Oxford Cambridge and RSA

Friday 9 June 2023 – Afternoon

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

F

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 **32** pages.

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

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Section A

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

Write your answers to each question in the box provided.

1 Which process in the carbon cycle **decreases** the amount of carbon dioxide in the air?

A Combustion

B Decomposition

C Photosynthesis

D Respiration

Your answer ☐ **[1]**

2 Which of these is a **biotic** factor that can affect the growth of plants?

A Carbon dioxide levels

B Light availability

C Mineral content of the soil

D Number of primary consumers

Your answer ☐ **[1]**

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3 Using the data in the table, how many people living in the UK have a Y chromosome in their cells?

Number of individuals of each sex in the UK, rounded to 2 significant figures	
males	females
33 000 000	34 000 000

A 33 000 000

B 34 000 000

C 66 000 000

D 67 000 000

Your answer ☐ **[1]**

4 A genetic disorder is caused by a dominant allele (D). The recessive allele is (d).

Which row shows all the possible genotypes for heterozygous and homozygous individuals?

	Heterozygous	**Homozygous**
A	Dd	dd
B	DD or dd	Dd
C	Dd	DD or dd
D	Dd	DD

Your answer ☐ **[1]**

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5 Which sentence is a correct description of a chromosome?

A A length of protein that contains the genetic material.

B A long molecule of DNA that contains genes.

C A part of a gene that codes for a particular protein.

D A strand of DNA that can leave the nucleus.

Your answer ☐ **[1]**

6 What does the lining of the trachea (windpipe) produce to defend the body against pathogens?

A Acid

B Antigen

C Enzymes

D Mucus

Your answer ☐ **[1]**

7 There are 28 chromosomes in each elephant sperm cell.

What is the diploid number of chromosomes in elephants?

A 14

B 28

C 56

D 112

Your answer ☐ **[1]**

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8 Charles Darwin and Gregor Mendel did important work in the development of science.

Which row gives the areas of their work?

	Charles Darwin	Gregor Mendel
A	evolution	medicine
B	medicine	genetics
C	evolution	genetics
D	genetics	evolution

Your answer ☐ **[1]**

9 Ecotourism can cause benefits and problems for conservation.

Which row gives a benefit and a problem caused by ecotourism?

	Benefit	Problem
A	educates people about conservation	brings money into the local economy
B	brings money into the local economy	tourists can cause pollution and damage
C	tourists can cause pollution and damage	educates people about conservation
D	brings money into the local economy	educates people about conservation

Your answer ☐ **[1]**

10 When a drug is developed to treat a disease, the drug is tested.

What is the final stage in this testing?

A Testing on animals to see if it is safe.

B Testing on animals to work out the correct dose.

C Testing on healthy people to see if it has side effects.

D Testing on people with the disease to see if it is effective.

Your answer ☐ **[1]**

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11 The cuticle on plant leaves helps to prevent pathogens entering the plant.

Which statement describes how the cuticle does this?

A Acts as a physical barrier

B Engulfs microbes

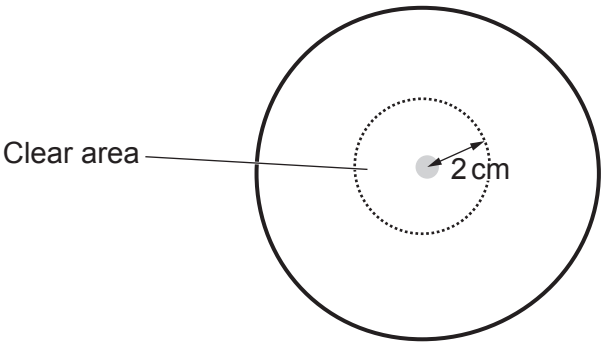
C Produces antimicrobial substances

D Releases antibodies

Your answer ☐ **[1]**

12 Antibiotics can be tested on bacteria growing on a Petri dish.

The clear area around an antibiotic disc gives information about how effective the antibiotic is.



What is the closest estimate of the clear area on this Petri dish?

(Include the disc and use the formula: Area = πr^2 where $\pi = 3$)

A $3\,cm^2$

B $4\,cm^2$

C $6\,cm^2$

D $12\,cm^2$

Your answer ☐ **[1]**

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13 Which statement describes why seeds from seedbanks are an important tool in conservation?

A If there is a food shortage then the seeds can be used for food.

B The seeds can be used if certain species of plants become extinct.

C The seeds can be used to feed endangered animals.

D The seeds grow fast as the temperature is warm inside the seedbank.

Your answer ☐ **[1]**

14 Which group will have the **most** organisms in any ecosystem?

A Community

B Population

C Species

D Trophic level

Your answer ☐ **[1]**

15 Biomass is lost as it passes through a food chain.

Which processes are responsible for this loss in biomass?

A Egestion, excretion and respiration

B Egestion, transpiration and respiration

C Excretion, transpiration and respiration

D Photosynthesis, egestion and excretion

Your answer ☐ **[1]**

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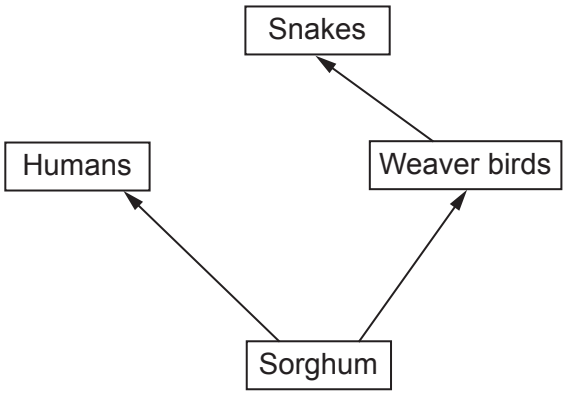
Section B

16 Sorghum is a crop plant grown in Africa for its seeds as shown in **Fig. 16.1**.

Fig. 16.1

(a) **Fig. 16.2** shows a food web containing sorghum.

Fig. 16.2



Write down the trophic level for each of these organisms in the food web.

Use the words from the list.

primary consumers	**producers**	**secondary consumers**

Sorghum .....

Snakes .....

[2]

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(b) Weaver birds are a major problem for farmers who grow sorghum.

One weaver bird can eat 15 g of sorghum seeds in a day.
A large colony of weaver birds has 5 000 000 birds.

Calculate the mass of seeds in **kilograms** that this colony eats in a day.

Mass of seeds = ... kg **[2]**

(c) Sorghum produces a bitter chemical in its seeds.
This makes the seeds less likely to be eaten by birds.

Complete each sentence about how the bitter chemical was first made by sorghum.
Use the words from the list.

gene	**meiosis**	**mutation**	**pathogen**	**sugar**

The bitter chemical was first made due to a change in a ..... .

This type of change is called a ..... .

[2]

(d) Farmers have developed varieties of sorghum with lower levels of the bitter chemical.

To do this they:

- chose two plants with less bitter chemical than other plants
- bred these plants together
- repeated the same steps with the offspring.

What is the name of this process?

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

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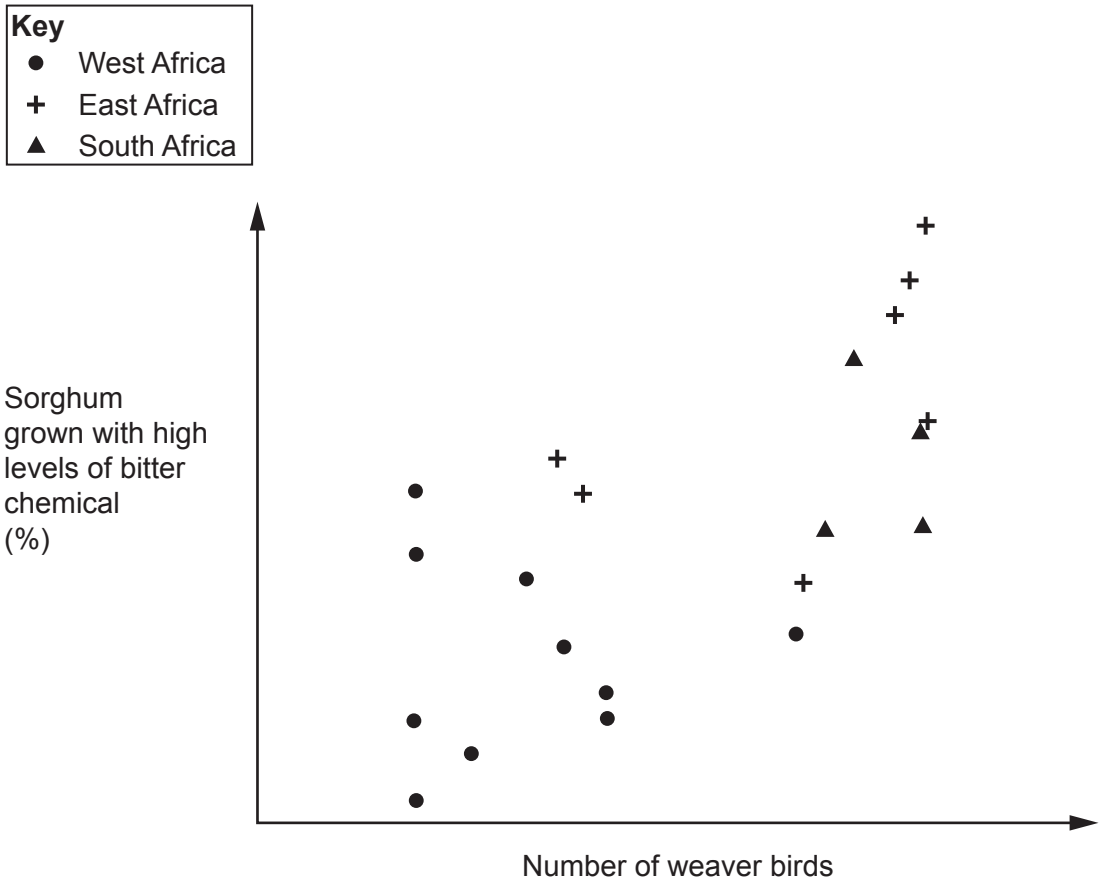
(e) Scientists recorded the percentage of sorghum grown with high levels of bitter chemical in different areas of Africa. They also recorded the number of weaver birds living in the same areas.

The graph shows the data they collected.



In some areas, there are low numbers of weaver birds.

(i) Which area of Africa, west, east or south, has the **least** number of weaver birds that eat sorghum?

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

(ii) Complete the sentence about the graph.

Put a ring around the correct option.

In the areas with low numbers of weaver birds, farmers choose to grow

a lower / a higher / the same percentage of sorghum with high levels of

bitter chemicals. **[1]**

(iii) Give a reason why the farmers make this choice.

.....

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

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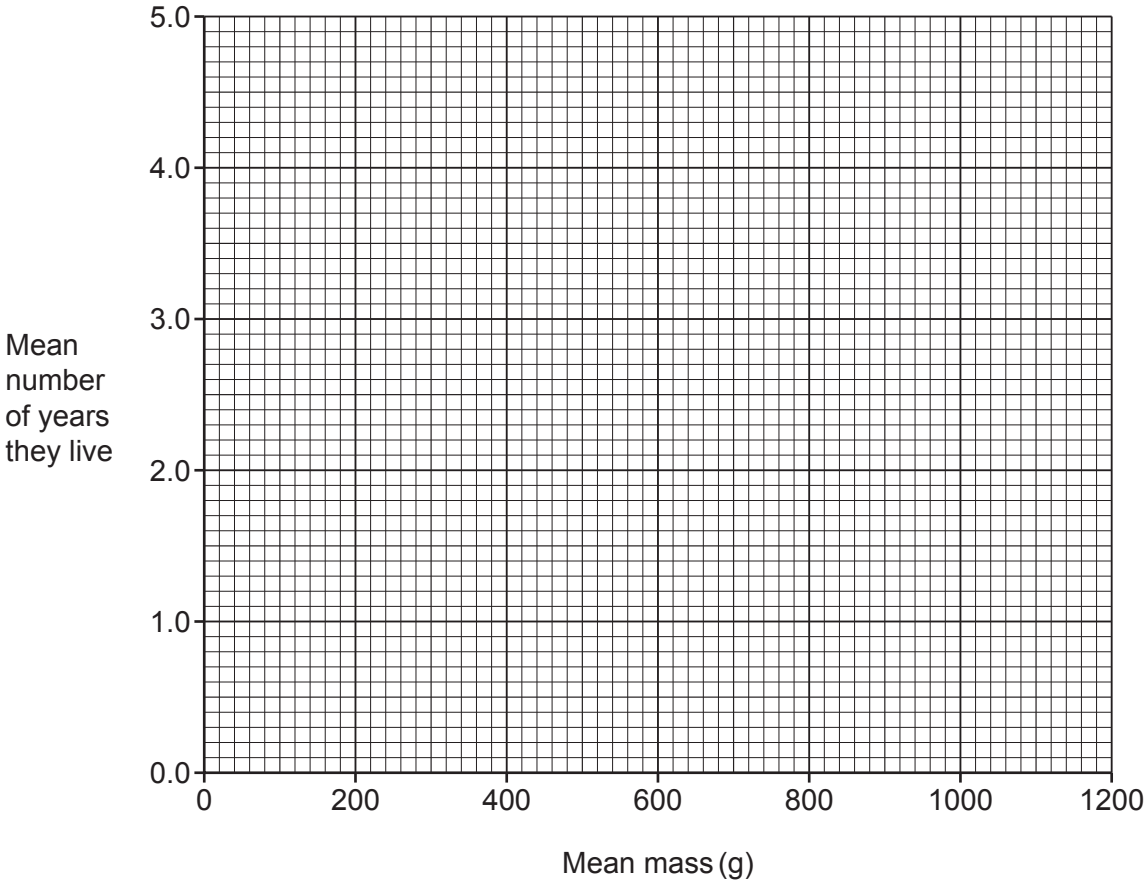
17 The table shows the mean mass of four types of rodent and the mean number of years they live.

Type of rodent	Mean mass (g)	Mean number of years they live
Gerbil	40	1.5
Guinea pig	1000	4.0
Rat	200	2.0
Squirrel	600	3.0

(a) **(i)** Plot the data from the table on the graph. **[2]**

(ii) Draw a line of best fit through the points. **[1]**



(iii) Mole rats are rodents that have a mean mass of 60 g.

Use your graph to predict the mean number of years that mole rats live.

Mean number = ... years **[1]**

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(iv) Mole rats actually live much longer than predicted by the graph.

Scientists think that one reason for this is that their cells do **not** divide in an uncontrolled way.

Explain why this would help the mole rats to live longer.

.....

.....

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

(b) Mole rats spend most of their time burrowing underground in tunnels.

The tunnels may have only 5% oxygen in the air compared with 21% above ground.

Complete the sentences below to show how the mole rats have adapted to live in the tunnels.

Mole rats have a low respiration rate. This means they need less ..... gas from the air.

This gas can be picked up from low levels in the air by the chemical inside their red blood

cells called ..... .

Mole rats also have few pain receptors in their tissues.

This means that any ..... acid produced by anaerobic respiration does not hurt.

Scientists think that mole rats have evolved these features by the process of

....

[4]

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18 Hepatitis is the name given to diseases that cause the liver to be inflamed.

The table gives information about four types of hepatitis.

	Hepatitis A	**Hepatitis B**	**Hepatitis D**	**Alcoholic Hepatitis**
Cause	Virus	Virus	Virus	Drinking alcohol
Details of cause	Virus is taken in through food and drink contaminated with faeces.	Virus is taken in through contaminated blood.	Virus is taken in through contaminated blood.	Excessive alcohol consumption over some time.
Effect on the body	Usually lasts for two months then a person cannot develop the disease again.	Usually lasts for one to three months then a person cannot develop the disease again.	Can only develop symptoms if a person has hepatitis B.	Can cause liver failure and death.

(a) For each of these questions choose your answers from the types of hepatitis shown in the table.

(i) List **all** the types of hepatitis that can be treated using antiviral tablets.

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

(ii) Which type of hepatitis can be prevented by regular hand washing?

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

(iii) Which type of hepatitis is a non-communicable disease?

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

(iv) Which type of hepatitis involves interaction between two different diseases?

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

(b) Explain why hepatitis **A cannot** be treated using antibiotics. Use information from the table.

.....

.....

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

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(c) Complete each sentence to explain why a person **cannot** develop hepatitis **A** or **B** twice.

Use the words from the list.

antibiotics	**antibodies**	**antigens**	**immune**
red blood	**vaccinated**	**white blood**	

On the surface of the viruses there are molecules called ..... .

These molecules are detected by ..... cells.

These cells produce protein molecules called ..... which attack the viruses.

If the person gets infected again, the protein molecules will destroy the viruses before they can make the person ill.

The person is said to be ..... .

[4]

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19 **(a)** Describe how scientists could estimate the number of one type of **plant** in a habitat.

.....

.....

.....

.....

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

(b)*

Buddleia, a pest or a friend?

Many people grow buddleia bushes in their gardens.

Buddleia flowers attract butterflies that feed on nectar. Birds and bats feed on butterflies. Foxes and badgers can live under the cover of the bushes.

Buddleia bushes spread and grow very quickly. In some areas this has caused the numbers of other plants to decrease.

In these areas, scientists have seen large numbers of butterflies. However, they only see the more common types of butterflies and not rare ones.

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Some scientists say buddleia are ‘pests’ but others say they are ‘friends’.

Use information from the passage to explain these different opinions about buddleia.

In your answer use ideas about:

- interdependence
- competition
- biodiversity.

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

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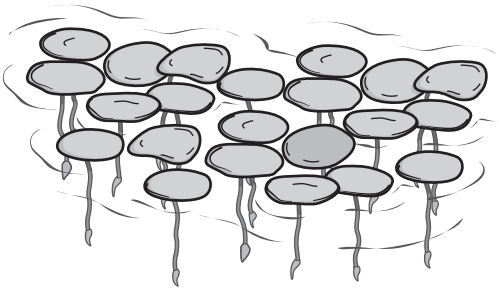
20 Duckweed is a small plant that floats on the surface of ponds.



Each plant has one leaf and it usually reproduces by dividing into two.

Only occasionally does it reproduce sexually by growing flowers.

(a) In the box next to each statement, put **A** if it applies to asexual reproduction or **S** if it applies to sexual reproduction.

It is a quicker process. ☐

It introduces variation into the population. ☐

[1]

(b) A student investigates the effect of acid rain on the reproduction rate of duckweed.

This is the student's method:

- Put pondwater with a pH of 4.5 in four different beakers.
- Add five duckweed plants to each beaker.
- Repeat this with beakers containing pondwater at pH 6.5 and 8.5.
- Leave the beakers for 10 days in the same conditions.
- After 10 days count how many duckweed plants are in each beaker.

The table shows the student's results.

	Number of duckweed plants after 10 days				
pH of pondwater	**Beaker 1**	**Beaker 2**	**Beaker 3**	**Beaker 4**	**mean**
4.5	6	5	7	6	6
6.5	12	14	11	11	12
8.5	7	6	5	14	8

(i) What is the **independent** variable in this investigation?

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

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(ii) Identify the **pH** of the pondwater where the mean number of duckweed plants is the same as the mode for the four beakers.

Tick (✓) **one** box.

4.5 ☐

6.5 ☐

8.5 ☐

[1]

(iii) The student thinks that there is a problem with their data at pH 8.5. This resulted in the mean being inaccurate.

Explain how the student could improve their investigation to get a more accurate result for the mean.

.....

.....

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

(iv) The student concluded that acid pollution slows the rate of duckweed reproduction.

Explain how acid pollution slows the rate of duckweed reproduction.

Use ideas about enzymes and photosynthesis in your answer.

.....

.....

.....

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

(v) The student also concluded that pH 6.5 is the best pH for duckweed reproduction.

The student's teacher says that they need to extend the experiment to be sure of this.

Describe how the student should extend their experiment.

.....

.....

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

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21 The demand for food in the world is growing but there are risks to the supply of food.

There are methods that can be used to reduce these risks.

(a) Draw lines to connect each **risk** with the correct **method used to reduce the risk**.

One line has been drawn for you.

Risk	**Method used to reduce the risk**
no soil	add fertilisers
soil low in minerals	use hydroponics
insects eating crops	use antibiotics
bacteria infecting animals	spray with pesticides

[2]

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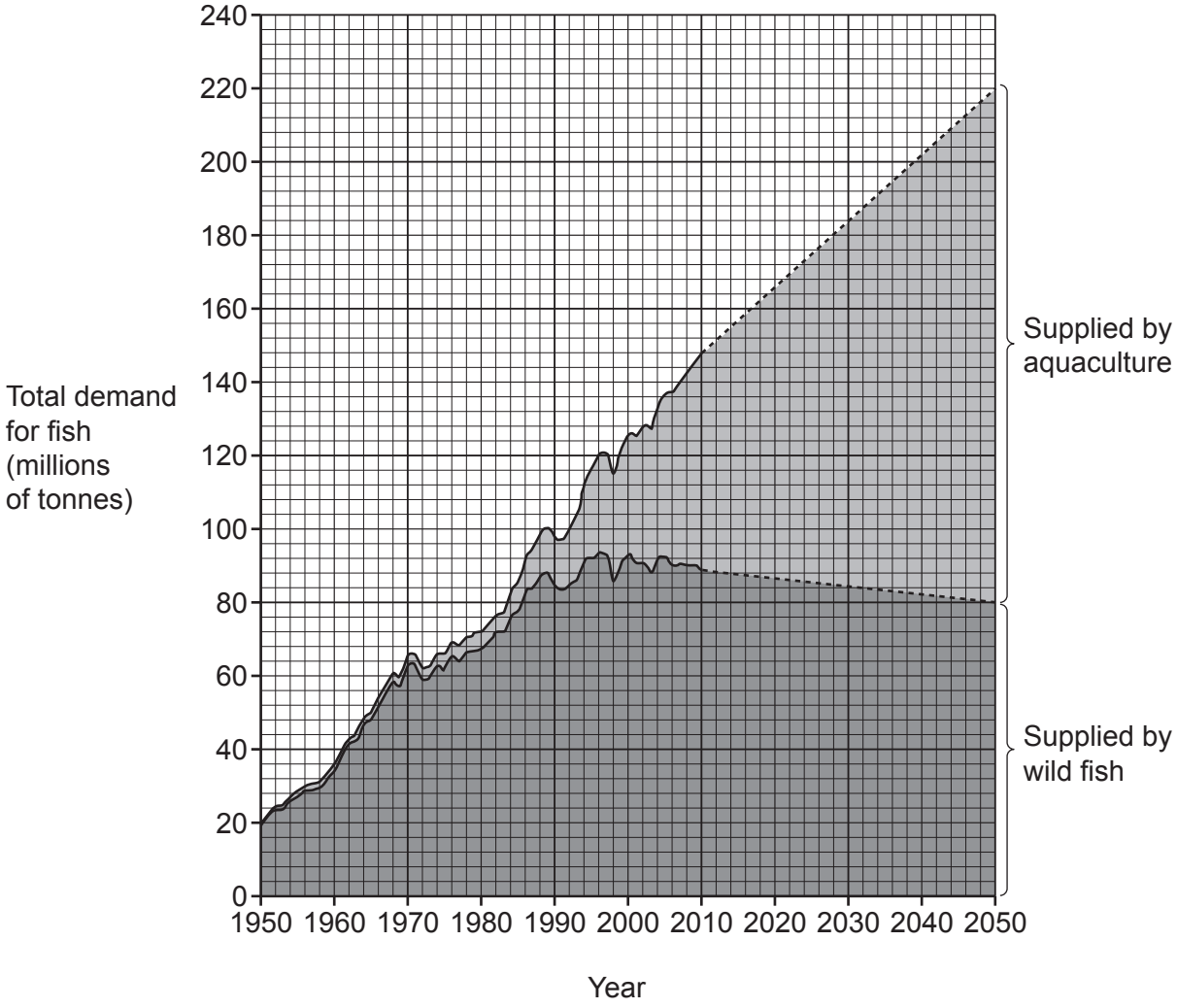
(b) Many people in the world eat fish as their main source of protein.

Wild fish: caught from the sea Aquaculture: fish grown in large tanks in lakes or the sea

The graph shows how the total demand for fish has changed since 1950 and how it is expected to change up to 2050. It also shows how the total demand is met by the supply of wild fish and fish from aquaculture.



Use the graph to complete each sentence about the demand for fish.

Put a ring around each correct number.

(i) The total demand for fish is expected to increase from 20 million tonnes in 1950 to

80 / 140 / 220 million tonnes in 2050. **[1]**

(ii) In 2050, the percentage of all fish supplied by wild fish is expected to be about

36% / 57% / 64%. **[1]**

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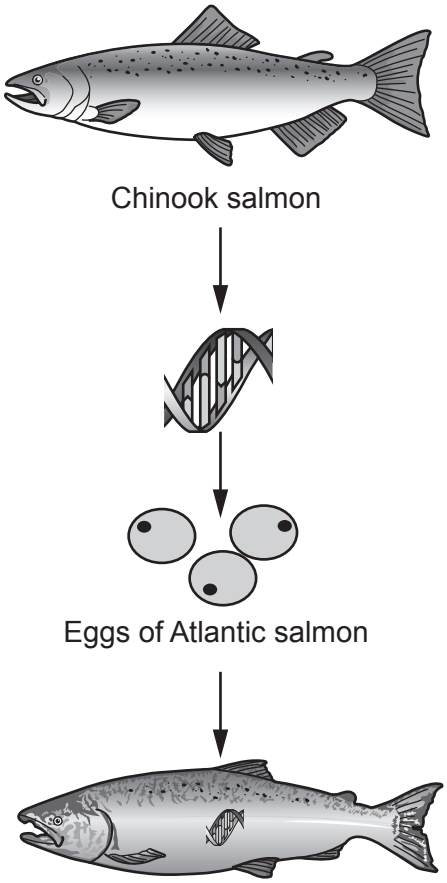
(c) Scientists are using genetic engineering to increase the mass of Atlantic salmon produced by aquaculture.
Chinook salmon are fish that grow fast.

The diagram shows how scientists are producing genetically engineered Atlantic salmon.



(i) Describe how scientists can increase the mass of Atlantic salmon using genetic engineering.

.....

.....

.....

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

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(ii) In 2020 some salmon escaped into the sea from a tank used in aquaculture.

Suggest why this problem makes some people concerned about producing genetically engineered salmon.

.....

.....

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

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22 **(a)** Complete each sentence about decomposition.

Decomposition is caused by microorganisms such as ..... .

The microorganisms use the process of ..... to release the energy in dead organisms.

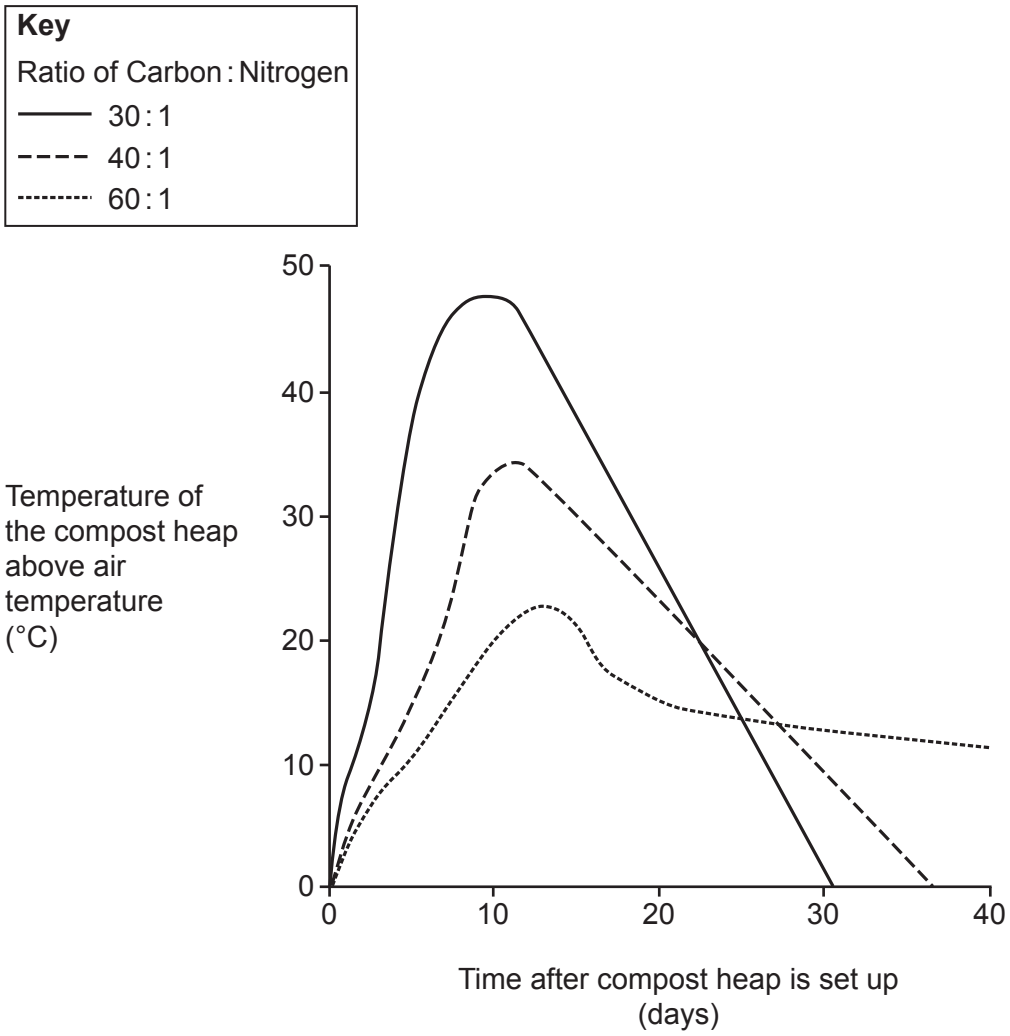
Decomposition also allows minerals to be ..... in nature for plants to use.

[3]

(b) Some students investigate plant decomposition.
They put three different plant wastes into compost heaps.
Each type of plant waste contains different ratios of carbon to nitrogen.

They measure the rate of decomposition by measuring the temperature in the compost.

The graph shows their results.



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(i) The pupils used the temperature of the compost heap as a measure of the rate of decomposition.

Which statement explains why they could do this?

Tick (✓) **one** box.

- Carbon dioxide contains more energy than oxygen. ☐
- Decomposition involves an endothermic reaction. ☐
- Microorganisms give off heat when they decompose waste. ☐
- Mineral salts will increase the temperature of the compost. ☐

[1]

(ii) Which statement describes the results of the investigation?

Tick (✓) **one** box.

- High levels of carbon results in faster decomposition. ☐
- If the carbon : nitrogen ratio is higher, then decomposition is faster. ☐
- Low levels of nitrogen result in faster decomposition. ☐
- The higher the nitrogen content compared to carbon, the faster the rate of decomposition. ☐

[1]

(iii) Give **one** abiotic factor that the students should keep constant in their experiment.

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

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(c) The table shows the mass of carbon and nitrogen in different plant materials.

Plant material	**Mass of carbon per kg (g)**	**Mass of nitrogen per kg (g)**
Fruit waste	14	0.350
Horse manure	18	0.600
Straw	9	0.015

Which plant material would decompose the **fastest**?

Explain your answer using calculations and the graph in **(b)**.

Plant material .....

Reason .....

.....

.....

[3]

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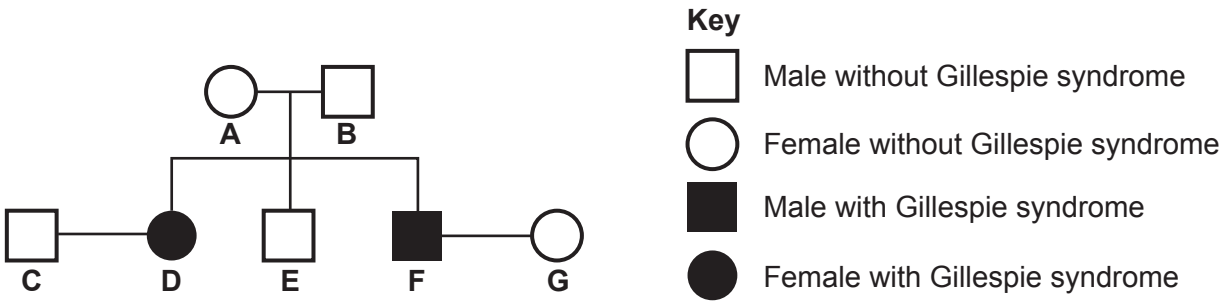
23 Gillespie syndrome is a rare genetic disorder.
People with Gillespie syndrome have eyes with no iris and damage to their cerebellum.

Fig. 23.1 shows the inheritance of Gillespie syndrome in a family.

Fig. 23.1



(a) A doctor makes this statement:
The allele causing Gillespie syndrome in this family is recessive.

Explain why this statement is correct. Use evidence from **Fig. 23.1**.

.....

.....

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

(b) Person **A** and person **B** are expecting another baby.

Complete **Fig. 23.2** to find the probability that it will have Gillespie syndrome.

(Use G for the dominant allele and g for the recessive allele.)

Fig. 23.2

		Person **B**	
Person **A**			

Probability = ...
[3]

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(c) Person **D** is very sensitive to bright light and has difficulty controlling their balance.

Explain why this is.

.....

.....

.....

.....

.....

..... **[4]**

END OF QUESTION PAPER

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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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