxes.



(3)

(b) Describe the possible effects of a blood clot forming in a coronary artery.

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(3)

(c) Name **one** drug that helps to prevent clotting.

.....

(1)

Q3

(Total 7 marks)

Leave blank

4. (a) Genetic screening can be used to identify carriers of genetic diseases.

Suggest **two** features needed to ensure that a screening programme is effective.

1. .....

.....

2. .....

.....

(2)

(b) When the risk of having an affected child is high, prenatal diagnosis may be offered.

(i) Name **one** technique that can be used to obtain a suitable tissue sample for prenatal genetic testing.

.....

(1)

(ii) Describe how the tissue sample is used to detect the presence of a defective gene such as the one responsible for cystic fibrosis.

.....

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.....

(4)

Leave blank

(c) In cystic fibrosis, symptoms are linked to a mutated form of the CFTR protein which acts as a chloride channel.

(i) The normal CFTR protein has 1480 amino acids. Calculate the number of nucleotides present in the mRNA coding for this protein. Show your working.

Answer .....
(1)

(ii) The first mutation to be identified was a deletion of three adjacent base pairs at the 508th codon, which resulted in the loss of the amino acid phenylalanine.

Using your knowledge of protein structure, explain how the loss of one amino acid results in a chloride channel which cannot function correctly.

.....

.....

.....

.....
(2)

(iii) Explain why the defective chloride channel results in sticky mucus in the airways.

.....

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.....

.....
(2)

Q4

(Total 12 marks)

Leave blank

5. Approximately 20% of the UK population is obese. Obesity increases a person's risk of coronary heart disease and having a stroke, even without other risks being present.

(a) A person described as obese has a body mass index (BMI) greater than 30.

Calculate the BMI for a person weighing 65 kilograms with a height of 1.75 metres. Show your working.

Answer .....

(2)

(b) Suggest **two** reasons why obesity has increased in the UK.

1. .....

.....

2. .....

.....

(2)

Leave blank

(c) Leptin is a peptide consisting of a chain of 167 amino acids. It is synthesised by cells in adipose tissue, and circulates in the blood as a hormone. Leptin acts on the part of the brain known as the hypothalamus to reduce food intake and increase energy expenditure. Studies on genetically obese mice suggest that some forms of obesity are due to a lack of leptin production, as a result of a mutation in the gene that codes for the hormone.

In humans, a mutation of this type might one day be treated by somatic gene therapy.

(i) Summarise the principles involved in somatic gene therapy.

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(3)

(ii) Discuss the ethical issues that should be considered when developing gene therapy to treat obesity.

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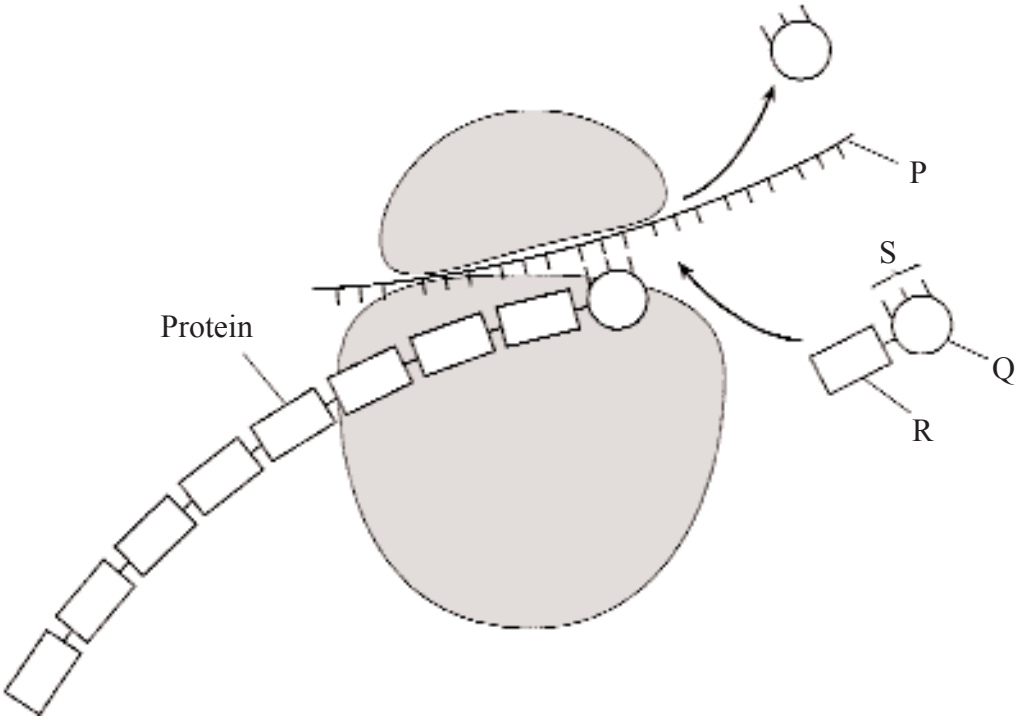
(2) **Q5**

(Total 9 marks)

Leave blank

6. During the process of protein synthesis in cells, the ribosome acts as a kind of 'workbench' where protein molecules are constructed.

The diagram below shows a protein being formed on a ribosome.



(a) Name the following structures shown on the diagram.

P .....

Q .....

R .....

S .....

(4)

Leave blank

(b) Complete the following passage describing the process of protein synthesis by writing the appropriate word in each space.

Genetic information is stored in the nucleus of a cell as molecules of

..... Protein synthesis occurs in the cytoplasm. Genetic

information is first copied in the process of ....., then

leaves the nucleus in the form of molecules of .....

In the cytoplasm these molecules pass to ribosomes to begin the process of

..... At the 'workbench' on the ribosome

..... base pairing occurs. Adenine pairs with

..... and cytosine pairs with

..... Adjacent amino acids are joined together by

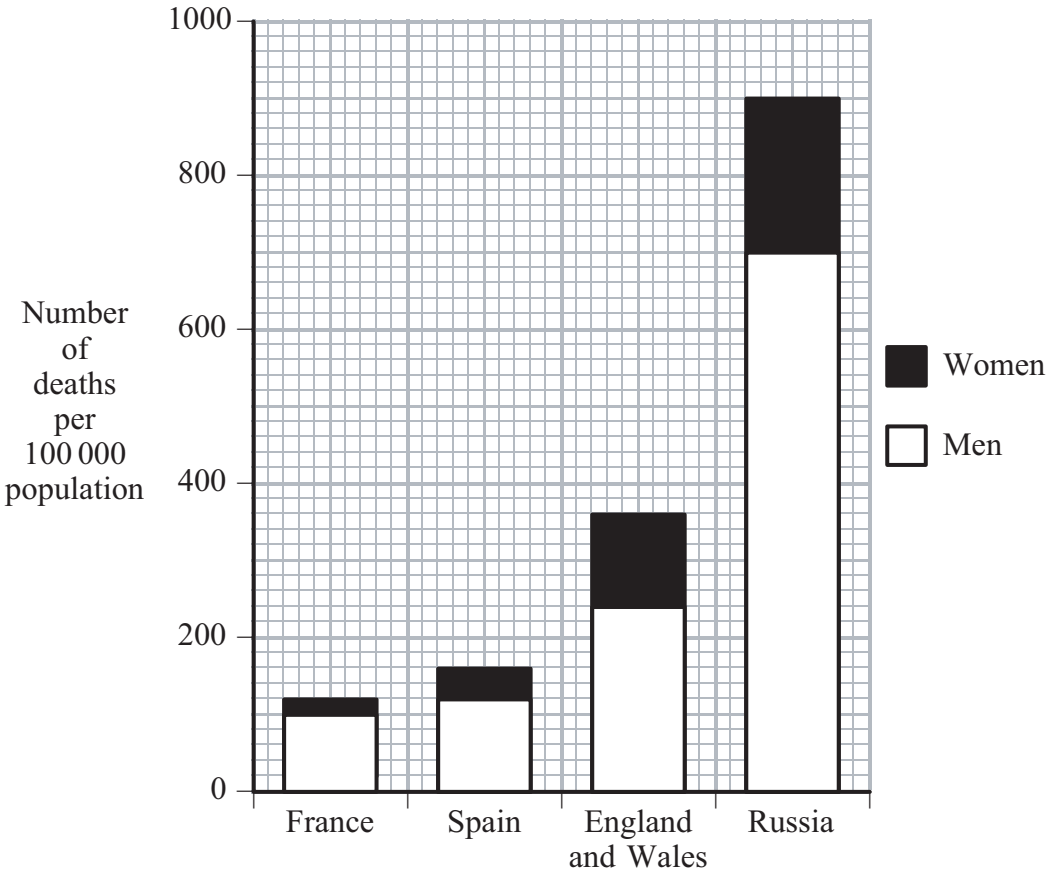
..... bonds.

(4) **Q6**

(Total 8 marks)

Leave blank

7. The chart below shows the number of deaths from cardiovascular disease per 100 000 population for men and women in four countries.



(a) Describe the differences in the death rates shown in the chart above.

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(3)

Leave blank

(b) One possible reason for the differences in the death rates due to cardiovascular disease between the different countries is the quantity of fruit and vegetables eaten.

Write a suitable null hypothesis that could be tested by an epidemiologist investigating the effect of fruit and vegetable consumption on deaths from cardiovascular disease.

.....

.....

(1)

(c) Suggest and explain **two** other reasons for the differences in the death rates between the countries due to cardiovascular disease.

1. .....

.....

.....

.....

(2)

2. .....

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(2) **Q7**

(Total 8 marks)

TOTAL FOR PAPER: 60 MARKS

END

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Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	1	3	2	/	0	1	Signature	

Paper Reference(s)

6132/01

Edexcel GCE

Biology (Salters-Nuffield)

Advanced Subsidiary

Unit Test 2

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
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7	
8	
Total	

Materials required for examination
Ruler

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, the paper reference, your surname and initials, and your signature.
The paper reference is shown above. Check that you have the correct question paper.
Answer ALL EIGHT questions in the spaces provided in this booklet.
If you need to use additional answer sheets, attach them loosely but securely inside this booklet.
Show all the steps in any calculations and state the units. Calculators may be used.
Include diagrams in your answers where these are helpful.

Information for Candidates

The marks for individual questions and parts of questions are shown in round brackets: e.g. (**2**).
The total mark for this question paper is 70.

Advice to Candidates

You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, taking account of your use of grammar, punctuation and spelling.

Leave blank

Answer ALL questions in the spaces provided.

1. The table below refers to some features of prokaryotic and eukaryotic cells.

Complete the table by writing a tick if the feature is present or a cross if the feature is absent. Do not leave any boxes empty. The first line has been done for you.

	Prokaryotic cell	Eukaryotic cell
Ribosomes present	✓	✓
Cell diameter usually more than 20 μm		
Cells may contain plasmids		
DNA combined with protein into chromosomes		
Nuclear membranes present		
Cell wall always present		

Q1

(Total 5 marks)

Leave blank

2. Read through the following account relating to some carbohydrates in plants, then write on the dotted lines the most appropriate word or words to complete the account.

Starch is made from the monosaccharide ..... whereas cellulose is made from the monosaccharide ..... . Polysaccharides are formed when ..... monosaccharides join together using ..... bonds.

Starch is ..... in water and can therefore be used to store ..... Cellulose molecules are held together in parallel groups by ..... bonds.

Q2

(Total 7 marks)

Leave blank

3. (a) Describe how the structure of a xylem vessel helps it to carry out the function of water transport in plants.

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(2)

(b) Explain how water moves through xylem vessels in the transpiration stream.

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(4)

Leave blank

(c) Mineral ions are carried in the transpiration stream. State the importance of each of the following ions for plant growth.

(i) Calcium ions

.....

.....

(ii) Magnesium ions

.....

.....

(iii) Nitrate ions

.....

.....

(3) **Q3**

(Total 9 marks)

Leave blank

4. (a) State three sources of evidence that global warming has been taking place over the past 150 years.

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.....

(3)

(b) Name one greenhouse gas other than carbon dioxide.

.....

(1)

(c) Climate change could mean extinction for many of Britain's rare species of plants. Suggest how a rare plant species may survive rising temperatures in Britain.

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(3)

(d) Predictions about the likely mean annual temperatures in Britain in the future are made using computer models.

Explain why the predictions may not prove to be accurate.

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(2)

Q4

(Total 9 marks)

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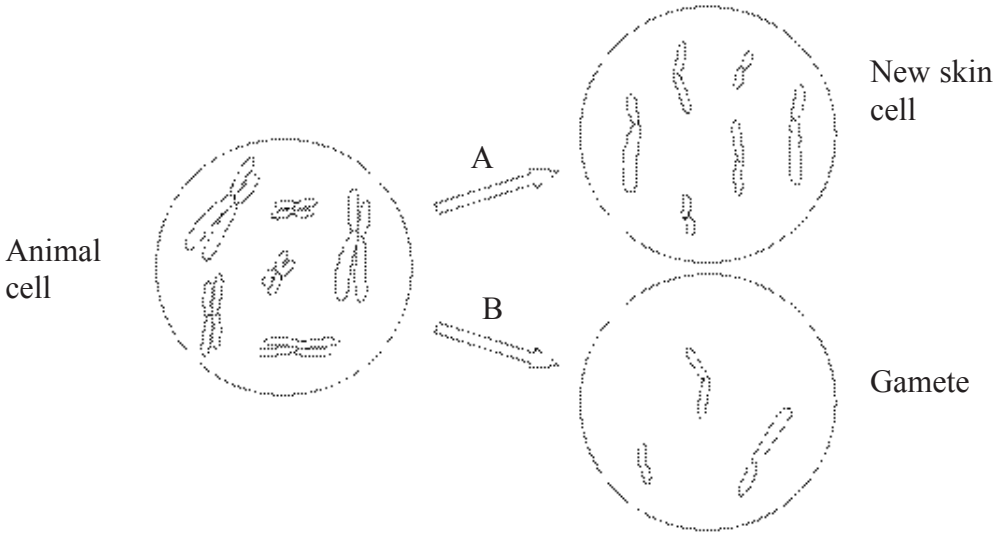
5. (a) The diagram below shows the results of two different types of cell division, A and B, in an animal cell with six chromosomes.



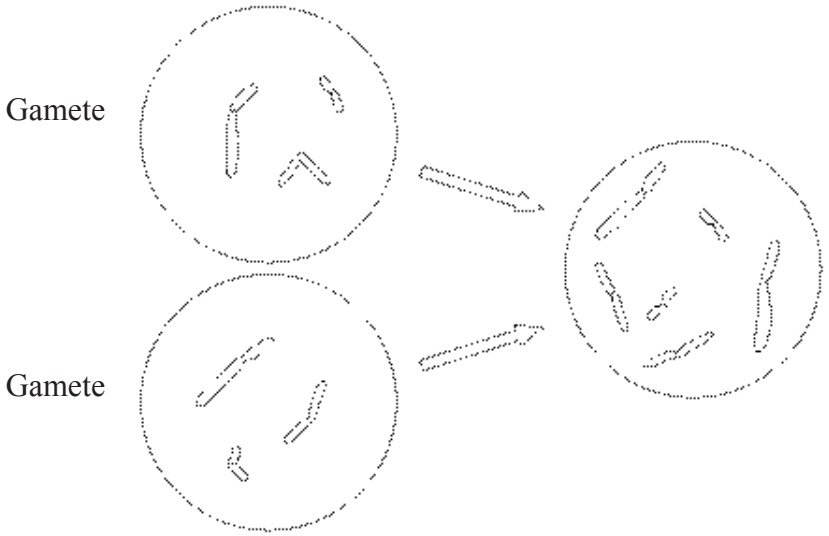
Name the types of cell division indicated by A and B.

A .....

B .....

(2)

(b) The diagram below shows the fusion of two gametes.



(i) Name the process by which gametes fuse.

.....

(1)

(ii) Name the type of cell formed by this process.

.....

(1)

Leave blank

(c) Explain how a cancer arises in lung tissue through the effects of smoking.

.....

.....

.....

.....

.....

.....

(3)

(d) The diagram below shows a sperm cell.

Name the organelles labelled X, Y and Z.

X .....

Y .....

Z .....

(3)

Q5

(Total 10 marks)

Leave blank

6. Oilseed rape is a yellow-flowered plant grown on a large scale on British farms for the oil which can be extracted from its seeds. One of the uses of this oil is in the production of 'biodiesel' for use as fuel for motor vehicles. Burning biodiesel results in the release of carbon dioxide into the atmosphere in the same way as burning fossil fuel.

(a) Explain why the use of biodiesel rather than fossil fuel would benefit the environment.

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(4)

Leave blank

(b) At present most rape seed oil requires chemical treatment before it is suitable for burning in engines. It is, however, possible to genetically modify oilseed rape plants so that the oil they contain is ready to use in engines without the need for this chemical treatment. The gene used to modify the oilseed rape comes from a different species of plant.

(i) Suggest why genetically modifying the oilseed rape might make it more likely to be taken seriously as an alternative to petrol or diesel for use in motor vehicles.

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(1)

(ii) Explain how genetic modification of plants differs from conventional breeding as a way of producing new varieties.

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(4)

(c) Do you think that the genetic modification of oilseed rape described in this question should be allowed to go ahead or should it be banned? Give reasons to support your decision.

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(3)

Q6

(Total 12 marks)

Leave blank

7. Garlic is known to contain an antibacterial substance called allicin.

(a) Suggest an advantage to a plant in producing antibacterial substances in its cells.

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(1)

(b) The presence of antibacterial substances in garlic can be demonstrated by grinding garlic in ethanol to produce an extract. A sample of this extract is then applied to a small disc of filter paper.

(i) Describe how you would demonstrate that this disc contained an antibacterial substance.

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(4)

(ii) A newly discovered rainforest plant is thought to contain a powerful antibacterial substance. Explain how you would compare the effectiveness of this new substance with allicin in garlic.

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(3)

Leave blank

(c) Suggest how this newly discovered plant substance might have a useful application which does not involve genetic modification.

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(1) **Q7**

(Total 9 marks)

8. The Human Genome Project has discovered the location of 30,000 genes. Only a small number of genes have a known function, so the next step is to find out what the rest of the genes do.

(a) (i) Explain what is meant by the word '**genome**'.

.....

.....

(1)

.....

(1)

(b) Some scientists want to use knowledge gained from the Human Genome Project to screen people to find out if they have a genetic predisposition to certain diseases, such as heart disease or lung cancer. They think that screening can help people to lead a healthier life.

Other scientists think that genetic screening should not be carried out because it will create extra problems for society.

(i) Suggest how knowing that you were more likely than other people to develop heart disease or lung cancer could help you lead a longer, healthier life.

.....

.....

.....

.....

(2)

(ii) Suggest how compulsory genetic screening of everyone might be of benefit to society.

.....

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(2)

Leave blank

(iii) Suggest why people might vote against compulsory genetic screening in a referendum.

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(3) **Q8**

(Total 9 marks)

TOTAL FOR PAPER:70 MARKS

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Paper Reference(s)

6133/02

Edexcel GCE

Biology (Salters-Nuffield)

Advanced Subsidiary

Unit 3 Paper 02 – Practical Work Review

This paper may be opened and given to candidates seven days before the examination date published in the timetable. The completed scripts must be sent to the examiner on or before the date published in the June series timetable.

Materials required for examination	**Items included with question papers**
Answer Book (AB08) Ruler Two practical work reports Authentication certificate	Nil

Instructions to Candidates

You are given this paper and allowed a period of seven days to prepare for it. You will be allowed one hour to write the paper under normal supervised examination conditions. Your teacher will advise you of the period allowed and the date and time when you must sit the paper.
Your answers to this paper may be hand written or word processed.

On the front sheet of your answers or your answer book, write the name of the examining body (Edexcel), your centre number, candidate number, the subject title (Biology (Salters-Nuffield)), the paper reference (6133/02), your surname, other names and signature.
Write your name, centre number and candidate number on every sheet of paper that you send.
Answer ALL THREE questions. Your answers to Questions 2 and 3 must be supported by attaching reports of two experiments that you have carried out and written up during your course to your answers or your answer book.
Show all the steps in any calculations and state the units.
Include diagrams in your answers where these are helpful.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets: e.g. (**2**).
The total mark for this paper is 20.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly numbered.
You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, taking account of your use of grammar, punctuation and spelling.

Answer ALL THREE questions

You should refer to your reports of the practical work that you completed during your course when you answer the questions in this paper.

For **Questions 2 and 3** you must select **two** different appropriate reports that you have written, and your answers must refer specifically to them. You may make brief annotations on your practical work reports if you wish, but must not bring any other notes into the examination.

You must attach the appropriate practical work reports to support your answers to Question 2 and to Question 3.

---

1. Answer the following questions with reference to practical work that you have carried out during your course.

(a) Describe what is meant by random error and give an example where your experimental results were affected by random error.

(2)

(b) Distinguish between the accuracy and the reliability of results.

(2)

(c) Explain how you would ensure that any results you obtain are reliable.

(2)

(Total 6 marks)

---

2. From the practicals that you have completed during the course, select **one** suitable practical report to support your answers to the following questions.

(a) Explain what is meant by the following terms.

(i) Dependent variable.

(ii) Independent variable.

(2)

(b) Identify the dependent variable in your report, and state how you ensured it was measured to a suitable level of accuracy.

(3)

(c) Describe how **one** other variable was or could have been controlled, and how it may have affected your results.

(2)

(Total 7 marks)

Include your practical report with this answer.

---

3. From the practicals that you have completed during the course, select another suitable practical report to support your answers to the following questions.

(a) Explain **two** procedures or precautions that you took to ensure safe working. You are reminded that these should specifically refer to the practical you have chosen.

(2)

(b) Explain why the graph you have drawn is the most appropriate way of displaying your results.

(5)

(Total 7 marks)

Include your practical report with this answer.

TOTAL FOR PAPER: 20 MARKS

END

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Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	1	3	4	/	0	1	Signature	

Paper Reference(s)

6134/01

Edexcel GCE

Biology (Salters-Nuffield)

Advanced

Unit Test 4

Time: 1 hour 15 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
Total	

Materials required for examination
Ruler

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, the paper reference, your surname and initials, and your signature.
The paper reference is shown above. Check that you have the correct question paper.
Answer ALL SIX questions in the spaces provided in this booklet.
If you need to use additional answer sheets, attach them loosely but securely inside this booklet.
Show all the steps in any calculations and state the units. Calculators may be used.
Include diagrams in your answers where these are helpful.

Information for Candidates

The marks for individual questions and parts of questions are shown in round brackets: e.g. (**2**).
The total mark for this question paper is 60.

Advice to Candidates

You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, taking account of your use of grammar, punctuation and spelling.

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Leave blank

Answer ALL questions in the spaces provided

1. (a) Explain the meaning of the term **pathogen**.

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(2)

(b) Explain how each of the following reduces the chances of pathogens causing disease.

(i) Inflammation

.....

.....

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.....

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.....

(3)

(ii) Lysozyme

.....

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.....

.....

(2)

(iii) Interferon

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(1) **Q1**

(Total 8 marks)

Leave blank

2. One of the roles of zoos is to conserve endangered animals. For example, some populations of tigers are under threat of extinction and a group of zoos in the USA is developing breeding programmes to maintain the species.

Renee Lynn/Science Photo Library

These zoos have an overall population of around 150 tigers, and the animals are regularly moved between zoos for breeding. It is estimated that one new pair of tigers will need to be introduced to the programme every seven years in order to maintain 90% of the genetic diversity of the tiger population in these zoos.

(a) Suggest **two** factors which might lead to the extinction of tigers in the wild.

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(2)

Leave blank

(b) Suggest why it is necessary to introduce new tigers to the breeding programme.

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(3)

(c) Explain the importance of maintaining at least 90% of the genetic diversity in the zoo population for the successful reintroduction of tigers into the wild.

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(4)

Q2

(Total 9 marks)

Leave blank

3. Two people were found dead early one morning. A man was found on his kitchen floor, and his wife was found in bed under the blankets. The police initially assumed that both had been murdered at the same time, and called a forensic scientist to confirm the times of death. He noticed that maggots of the blowfly were present on both corpses, but that they were noticeably bigger on the woman's corpse, and he was able to estimate the time since the maggots had hatched.

The table below summarises some of the data he collected.

Observation	Man's body	Woman's body
Air temperature around corpse / °C	10	15
Temperature of corpse / °C	10	15
Hours since blowfly eggs hatched	20	60

(a) Explain **two** other observations that could have been recorded to help to determine the time of death.

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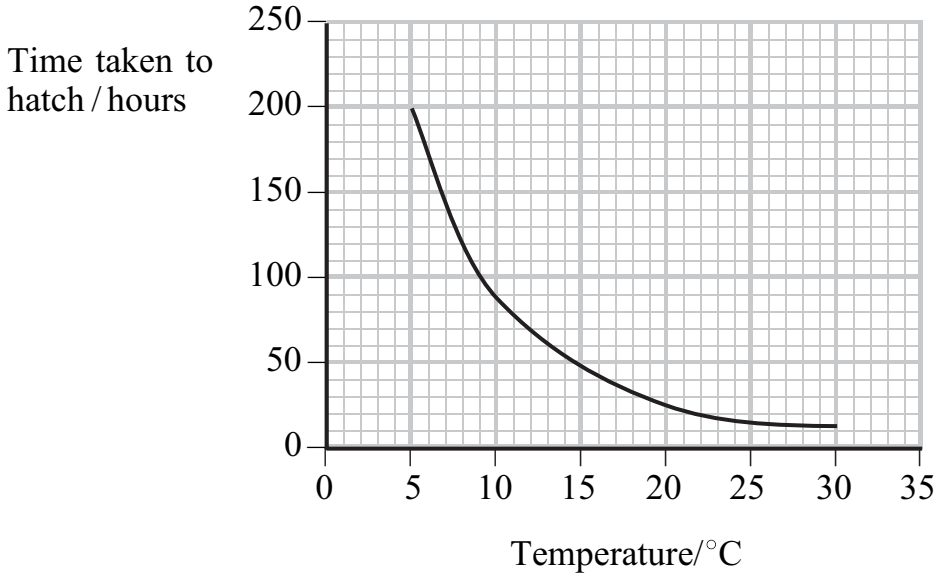
(2)

Leave blank

(b) The graph below shows the effect of temperature on the time taken for blowfly larvae to hatch from eggs.



Explain how the evidence collected at the scene and the information in the graph could support the theory that both people died at the same time.

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(3)

(c) Other insects, such as beetles, are known to be involved in the decomposition of human bodies. Suggest a reason why no beetles were found on these bodies.

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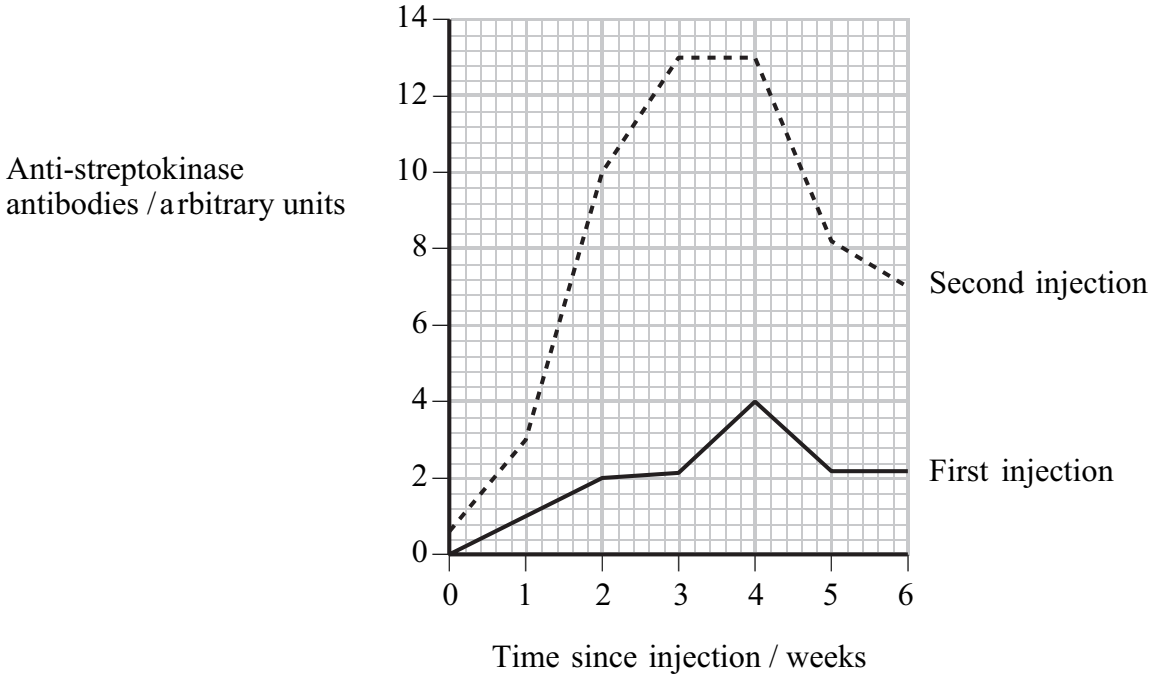
Q3

(2)

(Total 7 marks)

Leave blank

4. Dangerous blood clots in arteries, such as coronary arteries, can be dissolved by injecting streptokinase into the bloodstream. Streptokinase is an enzyme that rapidly digests blood clots. It is produced by bacteria and can be used as a treatment for patients with blocked arteries. The first treatment with streptokinase is much more effective than a second treatment. The graph below shows the concentration of anti-streptokinase antibodies in the blood following the first injection of streptokinase, and when streptokinase is injected again ten weeks later.



(a) Streptokinase acts as an antigen when injected into the blood. Explain what is meant by an **antigen**.

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(2)

(b) (i) With reference to the graph, compare the effects of the first and second injections on the concentration of antibodies in the blood over the first four weeks after injection.

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(3)

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(ii) Explain the differences in the immune responses to the first and the second injections.

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(4)

(c) Suggest why the manufacturers of streptokinase recommend that it should not be used to treat a second blood clot in the same patient soon after the first treatment.

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(2)

(d) State why the injection of a different enzyme would not be affected by the response to streptokinase.

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(1)

Q4

(Total 12 marks)

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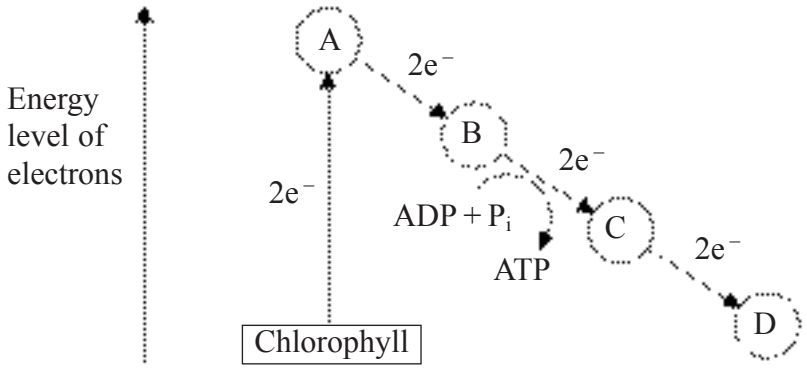
5. The diagram below shows one pair of electrons being passed between the molecules of the electron carrier system (A, B, C and D) during part of the light-dependent reactions of photosynthesis.



(a) (i) Explain how the pair of electrons move from chlorophyll to the electron carrier system.

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(2)

(ii) Explain how electrons lost from chlorophyll are replaced.

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(2)

(iii) Explain how ATP is synthesised when electrons pass between electron carriers B and C.

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(2)

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(b) Describe the Calvin cycle. You should answer this question in continuous prose.

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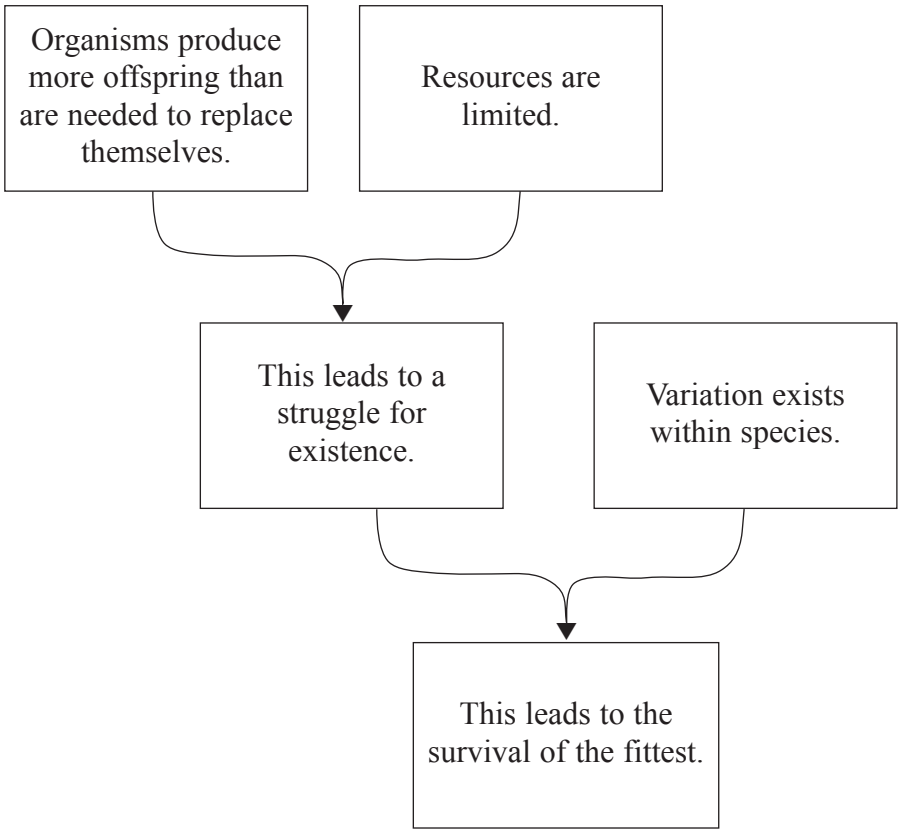
(6)

Q5

(Total 12 marks)

Leave blank

6. The diagram below summarises Darwin's theory of evolution by natural selection.



(a) Use the information in the diagram to explain what is meant by the following terms.

(i) Struggle for existence

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(2)

(ii) Survival of the fittest

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(2)

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(b) Darwin developed his theory of evolution in the 1830s, but waited until 1859 before publishing it. Suggest why he waited so long.

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(2)

(c) Natural selection is thought to be responsible for the development of mechanisms to evade the host immune system. This type of mechanism occurs in the human immunodeficiency virus (HIV).

Give **two** ways in which HIV is able to evade the host immune system.

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(2)

(d) In some human populations there are individuals who do not become infected by HIV even when they are exposed to the virus. Suggest how this could result in an 'evolutionary race' between HIV and the human population.

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(4)

Q6

(Total 12 marks)

TOTAL FOR PAPER: 60 MARKS

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Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	1	3	5	/	0	1	Signature	

Paper Reference(s)

6135/01

Edexcel GCE

Biology (Salters-Nuffield)

Advanced

Unit Test 5 Paper 01

Time: 1 hour

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
Total	

Materials required for examination
Ruler

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, the paper reference, your surname and initials, and your signature.
The paper reference is shown above. Check that you have the correct question paper.
Answer ALL FIVE questions in the spaces provided in this booklet.
If you need to use additional answer sheets, attach them loosely but securely inside this booklet.
Show all the steps in any calculations and state the units. Calculators may be used.
Include diagrams in your answers where these are helpful.

Information for Candidates

The marks for individual questions and parts of questions are shown in round brackets: e.g. (**2**).
The total mark for this question paper is 40.

Advice to Candidates

You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, taking account of your use of grammar, punctuation and spelling.

Leave blank

Answer ALL questions in the spaces provided

1. Parkinson's disease leads to the gradual loss of balance and movement, often with muscle tremors. This disease is believed to be caused by a lack of the neurotransmitter dopamine in parts of the brain. The disease can be treated with the drug L-dopa.

(a) Explain why the lack of dopamine leads to the symptoms of Parkinson's disease.

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(2)

(b) Suggest why L-dopa, rather than dopamine, is used for the treatment of patients with Parkinson's disease.

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(1)

(c) Multiple sclerosis is a disease that causes patches of inflammation in the brain. State the name of an imaging technique and describe how the images could be used to establish which parts of the brain have been damaged in a patient with multiple sclerosis.

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(3)

(Total 6 marks)

Q1

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2. There is much debate about the reasons for variation in human characteristics. One source of evidence in this 'nature and nurture' debate is provided by studies of identical (monozygotic or MZ) twins.

In one study, which involved 69 pairs of identical twins, fifty pairs of the twins had been brought up together since birth and nineteen pairs of the twins had been brought up apart since birth. The height, body mass and intelligence (IQ) of each twin was measured and the difference between each pair was determined for each characteristic.

The table below shows the mean differences between the pairs of twins.

Characteristic	Mean difference	
	50 pairs of identical twins brought up together	19 pairs of identical twins brought up apart
Height/cm	1.7	1.8
Body mass/kg	1.9	4.5
Intelligence (IQ)	3.1	6.0

(a) Explain what these figures suggest about the effects of nature and nurture on these three characteristics.

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(3)

(b) Suggest **two** reasons why the conclusions drawn from the data above should be treated with caution.

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(2) **Q2**

(Total 5 marks)

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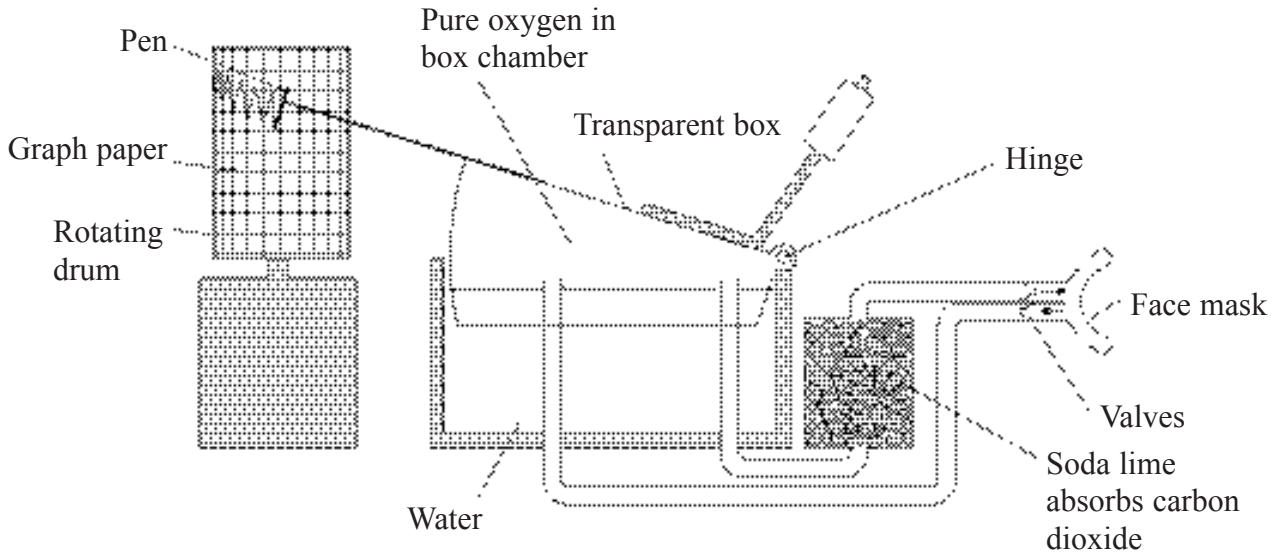
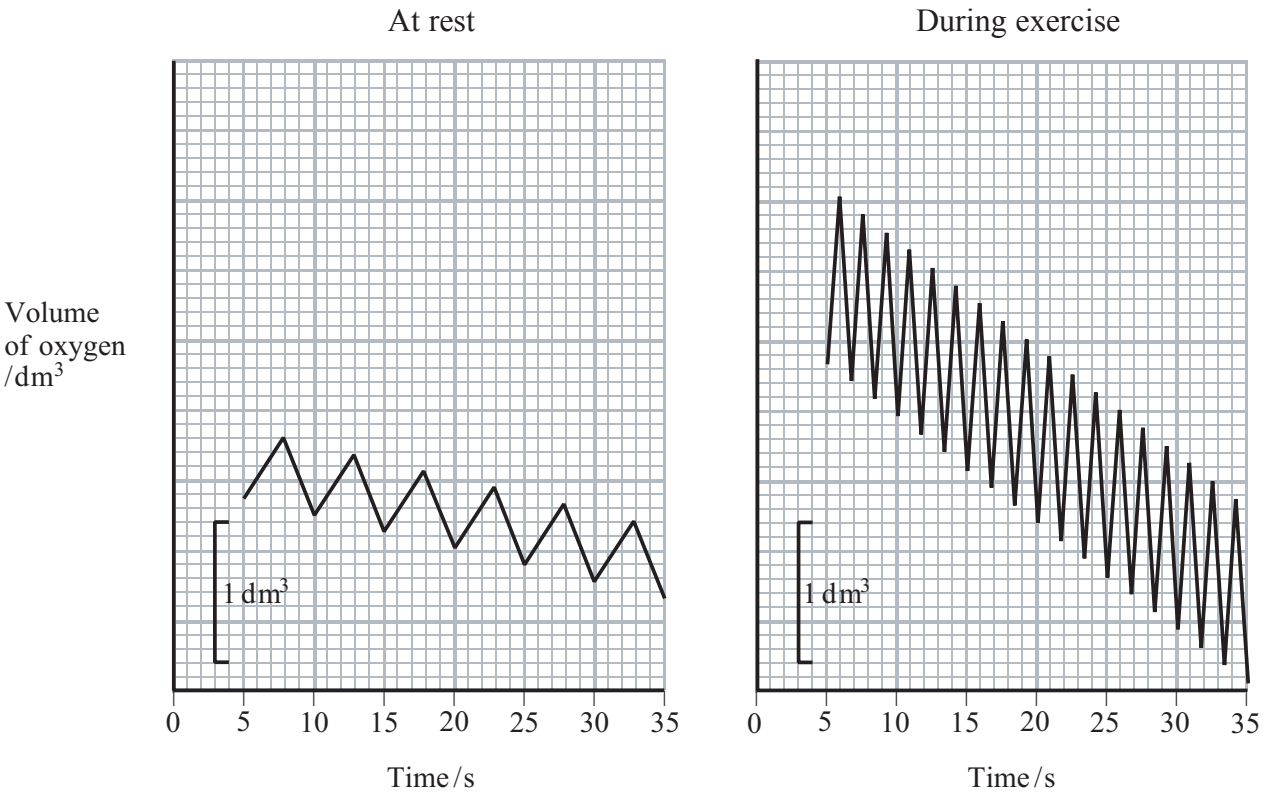
3. (a) The diagram below shows a spirometer. This apparatus is used to measure the volume of air breathed in and out and the frequency of breathing under different conditions.



A spirometer was used to compare a person's breathing at rest and during exercise. The results are shown in the graphs below.



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The minute volume is the volume of oxygen taken into the lungs in one minute, and is calculated by multiplying the tidal volume by the breathing rate.

(i) Using the information in the graphs, calculate the minute volume at rest. Show your working.

Answer .....

(2)

(ii) Calculate the increase in the minute volume that occurred in this person as a result of the exercise. Show your working.

Answer .....

(2)

(b) Cardiac output also increases during exercise.

(i) State what is meant by cardiac output.

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(1)

(ii) Explain how increases in minute volume and cardiac output during exercise enable rapid delivery of oxygen to muscles during exercise.

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(2) **Q3**

(Total 7 marks)

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4. (a) Explain how nerve impulses are conducted along a myelinated axon after an action potential has been initiated. You should write your answer in continuous prose.

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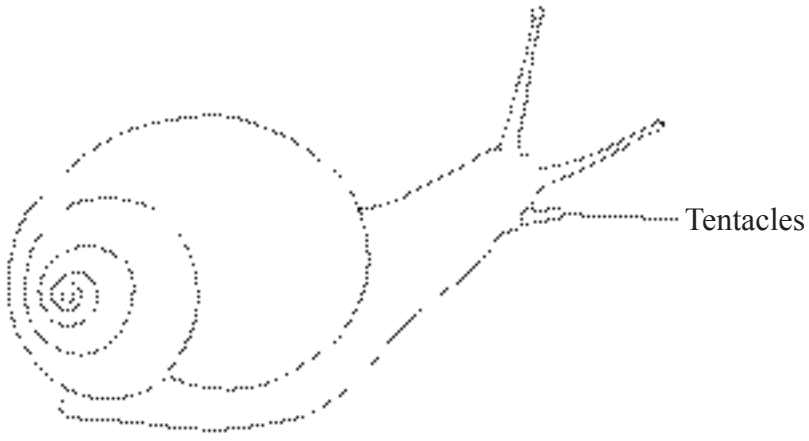
(6)

(b) Habituation is a type of learning that allows animals to ignore repeated unimportant stimuli. For example, snails withdraw their tentacles when the tentacles are gently touched, but if the tentacles are repeatedly stimulated in this way they are no longer withdrawn.



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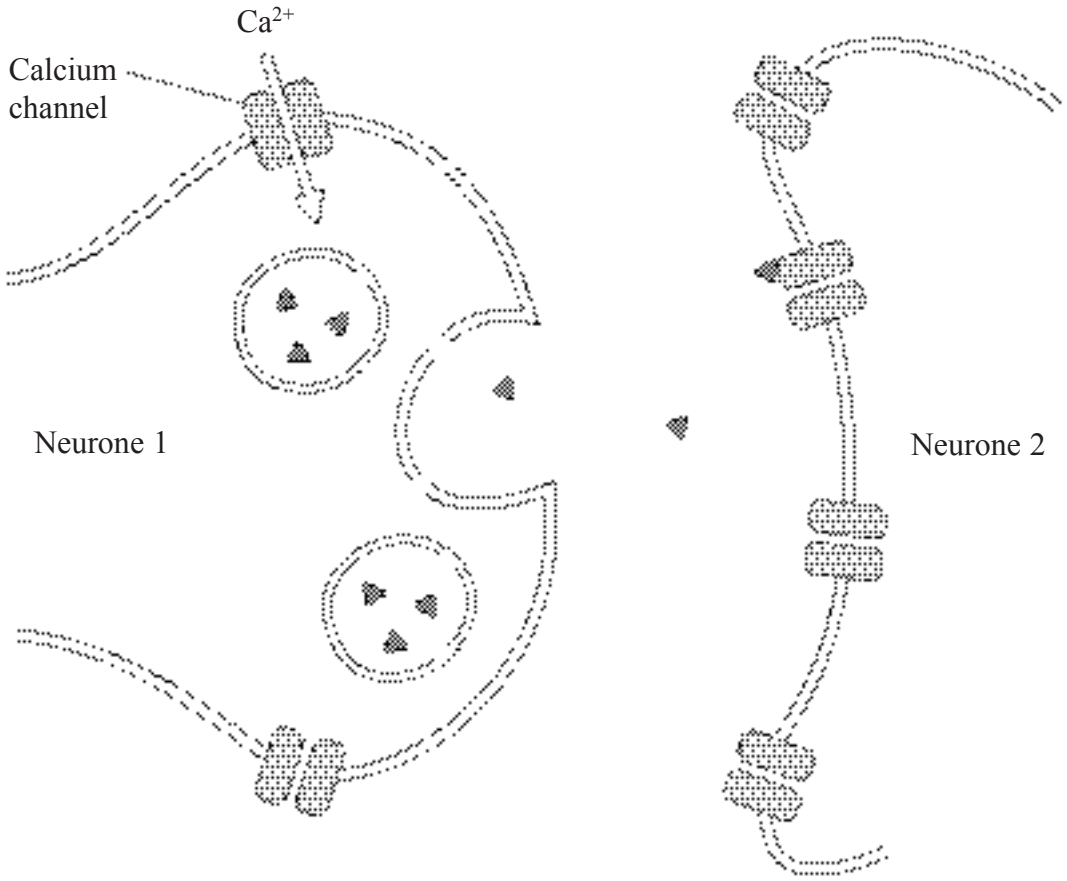
The diagram below shows a synapse involved in this type of response.



With repeated stimulation the calcium channels become less responsive. Using the diagram of the synapse and your own knowledge, suggest how changes in the functioning of the synapse might bring about habituation.

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(4) **Q4**

(Total 10 marks)

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5. In an investigation, small samples of tissue were removed from the leg muscles of international athletes of the same age and sex. The athletes included sprinters (100 m), middle distance runners (800 m) and long distance runners.

SDH is an enzyme involved in the reactions of the Krebs cycle. LDH is an enzyme that catalyses the conversion of pyruvate to lactate.

The results of the analysis of the muscles are shown in the table below.

Athletes	Mean percentage of slow twitch fibres	Mean SDH activity /arbitrary units	Mean LDH activity /arbitrary units
100 m sprinters	24	1.70	1.60
800 m runners	52	2.00	1.10
Long distance runners	70	2.25	1.00

(a) Explain why successful sprinters usually have a low percentage of slow twitch fibres in their leg muscles.

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(2)

(b) Explain the relationships between the mean activity of SDH and LDH in the leg muscles and the distances run by the athletes.

(i) SDH

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(2)

Leave blank

(ii) LDH

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(2)

(c) Describe the role of the electron transport chain of mitochondria in the synthesis of ATP.

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(4)

(d) Explain the fate of lactate produced by the activity of LDH in athletes such as sprinters.

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(2)

Q5

(Total 12 marks)

TOTAL FOR PAPER: 40 MARKS

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Paper Reference(s)

6136/01

Edexcel GCE

Biology (Salters-Nuffield)

Advanced

Unit Test 6 Synoptic Paper

Scientific Article

The first question in the synoptic paper will relate to the following scientific article, which you should study during your course.

You may be asked to summarise the information in the article, and explain or comment on the biology and issues within the context of the article.

The question will be worth about 20 marks out of a total of 60 marks for the paper.

The article is adapted from a book called *Nature via Nurture* by Matt Ridley. It explores some recent ideas about the way that genes might be involved in the growth, development and behaviour of organisms, and how this might affect our ideas about evolution.

NATURE VIA NURTURE

THE SIMIAN SOAP OPERA

Sociologists and anthropologists, with their emphasis on human culture, had outlawed all talk of human instinct. By the middle of the twentieth century, it was heresy to speak of animal minds, and heresy to speak of human instincts. Difference, not similarity, was all.

That was all to change in 1960, when Jane Goodall, a young woman virtually untrained in science, began to watch wild chimpanzees in the Gombe National Park on the shores of Lake Tanganyika in Africa.

She later wrote:

'How naïve I was. As I had not had an undergraduate science education I didn't realise that animals were not supposed to have personalities, or to think, or to feel emotions or pain . . . Not knowing, I freely made use of all those forbidden terms and concepts in my initial attempts to describe, to the best of my ability, the amazing things I had observed at Gombe.'

As a result, Jane Goodall's account of life among the chimps of Gombe reads like a soap opera about the Wars of the Roses written by Jane Austen – all conflict and character. We feel the ambition, the jealousy, the deception and the affection; we distinguish personalities; we sense motives; we cannot help but empathise:

'Gradually, Evered's confidence returned – partly, no doubt, because Figan was by no means always with his brother: Faben was still friendly with Humphrey, and Figan, wisely, steered clear of the powerful male. Moreover, even when the brothers were together, Faben did not *always* help Figan: sometimes he just sat and watched.'

Though few realised it until later, Goodall's anthropomorphism had driven a stake through the heart of human exceptionalism. Apes were revealed not as blundering, primitive automata, who were bad at being people, but as beings with social lives as complex and subtle as ours. Either human beings must be more instinctive, or animals must be more conscious than we had previously suspected. The similarities, not the differences, were what caught the attention.

Defining human uniqueness had been a cottage industry for philosophers for centuries. Aristotle said man was a political animal. Descartes said we were the only creature that could reason. Marx said we alone were capable of conscious choice. Now only by heroically narrow definitions of these concepts could Goodall's chimps be excluded.

St Augustine said we were the only creature to have sex for pleasure rather than procreation. Chimpanzees begged to differ, and their southern relatives, bonobos (pygmy chimpanzees), were soon to blow the definition to smithereens. Bonobos have sex to celebrate a good meal, to end an argument or to cement a friendship. Since much of this sex is homosexual or with juveniles, procreation cannot even be an accidental side effect.

Then we thought we were the only species to make and use tools. One of the first things Jane Goodall observed was chimpanzees fashioning stalks of grass to extract termites, or crushing sponges of leaves to get drinking water. Leakey telegraphed her ecstatically: 'Now we must redefine tool, redefine man, or accept chimpanzees as humans.'

Next we told ourselves that we alone had culture: the ability to transmit acquired habits from one generation to the next by imitation. But what are we to make of the chimpanzees of the Tai forest in West Africa, which for many generations have taught their young to crack nuts using wooden hammers on a rock anvil? Or the killer whales that have utterly different hunting traditions, calling patterns and social systems according to which population they belong to?

We had assumed we were the only animal to wage war and to kill our fellows. But in 1974 the chimps of Gombe (and subsequently most other colonies studied in Africa) put paid to that theory by raiding silently into the territory of neighbouring troops, ambushing the males and beating them to death.

We still believed we were the only animal with language. But then we discovered monkeys have a vocabulary for referring to different predators and birds, while apes and parrots are capable of learning quite large lexicons of symbols. So far there is nothing to suggest that any other animal can acquire a true grasp of grammar and syntax, though the jury is still out for dolphins.

Some scientists believe that chimpanzees do not have a 'theory of mind': that is, they cannot imagine what another chimpanzee is thinking. If so, for example, they could not act upon the knowledge that another individual holds a false belief. But experiments are ambiguous. Chimps regularly engage in deception. In one case, a baby chimp pretended that he was being attacked by an adolescent in order to get his mother to allow him to suckle from her nipple. It certainly looks as if they are capable of imagining how other chimps think.

This debate has been running for more than a century. In 1871 Darwin drew up a list of human peculiarities that had been claimed to form an impassable barrier between man and animals. He then demolished each peculiarity one by one. Though he believed that only man had a fully developed moral sense, he devoted a whole chapter to the argument that a moral sense was present, in primitive form, in other animals. His conclusion was stark:

"The difference in mind between man and the higher animals, great as it is, is certainly one of degree and not of kind. We have seen that the senses and intuitions, the various emotions and faculties, such as love, memory, attention, curiosity, imitation, reason, etc., of which man boasts, may be found in an incipient, or even sometimes in a well-developed condition, in the lower animals."

Wherever you look there are similarities between our behaviour and that of animals, which cannot be simply swept under the carpet. Yet, of course, it would be perverse to argue that people are no different from apes. The truth is we are different. We are more capable of self-awareness, of calculation and of altering our surroundings than any other animal. Clearly, in some sense, this sets us apart. We have built cities, travelled in space, worshipped gods and written poetry. Each of these things owes something to our animal instincts – shelter, adventure and love – but that rather misses the point of them. It is when we go beyond instinct that we seem most particularly human. Perhaps, as Darwin suggested, the difference is one of degree rather than kind; it is quantitative, not qualitative. We can count better than chimpanzees; we can reason better, think better, communicate better, emote better, perhaps even worship better. Our dreams are probably more vivid, our laughter more intense, our empathy more profound.

Yet that leads straight back to mentalism, equating an ape with an apprentice person. Modern mentalists have diligently tried to teach animals to 'speak'. Washoe (a chimp), Koko (a gorilla), Kanzi (a bonobo) and Alex (a parrot) have all done remarkably well. They have learned hundreds of words, usually in the form of sign language, and have learned to combine them into primitive phrases. Yet, as Herbert Terrace pointed out after doing the same with a chimpanzee called Nim Chimpsky, all that these experiments have taught us is how bad these animals are at language. They rarely even rival a two-year-old child, and they seem incapable of using syntax and grammar except by accident. As Stalin is reputed to have said of military force, quantity has a quality all its own. We are so much better at language than even the cleverest ape that it really could be called a difference of kind, not degree. That is not to say it does not have roots and homologies in animal communication, but then a bat's wing has homology with a frog's front foot, and a frog cannot fly. To concede that language is a qualitative difference does not imply that we can set human beings apart from nature, though. Trunks are unique to elephants. Spitting venom is unique to cobras. Uniqueness is not unique to humans.

So which are we, similar to apes or different from apes? Both. The argument about human exceptionalism, today as in Victorian times, is mired in a simple confusion. People still insist that their opponents must take sides: either we are instinctive animals, or we are conscious beings, but we cannot be both. Yet both similarity and difference can be true at the same time. Neither similarity nor difference wins; they coexist. Let some scientists study the similarities while others study the differences. It is time we abandoned what the philosopher Mary Midgley has called 'the strange segregation of humans from their kindred that has deformed much of enlightenment thought'.

THROWING SWITCHES

Despite having roughly the same set of genes, human beings and chimpanzees look different. How do you get two different species from one set of genes? How can we have a brain that is three times the size of a chimp's, and is capable of learning to speak, and yet not have an extra set of genes for making it?

I cannot resist a literary analogy. The opening sentence of Charles Dickens's novel *David Copperfield* reads: 'Whether I shall turn out to be the hero of my own life, or whether that station will be held by anybody else, these pages must show.' The opening sentence of J. D. Salinger's novel *The Catcher in the Rye* reads: 'If you really want to hear about it, the first thing you'll probably want to know is where I was born, and what my lousy childhood was like, and how my parents were occupied and all before they had me, and all that David Copperfield kind of crap, but I don't feel like going into it.' In the pages that follow, to a close approximation, Dickens and Salinger use the same few thousand words. There are words that Salinger uses but not Dickens, like elevator or crap. There are words that Dickens uses but not Salinger, like caul and pettish. But they will be few compared with the words they share. Probably there is at least 90 per cent lexical concordance between the two books. Yet they are very different books. The difference lies not in the use of a different set of words, but in the same set of words used in a different pattern and order. Likewise, the source of the difference between a chimpanzee and a human being lies not in the different genes, but in the same set of 30,000 genes used in a different order and pattern.

I say this with confidence for one main reason. The most stunning surprise to greet scientists when they first lifted the lid on animal genomes was the discovery of the same sets of genes in wildly different animals. In the early 1980s, fly geneticists were thrilled to discover a small group of genes they called the hox genes that seemed to set out the body plan of the fly during its early development – roughly telling it where to put the head, the legs, the wings and so on. But they were completely unprepared for what came next. Their mouse-studying colleagues found recognisably the same hox genes, in the same order, doing the same job. The same gene tells a mouse embryo where (but not how) to grow ribs as tells a fly embryo where to grow wings: you can even swap them between species. Nothing had prepared the biologists for this shock. It meant, in effect, that the basic body plan of all animals had been worked out in the genome of a long-extinct ancestor that lived more than 600 million years before and preserved ever since in its descendants (and that includes you).

Hox genes are the recipes for proteins called 'transcription factors', which means that their job is to 'switch on' other genes. A transcription factor works by attaching itself to a region of DNA called a promoter. In creatures such as flies and people (as opposed to bacteria, say), promoters consist of about five separate stretches of DNA code, usually upstream of the gene itself, sometimes downstream. Each of those sequences attracts a different transcription factor, which in turn initiates (or blocks) the transcription of the gene. Most genes will not be activated until several of their promoters have transcription factors attached to them. Each transcription factor is itself a product of another gene somewhere else in the genome. The function of many genes is therefore to help switch other genes on or off. And the susceptibility of a gene to being switched on or off depends on the sensitivity of its promoters. If its promoters have shifted, or changed sequence so that the transcription factors find them more easily, the gene may be more active. Or if the change has made the promoters attract blocking transcription factors rather than enhancing ones, the gene may be less active.

Small changes in the promoter can therefore have subtle effects on the expression of the gene. Perhaps promoters are more like thermostats than switches. It is here in the promoters that scientists expect to find most evolutionary change in animals and plants – in sharp contrast to bacteria. For example, mice have short necks and long bodies; chickens have long necks and short bodies. If you count the vertebrae in the neck and thorax of a chicken and a mouse, you will find that the mouse has 7 neck and 13 thoracic vertebrae; the chicken has 14 and 7 respectively. The source of this difference lies in one of the promoters attached to one of the hox genes, Hoxc8, a gene found in both mice and chickens whose job is to switch on other genes that lay down details of development. The promoter is a 200-letter paragraph of DNA and it has just a handful of letters different in the two species. Indeed, changes in as few as two of these letters may be enough to make all the difference. The effect is to delay the expression of the Hoxc8 gene slightly in the development of the chicken embryo. Since development of the vertebral column starts at the head, this means the chicken goes on making neck vertebrae longer than the mouse. In the python, Hoxc8 is expressed right from the head and goes on being expressed for most of the body. So pythons consist of one long thorax – they have ribs all down the body.

The beauty of the system is that the same gene can be reused in different places and at different times simply by putting a set of different promoters beside it. The 'eve' gene in fruit flies, for example, whose job is to switch on other genes during development, is switched on at least ten separate times during the fly's life, and it has eight separate promoters attached to it, three upstream of the gene and five downstream. Each of these promoters requires 10–15 proteins to attach to it to switch on expression of the eve gene. The promoters cover thousands of letters of DNA text. In different tissues, different promoters are used to switch on the gene. This, incidentally, seems to be one reason for the humiliating fact that plants usually have more genes than animals. Instead of reusing the same gene by adding a new promoter to it, a plant reuses a gene by duplicating the whole gene and changing the promoter in the duplicated version. The 30,000 human genes are probably used in at least twice as many contexts during development thanks to batteries of promoters.

To make grand changes in the body plan of animals, there is no need to invent new genes, just as there is no need to invent new words to write an original novel. All you need to do is switch the same ones on and off in different patterns. Suddenly, here is a mechanism for creating large and small evolutionary changes from small genetic differences. Merely by adjusting the sequence of a promoter, or adding a new one, you could alter the expression of a gene. And if that gene is itself the code for a transcription factor, then its expression will alter the expression of other genes. Just a tiny change in one promoter will produce a cascade of differences for the organism. These changes might be sufficient to create a wholly new species without changing the genes themselves at all.

In one sense, this is a bit depressing. It means that until scientists know how to find gene promoters in the vast text of the genome, they will not learn how the recipe of a chimpanzee differs from that of a person. The genes themselves will tell them little, and the source of human uniqueness will remain as mysterious as ever. But in another sense it is also uplifting, reminding us, more forcefully than ever, of a simple truth that is all too often forgotten, that bodies are not made, they grow. The genome is not a blueprint for constructing a body; it is a recipe for baking a body. The chicken embryo is marinaded for a shorter time in the Hoxc8 sauce than the mouse embryo. This is a metaphor I shall return to frequently in the book, for it is one of the best ways of explaining why nature and nurture are not opposed to each other, but work together.

As the hox story illustrates, DNA promoters express themselves in the fourth dimension: their timing is all. A chimp has a different head from a human being not because it has a different blueprint for the head, but because it grows the jaws for longer and the cranium for less long than does the human being. The difference is all timing.

The process of domestication, by which the wolf was turned into the dog, illustrates the role of promoters. In the 1960s, a geneticist named Dmitri Belyaev was running a huge fur farm near Novosibirsk in Siberia. He decided to try to breed tamer foxes, because however well they had been handled and however many generations they had been kept in captivity, foxes were nervous and shy creatures in the fur farm (with good reason, presumably). So Belyaev started by selecting as breeding stock the animals that allowed him closest before fleeing. After 25 generations he did indeed have much tamer foxes, which, far from fleeing, would approach him spontaneously. The new breed of foxes not only behaved like dogs, they looked like dogs: their coats were piebald, like collies, their tails turned up at the end, the females came on heat twice a year, their ears were floppy, their snouts shorter and their brains smaller than in wild foxes. The surprise was that merely by selecting tameness, Belyaev had accidentally achieved all the same features that the original domesticator of the wolf had got – and that was probably some race of the wolf itself, which had bred into itself the ability not to run away too readily from ancient human rubbish dumps when disturbed. The implication is that some promoter change had occurred which affected not one, but many genes. Indeed, it is fairly obvious that what happened in both cases was that the timing of development had been altered so that the adult animals retained many of the features and habits of pups: the floppy ears, the short snout, the smaller skull and the playful behaviour.

What seems to happen in these cases is that young animals do not yet show either fear or aggression, these developing last during the forward growth of the limbic system at the base of the brain. So the most likely way for evolution to produce a friendly or tame animal is to stop brain development prematurely. The effect is a smaller brain and especially a smaller 'area 13', a late-developing part of the limbic system that seems to have the job of disinhibiting adult emotional reactions such as fear and aggression. Intriguingly, such a taming process seems to have happened naturally in bonobos since their separation from the chimpanzee more than two million years ago. For its size the bonobo not only has a small head, but also reduced aggression and several juvenile features retained into adulthood including a white anal tail tuft, high-pitched calls and unusual female genitals. Bonobos have unusually small area 13s.

So do human beings. Surprisingly, the fossil record suggests that there has been a rather steep decline in human brain size during the past 15,000 years, partly but not wholly reflecting a shrinking body size that seems to have accompanied the arrival of dense and 'civilised' human settlement. This followed several million years of more or less steady increases in brain size. In the Mesolithic (around 50,000 years ago) human brains averaged 1,468 cm^3 (in females) and 1,567 cm^3 (in males). Today the numbers have fallen to 1,210 cm^3 and 1,248 cm^3, and even allowing for some reduction in body weight, this seems to be a steep decline. Perhaps there has been some recent taming of the species. If so, how? Richard Wrangham believes that once human beings became sedentary, living in permanent settlements, they could no longer tolerate anti-social behaviour and they began to banish, imprison or execute especially difficult individuals. In the past in highland New Guinea, more than one in ten of all adult deaths were by the execution of 'witches' (mostly men). This might have meant killing the more aggressive and impulsive – hence more developmentally mature and bigger-brained – people.

Such self-taming, however, seems to be a recent phenomenon in our species and is not able to explain the selective pressures that led to the divergence of human beings from chimp-like ancestors more than five million years ago. But it does support the idea of evolution happening through the adjustment of gene promoters rather than genes themselves: hence the alteration of several irrelevant features caught in the slipstream of a reduction in impulsive aggression.

The startling new truth that has emerged from the human genome – that animals evolve by adjusting the thermostats on the fronts of genes, enabling them to grow different parts of their bodies for longer – has profound implications for the nature–nurture debate. Imagine the possibilities in a system of this kind. You can turn up the expression of one gene, the product of which turns up the expression of another, which suppresses the expression of a third, and so on. And right in the middle of this little network, you can throw in the effects of experience. Something external – education, food, a fight, or requited love, say – can influence one of the thermostats. Suddenly nurture can start to express itself through nature.

Adapted from *Nature via Nurture* by Matt Ridley

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Paper Reference(s)

6136/01

Edexcel GCE

Biology (Salters-Nuffield)

Advanced

Unit Test 6 Synoptic Paper

Time: 2 hours

Materials required for examination
AB12

Items included with question papers
A copy of the scientific article 'Nature via Nurture'

Instructions to Candidates

In the boxes on the answer book provided, write the name of the examining body (Edexcel), your centre number, candidate number, the subject title, the paper reference, your surname, other names and signature.
The paper reference is shown above. Check that you have the correct question paper.
Answer THREE questions in the answer book. You must answer Questions 1 and 2, and then EITHER Question 3 OR Question 4. You should allow 45 minutes for answering Question 3 or 4, including planning time.
Show all the steps in any calculations and state the units. Calculators may be used.
Include diagrams in your answers where these are helpful.
Additional answer sheets may be used.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets: e.g. (**2**).
The total mark for this paper is 60.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly numbered.
You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, taking account of your use of grammar, punctuation and spelling.
This question paper is designed to give you the opportunity to make connections between different areas of biology and to use skills and ideas developed throughout the course in new contexts. You should include in your answers relevant information from the whole of your course.

Answer BOTH questions 1 and 2

1. The scientific article you have studied is adapted from a book called '*Nature via Nurture*' by Matt Ridley. Use the information from the article and your own knowledge to answer the following questions.

(a) Name **three** characteristics that were once thought to be unique to humans. For each characteristic, give an example of animal behaviour now known to display that characteristic.

(6)

(b) Humans and chimpanzees are very different animals, despite being 99% genetically similar. Suggest how similar genetic information can produce very different animals.

(2)

(c) Suggest why plants often have more genes than animals.

(1)

(d) Explain how Dmitri Belyaev's tame foxes developed many of the characteristics of domestic dogs.

(3)

(e) The article argues that the phenotypes of organisms are affected as much by promoters as by genes. Using examples from the article, explain how promoters and genes work together to affect the phenotypes of organisms.

(8)

(Total 20 marks)

Question 2 is on page 7

Data Sheet for Question 2

Investigating a Roman Fort at Vindolanda

Figure 1. Exceptional conditions meant that all sorts of organic materials have been preserved for 1900 years.

Archaeologists excavated a building with a floor area of 30 m^2, which had been part of the fort at Vindolanda. It was made of wood, mainly from birch and oak trees.

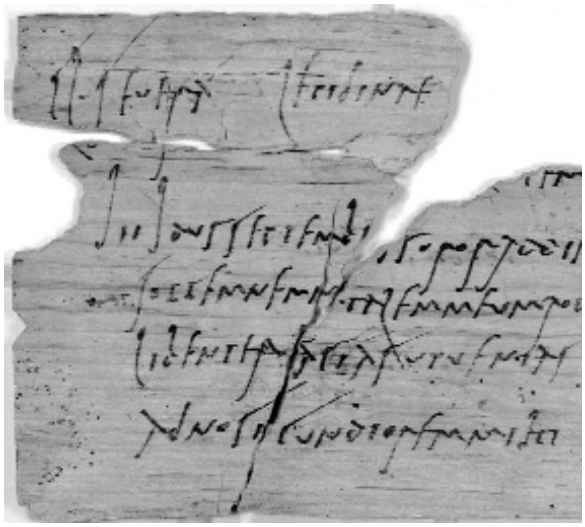
The floor of the building had several thick layers of leaves of bracken (a type of fern). Calculations based on the present productivity of bracken at the site suggest that it must have been necessary to cut down an area of 10 000 m^2 (1 hectare) of bracken to create a new layer. The ferns were soaked with urine, and contained human faeces and 250 000 pupae of flies.

This has led to the suggestion that, in this building, animals or even Roman soldiers lived in squalor. Another possible explanation is that the room was used for leather working since a lot of leather items, leather workers' tools and cloth were found amongst the bracken. It is known that urine and bracken were used as part of the leather-making process.

The bracken layers had a pH of 5.3–5.6 and conditions were anaerobic. Since the site was abandoned in 125 AD, soil conditions have been cold due to the local climate.

It was amongst these layers that almost 300 thin pieces of wood used as writing paper were found. These consisted of a mixture of personal letters and storekeeper's lists, all written in ink. One of the personal letters is shown in Figure 2.

Figure 2. A 1900 year old birthday party invitation, possibly the earliest known example of a woman's handwriting.



The invitation is written in Latin:

Claudia Seuera Lepidinae suae salutem iii Idus Septembres, soror, ad diem sollemnem natalem meum rogo libenter facias ut uenias ad nos iucundiorem mihi diem interuentu tuo factura.

Translation:

Claudia Severa to her Lepidina greetings. On 11th September, for the day of the celebration of my birthday, sister, I give you a warm invitation to make sure that you come to us, to make the day more enjoyable for me by your arrival.

The invitation was written between 97 and 110 AD to Sulpicia Lepidina, wife of the commander of the Roman garrison at Vindolanda, near Hadrian's Wall. Claudia lived in another fort nearby where her own husband was the commander.

Photograph used by kind permission of The British Museum/Centre for the Study of Ancient Documents. Further information can be found at Vindolanda Tablets Online http://vindolanda.csad.ox.ac.uk

Figure 3. Pollen diagram from Muckle Moss, a peat bog 3 km from Vindolanda.

Redrawn from Pearson (1960) and Seaward (1976)

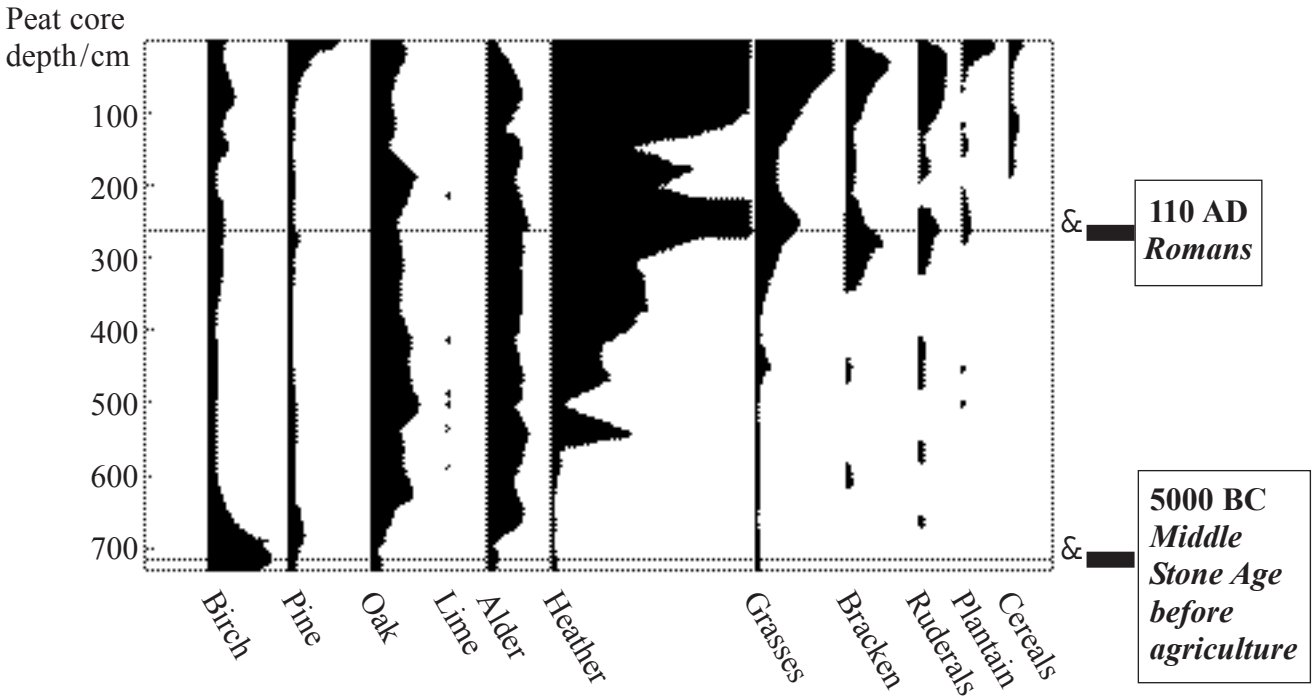


Figure 4. Notes on species

Birch and **Pine**: these trees may indicate **forest re-establishment**.

Oak: probably the dominant tree of much of the woodland of Britain before deforestation due to human activity.

Lime: a tree whose appearance usually means the **climate became warmer**.

Alder: a tree whose appearance in a pollen core often means the **climate became wetter**.

Heather and grasses: tend to take over when woodland has been cut down or lost, because of the introduction of **grazing animals**, such as sheep, by humans.

Bracken: a fern which grows on moorlands when woodland has been cut down and the land is **overgrazed by sheep**, which do not eat bracken.

Ruderals are weeds of arable land where crops are grown. Ruderal pollen usually means **humans were growing crops** nearby.

Plantains are small plants which grow well amongst short grass. Increase in plantain pollen usually means **grazing animals introduced by humans**.

Cereals such as wheat, oats and barley were grown as crops. Cereals do not produce as much pollen as ruderals and plantains.

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2. Carefully remove the data sheet from the staples in the middle of this booklet.

Archaeologists have excavated the site of a Roman fort at Vindolanda, near Hadrian's Wall in the north of England. The excavation revealed large amounts of organic material (Figure 1), including an invitation to a woman called Sulpicea Lepidina to attend a birthday party (Figure 2). The pollen in a nearby peat bog has also been investigated (Figures 3 and 4).

(a) Using the data in Figures 3 and 4, briefly describe the vegetation in this area in 5000 BC.

(2)

(b) An impressive feature of the site was the discovery of large quantities of organic material, which would normally have been expected to have rotted away (Figure 1). This included leather shoes and Lepidina's party invitation (Figure 2).

Suggest reasons why decay was prevented at this site.

(3)

(c) Describe the vegetation that Lepidina would have seen as she travelled to the birthday party.

(3)

(d) Explain the changes in vegetation between 5000 BC and 110 AD.

(5)

(e) The Roman army was withdrawn from Britain around 410 AD. The local population probably fell on hard times and became much reduced. The data in Figure 3 suggest that the original oak forest recovered.

Describe and explain how the re-establishment of the oak forest may have taken place.

(5)

(f) Suggest why the amount of bracken changed while the Romans were at Vindolanda.

(2)

(Total 20 marks)

Questions 3 and 4 are on page 8

Answer ONE of the following essay questions.

You should choose EITHER Question 3 OR Question 4.

You are expected to answer in continuous prose. You should use examples from the biology course you have studied but need not restrict yourself to the course content.

You should spend approximately 45 minutes answering Question 3 or 4, including planning time.

Marks will be awarded for the following areas:

Breadth: Selection of a range of relevant examples	**(up to 6 marks)**
Depth: Further description and discussion of the examples	**(up to 8 marks)**
Balance: Recognition of advantages and disadvantages or benefits and risks	**(up to 6 marks)**
Style: Coherence, clarity and expression	**(up to 4 marks)**

---

3. Worldwide, humans use approximately 80 million tonnes of fats and oils every year, most of which are derived from plants. Not all of this is eaten.

'Fat – good or evil?' Discuss the structure, functions and uses of lipids and their importance to humans.

(Total 20 marks)

---

4. Current developments in gene technology are expected to make a significant impact on society over the next few decades.

Discuss the techniques, applications and implications of gene technology.

(Total 20 marks)

TOTAL FOR PAPER: 60 MARKS

END

Do not write in this space

Mark schemes

General information

The following symbols are used in the mark schemes for all questions:

Symbol	Meaning of symbol
; semi colon	Indicates the end of a marking point
eq	Indicates that credit should be given for other correct alternatives to a word or statement, as discussed in the Standardisation meeting
/ oblique	Words or phrases separated by an oblique are alternatives to each other
{} curly brackets	Indicate the beginning and end of a list of alternatives (separated by obliques) where necessary to avoid confusion
() round brackets	Words inside round brackets are to aid understanding of the marking point but are not required to award the point
[] square brackets	Words inside square brackets are instructions or guidance for examiners

Crossed out work

If a candidate has crossed out an answer and written new text, the crossed out work can be ignored. If the candidate has crossed out work but written no new text, the crossed out work for that question or part question should be marked, as far as it is possible to do so.

Spelling and clarity

In general, an error made in an early part of a question is penalised when it occurs but not subsequently. The candidate is penalised once only and can gain credit in later parts of the question by correct reasoning from the earlier incorrect answer.

No marks are awarded specifically for quality of language in the written papers, except for the essays in the synoptic paper. Use of English is however taken into account as follows:

- the spelling of technical terms must be sufficiently correct for the answer to be unambiguous

  eg for amylase, ‘ammalase’ is acceptable whereas ‘amylose’ is not

  eg for glycogen, ‘glicojen’ is acceptable whereas ‘glucagen’ is not

  eg for ileum, ‘illeum’ is acceptable whereas ‘ilium’ is not

  eg for mitosis, ‘mytosis’ is acceptable whereas ‘meitosis’ is not
- candidates must make their meaning clear to the examiner to gain the mark
- a correct statement that is contradicted by an incorrect statement in the same part of an answer gains no mark — irrelevant material should be ignored.

Unit SN1 (6131)

Question 1

Maximum mark

(a) Flatworm has a large surface area: volume ratio/converse

Diffusion {sufficient/effective} for flatworm's {needs/eq} /converse

Mammal {has higher metabolic rate/is warm blooded/eq} /converse

2 marks

(b) (i) Top two open

Bottom two closed

2 marks

(ii) X drawn anywhere in the right atrium

1 mark

(iii) Pacemaker/sets rhythm of heart/initiates cardiac cycle/eq

1 mark

(c) Blood at high pressure

High concentration of oxygen/eq

High concentration of glucose/eq

2 marks

Total 8 marks

Question 2

Maximum mark

(a)

Process	Requires energy from respiration (ATP)	Requires a concentration gradient
Diffusion	✗	✓
Facilitated diffusion	✗	✓
Osmosis	✗	✓
Active transport	✓	✗

[Two correct for one mark]

4 marks

(b)

1. Large surface area; due to
    2. Many alveoli/eq
    3. Large number/networks of capillaries/eq
4. Small diffusion path/thin exchange surface/eq
    5. {Flattened/thin/squamous} alveolar (epithelial) cells/walls
    6. Capillary (endothelial) cells/walls
7. Large difference in concentration: due to
8. Ventilating the lungs/eq
9. Circulation of blood/eq

4 marks

Total 8 marks

Question 3

Maximum mark

(a) Platelets

Prothrombin

Fibrinogen

3 marks

(b)
1. Lack of blood to {cardiac/heart} muscle
2. So lack of {oxygen/glucose} /ischaemic/anaerobic/eq
3. Muscle stops working/damaged/cells die
4. Pain/angina/lactic acid build up
5. Myocardial infarction/heart attack/eq

3 marks

(c) Warfarin/aspirin/streptokinase/adheparin/hirudin/clopidogrel

1 mark

Total 7 marks

Question 4

Maximum mark

(a)
1. Test is inexpensive
2. Test is reliable/no false positives/eq
3. Test is {simple/painless/eq}
4. Quick turnaround of results
5. Counselling follow-up
6. Education about the test/advertise the test
7. Confidentiality

2 marks

(b) (i) Amniocentesis/chorionic villus sampling

1 mark

(ii)
1. Reference to extraction of DNA (from cells)/eq
2. Use of restriction enzymes
3. Gel electrophoresis
4. Any detail of gel electrophoresis eg {large and small sections/positive and negatively charged sections} separate
5. Southern blotting/use of nylon sheet/eq
6. Correct reference to use of gene probe
7. Detail of (gene probe) eg {complementary/radioactive}
8. Reference to comparison to identify the gene

4 marks

Maximum mark

(c) (i) 4440

1 mark

(ii) 1. Change in amino acid sequence/primary structure

2. Affects the (specific) shape/tertiary structure of the protein

3. Channel does not allow passage of chloride ions

4. Does not allow chloride (ions) to leave epithelial cells

2 marks

(iii) 1. Chloride (ion concentration) builds up in the cell

2. Causes water to move into the cell

3. By osmosis

4. Loss of water from mucus makes it sticky/eq

2 marks

Total 12 marks

Question 5

Maximum mark

(a) Mass (kg) divided by height^2 (m^2)/65 ÷ 1.75^2

21/21.2 (kg m^{-2})

2 marks

(b) Less exercise/eq

Quantity: increased availability of food/people are wealthier/eq

Quality: more high {fat/sugar} foods/fast food/processed food/eq

2 marks

(c) (i) 1. Reference to {isolating/identifying} normal (leptin) gene

2. Inserting normal (leptin) gene into {target cells/cells of adipose tissue}

3. Reference to use of vectors

4. Such as {virus/plasmids}/liposome

5. Identify whether the normal gene is being expressed/has the treatment worked/gene is translated/correct protein made/eq

3 marks

(ii) 1. Reference to side effects/risk of diseases in the patient eg cancer/eq

2. Reference to cost of treatment/resources diverted to this from treatments for life threatening diseases

3. Reference to consent of patient/confidentiality issues

4. Treatment not cure/genes still present to be passed on/reference to somatic as opposed to germ line

5. Reference to counselling

6. Reference to {animal/embryo} testing

2 marks

Total 9 marks

Question 6

Maximum mark

(a)

P	mRNA
Q	tRNA
R	amino acid
S	anticodon

4 marks

(b)

DNA

Transcription

mRNA/messenger RNA

Translation

Complementary

Uracil

Guanine

Peptide

[1 mark for each two correct]

4 marks

Total 8 marks

Question 7

Maximum mark

(a)

1. Higher death (rate) among men than women in all countries
2. Highest (rates) of death in Russia/lowest (rates) of death in France
3. Any valid comparison between countries
4. Supporting data quoted to back up any valid point
5. Correct reference to different ratio of men/women death rates between countries

3 marks

(b) There is no {difference/correlation} in the death rates between people who eat lots of fruit and vegetables and those who {don't eat/eat less} fruit and vegetables/eq

1 mark

Question 7 continued

Maximum mark

(c) [Paired points — marks for reasons must be linked to a potential difference]

	Potential difference	Reason
1.	Different levels of health care	Better treatment/diagnosis/drug availability/eq
2.	Smoking	Smoking can cause atherosclerosis/carbon monoxide reduces oxygen transport/nicotine increase blood pressure/eq
3.	{Saturated fat/red meat/eq} intake/converse	Raises blood cholesterol level/HDL:LDL ratio/eq
4.	Lack of exercise	Exercise strengthens heart/eq
5.	Obesity levels	Higher {fat/cholesterol} levels/eq
6.	Levels of stress	Adrenaline/high blood pressure/fast heart rate/eq
7.	Health awareness	Knowledge of risk factors aids preventative action/eq
8.	Poverty/poor living conditions	Affects {diet/health/eq}
9.	Alcohol intake	High levels increase blood pressure/{low levels may reduce risk of CHD/red wine antioxidants}
10.	Age profile of country	CHD increases with age
11.	Genetic differences	Genes may affect health of heart, eg hypercholesteraemia (gene/allele)
12.	Salt intake	High blood pressure
13.	Any valid point	Any valid linked reason

4 marks

Total 8 marks

Unit SN2 (6132)

Question 1 **Maximum mark**

	Prokaryotic cell	Eukaryotic cell
Ribosomes present		
Cell diameter usually more than 20 μm	✗	✓
Cell may contain plasmids	✓	✗
DNA combined with protein into chromosomes	✗	✓
Nuclear membranes present	✗	✓
Cell wall always present	✓	✗

Total 5 marks

Question 2	Maximum mark
{Alpha/α} glucose	
{Beta/β } glucose	
More than two/several/many	
Glycosidic	
Insoluble	
Energy/glucose	
Hydrogen	
	Total 7 marks

Question 3 **Maximum mark**

(a) 1. (Dead cells so) {no contents/hollow/(like) tubes/(like) pipes} /reference to lumen

2. {No/reduced} {end/cross} walls

3. Lignin qualified with reference to water eg waterproofing/strengthens to withstand pressure

4. Pits for lateral movement (of water)

2 marks

(b) (Forces of) adhesion

Intermolecular force between water and {cellulose/lignin}

(Forces of) cohesion

Intermolecular force between water molecules

Pulled up xylem by transpiration/correct reference to evaporation as driving force

Difference in water potential/(hydrostatic) pressure

Root pressure/described in terms of osmosis in roots

4 marks

(c) (i) Intercellular cement/calcium pectate/middle lamella/helps to hold cells together

(ii) For making chlorophyll/enzyme cofactors

(iii) Making {protein/DNA/RNA/ATP}

3 marks

Total 9 marks

Question 4 **Maximum mark**

(a) Long term weather records/direct temperature records

Pollen analysis/use of pollen

Dendrochronology/study of tree rings

Melting of {polar ice/glaciers}

Phenological records

Coral bleaching

3 marks

(b) Methane/water vapour/oxides of nitrogen/example of NO_x/CFCs **1 mark**

(c) By {spreading/growing} in a different habitat/change of distribution

By growing further north

By growing at a higher altititude

Appropriate reference to mutation/evolution/natural selection

Appropriate reference to (seed) dispersal **3 marks**

(d) Assume that existing trends will continue

May not be based on enough data (to establish trend accurately)

Interactions between factors may prove to be more complicated than was predicted/changes in fossil fuel combustion by Humans

Example of unpredictable event which may affect climate eg volcanic eruptions/{Atlantic conveyer/Gulf Stream} breaks down

2 marks

Total 9 marks

Question 5 **Maximum mark**

(a) A Mitosis

B Meiosis

2 marks

(b) (i) Fertilisation/syngamy

1 mark

(ii) Zygote/diploid cell

1 mark

(c) 1. {Carcinogens/chemicals which cause mutation} in {smoke/tar}

2. Uncontrolled {mitosis/cell division}

3. (Uncontrolled cell division leading to) formation of a {tumour/mass of abnormal cells/malignant growth}

4. Reference to {mutation/DNA damage}

5. Reference to disruption of mechanisms which control {cell division/cell activity}/causes cells to multiply faster than cells die

3 marks

(d) X Acrosome

Y Nucleus

Z Mitochondria

3 marks

Total 10 marks

Question 6 **Maximum mark**

(a) Renewable/can grow some more when it runs out

Reserves of fossil fuel are {not being replaced and will run out/finite

Does not release {sulphur/sulphur dioxide/SO2/other harmful gases in fossil fuel smoke}/less carbon dioxide

Does not contribute to {global warming/climate change/does not contribute to acid rain

Carbon neutral/does not add to the carbon dioxide (already) in the atmosphere/does not upset the balance of carbon dioxide in the atmosphere/carbon dioxide given out in combustion replaces carbon dioxide (recently) taken in

OR Converse — {Burning fossil fuels represents a net increase of carbon dioxide/eq}/fossil fuel represents carbon that had been locked up for a long time

4 marks

(b) (i) (by making it) cheaper

1 mark

(ii) Cannot transfer genes between different species (by conventional method) (GM can)

Conventional method involves transfer of pollen (GM does not)

GM involves transferring {genes/DNA} by {vectors/bacteria/plasmids (in bacteria)/gene guns/virus} (GM does not)

Conventional process very slow (GM faster)

Conventional process hit and miss/unreliable/difficult to control (GM more controlled)

Conventional process involves (artificial) selection/selection described (GM does not)

Conventional process may use mutations/mutagens (GM does not)

GM makes use of mapping of DNA/gene sequencing/other appropriate examples of modern techniques (conventional methods do not)

4 marks

(c) [Responses must refer to the specific example rather than being just general objections to GM]

[To gain full marks the candidate must choose either 'for' or 'against', maximum two marks if the candidate does both]

Should be banned:

1. Reference to the possibility of unexpected undesirable consequence of GM
2. Reference to pollen reaching other plants
3. And transferring gene to {wild/organic} crops
4. Appropriate reference to the 'precautionary principle'
5. So much fossil fuel is being burnt that developing GM oilseed rape isn't going to make enough difference (to risk GM)

Should go ahead:

6. Evidence suggest the risks {are small/have been over emphasised}
7. The danger of burning fossil fuels is very serious/need to conserve fossil fuels
8. Correct and appropriate reference to {climate change/consequence of burning fossil fuel}
9. Excessive carbon dioxide emissions are a far greater risk than GM
10. Problems of antibiotic resistance can be overcome

3 marks

Total 12 marks

Question 7 **Maximum mark**

(a) Protection (of plant) from (bacterial) disease

1 mark

(b) (i) Correct reference to {bacteria/bacterial} innoculum

{Sterile/aseptic} techniques

Incubation/left to grow for a time

At temperature in the range 25–40˚C/for 24 hours (accept up to 5 days)

Correct reference to using a Petri dish or similar suitable piece of apparatus/correct reference to use of {a medium/agar}

(If antibacterial substance is present) {clear/bacteria-free} zone around disc

4 marks

(ii) A bigger {clear/bacteria-free} zone than with garlic means the new substance is a more effective antibacterial agent/converse

Keep in same conditions/use same dish

Specific reference to any two variables to be standardised eg {mass of plant material used/incubation time/incubation temperature/volume of extract used/size of filter paper disc/type of filter paper/etc}

Specific reference to quantitative means of comparing the differences in size of the clear zones

3 marks

(c) {Food preservative/food additive} to counteract {disease/food poisoning}/(chemotherapeutic) medicine to fight bacterial infection/{disinfectant/antiseptic/antibiotic}/toothpaste

1 mark

Total 9 marks

Question 8 **Maximum mark**

(a) (i) The total of all the {genes/genetic material/DNA/alleles} in {humans/ an organism}

1 mark

(ii) {On/in/as part of/as sections of} {chromosomes/chromatids/ chromatin/DNA}

1 mark

(b) (i) 1. Reference to example eg {avoid smoking/eat a special diet/avoid fatty foods}/more exercise

2. (With reference to one of the above examples) the need to be particularly careful when one knows one is {particularly at risk/at greater risk than general population}

3. Could have treatment in advance of onset of condition/could make preparation for coping with problem/more check ups/closer monitoring

2 marks

(ii) 1. To inform health service {planning/budget/priorities}/identify people at risk

2. Early {treatment/diagnosis} {may reduce problems later/may help determine the appropriate dose of medication}

3. Advising people with defective genes about having children/deciding whether to abort affected fetuses

4. Thus reducing cost/burden to society

5. Reduces insurance premiums for people without genetic defects

6. To determine medical research priorities

2 marks

(c) (iii) 1. Undue intrusion into people's lives by government/infringement of {civil liberty/human rights}

2. Easier to cope if you don't know in advance/prefer not to know/creates needless stress

3. Implication for insurance premiums

4. Risk of discrimination

5. Pressure to have abortions/to avoid having children

6. Cost too much/too much taxation

[Any TWO]

Development mark (in appropriate context to one of the points above):

7. The benefits are not worth the {risks/cost}

8. {Health/life} insurance too expensive for those at risk/people might have to declare results of screening to get insurance

9. Lack of confidence in {government/administrators} to keep data confidential/data protection issues

[Any ONE]

3 marks

Total 9 marks

Unit test (6133/02)

Question 1 **Maximum mark**

(a) Idea of random error as values lying above or below an average value

Valid example of random error identified
[Must be clear that the variation in the dependent variable is caused by random error, the mark cannot be given for just naming the dependent variable]

Suggested cause of random error for stated example

2 marks

(b) (Reliability meaning) a measure of the {confidence/trust/consistency} in a set of measurements or observations/repeated values are close together/eq

(Accuracy meaning) close to the {true/correct/real} value/eq

2 marks

(c) Need for {repetition/replication} of {measurements/results}

Dealing with anomalies (in a sensible way, eg leaving out figures which are anomalous, having large amounts of data)

Controlling variables

2 marks

Total 6 marks

Question 2 **Maximum mark**

(a) (i) The dependent variable is the one that is measured in some way

1 mark

(ii) The independent variable is the factor that is being {varied/changed/manipulated/eq}

1 mark

(b) Dependent variable correctly identified (this must be specific, eg absorbance/transmission in beetroot, not 'how purple the solution is')

Description of how it was measured/(state) apparatus used to measure it

Other details of technique, eg {dots on paper/calibrating colorimeter/reference blank/reference to chosen apparatus more accurate than another/relevant calculation of percentage error/weights added to nettle fibre carefully/in (small) increments}

3 marks

(c) Relevant variable identified and appropriate technique to control variable

Effect on results if variable changes

2 marks

Total 7 marks

Question 3 **Maximum mark**

(a) Two safety aspects (procedures/precautions) clearly explained

[Each must be explained and be specific to the practical chosen]

2 marks

(b)
1. Type of graph described is appropriate for data
2. Type of data – continuous or discontinuous
3. Statement that independent and dependent variables on correct axes
4. Suitable scales
5. All data included on graph (eg error bars etc)
6. Suggestions for what {was/might have been} plotted (eg means, percentages etc)
7. Justification of {line of best fit/curve/line joining the points}
8. {Error bars/range bars/maximum/minimum} to show variability
9. Allows you to see clearly the trends in the data/use for {predictive purposes/calculations}/eq
10. Identification of anomalies

5 marks

Total 7 marks

Unit test (6134)

Question 1 **Maximum mark**

(a) Organism that causes disease

Eg {virus/bacterium/fungus}

2 marks

(b) (i) (Release) histamine

Dilation of arterioles/increased blood flow/vasodilation

Oedema/swelling/leakage of plasma

More white blood cells/eq (attack pathogens);

Mast cells

3 marks

(ii) Enzyme

Tears/saliva/nasal secretions

Breaks down (cell walls of) bacteria/kills bacteria/lysis

2 marks

(iii) {Destroys/prevents replication of} viruses

OR

Secreted by infected cells

1 mark

Total 8 marks

Question 2 **Maximum mark**

(a) Conflict with {farmers/agriculture}/eq/destruction of natural habitat

Isolated populations breed less successfully

Reference to climate change in habitat

Removal of prey species/reference to food chain

{Poaching/eq}/example of why tigers are removed eg chinese medicine

2 marks

(b) (Breed from animals that are) {unrelated/from the wild/from another zoo/from outside the programme}

{Maintaining/increasing} breeding population

Different genetic makeup (from existing tigers)/introduction of new genes/eq

Prevents {inbreeding/homozygosity}/promotes heterozygosity/less risk of genetic disorder

{Genes/alleles/eq} mixed/larger gene pool

Replace genes lost as captive animals die

[Allow converse of points]

3 marks

(c) Tigers occur in a wide variety of natural habitats

(90% is a) high proportion of the different alleles/keeps many different alleles in the population

Provides variety in phenotype

Allows adaptation to {new/natural} environment

Some individuals will survive {changed/different} conditions/similar organisms would be affected in the same way by adverse environmental change

Maintain {gene flow/similarity} to wild population/prevent loss of wild characteristics/successful breeding between wild and captive populations

4 marks

Total 9 marks

Question 3 **Maximum mark**

(a) (Extent of) decomposition/colour/smell/bloating

(Degree of) {muscle contraction/rigor mortis}

Any other relevant factor

2 marks

(b) Man 20h since hatching + 90h to hatch = 110h

Woman 60h since hatching + 50h to hatch = 110h

[Allow 110 hrs without working — max 1 mark]

Likely that both had eggs laid on them {110h ago/at same time}

Blankets {increase temperature/keep high temperature/eq}

Woman at higher temperature

Eggs hatch quicker at higher temperature

3 marks

(c) (Beetles) not able to enter house/bodies {inside/not outside}

{Conditions/example of condition} not suitable for beetles/conditions need to change

Beetles need other organisms to change conditions

Reference to succession

2 marks

Total 7 marks

Question 4 **Maximum mark**

(a) {Foreign/non-self/eq} substance/eq

Which stimulates an immune response/eq

Antibodies produced/reference to specificity/binds to antibodies

2 marks

(b) (i) 1. Increase is more rapid

2. More antibody produced overall by second injection/converse

3. Second injection peaks before first injection/converse

4. Antibody present at 0 weeks for second injection

5. Plateaus at peak only in second injection

6. Credit quantitative comparison

3 marks

(ii) 1. Memory cells already present

2. More cells to respond to antigen

3. So more likely that the antigen would be detected

4. Reference to {clonal selection/clone/cloning}

5. Reference to plasma cells produced {faster/in greater numbers}

6. Plasma cells produce the antibodies

7. Reference to {primary/secondary} immune response

4 marks

(c) High circulating antibody

Removes streptokinase/prevents streptokinase activity

Not an effective treatment

Could cause damaging response

2 marks

(d) {Response/antibodies} specific to this antigen/different antigen

1 mark

Total 12 marks

Question 5 **Maximum mark**

(a) (i) (Gaining) light energy/chlorophyll excited/photoexcitation

Results in {excited electrons/electrons raised to a higher energy level}

Electrons able to leave chlorophyll molecule/oxidation of chlorophyll

Get picked up by molecule A/must have somewhere to go

2 marks

(ii) Photolysis/splitting using light energy

Of water

Hydroxide ions as source of electrons/$2OH^- \longrightarrow 2OH + 2e^-$

Cyclic photophosphorylation

2 marks

(iii) As electrons move from carrier to carrier energy is released/eq

Oxidation – reduction reactions

(Energy used to) synthesise ATP from ADP + Pi

H^+ moved into lumen of thylakoid using light energy

H^+ diffuse out of thylakoid synthesising ATP

2 marks

Question 5 continued **Maximum mark**

(b)
1. (Takes place in the) stroma
2. (During the) light independent stage
3. RuBP required for carbon dioxide fixation/eq
4. Reference to {RuBP carboxylase/Rubisco}
5. To provide {GP/PGA}
6. Reference to {reduced NADP/$NADPH^+$/$NADPH_2$}
7. Reduction (of GP/PGA)
8. To {GALP/TP/PGAL/3C sugar/triose}
9. Requires ATP/ATP broken down
10. {GALP/eq} used to form glucose
11. {GALP/eq} used to regenerate RuBP

Content — maximum 5 marks

[indicate by $\checkmark^P$ or $\times^P$] **Continuous prose — 1 mark**

6 marks

Total 12 marks

Question 6 **Maximum mark**

(a) (i) Competition

For {limited resources/relevant example}/between too many organisms

2 marks

(ii) (Survive to) reproduce

By organisms best {suited/adapted} to the environment

Best able to obtain {resources/named resource eg food/mate/place to live}

2 marks

(b) Collected more evidence/confirm ideas

Reference to Wallace [any sensible context]

Reference to controversy

Reference to religious beliefs contradicted

Reference to humans {evolving/arising/descending} from animals

2 marks

(c) Enters the cells of host/inside cells

Protein coat changes

Mutation

2 marks

Question 6 continued **Maximum mark**

(d) *Could apply to humans or HIV:*

1. Selective advantage/survive to breed
2. Advantageous {gene/allele} passed to offspring
3. {Allele frequency/eq} increases in population/more HIV resistant people
4. (These changes act as a) selection pressure on the other species (humans affect HIV/converse)
5. Virus has {larger numbers/quicker reproductive cycle/quicker production of offspring}
6. Genetic changes to virus population are quicker/converse
7. Human genetic change will always lag/eq/converse

4 marks

Total 12 marks

Unit test (6135/01)

Question 1

Maximum mark

(a) Reference to non-functioning of synapses/eq

Control of {motor functions/motor neurone function}

Reference to {cerebellum/motor cortex/parietal lobe}

Reference to {substantia nigra/basal ganglion/mid brain}

2 marks

(b) Dopamine cannot enter the brain/L-dopa can be converted to dopamine/L-dopa is {easier/cheaper} to make/converse

1 mark

(c)
1. {MRI/FMRI} scan/{CT/CAT} scan/thermal imaging/X-rays/PET
2. Reference to 3-D image [only applies to MRI, FMRI, CAT scan and PET]
3. {Shape/size/colour} difference
4. Density of tissue
5. Comparison to image of a normal brain/method of identification of damaged areas
6. Reference to monitoring over time

3 marks

Total 6 marks

Question 2

Maximum mark

(a)

1. Identical twins are genetically identical/eq
2. Height mainly due to {genes/nature}/not affected much by environment
3. Body mass and intelligence are mainly due to {environment/nurture/eq}
4. Reference to figure(s) to back up argument/valid comparison eg less effect of nurture of those reared together/converse

[max 2 marks for description]

5. Reference to body mass eg diet, exercise
6. Reference to intelligence eg schooling, parental encouragement
7. Reference to height being {polygenic/multifactorial}

[max 2 marks for explanation]

3 marks

(b)

1. Only a small sample/eq
2. Fewer (MZ) twins reared apart/converse
3. Characteristics not measured using {same/comparable} units
4. Intelligence {difficult to measure/subjective/testing unreliable}
5. Reference to not knowing whether the differences are statistically significant
6. No comparison with {unrelated people/rest of population/dizygotic twins/other siblings}
7. Reference to two samples being matched for {age/sex/culture/race/eq}
8. One-off measurements and differences in characteristics may change over time
9. Fears that the data may have been falsified

2 marks

Total 5 marks

Question 3

Maximum mark

(a) (i) {0.4 – 0.55} x 12

= {4.8 – 6.6} (dm^3 min^{-1})

2 marks

(ii) {1.1 - 1.3} x 36 = {39.6 - 46.8} (dm^3 min^{-1})

Increase of {33.0/42.0}/increased by about 6 times

2 marks

(b) (i) Heart rate x stroke volume/volume of blood pumped out of {heart/ventricles} in <u>one minute</u>/eq

1 mark

(ii) (As minute volume increases) {volume of oxygen breathed in/gas exchange/tidal volume} increases/eq

Increased <u>diffusion</u> of oxygen into {blood/muscle}

(Increase in cardiac output) increases volume of (oxygenated) blood reaching muscles/eq

2 marks

Total 7 marks

Question 4 **Maximum mark**

(a)

1. Reference to local currents
2. Depolarisation of {adjacent/next} section of axon
3. Sodium channels open/sodium ions move in (to axon)
4. More sodium ions move <u>in</u> so more sodium channels open/positive feedback idea
5. Correct reference to +40 mV/{becomes positive/less negative} inside the axon
6. Potassium channels open/potassium ions move <u>out</u> (of the axon)
7. Membrane repolarises
8. Wave of depolarisation/depolarisation — repolarisation process repeats itself along the axon/eq
9. Refractory period/hyperpolarised/more negative than resting potential
10. Idea of impulse moves in one direction only
11. Myelin sheath speeds up conduction
12. Current jumps between {nodes of Ranvier/gaps in the myelin sheath}/saltatory effect

6 marks

(b)

1. Less calcium (ions) enter into neurone /fewer calcium channels open
2. Fewer neurotransmitter vesicles {move to/fuse with} (presynaptic/neurone 1) membrane/less neurotransmitter released (into synaptic cleft)
3. Less neurotransmitter diffuses (across the synaptic cleft)
4. Less neurotransmitter binds to {receptor/sodium channel} on (postsynaptic/neurone 2) membrane
5. Fewer sodium (ion) channels open/less sodium (ions) enter
6. Less membrane depolarisation/{fewer/no} action potentials initiated (in neurone 2)

4 marks

Total 10 marks

Question 5 **Maximum mark**

(a) Sprinting requires rapid {release of energy/production of ATP}/eq

Slow fibres {generate ATP/respire} aerobically
OR
Fast twitch fibres can (produce ATP) {respire anaerobically/by glycolysis}

Slow twitch fibres have more {mitochondria/myoglobin}/converse

2 marks

(b) (i) As distance of event increases, SDH (activity) increases/eq/converse

The longer the distance the more {energy/ATP} produced aerobically/eq/converse

Reference to SDH being involved in <u>aerobic</u> respiration

(ii) LDH (activity) is greater over shorter distances/eq

The shorter the distance the more {energy/ATP} produced anaerobically

Reference to LDH being involved in anaerobic respiration

4 marks

(c)
1. Correct reference to reduced {coenzymes/$NADH_2$/$FADH_2$}
2. Hydrogen splits into electrons and {protons/H^+}
3. Electrons passed from one carrier to next
4. From higher energy levels to lower energy levels
5. {Redox/oxidation} reactions release energy (for synthesis of ATP)
6. Reference to more ATP being produced/eq
7. Oxygen as terminal electron acceptor/water is formed

4 marks

(d)
Most of the lactate is converted back into pyruvate

And is (oxidised) to carbon dioxide and water (via the Krebs cycle)

Releasing energy to synthesise ATP

Some lactate may also be converted into glycogen (and stored in the muscle or liver)

Reference to oxygen debt

2 marks

Total 12 marks

Unit SN6 (6136)

Question 1

Maximum mark

(a) [One mark for each characteristic listed — maximum 3 marks]
[One mark for each relevant animal example — maximum 3 marks]

	Characteristic:	*Animal example*:
1.	Sex for pleasure	Bonobos/chimps
2.	Tools use	Chimps using stalks of grass to extract termites/crushing sponges of leaves to get water/eq
3.	Culture/eq	Certain populations of chimps using hammers/killer whales with different {hunting/calling/social} patterns according to their population
4.	Waging war	Chimp raiding parties killing males of neighbouring troops
5.	Language	Monkeys with vocabularies for different predators and birds/ {apes/parrots} capable of learning symbols
6.	Theory of mind	Chimps engaging in deception
7.	Abstract reasoning/subjectivity	Baboons performing well at computer discrimination tasks

6 marks

(b) 1. Switching genes on for different lengths of time

2. Using the same genes in a different order and pattern

3. Reference to environmental factors affecting gene expression

4. Appropriate reference to promoters

2 marks

(c) Plants reuse genes by duplicating the whole gene and changing the promoter in the duplicated version/eq/converse

1 mark

Question 1 continued

Maximum mark

(d)

1. Selecting for tameness ('genes') affected other {genes/characteristics}
2. Reference to promoters affecting more than one gene
3. Reference to timing of development
4. Retaining juvenile features
5. Example of juvenile feature

3 marks

(e) *Background description:* **[max 6 marks]**

1. Promoters are stretches of DNA associated with a particular gene
2. Transcription factors attach to {gene/DNA/promoter}
3. (Transcription factors) are proteins
4. (Transcription factors are therefore) the products of genes
5. Reference to interaction between genes
6. (Transcription factors binding to promoters) {either switch genes on or off/control transcription/control gene expression}
7. Correct reference to RNA polymerase
8. Changes in promoters can change the expression of a gene
9. Sensitivity of a gene depends on the sensitivity of its promoter/promoter acts as genetic thermostat
10. Cascade effect if the gene changed is the code for a transcription factor
11. Evolution could occur through the adjustment of gene promoters rather than genes themselves
12. {Experience/nurture/eq} could affect one of the {promoters/thermostats/eq}

Question 1 part (e) continued

Maximum mark

Examples: **[max 4 marks]**

13. Hox(c8) controlling the number of neck vertebrae in mice, chickens and pythons

14. 'Eve' gene of fruit flies is switched on at least 10 separate times during a flie's life

15. Chimps have {longer jaws/shorter craniums} than humans because of the timing of development of the head

16. Promoter change in {foxes/wolves/dogs} so that adult animals display {features/habits} of puppy eg {floppy ears/short snout/smaller skull/playful behaviour/less fear/less aggression/smaller brain/smaller limbic system}

17. {Smaller brains/less aggression} in humans/bonobos

8 marks

Total 20 marks

Question 2

Maximum mark

(a)
1. The area was {covered/dominated} by {forest/trees}
2. Dominated by birch/eq
3. Very little grassland/no {bracken/ruderals/plantains/cereals/farmland}

2 marks

(b)
1. {No/reduced} {bacteria/microbes}
2. Lack of oxygen
3. Might be {too acid/too low pH} (for many bacteria)
4. {Chemical substances/named possible examples eg tannins/urine} may kill bacteria
5. Bacterial {growth/function/eq} is reduced at low temperatures
6. Reference to temperature dependence of enzymes

3 marks

(c)
1. Presence of {grassland/pasture/farmland}
2. Lots of heather
3. {Patchy/eq} {forest/woodland}
4. (Forest) {dominated/eq} by {oak/alder/birch}
5. Some {arable land/crops}

3 marks

Question 2 continued

Maximum mark

(d)
1. Wood used by people
2. Deforestation/eq
3. Which leads to expansion of {grass/bracken/heather}
4. Reference to grazing {beginning/introduction/increasing/eq} (in 110 AD)
5. Which {prevents reforestation/deflected succession}
6. Increased {rainfall/wet conditions} so alder increased
7. Introduction of {arable/crop/eq} farming (shown by presence of ruderals)/eq
8. No evidence that (arable) crops were cereals/eq [discussion of reason for lack of pollen]
9. Increase in human population

5 marks

(e)
1. By succession
2. Secondary (succession)
3. Less cultivation means more {weeds/ruderals}
4. Followed by grass
5. Reference to scrub phase/eq
6. Grazing tolerance/scrub cannot be grazed
7. Scrub protects young trees/less grazing (means more tree seedlings survive)
8. Trees shade out {grass/ruderals/scrub/heather}
9. Reference to climax
10. Less use of wood/eq

5 marks

Question 2 continued

Maximum mark

(f) Decreases

Romans are cutting it down to use

In leather making

2 marks

Total 20 mark

Questions 3 and 4: Essays

Marks are awarded under four components and these reflect the key aspects of being synoptic:

A: Breadth — for selecting items from *different* parts of the specification. **Up to 6 marks** for 6 items. Left hand column

B: Depth — for at least some of these items in depth **up to 8 marks** for developing at least three items. Right hand column.

C: Balance — a balanced approach to the dilemma underlying the question — **un-picking the question**. Some essay contents argue 'for', others 'against' but that (for top marks) it's about balancing arguments and/or evaluating risks. **Up to 6 marks**.

D: Coherence, clarity and expression of the answer (effectively style) — the student may know a lot of facts about the subject but can he or she express ideas, synthesise them and weave them together into a seamlessly synoptic essay? **Up to 4 marks**.

Note that the **maximum** total mark is 20. The mark scheme recognises more than one approach to getting full marks.

D: Coherence, clarity and expression of the answer

This strand will award students for **style** of their answer and is quite distinct from mentioning the big ideas (C). It isn't *what* candidates say but *how* they say it.

4 marks A truly synoptic essay which links together information from different parts of the specification in a coherent and logical style (introduction. Conclusion, good use of paragraphs and well illustrated by examples). Good spelling, punctuation, grammar and sound use of technical terminology.

3 marks Good logical structure with good spelling, punctuation, grammar and sound use of technical terminology, but tends to be a collection of information which, although relevant, tends to be disjointed and only partly attempts to synthesise information.

2 marks A reasonably coherent account that includes satisfactory spelling, punctuation and grammar, which tends to be disjointed. A collection of information with little or no attempt to link ideas together.

1 mark Some relevant information is presented in an intelligible way using correctly formulated simple sentences.

0 marks The use of English is not adequate to convey scientific information beyond naming a list of examples. *A candidate who has scored some marks (particularly in strand A) for mentioning some relevant points may nevertheless fail to score marks in strand D if he or she fails to form simple sentences.*

4 marks (maximum)

Question 3

Worldwide, humans use approximately 80 million tonnes of fats and oils every year, most of which is derived from plants. Not all of this is eaten. 'Fat — good or evil?' — Discuss the structure, functions and uses of lipids and their importance in humans.

A: Breadth — maximum of points need only be mentioned provided they are in proper context. **6 marks (maximum)**	**B: Depth —** technical terms used in proper context. **8 marks (maximum)**
A1 — structure — fatty acids + glycerol	B1 — more detailed description of molecular structure using formula, verbal description or diagram describing a **triglyceride as three fatty acids + glycerol** B2 — **phospholipid as fatty acid, glycerol and phosphate** (description or diagram) B3 — correct reference to **condensation/hydrolysis/formation of ester bond**
A2 — double bonds unsaturated/saturated without double bonds	B4 — structural distinction between **saturated and unsaturated** or between **mono and polysaturates** B5 — fats **solid** and oils **liquid** at room/environmental temperatures B6 — **plant sources** tend to be {oils/unsaturated}/converse for animals B7 — (lipids can be**) fats, oils, waxes or steroids**
A3 — storage of lipid soluble vitamins A4 — as energy source (in diet)/energy storage (in the body)	B8 — link this to role in **storage and transport** of lipid soluble **vitamins** B9 — **energy content *much* higher/about twice as much** as other food/carbohydrates B10 — can be important in diet of {animals/human} with {unreliable food supply/high energy requirements}/reference to **balance between energy use and energy gain** B11 — relevant reference **aerobic respiration of {glycerol/fatty acids**}/relevant details of **RQ** {comparisons/calculations}
A5 — in cell membranes	B12 — correct chemical explanation **of why lipids are not soluble in water** eg non-polar so unable to form hydrogen bonds/water will make bonds with other water molecules and not lipid B13 — role of lipid membranes in **endo** and {**exocytosis/secretion**}/reference to fluid nature of lipid membranes B14 — role of membranes in **compartmentalisation** inside cells/role of **specialised membranes** to provide large surface area (eg **thylakoids** in chloroplasts/**cristae** in mitochondria)

A6 — (reference to/description of) **lipid bilayer**/suitably labelled diagram/key part of fluid mosaic model	B15 — **hydrophilic and hydrophobic orientation** of lipid molecules B16 — {**head**/glycerol} hydrophilic/fatty acid (**tail**) {hydrophobic/water hating/repelled by water} (getting it the **right way round**)
A7 — as (thermal) insulation	B17 — expansion of role of fat in providing **thermal insulation** and/or protection using at least two specific examples
A8 — electrical insulation in nervous transmission	B18 — description of importance of **myelin sheaths** in speeding up nervous transmission/saltatory conduction
A9 — water storage in desert animals	B19 — explained in terms of **release of water when oxidised in aerobic respiration** B20 — reference to specific example eg camels' humps — fat as stored water
A10 — potential source of fuel A11 — example of non-energy other products commercial products eg cooking oil/soap/candles/margarine/inks/varnish	B21 — concept of **biofuels** explained with example eg biodiesel from rape B23 — **a renewable energy** in contrast to burning fossil fuel
A12 — water proofing agent	B24 — example eg in animals fur/sheep's wool/human hair
A13 — (too much) fat in diet a common cause of obesity	B25 — strain on joints/osteoarthritis/hernias/diabetes mellitus/hypertension/varicose veins/reduced/fertility/ back problems B26 — bullying/discrimination/psychological effects
A14 — (too much) fat in diet linked to cardiovascular disease	B27 — description of atherosclerosis; HDL:LDL {levels/ratio} B28 — cardiovascular disease linked to increased risk of cancer/cardiovascular disease/lower life expectancy

C1 **Two** examples *used* to emphasise that lipids can be of benefit eg minimum requirement in human diet; energy important in the diet; fat important as protection/electrical insulation in nerves; heat insulation important in a cold climate; biofuels less {pollution/CO_2 emission/less global warming}; biofuels offer possible solution to global warming

C2 **Two** examples *used* to emphasise that lipids can be a problem eg leads to obesity; linked to cardiovascular disease; polysaturated more than saturated; serious problem in (well-fed) western society

C3 **Two** points to emphasise question of balance: depends on balance of energy consumption and intake; obesity a problem when people eat too much but don't do enough exercise; fat rich diet important for people/ animals who work hard/live in a cold climate; would take a lot of land to produce enough biofuel to replace fossil fuel; the body can handle some lipid but not too much

6 marks (maximum)

D: Coherence, clarity and expression of the answer

This strand will award students for **style** of their answer and is quite distinct from mentioning the big ideas (C). It isn't *what* candidates say but *how* they say it.

4 marks A truly synoptic essay which links together information from different parts of the specification in a coherent and logical style (introduction. Conclusion, good use of paragraphs and well illustrated by examples). Good spelling, punctuation, grammar and sound use of technical terminology.

3 marks Good logical structure with good spelling, punctuation, grammar and sound use of technical terminology, but tends to be a collection of information which, although relevant, tends to be disjointed and only partly attempts to synthesise information.

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1 mark Some relevant information is presented in an intelligible way using correctly formulated simple sentences.

0 marks The use of English is not adequate to convey scientific information beyond naming a list of examples. *A candidate who has scored some marks (particularly in strand A) for mentioning some relevant points may nevertheless fail to score marks in strand D if he or she fails to form simple sentences.*

4 marks (maximum)

Question 4

Current developments in gene technology are expected to make a significant impact on Society over the next few decades. Discuss the techniques, applications and implications of gene technology.

A: Breadth – maximum of points need only be mentioned provided they are in proper context. **6 marks (maximum)**	**B: Depth –** technical terms used in proper context. **8 marks (maximum)**
A1 – clear evidence that candidate understands **what is meant by GM** in terms of transferring {genes/DNA/genetic material} between species or techniques to investigate DNA	B1 – cutting and splicing DNA; B2 – reference to enzymes eg {endonuclease cuts/ligase splices} **B3 –** reference to means of getting genes into organisms eg {plasmids/viruses/liposomes/gene guns/agrobacterium} B5 – use of **antibiotic resistant genes** for marking and screening/how successful transgenic organisms can be separated from the others
A2 – used to make GM plants/crops	B6 – named **example of GM crop** B7 – purpose of the genetically modified plant used as example eg herbicide resistance/insecticide production/improved yield/reduced fertiliser requirement/salt tolerance/eq
A3 – developing new breeds of GM animals	B8 – named **example of GM** animal {in context/with reason or purpose} B9 – purpose of genetically modified animal example (other than drugs or antibiotics) eg production of human antigens on pigs hearts for xenotranspiration
A4 – modification of microbes for biotechnology	B10 – examples of **pharmaceutical products from bacteria** eg insulin B11 – why the pharmaceutical product is useful eg insulin to treat diabetes
A5 – cloning *of successful transgenic* {plants/animals} *[NB: cloning as such is not regarded as gene technology – only as a technique associated with it for mass-producing transgenic organisms]*	B12 – details of **technique of cloning of animals** eg as exemplified by Dolly the Sheep B13 – **therapeutic cloning** eg organ replacement/stem cells, briefly explained

A6 – PCR polymerase chain reaction	B14 – **PCR technique** briefly explained B15 – role of **DNA {polymerase**/primers} explained B16 – example of application of PCR
A7 – genetic screening of embryos for genetic abnormalities	B17 – **disease screening briefly explained** B18 – example of a genetic disorder detected by embryo screening
A8 – genetic screening of adults for {being carriers of genetic disease/risks of developing a disease}	B19 – named **example** of a disease or disorder that can be detected with **genetic screening** for adults (not the same as the example for embryo screening)
A9 – genetic finger printing	B20 – **DNA fingerprinting** briefly explained – producing a unique profile of a person's DNA which enables them to be identified from a sample of their {cells/semen} B21 – example of the use of genetic fingerprinting eg in forensic pathology B22 – the role of **electrophoresis** in genetic finger printing/other forms of DNA analysis B23 – reference to detail involved with genetic fingerprinting eg **Southern blotting**
A10 – gene therapy	B24 – named example of **gene therapy**
A11 – development of potential new {drugs/medication} using GM technology	B25 – reasonable example to illustrate the scope of GM technology in developing **new pharmaceutical products** to treat conditions currently difficult to treat eg{vaccines/anti-cancer drugs/antisense drugs
A12 – reference to the Human Genome Project	B26 – any valid example to illustrate the potential value of the **HGP**

C1 **Two** examples *used* to make the point that GM is *clearly of benefit*: few would dispute the benefit to society of catching criminals/producing life-saving drugs/vaccines; developing new crops to feed the starving; curing incurable genetic diseases; genetic screening useful in planning of health service/eq

C2 **Two** examples *used* to make the point that many have doubts about GM: ethical objections to possibility it may lead to pressure to allow designer babies/to abort foetuses suspected of genetic abnormalities; may lead to discrimination against people with abnormal genes/GM accident may produce killer microbes or other serious consequences/might be used in germ warfare/may lead to undesirable ecological consequences/super weeds discussed in correct context; may mean that (a few) international biotech companies have too much power

C3 **Two** examples illustrating that it's not black and white: similarities between GM and traditional breeding means its as question of degree/eq

the benefits of GM are not worth the risks OR the benefits of GM are so big we cannot afford to ignore it; some applications eg genetic finger printing should be allowed others banned eg designer babies/eq if we/UK/Europe/West don't do GM research other countries will anyway

6 marks (maximum)

D: Coherence, clarity and expression of the answer

This strand will award students for **style** of their answer and is quite distinct from mentioning the big ideas (C). It isn't *what* candidates say but *how* they say it.

4 marks A truly synoptic essay which links together information from different parts of the specification in a coherent and logical style (introduction. Conclusion, good use of paragraphs and well illustrated by examples). Good spelling, punctuation, grammar and sound use of technical terminology.

3 marks Good logical structure with good spelling, punctuation, grammar and sound use of technical terminology, but tends to be a collection of information which, although relevant, tends to be disjointed and only partly attempts to synthesise information.

2 marks A reasonably coherent account that includes satisfactory spelling, punctuation and grammar, which tends to be disjointed. A collection of information with little or no attempt to link ideas together.

1 mark Some relevant information is presented in an intelligible way using correctly formulated simple sentences.

0 marks The use of English is not adequate to convey scientific information beyond naming a list of examples. *A candidate who has scored some marks (particularly in strand A) for mentioning some relevant points may nevertheless fail to score marks in strand D if he or she fails to form simple sentences.*

4 marks (maximum)

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