GCSE

WJEC CBAC

4461/02

‖‖‖ ‖ ‖‖‖‖‖‖‖‖‖‖‖‖ ‖‖‖‖ ‖‖‖‖‖‖‖‖‖‖‖‖‖
W15-4461-02

SCIENCE A/BIOLOGY

BIOLOGY 1
HIGHER TIER

A.M. WEDNESDAY, 7 January 2015

1 hour

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication used in your answer to questions **4** and **11**.

*Answer **all** questions.*

1. The diagram below shows the pyramid of numbers for a food chain found in a small wood.

Sparrowhawks

Blue tits

Caterpillars

Oak tree
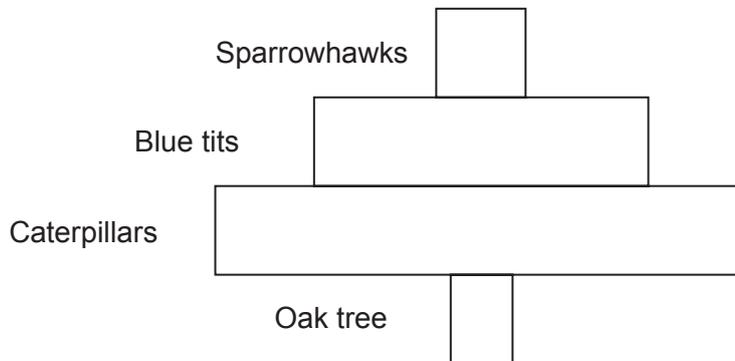
(a) (i) Show the correct relationship in the food chain by adding **one** of the following numbers to **each** of the feeding levels in the above pyramid of numbers. [1]

1   17   3456   2

    (ii)   I   In the space below draw a **labelled** pyramid of biomass for this food chain. [1]

            II Show the correct relationship in the food chain by adding **one** of the following masses to **each** of the feeding levels in **your pyramid** of biomass shown in a(ii) I. [1]

0.18 kg   5137 kg   1.2 kg   43 kg

(b) Use the information on the opposite page and your own knowledge to complete the following diagram. [2]

....	→		←	third stage consumer
Blue tit	→		←	....
		decomposers		
....	→		←	first stage consumer
Oak tree	→		←	....
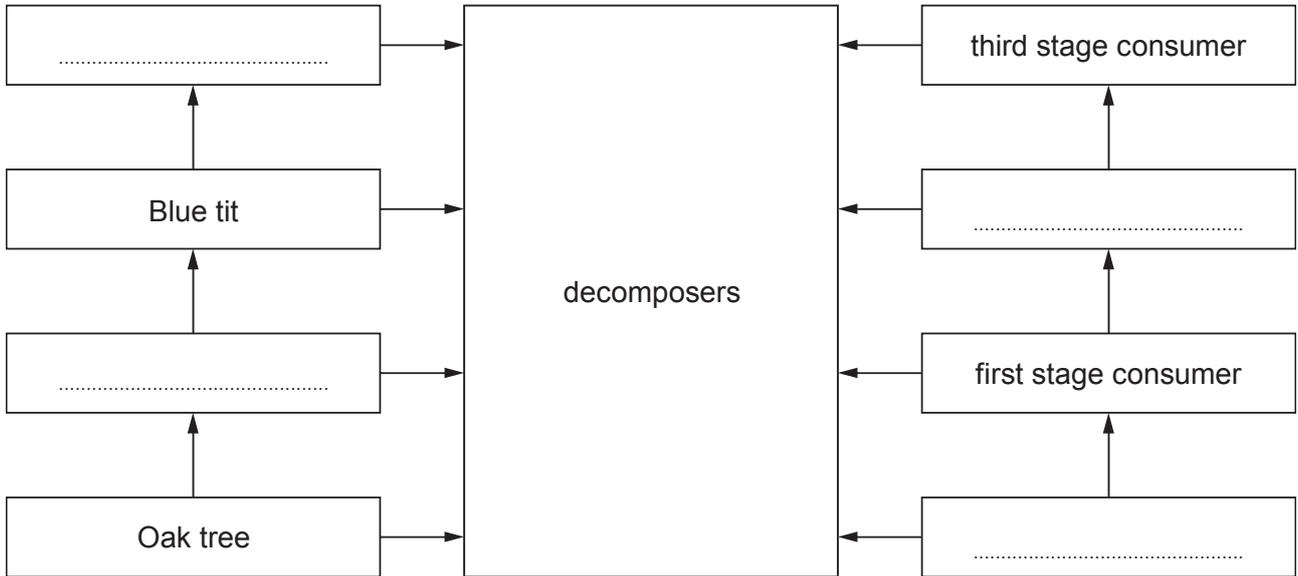
(c) In which of the following do **all** of the processes **add** carbon dioxide to the air? <u>Underline</u> the correct answer. [1]

  (i)   decomposition *and* respiration *and* photosynthesis

 (ii)   decomposition *and* respiration *and* photosynthesis *and* combustion

(iii)   respiration *and* combustion *and* photosynthesis

(iv)   respiration *and* combustion *and* decomposition

6

2. Rhys used the apparatus shown below to find the energy in a piece of food.
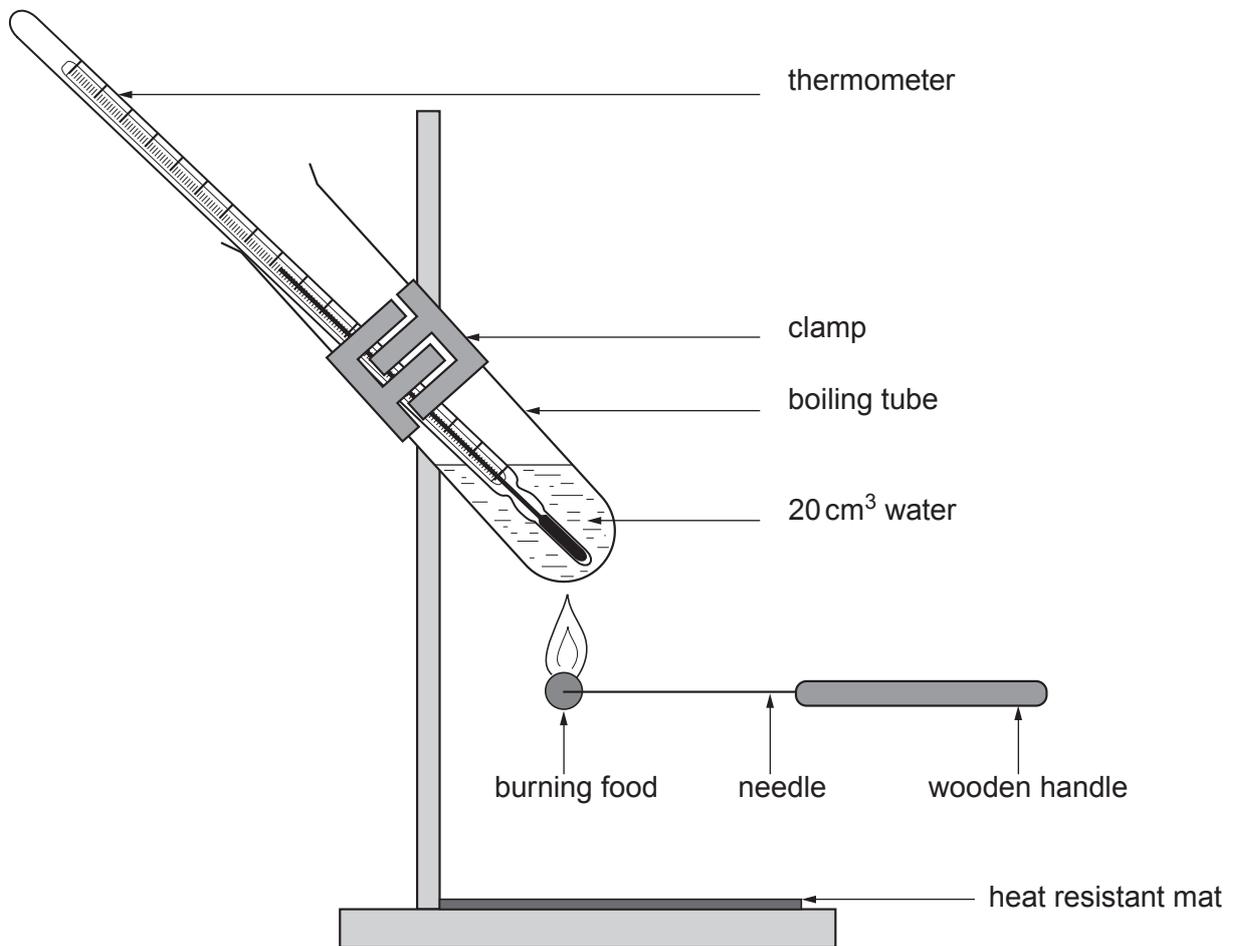
(a) The first time Rhys carried out the experiment he obtained the following results.

initial temperature of water (°C)	final temperature of water (°C)
19	35

(i) Use the formula below to calculate the energy content of this piece of food. Show your working. [2]

Energy content (J)= rise in temperature (°C) x volume of water (cm^3) x 4.2

Energy content .... J

(ii) The mass of this piece of food was 0.2 g. Calculate the energy content of 1 g of this food. [1]

Energy content .... J

Rhys repeated the experiment and obtained the following results.

repeat	energy content of food (J/g)
1	5049
2	7260
3	6800
4	4896
5	5724

(b) Suggest **three** possible reasons why the measured energy content in J/g of the food differed each time Rhys carried out the experiment. [3]

(i) ....

....

(ii) ....

....

(iii) ....

....

6

BLANK PAGE

3. Intensive farming methods use very large amounts of chemical pesticides to increase crop yields.

The Western flower thrips *(Frankliniella occidentalis)* is an insect which eats crops, including fruit and vegetables, causing world-wide damage.

A Western flower thrips

Scientists at Swansea University have done research into pest control using bacteria which naturally live only in the thrips. The bacteria affect a gene which controls eating in the thrips. The thrips stops feeding and dies. The bacteria pass naturally between the thrips.

(a) Use the information above to suggest **one** advantage to the farmer of using this new method of pest control over the use of chemical pesticides. [1]

....

....

(b) Apart from the use of pesticides state **one** *other* method farmers use to increase crop yields. [1]

....

....

(c) DDT is a powerful insecticide which was extensively sprayed onto crops in the middle part of the twentieth century. Its use is now banned in many regions of the world because it resulted in the death of many top predators. One of the top predators affected was the American Bald Eagle *(Haliaeetus leucocephalus)* whose numbers in the USA dropped to only 834 in 1963.

The food chain below shows the concentration of DDT in ppm (parts per million) in the tissues of the organisms in a food chain.

American Bald Eagle
13.8 ppm

large fish
2.07 ppm

small fish
0.23 ppm

aquatic plants
0.04 ppm
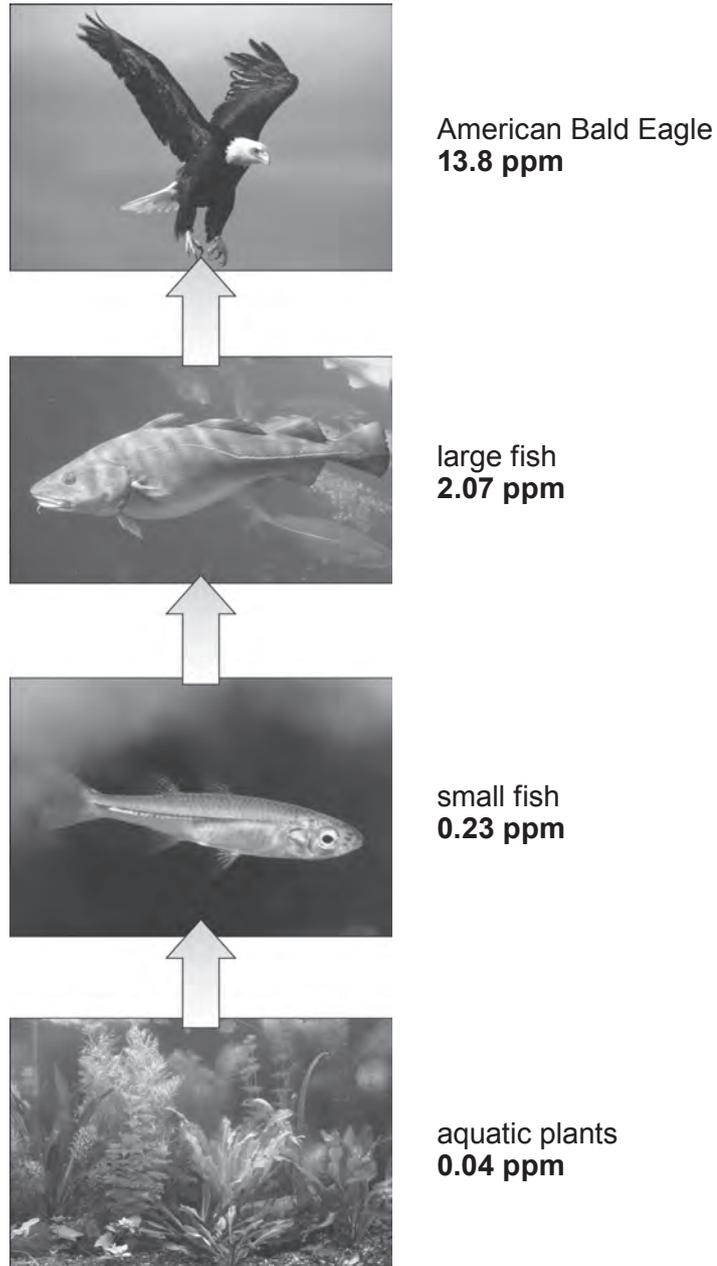
The graph below shows the number of breeding American Bald Eagles in Florida between 1942 and 1959.
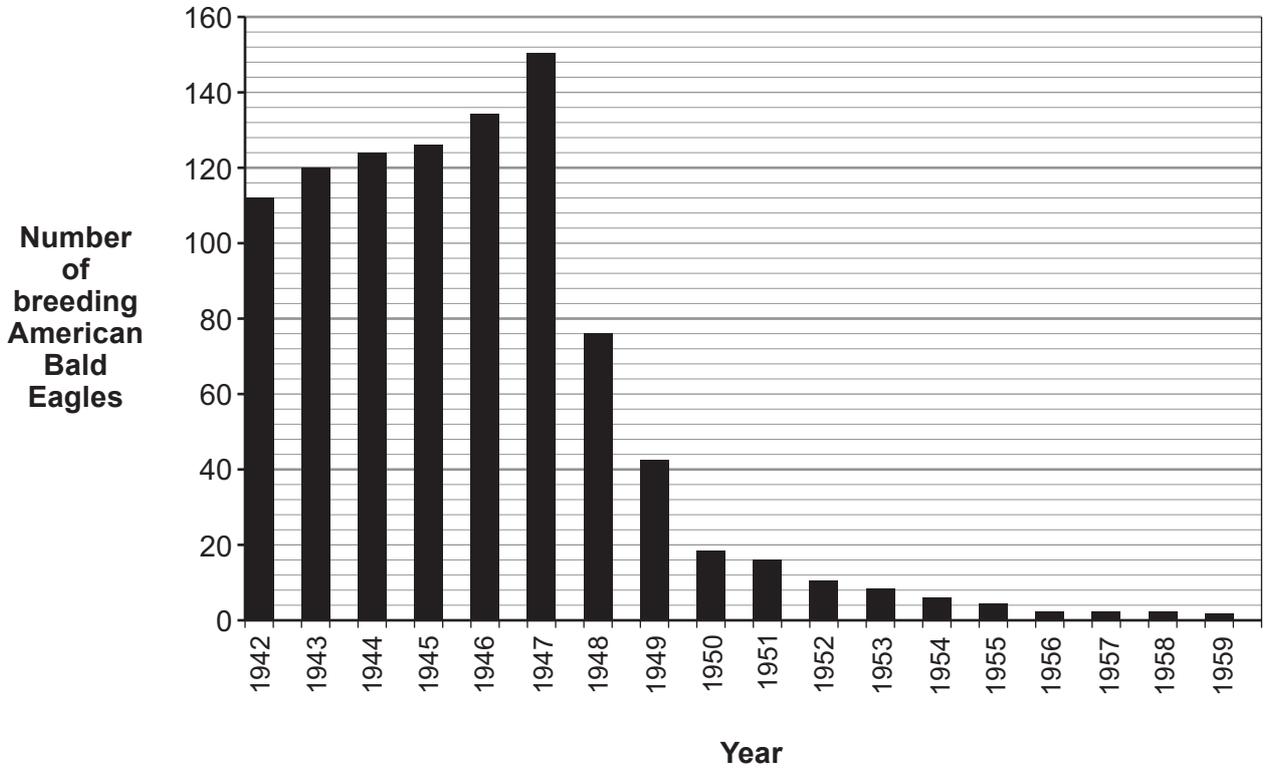
Year

(i) From the graph, suggest the year in which DDT was first used in Florida as an insecticide. [1]

....

(ii) Suggest why DDT is found in the aquatic plants if it is only sprayed onto crops grown on land. [1]

....

....

(iii) The aquatic plants and fish are not killed by the DDT but the American Bald Eagle is. Explain the reason for this. [2]

....

....

....

....

6

4. The level of blood glucose must be kept within a very narrow range. It must not be allowed to rise too high or fall too low.

After a meal the blood glucose level begins to rise. Describe the processes which occur in the human body to bring the level of glucose in the blood back down to its normal level.   [QWC 6]

....

....

....

....

....

....

....

....

....

....

....

....

....

....

6

5. A high level of blood cholesterol increases the risk of heart disease. One cause of high blood cholesterol is the inherited condition known as FH (familial hypercholesterolaemia).

FH is caused by a dominant allele (**B**). The recessive form of this allele (**b**) results in low levels of cholesterol (non-FH).

(a) State the meaning of the terms:

(i) allele; [1]

....

....

(ii) recessive. [1]

....

....

....

(b) (i) Complete the Punnett square below to show the possible genotypes of the children produced by parents both of whom are heterozygous for FH.

Use the letters **B** and **b**. [2]

Gametes		

(ii) What is the probability of two heterozygous parents producing a child with FH? [1]

....

(iii) What is the phenotypic ratio of the children produced? [1]

.... FH : .... non-FH

(4461-02) **Turn over.**

6

6. The drawing shows the chromosomes from a human cell.
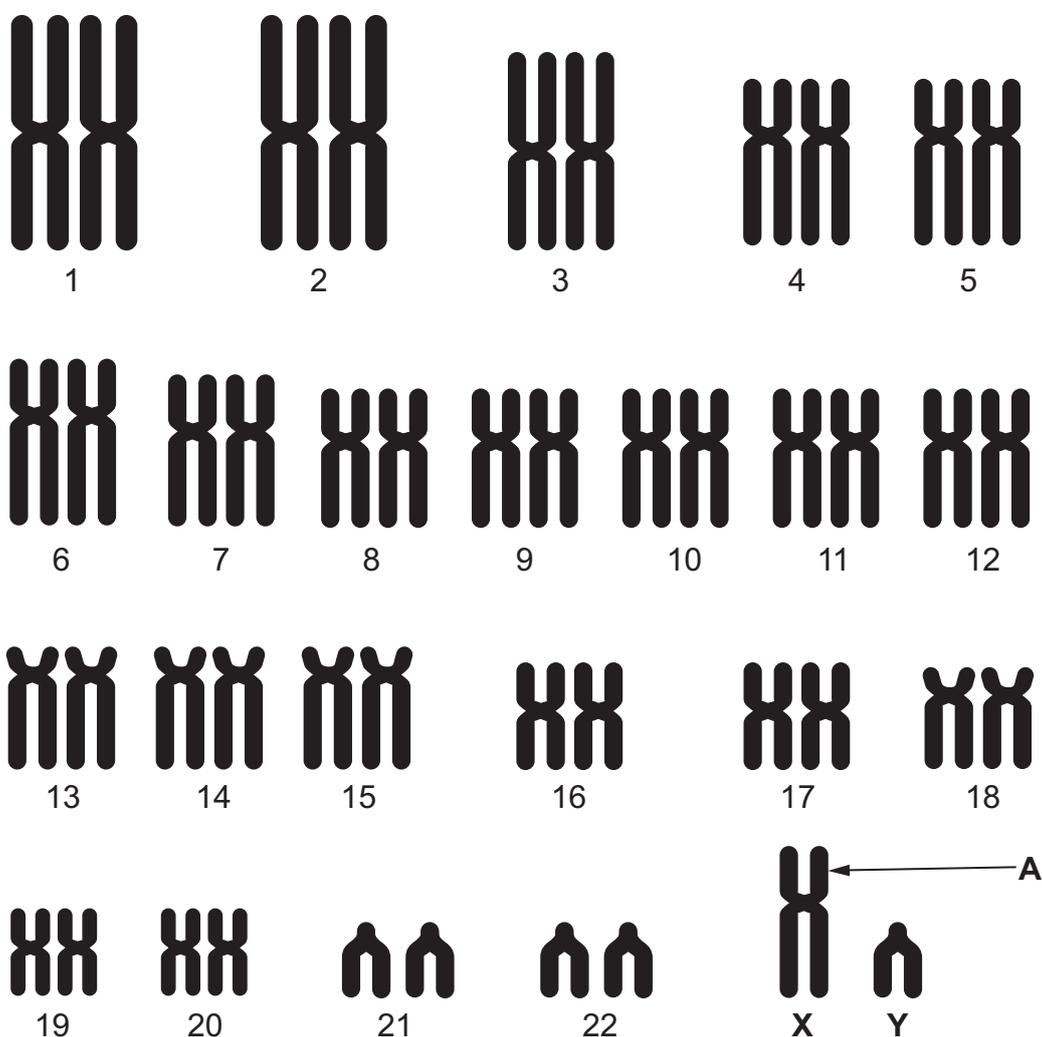
(a) How does the drawing show that the cell is not a gamete? [1]

....

(b) Point A on the X chromosome shows the position of an allele. Give the reason why a male cannot be heterozygous for this allele. [1]

....

....

(c) Describe how genes are arranged on a chromosome. [1]

....

....

3

BLANK PAGE

7.

In 1989, fishermen in the English Channel caught specimens of a species of prawn which they could not identify. They sent the prawns to a marine biologist who said that the species had not been recorded in British waters before. He identified the species by comparing its genetic profile with those of known species of prawn. The results are shown below.

Unknown species	*Palaemon serratus*	*Penaeus kerathurus*	*Penaeus japonicus*	*Palaemon elegans*
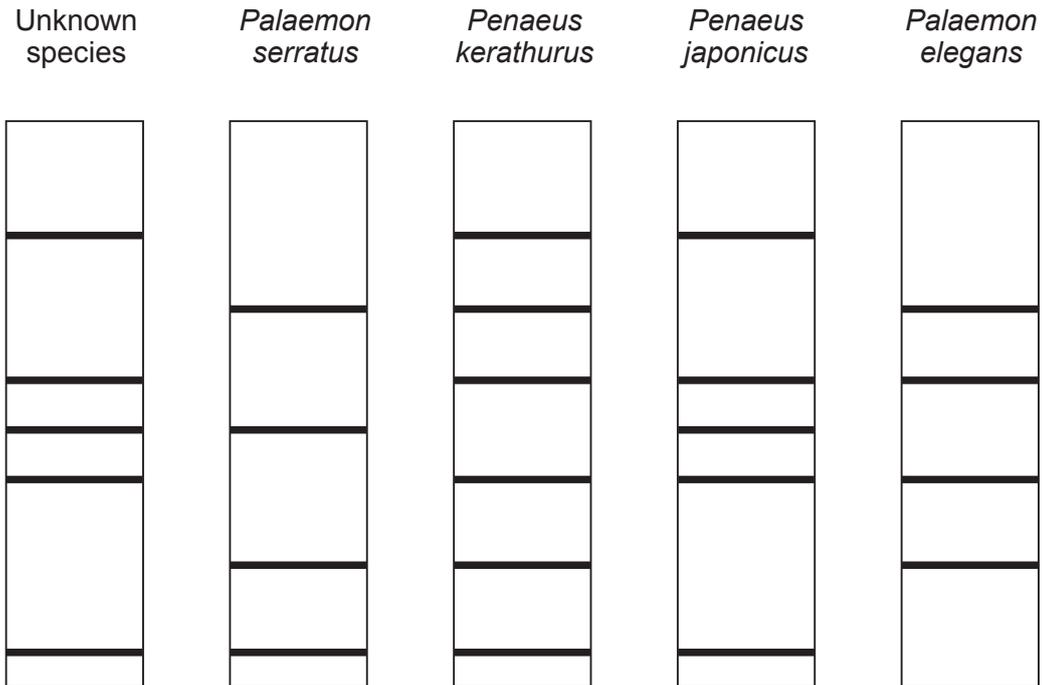
(a) Use the genetic profiles to identify the unknown species. [1]

....

(b) Which of the other prawn species would be most likely to cross breed with the unknown species? Give a reason for your answer. [2]

....

....

(c) Prawns have different names in different languages. For example: Italian – gamberi and French – crevette. State precisely, how marine biologists avoid confusing the names of the organisms that they study. [1]

....

....

4

8. Mussels are bivalve invertebrates where the shell is made of two valves.

gap between valves

valve ——————— valve
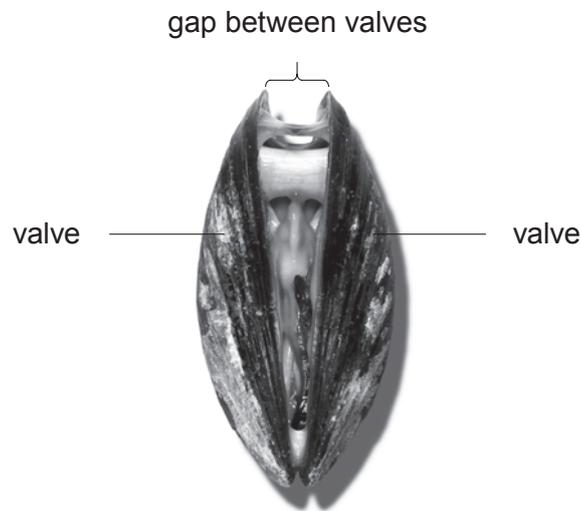
In 2013, scientists investigated whether mussels could be used to monitor nitrate pollution in water.

Mussels feed by filtering food particles out of the water. Mussels open their shells when feeding.

Sensors were placed on mussels in aquarium tanks to measure the size of the gap between the valves in different concentrations of nitrate.

The results of the laboratory investigation are shown in the graph below.

gap between shells of mussels (mm)

concentration of nitrate (mg per litre)

Examiner only
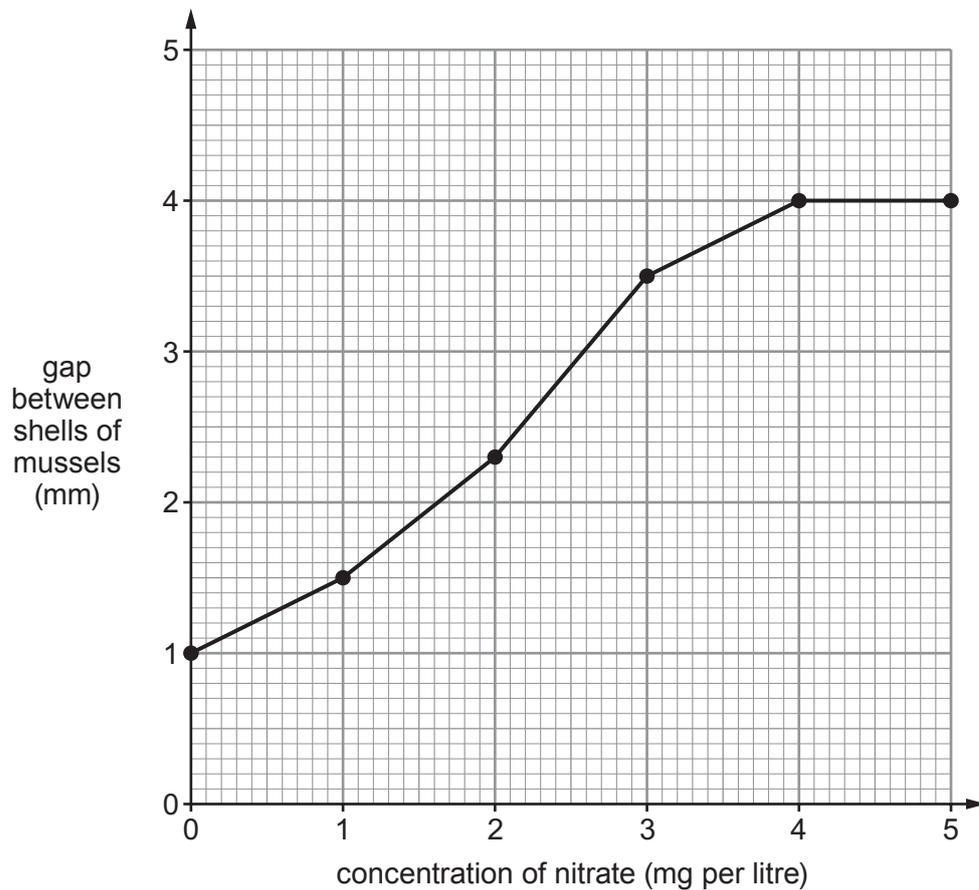
(a) Describe the trend shown by the graph opposite. [1]

....

....

(b) Scientists carried out trials to see if mussels with 'nitrate monitoring sensors' could be used where the Mississippi river meets the Gulf of Mexico.

Suggest **two** factors that may have affected these trials that would **not** have affected the results in the laboratory investigation. [2]

(i) ....

(ii) ....

(c) Scientists think that nitrate pollution could result in 'dead zones' in which marine life could suffocate. Explain how this might happen. [3]

....

....

....

....

....

....

....

6

Turn over.

9. Waders are species of birds which feed in shallow water and nest on land. The table below shows numbers of breeding pairs of four species of waders on two Scottish islands, Islay and Arran, in 1983 and 2000.

	number of breeding pairs of waders			
	Islay		Arran	
wader	1983	2000	1983	2000
Lapwing	1869	1287	1104	1364
Redshank	1288	760	486	733
Dunlin	2016	884	803	558
Snipe	655	280	172	154

(a) Calculate the percentage decrease in the number of breeding pairs of snipe on Islay between 1983 and 2000. [2]

Percentage decrease .... %

(b) Four hedgehogs were introduced to Islay in 1974. No other carnivorous mammals live on the island. By 1983, the population of hedgehogs on the island was very large.

In the 1980s, a species of flatworm from New Zealand, was accidentally introduced to Islay.
Arran has remained free of hedgehogs and flatworms.

flatworm

Islay

Arran

**Scotland invaded
by NZ flatworm**
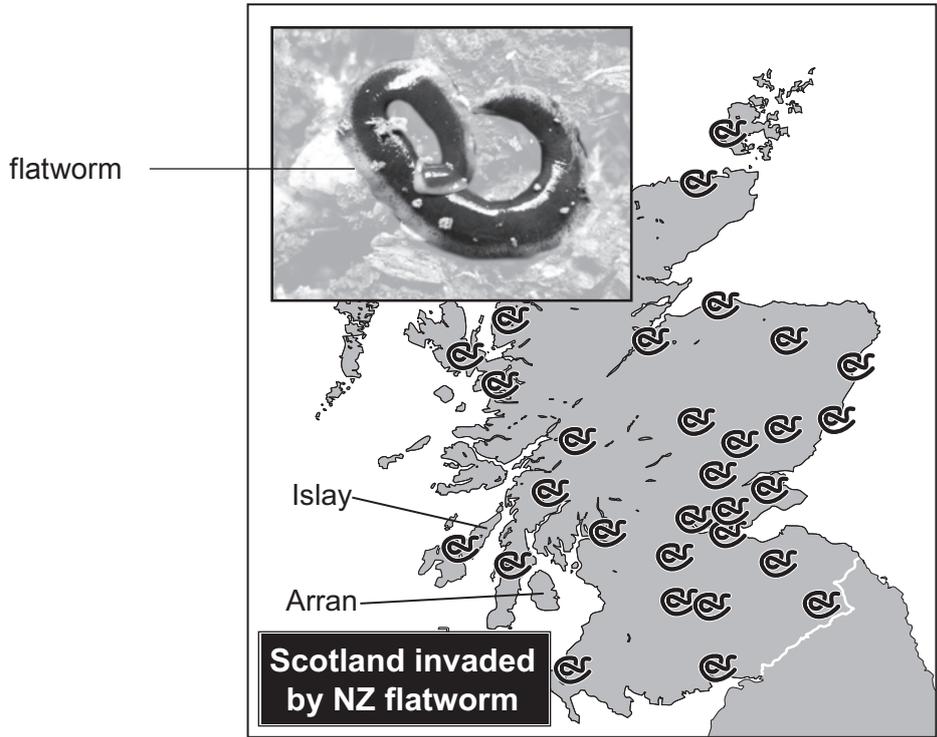
- Hedgehogs eat invertebrates and the eggs of waders.
- Flatworms do not eat birds' eggs, but eat the same types of invertebrates as hedgehogs.
- Hedgehogs do not eat flatworms.

(i) Explain why the number of waders on Islay has decreased since the introduction of the flatworm. [2]

....

....

....

(ii) How does the data from Arran suggest that predation may **not** be the only reason for the decrease in the number of waders? [1]

....

....

(iii) Suggest **two** factors that have allowed a large increase in the population of hedgehogs on Islay. [2]

....

....

7

(4461-02)

Turn over.

10. Some students collected leaves from a number of different beech trees.

The students measured the length of each leaf. The results are shown in the table below.

	length of leaf (mm)				
	21-30	31-40	41-50	51-60	61-70
number of leaves	51	72	74	66	47

(a) Use the data shown in the table to construct a bar graph in the grid below to show the variation in the length of beech leaves. Label the axes and use a suitable scale. Use a ruler for the bars. [3]
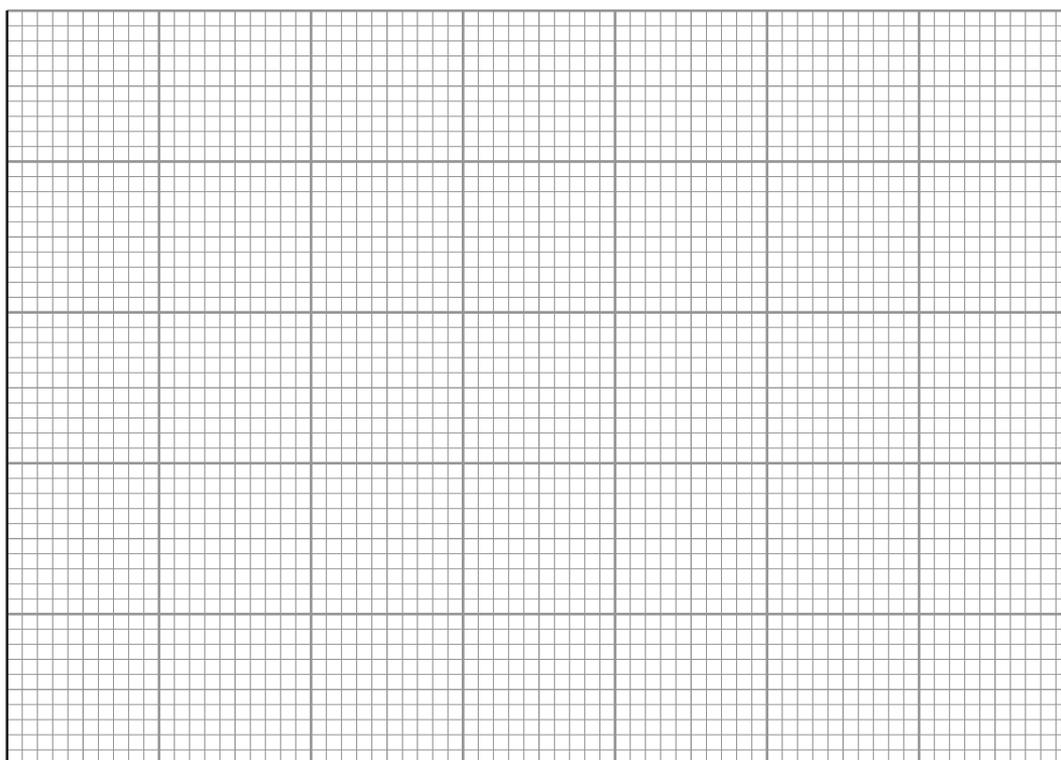
(b) Name the type of variation shown on your bar graph. [1]

....

4

11.

Deer mice live in the sand hills of Nebraska, USA. The genetic analysis of ancient remains of deer mice has shown that 10 000 years ago, the only genes for their coat colour were for dark coloured fur.

Their environment changed about 10 000 years ago when sand hills formed. Deer mice, living today, have sand coloured fur which is controlled by a gene called 'agouti'. This gene has not been found in the ancient remains of deer mice.

Write an explanation of the evolution of the coat colour in deer mice. In your explanation, refer to the processes of natural selection and the importance of genetic analysis in finding evidence for evolution. [6 QWC]

....

....

....

....

....

....

....

....

....

....

....

....

....

END OF PAPER

(4461-02)

BLANK PAGE

BLANK PAGE