Please check the examination details below before entering your candidate information

| Candidate surname | Other names |
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**Pearson Edexcel Level 3 GCE**

Centre Number | Candidate Number

# Thursday 6 June 2019

Morning (Time: 2 hours) | Paper Reference **9BN0/01**

# Biology A (Salters Nuffield)

## Advanced

## Paper 1: The Natural Environment and Species Survival

**You must have:**
Calculator, HB pencil, ruler

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- 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.*

## Information

- 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.
- 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

- 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*


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**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 ☒.**

**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)**

☐ **A** cristae

☐ **B** matrix

☐ **C** stroma

☐ **D** thylakoids

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

**(1)**

☐ **A** carbon dioxide and reduced NADP

☐ **B** glucose and oxygen

☐ **C** reduced NAD, ATP and oxygen

☐ **D** reduced NADP, ATP and oxygen

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

**(1)**

☐ **A** glucose

☐ **B** reduced NAD

☐ **C** reduced NADP

☐ **D** water

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(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.

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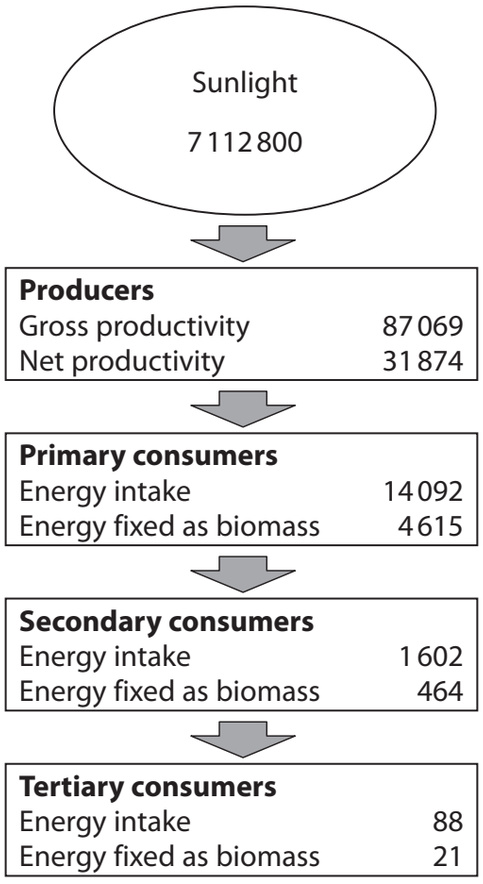
**2** Silver Springs is a state park in Florida. The photograph shows one of the many waterways in this state park.

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

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

**(1)**

Answer ..... $kJ\,m^{-2}\,yr^{-1}$

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

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

Calculate the efficiency of energy transfer between primary consumers and secondary consumers.

**(1)**

..... %

(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)**

☒ **A** 1.2%

☒ **B** 12%

☒ **C** 36.6%

☒ **D** 55.8%

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

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

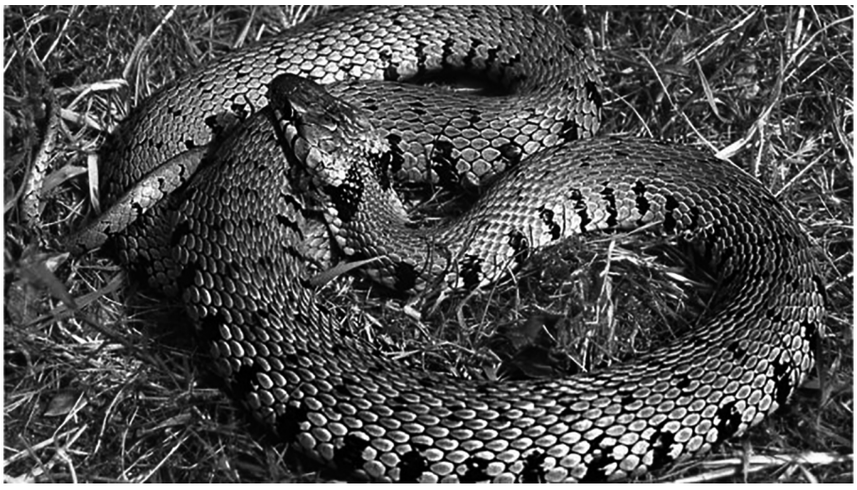
The barred grass snake was thought to be a variation of the common grass snake, *Natrix natrix*.

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.

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



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

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

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

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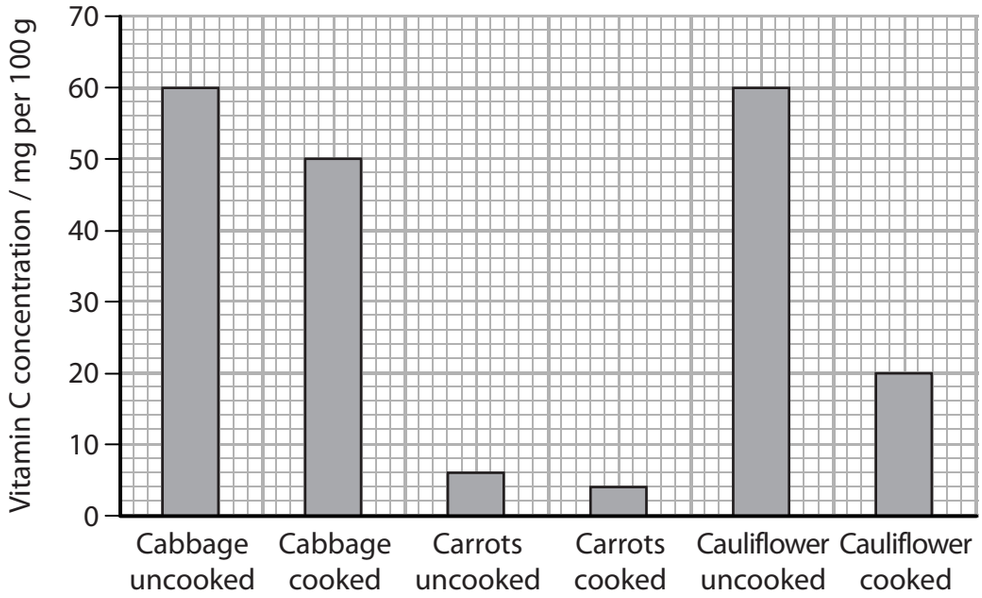
**4** Vitamin C has antioxidant properties. The human body cannot make or store vitamin C. A healthy diet must contain vitamin C.

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




(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)**

☒ **A** 0

☒ **B** 1

☒ **C** 2

☒ **D** 3

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(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)**

Answer .....

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

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**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)**

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

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(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.

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

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**(Total for Question 5 = 12 marks)**

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**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)**

☒ **A** amyloplast

☒ **B** chloroplast

☒ **C** mesosome

☒ **D** ribosome

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

**(1)**

☒ **A** amyloplast

☒ **B** Golgi apparatus

☒ **C** mesosome

☒ **D** vacuole

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

**(1)**

☒ **A** amyloplast

☒ **B** cell wall

☒ **C** pili

☒ **D** smooth endoplasmic reticulum

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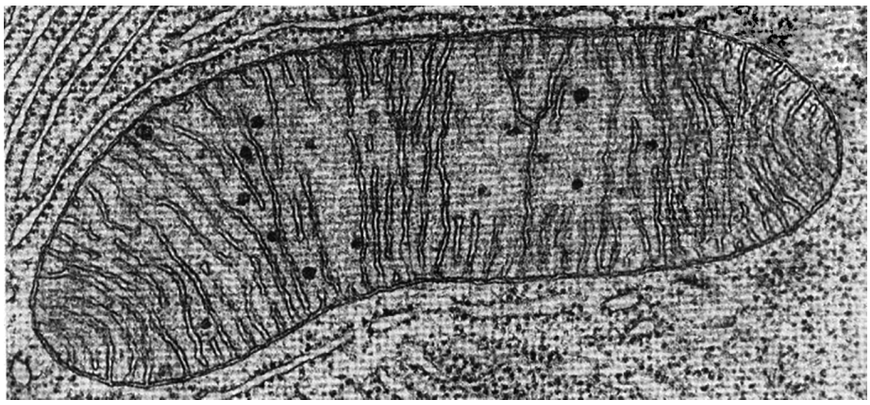
(b) The photograph shows an electron micrograph of a mitochondrion from a liver cell.



Magnification ×20 000

Calculate the maximum actual length of this mitochondrion.

**(2)**

Answer .....

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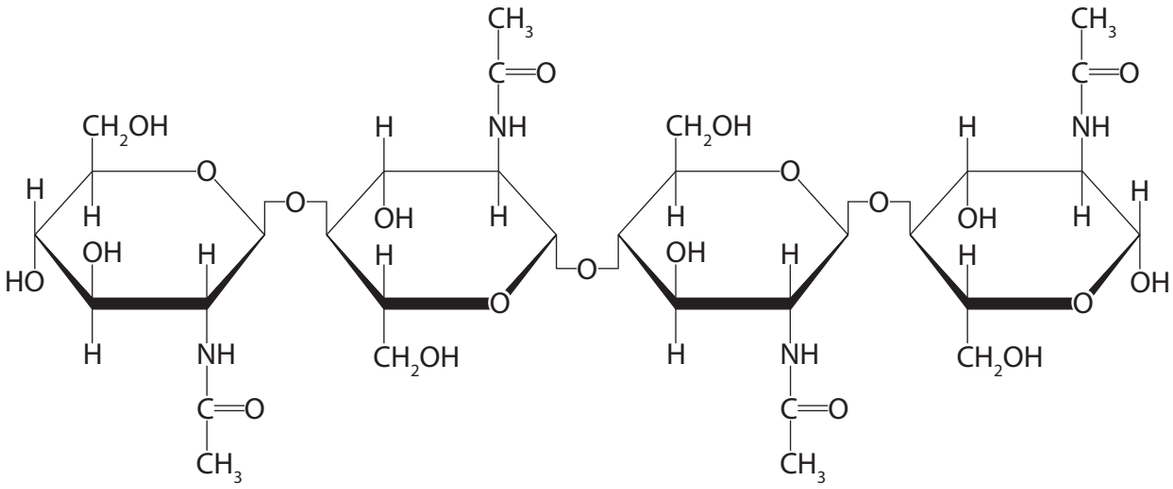
(c) The diagram shows part of a molecule of chitin, a modified polysaccharide found in fungal cell walls.



Compare and contrast the structure of chitin with that of a cellulose molecule.

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**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)**

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(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.

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(c) A bacteriostatic antibiotic works by

**(1)**

☒ **A** destroying bacteria

☒ **B** destroying viruses

☒ **C** preventing the multiplication of bacteria

☒ **D** preventing the development of antibiotic resistance

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

Describe the infection control practices hospitals have introduced.

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**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)**

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

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(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 |

Deduce the relative impact of the genotype and environmental factors on the development of VTE.

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**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 / $mm^3$ |
|---|---|
| 20 | 80 |
| 30 | 240 |
| 40 | 540 |
| 50 | 320 |
| 60 | 120 |

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

**(1)**

Answer .....

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(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)**

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

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(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.

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**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)**

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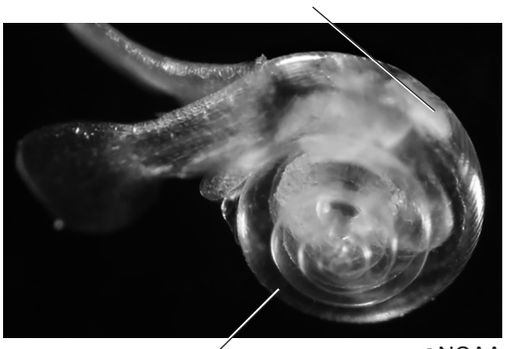
*(b) Pteropods are small free-swimming snails found in oceans throughout the world. They are a food source for a variety of fish including salmon, mackerel and herring.

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 show a healthy snail and a snail with a damaged shell found in the ocean around Hawaii.

Healthy snail

smoothly contoured shell ridges

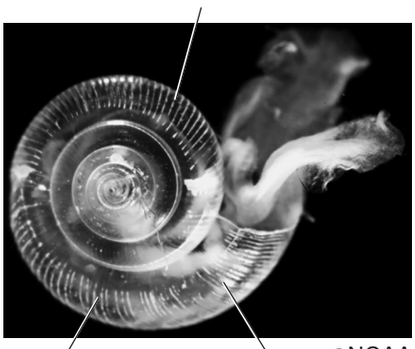


@NOAA

clear, glass-like shell

Snail with damaged shell

ragged, dissolving shell ridges



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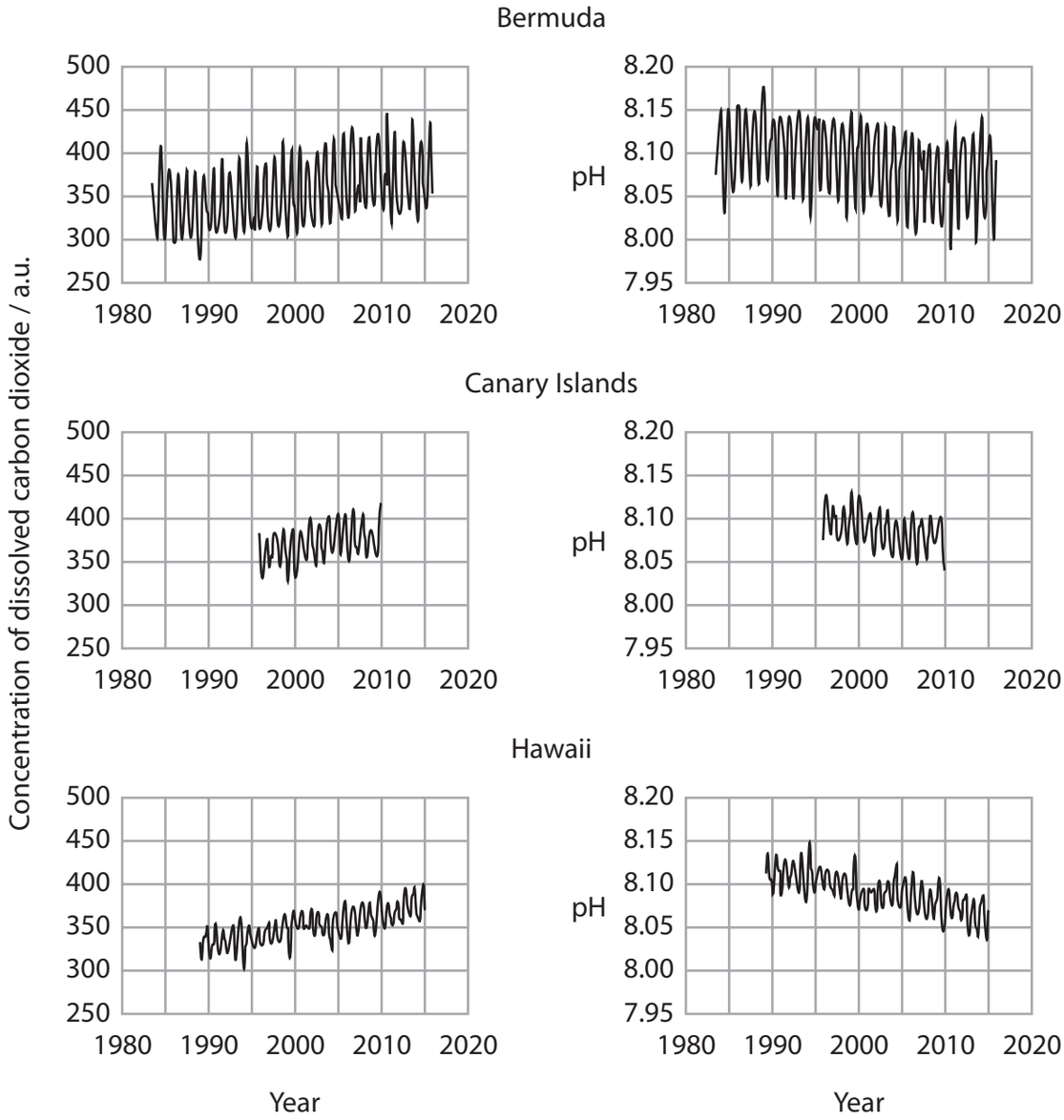
severe abrasions/weak spots

cloudy shell

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.

These records are shown in the graphs.

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

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(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.

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**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)**

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

Which of the following describes the genotype of the parents?

**(1)**

☒ **A** bb and Bb

☒ **B** Bb and Bb

☒ **C** BB and BB

☒ **D** BB and bb

(ii) Draw a genetic diagram to show the probability of their future children developing Batten disease.

**(2)**

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

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

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

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Assess the advantages and disadvantages of these types of screening for genetic disorders.

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**(Total for Question 11= 11 marks)**

**TOTAL FOR PAPER = 100 MARKS**

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