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F

Friday 26 November 2021 – Morning

GCSE (9–1) Biology A (Gateway Science)

J247/02 Paper 2 (Foundation Tier)

Time allowed: 1 hour 45 minutes

You must have:
- a ruler (cm/mm)

You can use:
- a scientific or graphical calculator
- an HB pencil

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **28** pages.

ADVICE
- Read each question carefully before you start your answer.

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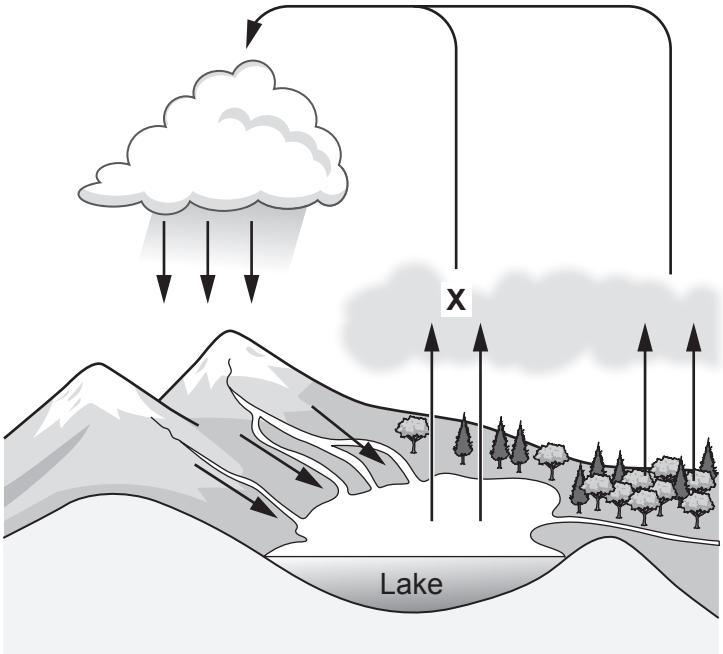
SECTION A

Answer **all** the questions.

You should spend a maximum of 30 minutes on this section.

Write your answer to each question in the box provided.

1 The diagram shows the water cycle.



Which process is **X**?

A Evaporation

B Precipitation

C Run-off

D Transpiration

Your answer ☐ **[1]**

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2 What are stem cells?

A Any cells in the skin.

B Cells that can form any type of cell.

C Cells that do not have a nucleus.

D Cells with half the normal number of chromosomes.

Your answer ☐ **[1]**

3 Which process causes the **loss** of biomass from food chains?

A Growth

B Photosynthesis

C Predation

D Respiration

Your answer ☐ **[1]**

4 Tigers hunt and kill deer to eat.

Which is the correct description of this relationship?

A Competition

B Mutualism

C Parasitism

D Predation

Your answer ☐ **[1]**

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5 Which process can result in a new allele being formed?

A Asexual reproduction

B Fertilisation

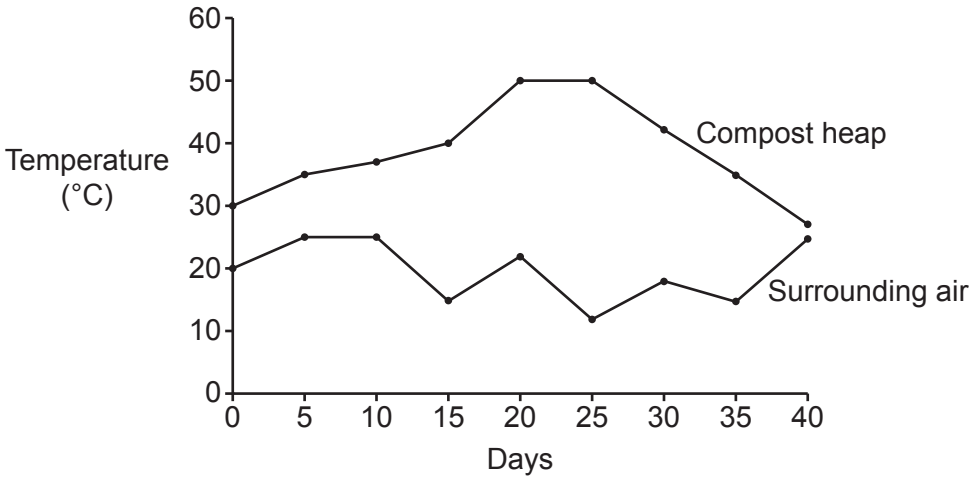
C Mutation

D Natural selection

Your answer ☐ **[1]**

6 A student measured the temperature in a compost heap and the temperature of the surrounding air.

The graph shows the results.



Which is an explanation of the student's results?

A The compost heap is cooler due to the photosynthesis of microorganisms.

B The compost heap is cooler due to the respiration of microorganisms.

C The compost heap is warmer due to the photosynthesis of microorganisms.

D The compost heap is warmer due to the respiration of microorganisms.

Your answer ☐ **[1]**

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7 Which scientists worked separately but developed a very similar theory?

A Darwin and Wallace

B Mendel and Darwin

C Wallace and Mendel

D Wallace, Darwin and Mendel

Your answer ☐ **[1]**

8 Which of these changes would cause an **increase** in biodiversity?

A Draining ponds to build a car park.

B Keeping tigers in a zoo.

C Reintroducing otters into an area where they had died out.

D Replacing a woodland with a field that contains wheat.

Your answer ☐ **[1]**

9 A genetic condition is controlled by a dominant allele **P**.

How is the genotype **Pp** described?

A Haploid

B Heterozygous

C Homozygous dominant

D Homozygous recessive

Your answer ☐ **[1]**

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10 Gene technology can be used to produce new crop plants.

Which is an **ethical** argument against the use of gene technology?

A It can be very expensive.

B Only well-trained scientists can carry out the process.

C Research and development takes a long time.

D We have no right to change an organism's genes.

Your answer ☐ **[1]**

11 The diploid number of chromosomes in sheep is 54.

How many chromosomes would be found in a sperm cell from a sheep?

A 23

B 27

C 54

D 108

Your answer ☐ **[1]**

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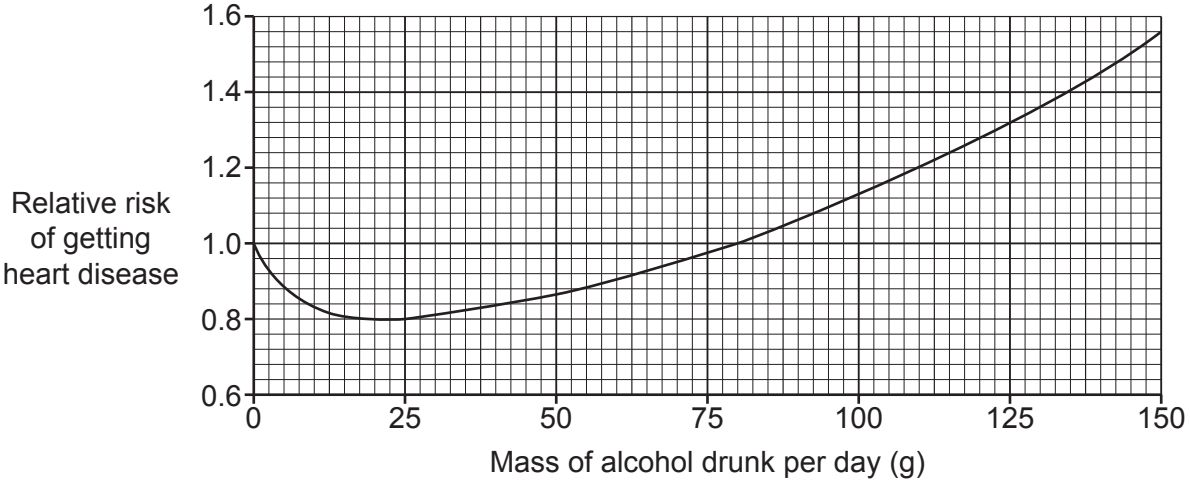
12 Scientists studied how the mass of alcohol drunk per day affects the relative risk of getting heart disease. The graph shows the results of their study.

A relative risk of more than 1.0 means that a person who drinks alcohol is more likely to get heart disease compared to a person who drinks no alcohol.



Which conclusion can be made from this graph?

A Drinking 80 g of alcohol a day does not increase the risk of heart disease.

B Drinking above 80 g of alcohol per day reduces the risk of heart disease.

C Drinking alcohol has little effect on the risk of heart disease.

D Drinking any mass of alcohol increases the risk of heart disease.

Your answer ☐ **[1]**

13 Some diseases can be caused by the action of different risk factors.

Which row in the table gives a correct risk factor for the disease?

	Risk factor	**Disease**
A	High sugar intake	Liver cirrhosis
B	Excessive alcohol intake	Type 1 diabetes
C	Smoking	Bronchitis
D	High levels of exercise	Lung cancer

Your answer ☐ **[1]**

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14 What is the best definition of an **antiseptic**?

A A chemical that destroys bacteria on the outside of the body.

B A chemical that destroys viruses inside the body.

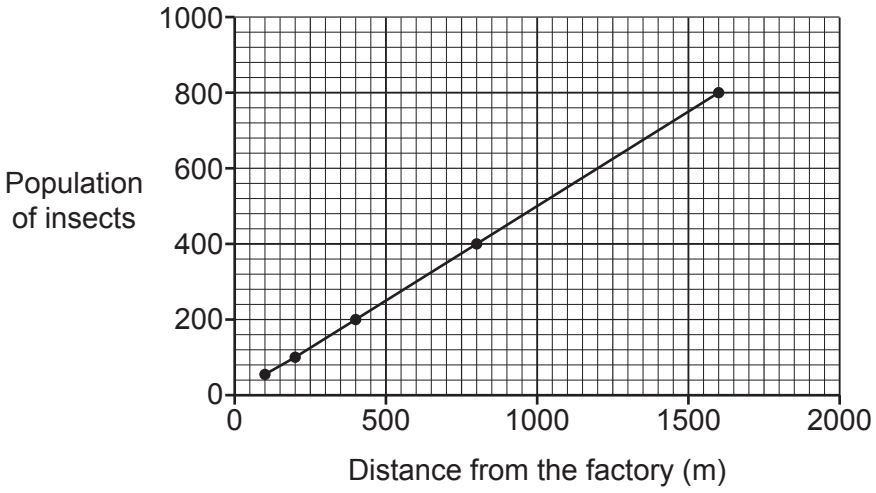
C A protein that destroys bacteria inside the body.

D A protein that destroys viruses on the outside of the body.

Your answer ☐ **[1]**

15 A student estimated the population of insects at different distances from a factory using capture-recapture.

They plotted their results on a graph.



Which of these statements describes the student's results?

A Population size = distance from the factory

B Population size ∝ distance from the factory

C Population size > distance from the factory

D Population size ~ distance from the factory

Your answer ☐ **[1]**

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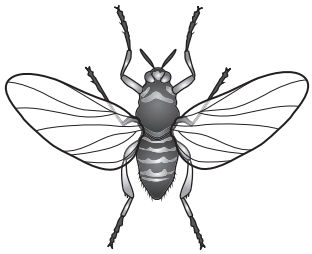
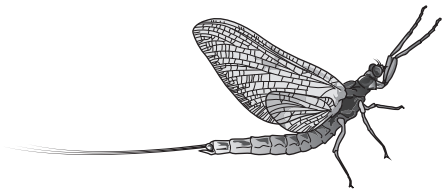
SECTION B

Answer **all** the questions.

16 The drawings show two types of insect called the Blandford fly and the mayfly.



Blandford fly



Mayfly

(a) The young of both Blandford flies and mayflies live in rivers and eat algae.

Large fish called trout eat the young of both Blandford flies and mayflies.

(i) Complete the sentences about the river and the organisms.

You can use each word once, more than once, or not at all.

community **ecosystem** **habitat** **population**

The river is a ..... where organisms live.

All the trout in the river are a ..... .

[2]

(ii) Draw lines to connect each organism with its correct trophic level.

	Primary consumers
Mayfly	Producers
Trout	Secondary consumers
	Tertiary consumers

[2]

(iii) What process in algae produces food for the organisms in the river?

..... **[1]**

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(b) Adult Blandford flies often bite people and feed by sucking up blood. Before they start feeding, they inject proteins into the skin.

These proteins have two actions:

- preventing platelets from working
- numbing the skin, temporarily taking away feeling in the area.

Suggest how each of these actions may help the fly.

Preventing platelets from working .....

.....

.....

.....

Numbing the skin .....

.....

.....

[3]

(c) After the fly has finished feeding, the person has an immune response against the proteins.

The list shows some stages in the immune response.

A Antibodies are released.

B Antibodies attach to the proteins.

C Enzymes digest the proteins inside the white blood cells.

D White blood cells engulf the proteins.

E White blood cells gather at the site.

Write these stages in the **correct order** in the boxes.

The first one has been done for you.

E				

[3]

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17 Sheep are kept by farmers to supply wool, milk and meat.

(a) The table gives some information about the amount of wool, milk and meat produced by four types of sheep.

	Yield per sheep (kg)		
Type of sheep	**Wool**	**Milk**	**Meat**
Badana	4.2	0.5	18
Churra	1.8	1.2	22
Lacho	1.8	2.0	22
Langhe	2.5	1.3	26

(i) A farmer keeps sheep to supply **milk**.

Which type of sheep should he keep to provide the highest milk yield?

..... **[1]**

(ii) Another farmer decides to use selective breeding to produce a new type of sheep. She wants the sheep to have both high wool and high meat yields.

Suggest which **two** types of sheep she should choose to breed together.

..... and .....

[2]

(iii) The farmer breeds the two types of sheep together.

Describe the next steps in her selective breeding method.

.....

.....

.....

.....

..... **[3]**

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(b) Sheep can die from a disease called bluetongue. Bluetongue is caused by a pathogen that is a virus.

The virus is spread to sheep by an insect when it bites the sheep.

(i) Write down the reason why the virus is described as a pathogen.

..... **[1]**

(ii) Farmers can spray their sheep to stop them being bitten by insects.

Which type of chemical is in the spray?

Put a ring around the correct answer.

antibiotic **antimicrobial** **fertiliser** **pesticide**

[1]

(c) In Europe, the insects carrying the virus are usually killed by frosts in the winter.

This **reduces** the number of sheep infected by bluetongue.

(i) Scientists think climate change could result in **more** sheep being infected with the bluetongue virus.

Explain why **more** sheep could be infected.

.....

.....

..... **[2]**

(ii) Scientists are trying to find a way to kill the insects using fungi.

Which term describes this type of control?

Tick (✓) **one** box.

Aseptic control ☐

Biological control ☐

Genetic control ☐

Hydroponic control ☐

[1]

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(iii) Another method that scientists are investigating is **genetic engineering**.

They hope to genetically engineer the insects so that they cannot carry the virus.

Describe what is meant by the term **genetic engineering**.

.....

.....

..... **[2]**

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18 Cancer is caused by changes in cells.

(a) What effect does cancer have on cells?

Tick (✓) **one** box.

Causes them to divide uncontrollably ☐

Makes them produce antibodies ☐

Makes them start producing hormones ☐

Stops them dividing by mitosis ☐

[1]

(b) Cancer can occur in the cells of the breast.

This type of cancer is often caused by the hormone oestrogen.

Explain why the removal of ovaries may be used as a treatment for breast cancer.

.....

.....

.....

..... **[2]**

(c) Cells usually become cancerous due to damage to their DNA.

Scientists have found a gene called *BRCA*. This gene usually produces a protein that repairs damaged DNA.

(i) There are 30 000 000 females in the UK and 1 in 400 of them has a mutation in their *BRCA* gene.

- 60% of women with this mutation could develop breast cancer.
- Calculate how many females in the UK could develop breast cancer due to a mutation in the *BRCA* gene.

Number of females = ... **[3]**

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(ii) Scientists can now test for the mutated *BRCA* gene in women.

This means they can give women the option of having their ovaries removed before breast cancer may start to develop.

Suggest **two** reasons why this is a difficult decision for some women.

1 .....

.....

2 .....

.....

[2]

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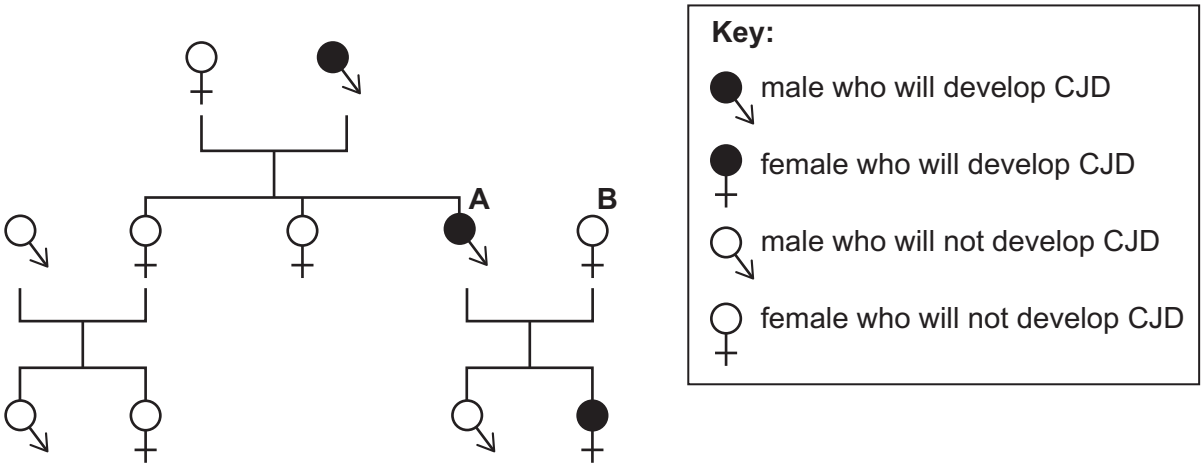
19 CJD is a group of diseases that occur in the brain. One type of CJD is caused by a **dominant allele**.

(a) The family tree shows the occurrence of this type of CJD in a family.



(i) **D** represents the dominant allele and **d** the recessive allele.

Person **A** in the family tree must have the genotype **Dd**.

Explain how you can tell this from the family tree.

.....

.....

.....

..... **[2]**

(ii) Person **A** and person **B** are expecting another child.

Complete the genetic diagram to calculate the probability that the child will develop CJD.

Person **B**

Person **A**		**d**	**d**
	D	.....	.....
	d	.....	.....

Probability = ... **[2]**

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(b) Scientists have produced a drug that will hopefully stop CJD developing. Before they inject this drug into people they will test it on animals.

Give **two** reasons why medicines are tested before they are given to people.

1 .....

.....

2 .....

.....

[2]

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20* Many people in China rely on rice for food.

Farmers have started to grow new types of rice called hybrid rice.

Figs. 20.1, **20.2**, **20.3** and **20.4** show information about China and rice production in the country.

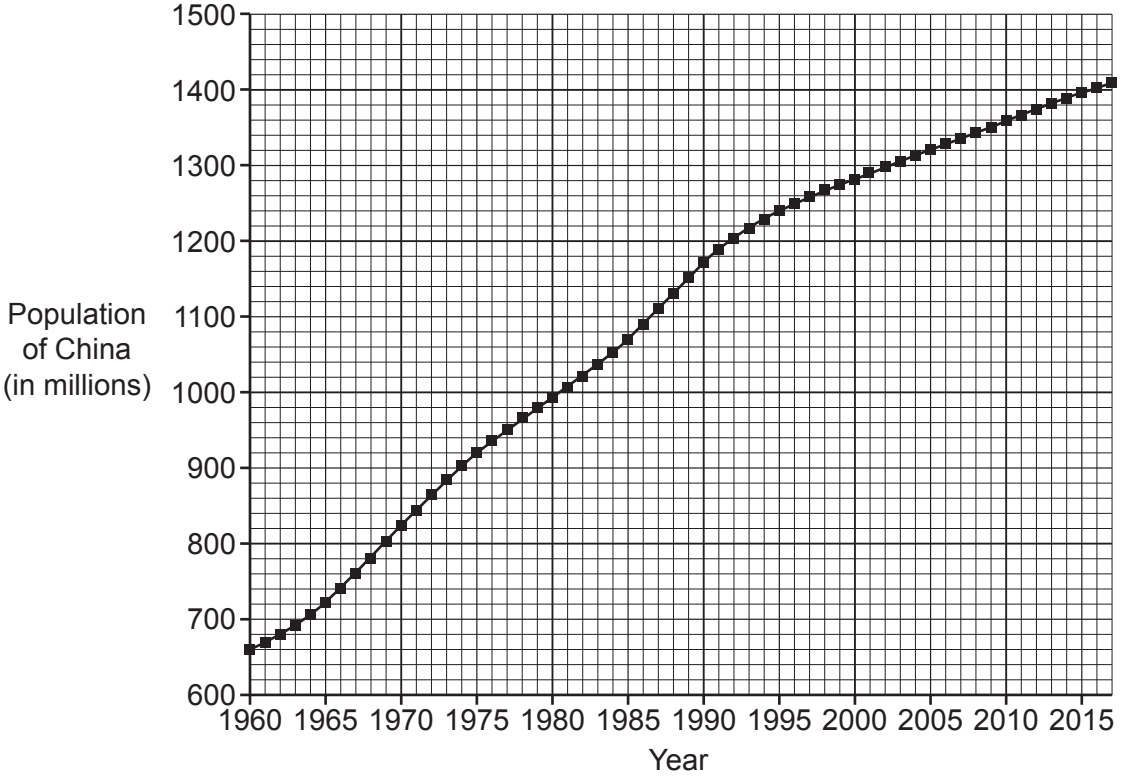

Fig. 20.1

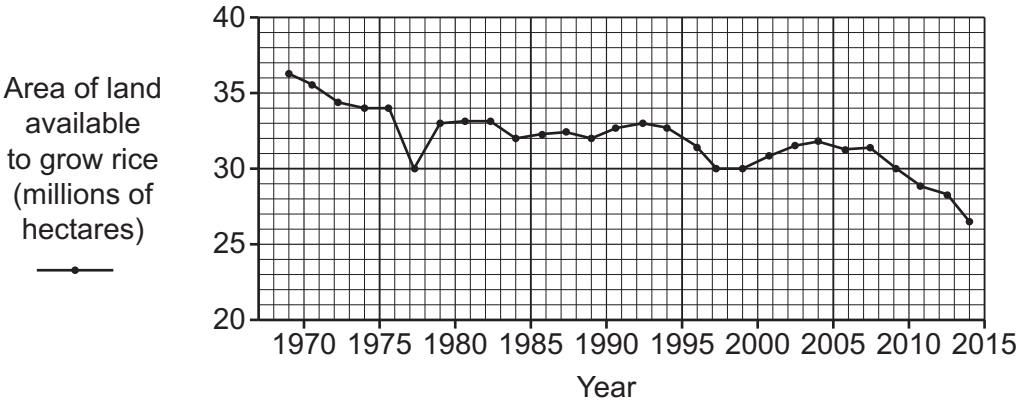

Fig. 20.2

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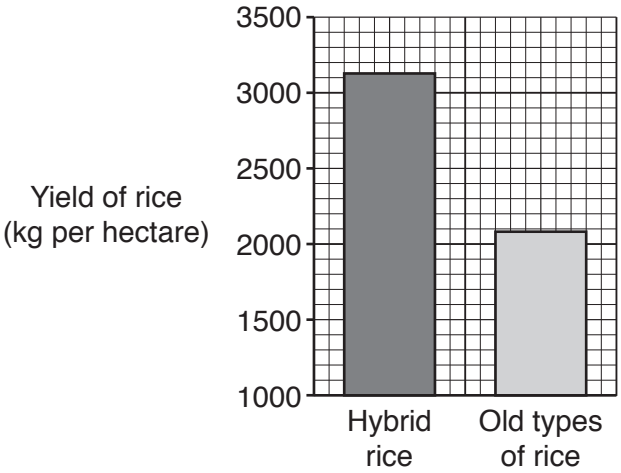

Fig. 20.3

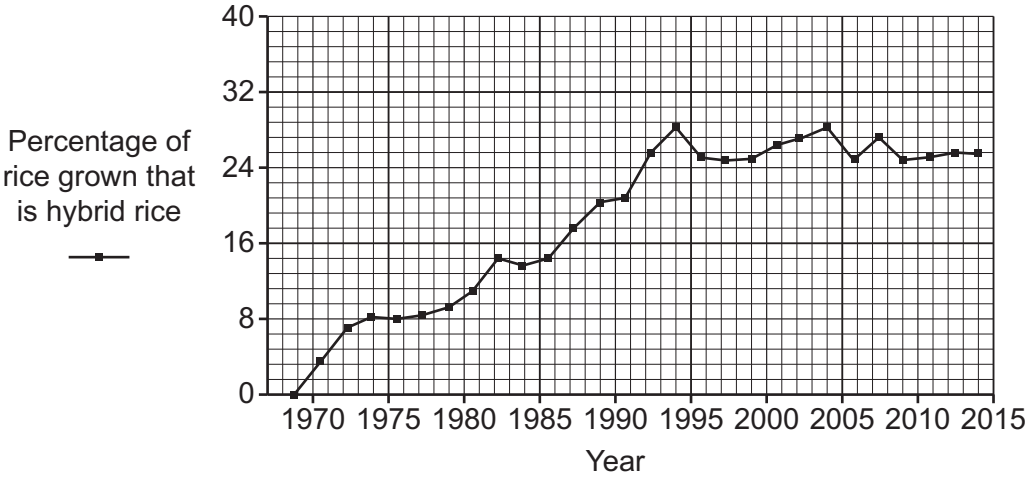

Fig. 20.4

Use the graphs in **Figs. 20.1**, **20.2**, **20.3** and **20.4** to explain the problems facing China and how China is changing its food production to solve these problems.

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..... **[6]**

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21 **Fig. 21.1** shows a type of small lizard called a skink.

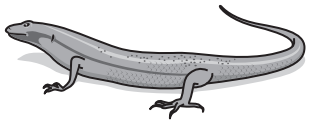

Fig. 21.1

Skinks living in New Zealand are puzzling scientists as the skinks have green blood. The scientists have found that the colour is due to a green chemical.

One of the scientists made this statement:

'The skinks must have haemoglobin in their blood otherwise they would die. However, the red colour of the haemoglobin is hidden by the green colour of the chemical.'

(a) Explain why the skinks need **haemoglobin** in their blood to stay alive.

.....

.....

..... **[2]**

(b) The green chemical also makes the skin of the skinks look green.

Scientists think that the colour may have evolved to protect the skinks from predators in the rainforests.

Explain how the skinks may have evolved to be green.

Use ideas about natural selection in your answer.

.....

.....

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..... **[3]**

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(c) The scientists made different-coloured models of the skinks.

Describe how they could use the models to test their ideas about why the skinks are green.

.....

.....

.....

..... **[2]**

(d) The scientists also observed that the factors that determine sex in skinks are different than in humans.

Which factor determines sex in humans?

Tick (✓) **one** box.

How many genes a person has	☐
The environment	☐
The number of chromosomes a person has	☐
Whether a person has a Y chromosome or not	☐

[1]

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(e) The scientists divided skink eggs into two groups, normal sized and small. They then recorded the sex of the skink when they hatched out.

Fig. 21.2 shows their results.

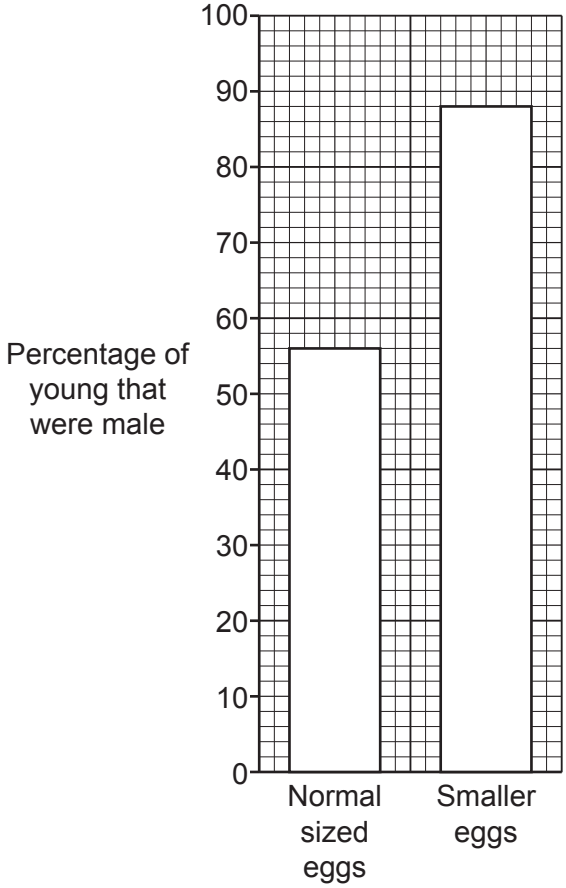

Fig. 21.2

(i) The scientists had 300 **normal sized** eggs.

Calculate how many male skinks hatched from these eggs.

Number of male skinks = ... **[2]**

(ii) Describe the relationship between egg size and the sex of the skinks.

.....

..... **[1]**

(iii) The scientists found that smaller eggs have a higher concentration of testosterone.

Explain how this can account for the results shown in the graph.

.....

.....

..... **[2]**

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22 Farmers' fields are usually surrounded by hedges. An example of this is shown in **Fig. 22.1**.

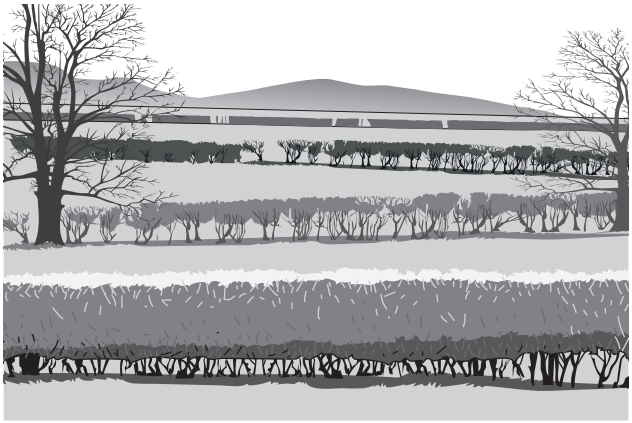

Fig. 22.1

Different plant species grow in the hedges. Scientists are studying hedges to find the number of different plant species.

(a) Write down why they would use a quadrat and a biological key in this process.

Quadrat .....

.....

.....

Key .....

.....

[3]

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(b) The scientists want to see if there is a link between the area of a field and the number of plant species growing in the hedge.

They sample hedges in five different sizes of fields, **A**, **B**, **C**, **D** and **E**.

The table shows the scientists' results.

Field	Area of field (m^2)	Mean number of plant species (per m of hedge)
A	3000	2.0
B	4000	1.7
C	7500	1.3
D	1500	2.1
E	10 000	1.2

(i) Plot the data for the five fields on the grid in **Fig. 22.2**.

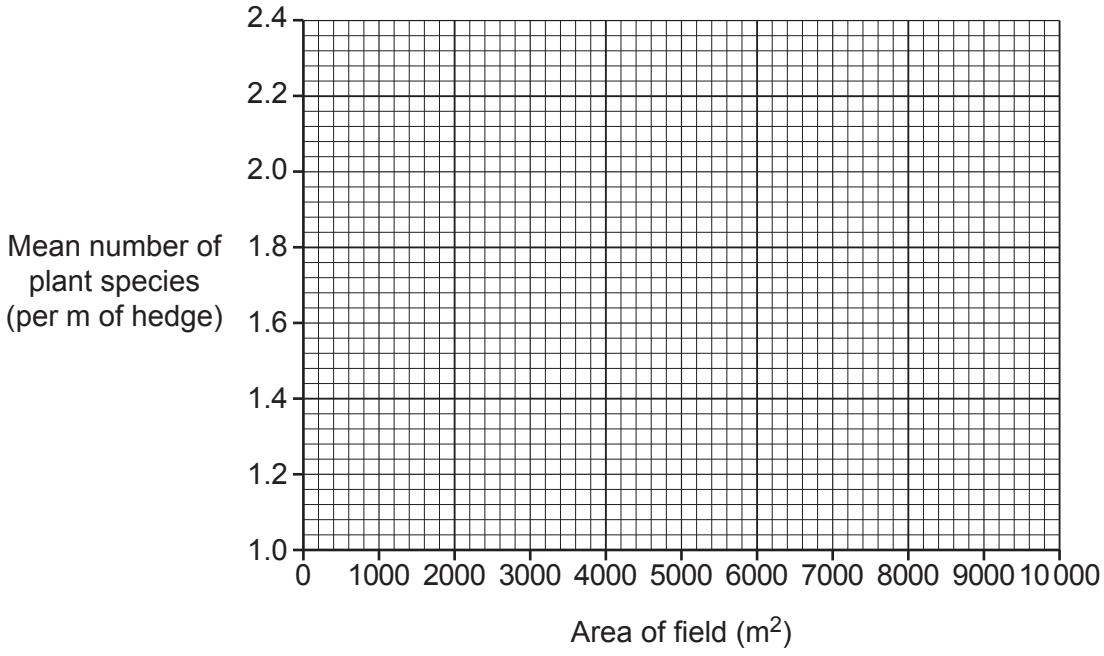

Fig. 22.2

[2]

(ii) Draw a line of best fit on the graph in **Fig. 22.2**. **[1]**

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(iii) There is a formula that can be used to estimate the age of a hedge.

$$\text{age in years} = \left(\begin{array}{c}\text{mean number of}\\ \text{plant species}\\ \text{per m of hedge}\end{array}\right) \times 110 + 30$$

The hedges in field **E** are 162 years old.

Calculate the age of the hedges in field **D**.

Age = ... years **[2]**

(iv) To try to grow more crops, farmers now use larger machines.

Modern farms have larger fields to make it easier to use these machines.

Does the scientists' data support the idea that older fields are smaller?

Explain your answer.

.....

.....

..... **[2]**

(c) Birds such as blackbirds make nests in hedges.

Fig. 22.3 shows a food web that occurs in a hedge next to a field of wheat.

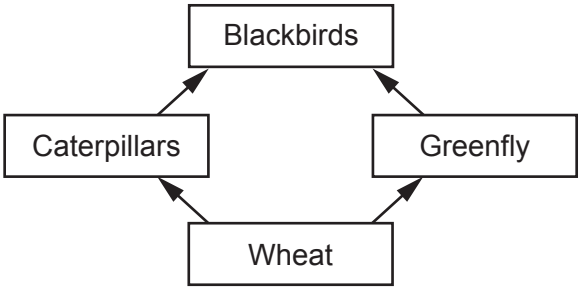

Fig. 22.3

Farmers are replanting hedges in their fields.

Use information from the food web in **Fig. 22.3** to explain how this could increase the yield of wheat.

.....

.....

..... **[2]**

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23 Sulfur dioxide is a gas released when coal and oil are burned. Sulfur dioxide dissolves in water to make an acid. Scientists think that this might harm plants by affecting photosynthesis.

(a) Photosynthesis is controlled by enzymes.

Which **two** statements explain how an acid could affect photosynthesis?

Tick (✓) **two** boxes.

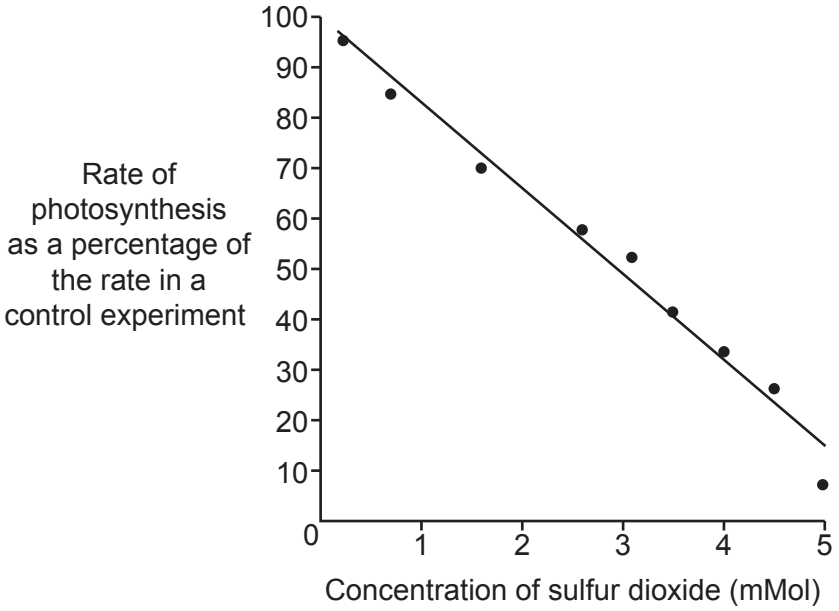
- Acid will decrease the pH and cause the enzyme to change shape. ☐
- Acid will increase the pH and cause the enzyme to change shape. ☐
- Acid will increase the pH and cause the substrate to change shape. ☐
- The enzyme will not fit into the active site of the substrate. ☐
- The substrate will denature. ☐
- The substrate will not fit into the active site of the enzyme. ☐

[2]

(b) Students take some spinach leaves and spray them with water containing different concentrations of sulfur dioxide.

They then measure the rate of photosynthesis of the leaves.

The graph shows their results.



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(i) The students plotted the rate of photosynthesis as a percentage of the rate in a control experiment. The control experiment involved spraying the leaves with a different substance.

Suggest what substance the students used to spray the leaves as a control.

..... **[1]**

(ii) One of the students makes this conclusion:

'The results of our experiment show that sulfur dioxide is affecting the plant and it is doing this because it forms an acid.'

Discuss whether this is a reasonable conclusion to make from the students' results.

.....

.....

.....

.....

..... **[2]**

(iii) Suggest how the students could modify their experiment to prove that sulfur dioxide is affecting the plant because it is an acid.

.....

.....

..... **[1]**

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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