

Paper Reference(s) 9BN0/01

Pearson Edexcel Level 3 GCE

Biology A (Salters Nuffield)

Advanced

**Paper 1: The Natural Environment and
Species Survival**

Thursday 6 June 2019 – Morning

**Time: 2 hours plus your additional time
allowance**

INSTRUCTIONS TO CANDIDATES

**Write your centre number, candidate number,
surname, other names and your signature in
the boxes below. Check that you have the
correct question paper.**

Centre No.					
Candidate No.					
Surname					
Other names					
Signature					
Paper Reference	9	B	N	0	/ 0 1



- **Use BLACK ink or ball-point pen.**
- **Answer ALL questions.**
- **Show your working in any calculation questions and include units in your answer where appropriate.**
- **Answer the questions in the spaces provided – there may be more space than you need.**

MATERIALS REQUIRED FOR EXAMINATION
Calculator, HB pencil, ruler

ITEMS INCLUDED WITH QUESTION PAPERS
Separate sheet for use with question 6(c)

INFORMATION FOR CANDIDATES

- **The total mark for this paper is 100.**
- **The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.**
- **You may use a scientific calculator.**

(Instructions continue on next page)

(Turn over)

- In questions marked with an **ASTERISK (*)**, marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

ADVICE TO CANDIDATES

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

(Turn over)

Answer ALL questions.

Some questions must be answered with a cross in a box ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

(Questions begin on next page)

(Turn over)

1 Photosynthetic plants use light as a source of energy for the synthesis of organic molecules. Photosynthesis is a two-stage process.

(a) The light-dependent reactions take place in the chloroplast.

(i) Which of the following describes where, in the chloroplast, the light-dependent reactions take place? (1 mark)

- ☐ **A cristae**
- ☐ **B matrix**
- ☐ **C stroma**
- ☐ **D thylakoids**

(Question continues on next page)

(Turn over)

**(ii) Which of the following are the products of the light-dependent reactions?
(1 mark)**

- ☐ **A carbon dioxide and reduced NADP**
- ☐ **B glucose and oxygen**
- ☐ **C reduced NAD, ATP and oxygen**
- ☐ **D reduced NADP, ATP and oxygen**

(Question continues on next page)

(Turn over)

(iii) Which of the following is the source of the hydrogen produced by the light-dependent reactions? (1 mark)

- ☐ **A glucose**
- ☐ **B reduced NAD**
- ☐ **C reduced NADP**
- ☐ **D water**

(Question continues on next page)

(Turn over)

- (b) In some commercial glasshouses, the concentration of carbon dioxide in the atmosphere is increased.**

**Explain why this increase in carbon dioxide concentration affects the growth of plants in glasshouses.
(3 marks)**

(Continue your answer on next page)

(Turn over)

(TOTAL FOR QUESTION 1 = 6 MARKS)

(Questions continue on next page)

(Turn over)

- 2 Silver Springs is a state park in Florida. The photograph shows one of the many waterways in this state park.**



- (a) Energy flow through this ecosystem has been studied. The results are shown in the flow chart on page 11. All values are given in $\text{kJ m}^{-2} \text{yr}^{-1}$.**

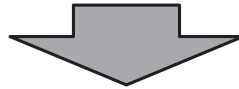
(Question continues on next page)

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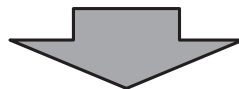
11



Producers	
Gross productivity	87 069
Net productivity	31 874



Primary consumers	
Energy intake	14 092
Energy fixed as biomass	4 615



Secondary consumers	
Energy intake	1 602
Energy fixed as biomass	464



Tertiary consumers	
Energy intake	88
Energy fixed as biomass	21

(Question continues on next page)

(Turn over)

- (i) Calculate how much energy is lost through respiration by the primary consumers. (1 mark)

Answer _____ $\text{kJ m}^{-2} \text{yr}^{-1}$

(Question continues on next page)

(Turn over)

(ii) The table gives details of energy transfers at the different trophic levels.

Trophic level	Energy fixed as biomass / $\text{kJ m}^{-2} \text{yr}^{-1}$	Transfer efficiency (%)
Producers	31 874	
Primary consumers	4615	14.5
Secondary consumers	464	
Tertiary consumers	21	4.5

(Question continues on next page)

(Turn over)

14

Calculate the efficiency of energy transfer between primary consumers and secondary consumers. (1 mark)

_____ %

(Question continues on next page)

(Turn over)

- (iii) The efficiency of photosynthesis can be measured as the percentage of energy from sunlight that is converted to gross primary productivity (GPP).

Which of the following shows the percentage efficiency of photosynthesis in this ecosystem? (1 mark)

- ☐ A 1.2%
- ☐ B 12%
- ☐ C 36.6%
- ☐ D 55.8%

(Question continues on next page)

(Turn over)

(b) Explain why the value for GPP is lower than the light energy available to the ecosystem. (3 marks)

(Continue your answer on next page)

(Turn over)

(TOTAL FOR QUESTION 2 = 6 MARKS)

(Questions continue on next page)

(Turn over)

- 3 A study of the genetics of grass snakes has led to the identification of a new species of grass snake in the UK.**

The barred grass snake was thought to be a variation of the common grass snake, *Natrix natrix*.

However, the barred grass snake, *Natrix helvetica*, has been found to be a different species.

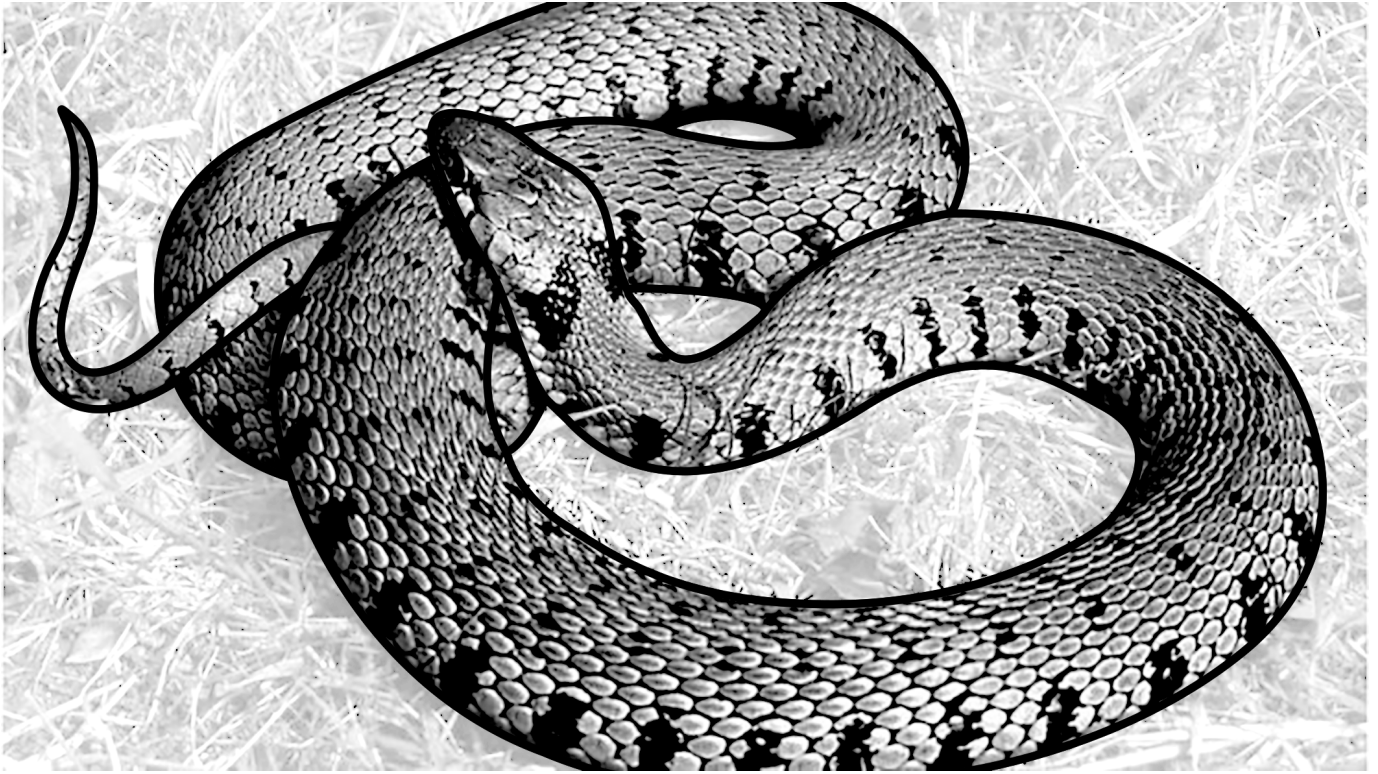
Both types of grass snake are normally found in lowland regions in the south of England. The snakes can be more than a metre long, are found near water and eat mainly amphibians such as frogs and newts.

The common grass snake is olive green with a bright yellow collar.

(Question continues on next page)

(Turn over)

The barred grass snake, shown in the photograph, is grey with black markings.



(Question continues on next page)

(Turn over)

(a) State what is meant by the term species. (1 mark)

(Question continues on next page)

**(b) Describe how DNA profiling could be carried out to show that these snakes are different species.
(4 marks)**

**(Continue your answer on next page)
(Turn over)**

(Question continues on next page)

(Turn over)

(c) Explain how these two species of snake could have arisen from a common ancestor. (4 marks)

(Continue your answer on next page)

(Turn over)

(TOTAL FOR QUESTION 3 = 9 MARKS)

(Questions continue on next page)

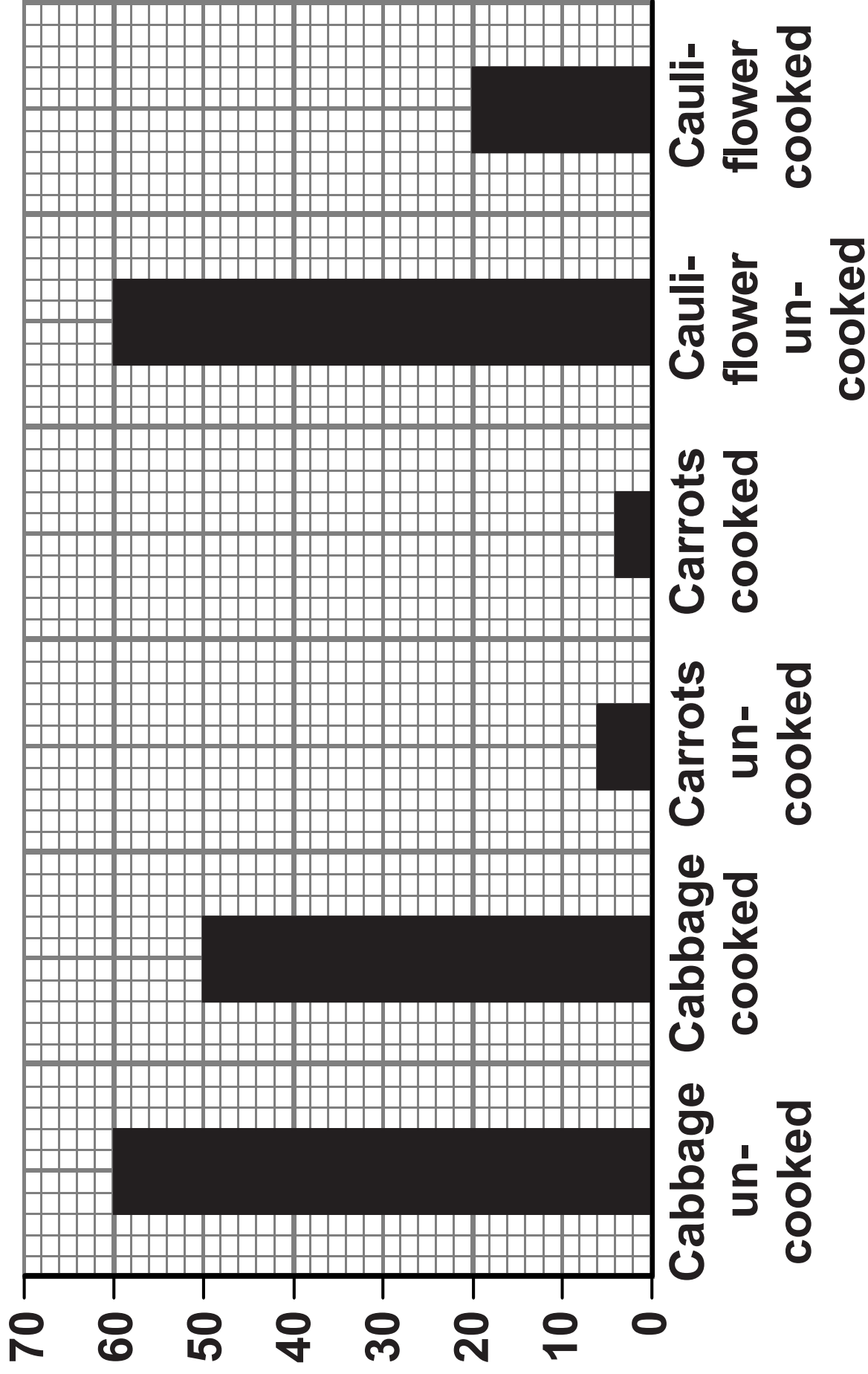
(Turn over)

- 4 Vitamin C has antioxidant properties. The human body cannot make or store vitamin C. A healthy diet must contain vitamin C.**

The graph on page 26 shows the concentration of vitamin C in a variety of cooked and uncooked vegetables.

(Question continues on next page)

**Vitamin C concentration
/ mg per 100 g**



(Question continues on next page)

(Turn over)

(a) (i) How many of the following conclusions are valid for these results?

- **cooking destroys all of the vitamin C**
- **each vegetable contains less vitamin C when it is cooked than when it is uncooked**
- **cabbage contains the most vitamin C**

(1 mark)

☐ **A 0**

☐ **B 1**

☐ **C 2**

☐ **D 3**

(Question continues on next page)

(Turn over)

- (ii) The recommended daily value (DV) of vitamin C for men is 90 mg.

Calculate the mass of cooked cauliflower that would provide 90 mg of vitamin C. (2 marks)

Answer _____

(Question continues on next page)

(Turn over)

(b) Devise a procedure that can be used to investigate the effect of cooking on the vitamin C content of cauliflower. (4 marks)

(Continue your answer on next page)
(Turn over)

(TOTAL FOR QUESTION 4 = 7 MARKS)

(Questions continue on next page)

(Turn over)

- 5 The extent of decomposition is important in helping to determine the time of death of a mammal.**

Body farms are outdoor laboratories where experiments take place to investigate the changes that take place after death in a range of conditions. Body farms use the bodies of pigs or donated human bodies.

The effects of factors such as temperature, moisture and position of the body on the rate of decomposition can be studied.

- (a) Explain the effect of ambient temperature on the rate of decomposition. (3 marks)**

(Continue your answer on next page)

(Turn over)

(Question continues on next page)

(Turn over)

(b) Describe the changes that occur inside a body in the first week after death. (3 marks)

(Continue your answer on next page)

(Turn over)

(Question continues on next page)

(Turn over)

(c) Body farms use the bodies of pigs to study the changes in insect species on a body after death.

(i) Describe how this study could be carried out. (3 marks)

(Continue your answer on next page)

(Turn over)

(Question continues on next page)

(Turn over)

- (ii) Explain how the results of this study could be used to help to establish the time of death of a human. (3 marks)**

(Continue your answer on next page)
(Turn over)

(TOTAL FOR QUESTION 5 = 12 MARKS)

(Questions continue on next page)

(Turn over)

6 Electron microscopes have enabled scientists to view the ultrastructure of cells.

(a) (i) Which of the following structures is found in animal cells? (1 mark)

☐ **A amyloplast**

☐ **B chloroplast**

☐ **C mesosome**

☐ **D ribosome**

(ii) Which of the following structures is found only in plant cells? (1 mark)

☐ **A amyloplast**

☐ **B Golgi apparatus**

☐ **C mesosome**

☐ **D vacuole**

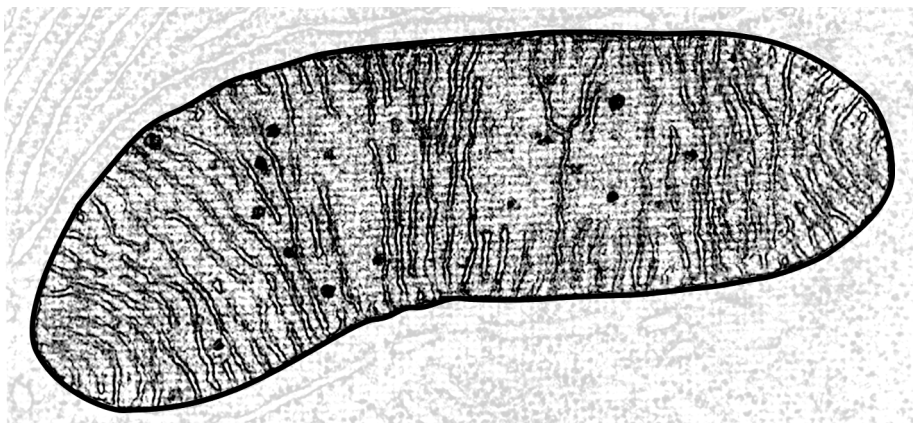
(Question continues on next page)

(Turn over)

(iii) Which of the following structures is found in both animal and plant cells? (1 mark)

- ☐ A amyloplast
- ☐ B cell wall
- ☐ C pili
- ☐ D smooth endoplasmic reticulum

(b) The photograph shows an electron micrograph of a mitochondrion from a liver cell.



Magnification $\times 20\,000$

(Question continues on next page)

(Turn over)

Calculate the maximum actual length of this mitochondrion. (2 marks)

Answer _____

(Question continues on next page)

- (c) The diagram provided on the separate sheet shows part of a molecule of chitin, a modified polysaccharide found in fungal cell walls.**

Compare and contrast the structure of chitin with that of a cellulose molecule. (3 marks)

(Continue your answer on next page)

(Turn over)

(TOTAL FOR QUESTION 6 = 8 MARKS)

(Questions continue on next page)

(Turn over)

- 7 Some species of bacteria have developed resistance to antibiotics.**

This has led scientists to investigate many molecules for antimicrobial properties.

Peptides extracted from broad bean plants and cowpea plants have been studied.

- (a) Describe how a peptide bond is formed. (2 marks)**

(Continue your answer on next page)

(Turn over)

(Question continues on next page)

(Turn over)

(b) The effects of these plant extracts were tested on pathogenic bacteria. It was found that each extract had an effect on its own, but the effect was greater when used together.

Devise a procedure that scientists may have used to measure the effects of these extracts on pathogenic bacteria. (4 marks)

(Continue your answer on next page)

(Turn over)

(Turn over)

**(c) A bacteriostatic antibiotic works by
(1 mark)**

- ☐ **A destroying bacteria**
- ☐ **B destroying viruses**
- ☐ **C preventing the multiplication of
bacteria**
- ☐ **D preventing the development of
antibiotic resistance**

(Question continues on next page)

(Turn over)

(d) Hospitals have developed practices in response to the increase in hospital acquired infections.

**Describe the infection control practices hospitals have introduced.
(3 marks)**

(Continue your answer on next page)

(Turn over)

(TOTAL FOR QUESTION 7 = 10 MARKS)

(Questions continue on next page)

(Turn over)

- 8 Thrombophilia is a condition that increases the risk of blood clots forming.**

This condition increases the risk of venous thromboembolism (VTE), a condition where a blood clot forms in a vein. Thrombophilia due to the production of overactive factor V can be inherited.

Factor V is involved in the conversion of prothrombin to thrombin.

- (a) (i) Describe the role of thrombin in blood clotting. (3 marks)**

(Continue your answer on next page)

(Turn over)

(Question continues on next page)

(Turn over)

(ii) Explain why a mutation in the gene coding for the protein factor V may increase the risk of VTE. (3 marks)

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

(Continue your answer on next page)
(Turn over)

(Question continues on next page)

(Turn over)

- (b) A study was carried out to determine the incidence of VTE in people of different ages. Those who developed VTE were then tested for the factor V gene mutation.

The results of this study are shown in the table.

Age range	Percentage incidence of VTE in the study group (%)	Percentage of VTE patients with factor V mutation in the study group (%)
less than 20 years of age	1·3	49·3
over 70 years of age	34·0	20·9

(Question continues on next page)

(Turn over)

Deduce the relative impact of the genotype and environmental factors on the development of VTE. (4 marks)

(Continue your answer on next page)
(Turn over)

(TOTAL FOR QUESTION 8 = 10 MARKS)

(Questions continue on next page)

(Turn over)

- 9 An experiment was carried out to determine the effect of temperature on the activity of the enzyme catalase in yeast cells.**

The substrate was hydrogen peroxide. A suspension of yeast cells was added to hydrogen peroxide.

The volume of oxygen produced during the initial two minutes was recorded. This was repeated at a range of temperatures.

The results are shown in the table.

Temperature / °C	Mean volume of oxygen / mm³
20	80
30	240
40	540
50	320
60	120

(Question continues on next page)

(Turn over)

- (a) (i) Calculate the temperature coefficient (Q_{10}) for this reaction between 20 °C and 30 °C.
(1 mark)**

Answer _____

(Question continues on next page)

(Turn over)

- (ii) Explain the effects of a temperature increase from 20 °C to 30 °C on the initial rate of activity of catalase in the yeast cells. (3 marks)**

(Continue your answer on next page)

(Turn over)

(Question continues on next page)

(Turn over)

- (iii) Explain what happens to the Q_{10} value between 40°C and 50°C .
(2 marks)

(Question continues on next page)

(Turn over)

(b) Leaf rust is a disease caused by a species of fungus. Leaf rust affects cereal crops such as wheat.

Leaf rust yeast spreads through cereal crops when the humidity is high.

Discuss the possible impact of climate change on the effects of leaf rust on the yield of wheat crops. (4 marks)

(Continue your answer on next page)

(Turn over)

(Questions continue on next page)

(Turn over)

10 The Intergovernmental Panel on Climate Change (IPCC) has issued the following statement:

“Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems.”

(a) Explain why anthropogenic emissions of greenhouse gases are affecting the climate. (3 marks)

(Continue your answer on next page)

(Turn over)

(Question continues on next page)

(Turn over)

***(b) Pteropods are small free-swimming snails found in oceans throughout the world. They are a food source for a variety of fish including salmon, mackerel and herring.**

In 2011, the health of these snails was studied in the ocean around Hawaii. A sample of these snails showed that 53% of them had damaged shells.

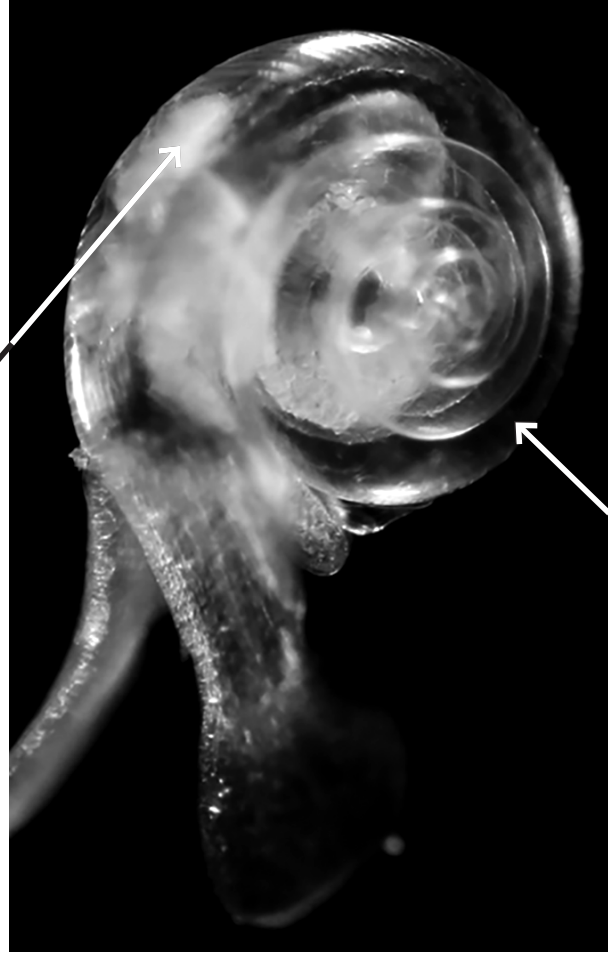
The photographs on page 68 show a healthy snail and a snail with a damaged shell found in the ocean around Hawaii.

(Question continues on next page)

(Turn over)

Healthy snail

smoothly contoured
shell ridges



clear, glass-like
shell

Snail with damaged shell

ragged, dissolving
shell ridges



severe abrasions/
weak spots

cloudy
shell

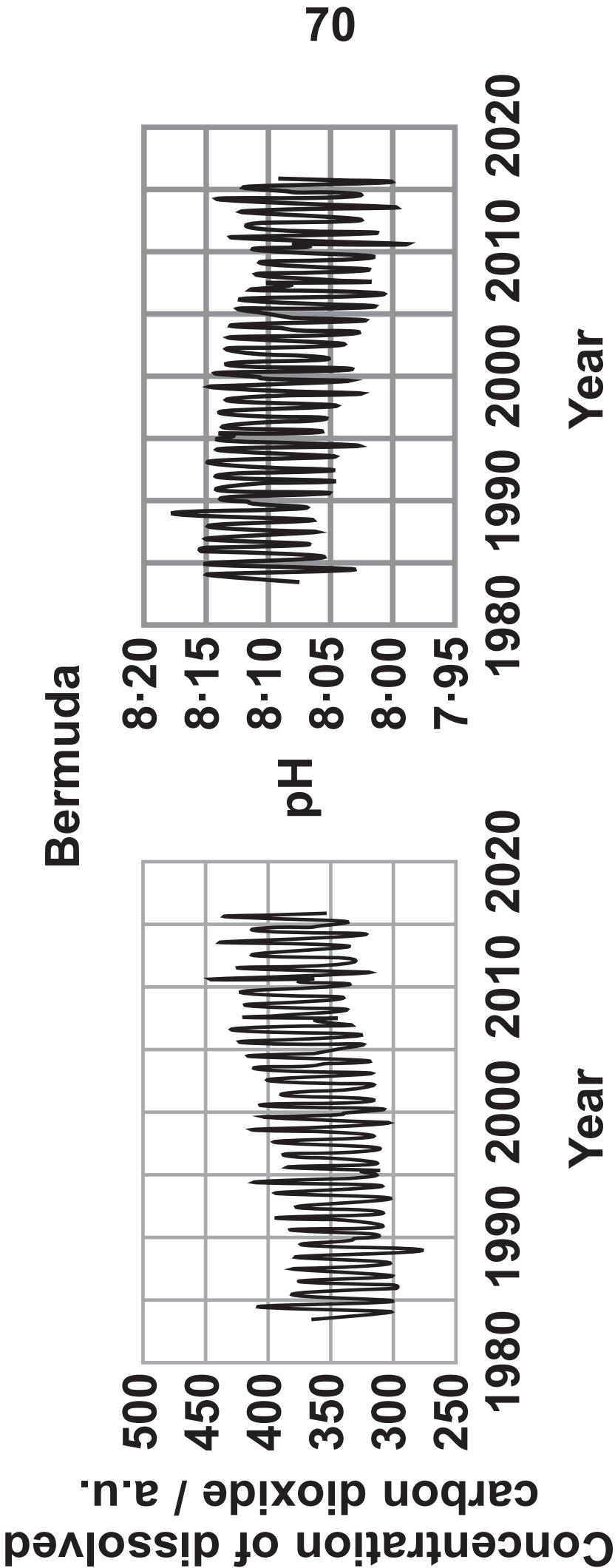
(Question continues on next page)

(Turn over)

The pH of sea water affects shell formation in these snails. The changes in carbon dioxide concentration and pH have been recorded in oceans surrounding several islands.

(Question continues on next page)

These records are shown in the graphs below and on pages 71 and 72.

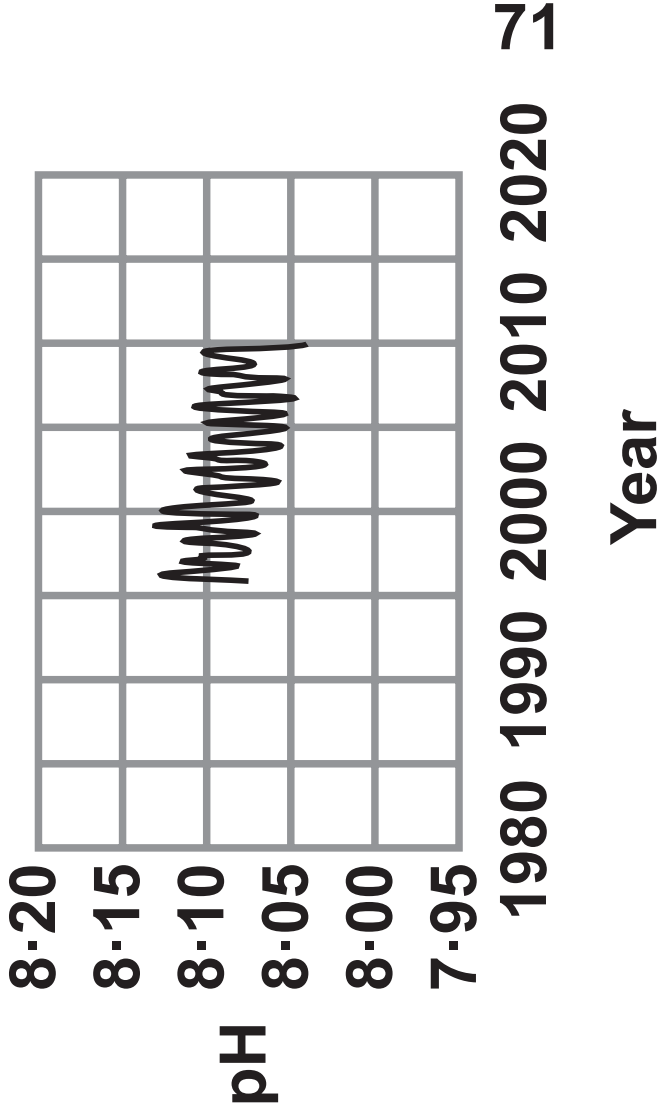
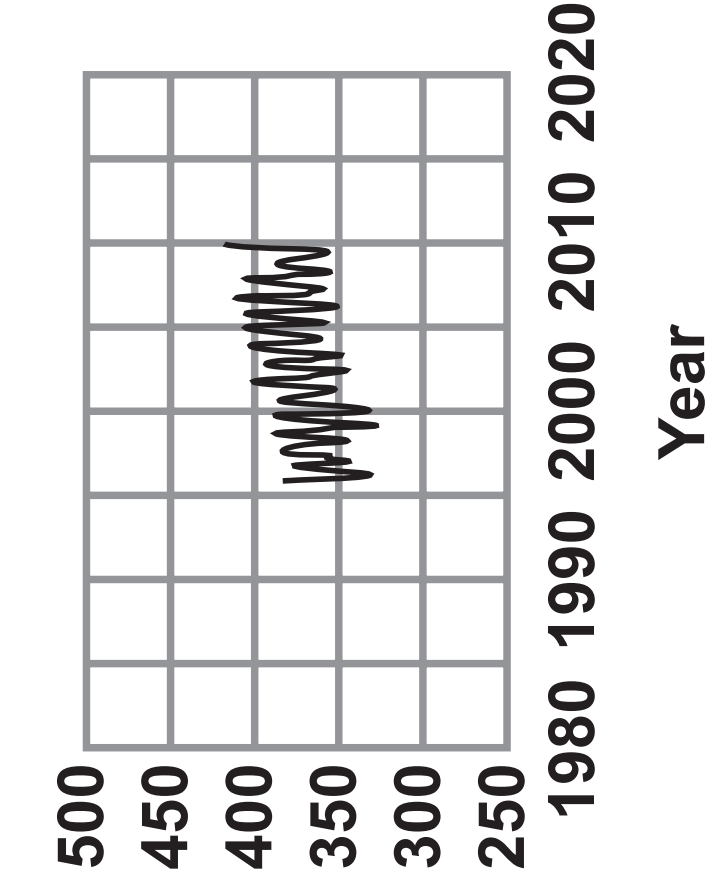


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(Turn over)

Concentration of dissolved
carbon dioxide / a.u.

Canary Islands

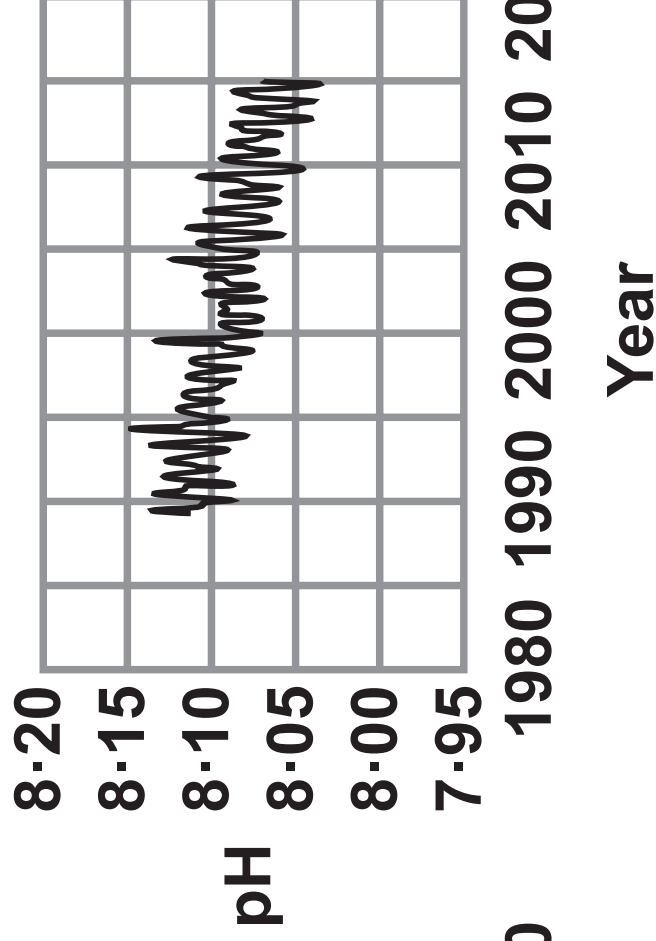
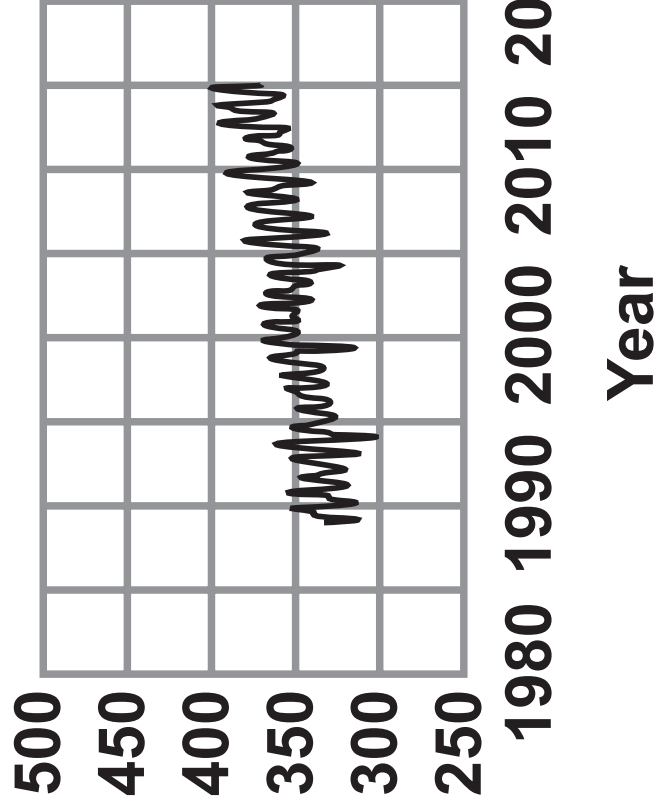


(Continues on next page)

(Turn over)

Concentration of dissolved
carbon dioxide / a.u.

Hawaii



(Question continues on next page)

(Turn over)

Analyse the data to discuss the likely impact of increased carbon dioxide emissions on fish populations in these oceans. (6 marks)

(Continue your answer on next page)
(Turn over)

(Turn over)

(Question continues on next page)

(Turn over)

(c) Climate change can also affect the life cycle of organisms.

The effect of temperature on the lifespan of fruit flies (*Drosophila melanogaster*) was investigated.

The results are shown in the table.

Temperature / °C	Lifespan / days
15	130·3
21	86·3
27	41·6
30	20·4

Determine the relationship between the increase in temperature and the change in lifespan. (2 marks)

(Continue your answer on next page)

(Turn over)

(TOTAL FOR QUESTION 10 = 11 MARKS)

(Questions continue on next page)

(Turn over)

11 Batten disease is a rare, inherited disorder of the nervous system. It usually begins in childhood. It is a recessive disorder.

(a) Explain what is meant by an inherited recessive disorder. (2 marks)

(Question continues on next page)

(Turn over)

- (b) (i) Parents without Batten disease have a child with Batten disease.**

**Which of the following describes the genotype of the parents?
(1 mark)**

- ☐ **A bb and Bb**
- ☐ **B Bb and Bb**
- ☐ **C BB and BB**
- ☐ **D BB and bb**

- (ii) On page 80 draw a genetic diagram to show the probability of their future children developing Batten disease. (2 marks)**

(Draw a genetic diagram on next page)

(Turn over)

(Question continues on next page)
(Turn over)

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

The table on pages 82 and 83 shows examples of some types of genetic screening and examples of where they may be used.

(Question continues on next page)

(Turn over)

Type of screening	Method	Example
Blood test to identify risk of a disease	DNA from a blood sample is examined	Identifying presence of BRCA1 and BRCA2 mutations where there is a family history of breast cancer
Blood test to identify carriers of a genetic disease	DNA from a blood sample is examined	Establishing if a person is heterozygous for a recessive condition such as cystic fibrosis (CF)
Amniocentesis	Fetal DNA from amniotic fluid is tested	Identifying genetic disorders in the fetus

(Continues on next page)

(Turn over)

Chorionic villus sampling (CVS)	Fetal DNA from placental tissue is tested	Identifying genetic disorders in the fetus
Non-invasive prenatal diagnosis (NIPD)	Analysis of fetal DNA fragments from blood samples from the mother	Identification of chromosomal disorders and a small number of single gene disorders in the fetus
Pre-implantation genetic diagnosis (PGD)	Combined with IVF to test embryo at 8-cell stage	Ensures only embryos without a genetic disorder such as CF are implanted

(Question continues on next page)

(Turn over)

**Assess the advantages and disadvantages of these types of screening for genetic disorders.
(6 marks)**

(Continue your answer on next page)

(Turn over)

(Turn over)

(TOTAL FOR QUESTION 11 = 11 MARKS)

TOTAL FOR PAPER = 100 MARKS
END