OCR
Oxford Cambridge and RSA

Friday 7 June 2024 – Afternoon

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

J247/04 (Higher 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

H

* J 2 4 7 0 4 *

* 9 9 8 5 7 3 2 4 2 8 *

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 the 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.

Section A

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

Write your answer to each question in the box provided.

1 Which row shows correct abiotic and biotic factors?

	Abiotic	Biotic
A	food	light intensity
B	food	predators
C	pH of soil	predators
D	temperature	light intensity

Your answer ☐ **[1]**

2 Which process can make new alleles?

A Evolution

B Mutation

C Selective breeding

D Specialisation

Your answer ☐ **[1]**

3 All the living organisms and the place where they live is called …

A A community

B A habitat

C A population

D An ecosystem

Your answer ☐ **[1]**

4 Which processes in the carbon cycle return carbon to the atmosphere?

A Decomposition and photosynthesis

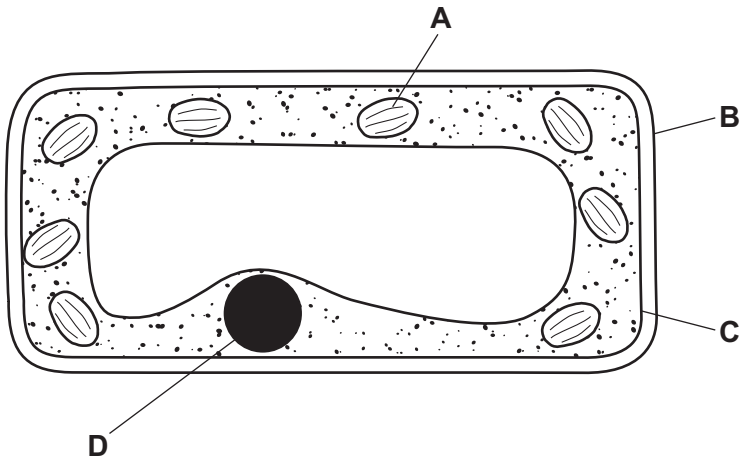
B Decomposition and respiration

C Photosynthesis and fossilisation

D Respiration and fossilisation

Your answer ☐ **[1]**

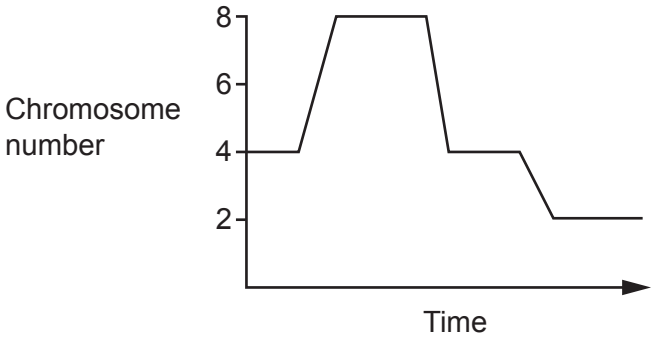
5 The diagram shows a labelled plant cell.



Which part of the plant cell gives **physical** protection against disease?

Your answer ☐ **[1]**

6 The graph shows the changes in chromosome number in a cell during meiosis.



What is the diploid number of chromosomes for this cell?

A 2

B 4

C 6

D 8

Your answer ☐ **[1]**

7 A gene controlling a characteristic has two possible alleles, **A** and **a**. **A** is the dominant allele.

One person is **Aa** and another person is **AA** for this gene.

Which statement correctly describes both people?

A They have different genomes but the same genotype.

B They have different phenotypes but the same genotype for this characteristic.

C They have the same genome but different genotypes.

D They have the same phenotype but different genotypes for this characteristic.

Your answer ☐ **[1]**

8 What is the advantage of sampling using a transect line rather than using random sampling?

A A transect allows changes in the size of populations over time to be seen.

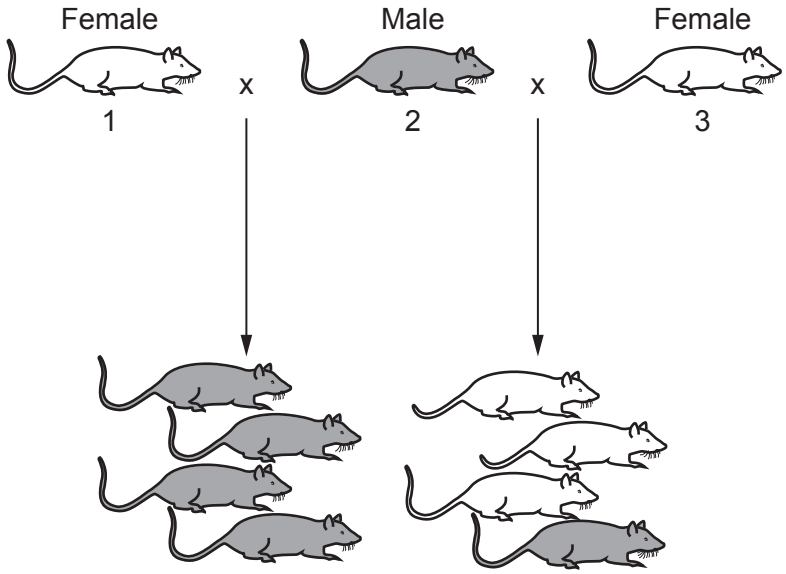
B A transect allows patterns in the distribution of organisms to be seen.

C A transect avoids areas which may contain few organisms.

D A transect gives a more accurate estimate of the population.

Your answer ☐ **[1]**

9 The diagram shows the results of two different crosses of rats.



Which is a possible explanation of the results of these crosses?

A Grey is dominant. Rat 2 is heterozygous.

B Grey is dominant. Rat 2 is homozygous dominant.

C White is dominant. Rat 1 is homozygous dominant.

D White is dominant. Rat 2 is heterozygous.

Your answer ☐ **[1]**

10 All types of white blood cell contain a nucleus.

Which function of white blood cells does **not** require a nucleus?

A Changing shape to squeeze out of capillaries

B Dividing by mitosis after detecting a pathogen

C Producing antibodies which are made of proteins

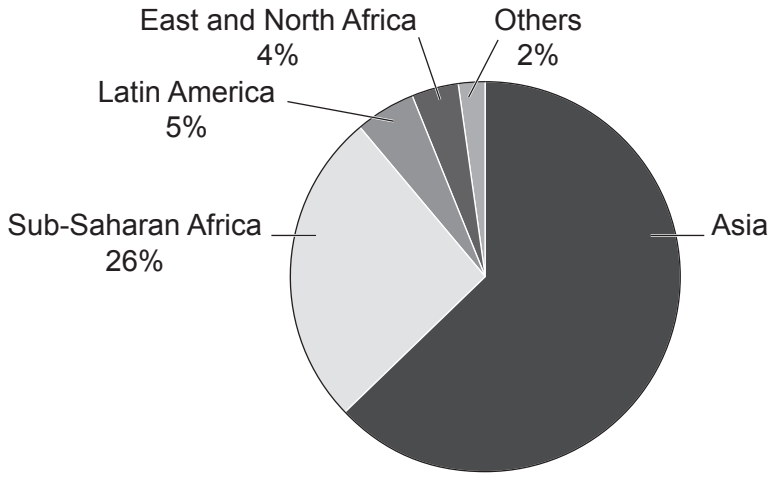
D Producing enzymes to digest pathogens

Your answer ☐ **[1]**

11 Lack of food security can lead to people being undernourished.

1×10^9 people in the world are undernourished.

The pie chart shows the percentage of undernourished people found in different parts of the world.



How many people are undernourished in Asia?

A 1.75×10^8

B 6.3×10^8

C 1.75×10^9

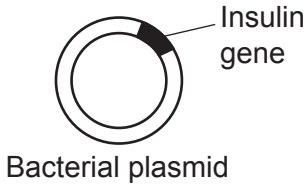
D 63×10^9

Your answer ☐ **[1]**

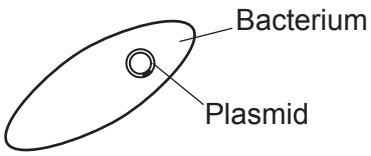
12 Bacteria can be genetically engineered to make human insulin.

The diagrams show four stages in this process.

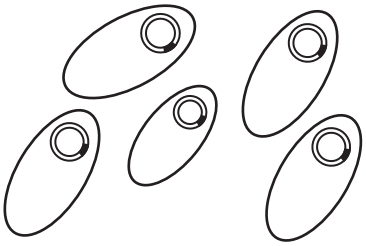
P



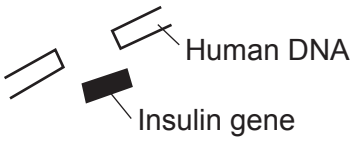
Q



R



S



What is the order of these processes in insulin production?

A P, S, Q, R

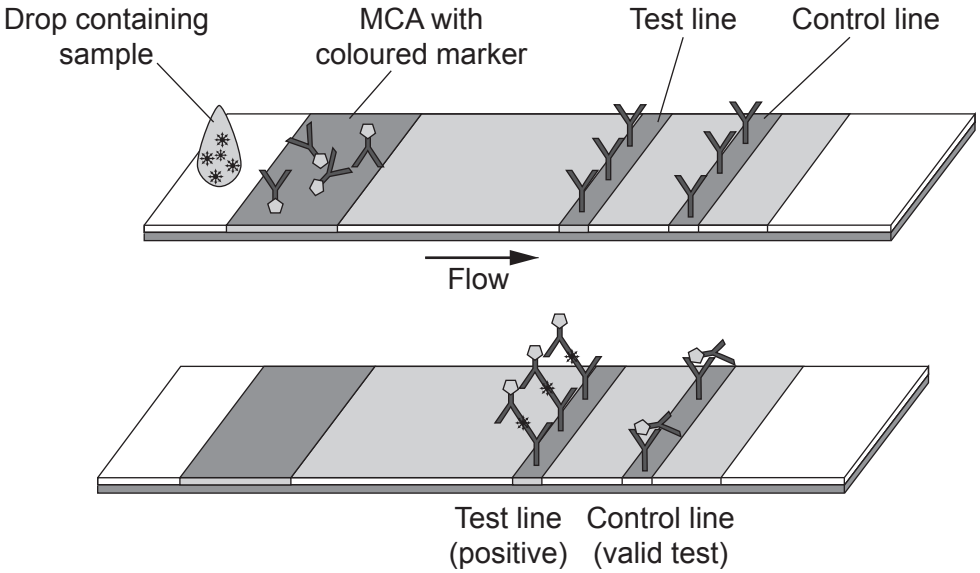
B R, Q, P, S

C R, Q, S, P

D S, P, Q, R

Your answer ☐ **[1]**

13 The diagram shows how monoclonal antibodies (MCA) are used in a test to detect pathogens.



Which statement describes how the tests work?

A MCA carry the antigens along to bind with other antibodies on the test line.

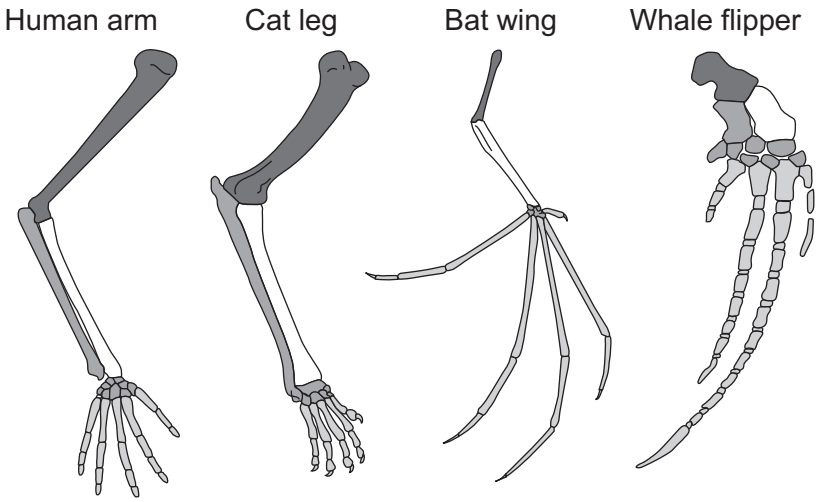
B MCA have antibiotics attached that combine with both the test and control antibodies.

C The coloured marker combines with antigens and with antibodies on the test line.

D The drop contains antibodies that get carried along by the MCA.

Your answer ☐ **[1]**

14 Why are the different structures of these limbs evidence for evolution?



A Differences in the limb bones show that humans, cats and bats evolved from whales.

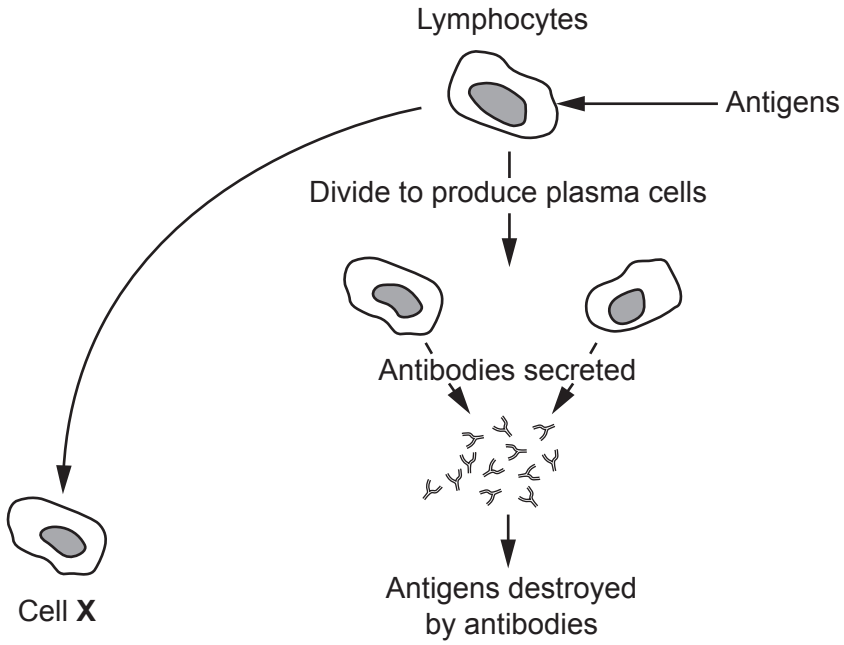
B Evolution is a random process producing similar structures for different functions.

C The limbs have a similar structure as the organisms all shared a common ancestor.

D The limbs have all evolved from a common ancestor to perform the same function.

Your answer ☐ **[1]**

15 The diagram shows how lymphocytes in the immune system respond to antigens.



What is the function of cell **X**?

A Cell **X** will live for many years and engulf foreign bacteria and viruses.

B Cell **X** will produce antibodies that will destroy plasma cells.

C Cell **X** will respond rapidly if the antigen reinfects the body again.

D Cell **X** will respond to antigens from different pathogens.

Your answer ☐ **[1]**

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Section B

16 The St Lucia racer is the rarest snake in the world.

The snake lives on the island of St Lucia. The diagram shows a food web from St Lucia.

(a) How many secondary consumers are in this food web?

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

(b) Mongooses are described as both **predators** and **competitors** of St Lucia racers.

Explain why.

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.....

.....

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

(c) Biomass is lost as it passes through this food web.

Put a (ring) around **two** ways that biomass is lost from this food web.

egestion **growth** **photosynthesis** **respiration**

[1]

(d) Mongooses were introduced into St Lucia by farmers to control pests in their fields.

(i) Which term describes this type of pest control?

Tick (✓) **one** box.

Abiotic control ☐

Biological control ☐

Chemical control ☐

Genetic control ☐

[1]

(ii) The mongooses soon spread throughout St Lucia.

- Female mongooses can breed 3 times each year and produce 3 babies each time.
- The St Lucia racer lays about 5 eggs each year.

Explain why the mongooses almost made the snake extinct.

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

(e) By 1973 the St Lucia racers were thought to be extinct but a small number were found on a small island off the coast of St Lucia.

There was a plan to build a bridge to allow tourists to visit the island.

(i) Suggest why these snakes have survived on the island.

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

(ii) Suggest why scientists are against the plan to build the bridge.

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

17 Antibiotics and antiseptics are both used to kill bacteria.

(a) Which is a correct statement about antiseptics and antibiotics?

Tick (✓) **one** box.

Antibiotics are not used inside the body, but antiseptics are. ☐

Antibiotics are used inside the body, but antiseptics are not. ☐

Antibiotics are used on living tissue and antiseptics on non-living tissue. ☐

Antibiotics are used on non-living tissue and antiseptics on living tissue. ☐

[1]

(b) Disinfectants also kill bacteria.

Some students do an experiment to see how well four different disinfectants (**A**, **B**, **C** and **D**) kill bacteria.

This is the method they use:

- Mix 2 cm^3 of each disinfectant solution with liquid nutrient agar.
- Pour each of the mixtures into separate Petri dishes and allow to set.
- Spread bacteria on the surface of the agar.
- Put each Petri dish in an incubator.

(i) Describe how the students should spread bacteria on the surface of the agar.

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

(ii) The students' teacher told them **not** to seal the lid on the Petri dishes all the way round with tape.

Explain why.

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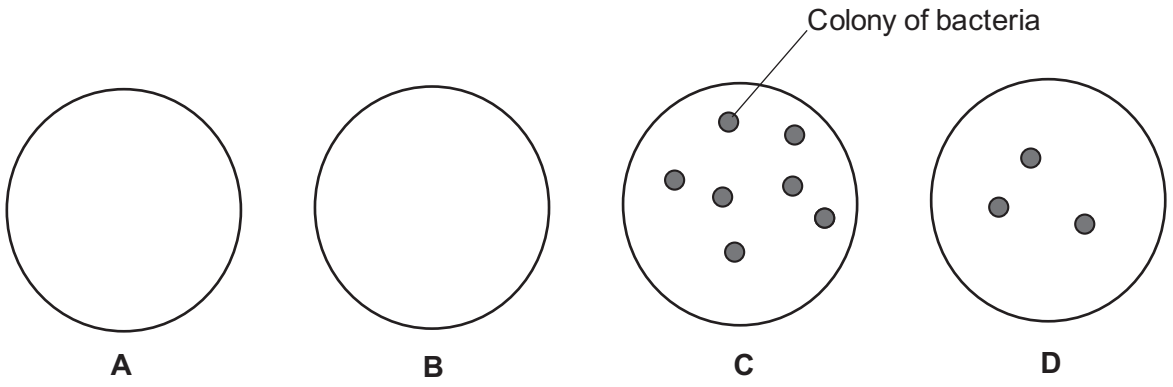
..... **[2]**

(c) The diagrams show the Petri dishes after 3 days.



(i) Explain **two** conclusions the students can make about disinfectants **B**, **C** and **D** from these results.

1 .....

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2 .....

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[2]

(ii) One of the students said that disinfectant **A** is equally effective at killing bacteria as disinfectant **B**.

Explain how the students could improve their experiment to test if that is true.

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

18 In many areas, the number of elephants living in Africa is decreasing. They are often killed by hunters.

The table shows how the number of elephants in Africa has changed.

Year	**1979**	**1989**	**2015**
Population size	1.3 million	600 000	400 000

(a) Calculate the percentage decrease in the population size between 1979 and 2015.

Give your answer to **2** significant figures.

Percentage decrease = ... % **[3]**

(b) What is the best description for how the population of elephants changed between 1979 and 2015?

Tick (✓) **one** box.

Dropping at a decreasing rate ☐

Dropping at a steady rate ☐

Dropping at an increasing rate ☐

[1]

(c) In some areas of southern Africa, elephants are very important for ecotourism.

(i) Explain what is meant by the term **ecotourism**.

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

(ii) In ecotourism areas, elephant numbers are increasing.

This is causing problems as the elephants are eating crops.

Scientists therefore want to control the population size.

They have used three main ways to do this:

- **Culling** – a certain number of elephants from each population are killed.
- **Relocation** – elephants are moved to a country where their numbers have dropped.
- **Contraception** – female elephants are treated to reduce their fertility.

Suggest **one** disadvantage for each of these methods.

Culling .....

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Relocation .....

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Contraception .....

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[3]

(iii) Scientists are using a new method of contraception to try and restrict the numbers of elephants.

This involves injecting antibodies which block the sperm receptor sites on eggs.

Describe **one** way that this method is different to the contraceptive pill used by female humans.

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

(d)* In East Africa, elephants are hunted for their tusks.

Scientists have found that:

- occasionally female elephants are born without tusks,
- the absence of tusks is caused by a mutated dominant allele,
- the allele for an absence of tusks is lethal if inherited by a male embryo.

Explain why the number of tuskless elephants is rapidly increasing in East Africa.

Explain also why the spread of this allele may have negative effects on the elephant population.

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

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19 Mistletoe is a green plant that is often seen growing high in a tree in winter.

Mistletoe can photosynthesise, but not at a very fast rate.

It therefore needs to act as a parasite on the tree.

(a) Put a (ring) around the term used to describe the **tree** in this relationship with the mistletoe.

competitor **host** **mutualistic partner** **prey**

[1]

(b) Explain why the mistletoe grows into the phloem of the tree.

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

(c) Scientists investigate two different species of mistletoe growing on a tree. One species of mistletoe has greener leaves than the other.

They give the tree carbon dioxide which contains radioactive carbon.

The carbon dioxide is not supplied to the mistletoe.

They then measure:

- the chlorophyll content of the mistletoe plants,
- the percentage of sugar that is radioactive in each type of mistletoe.

The table shows their results.

Species of mistletoe	**Chlorophyll content in mg / g of tissue**	**Percentage of sugar in the mistletoe that is radioactive (%)**
Dwarf mistletoe	0.4	39
Eastern mistletoe	0.9	1

(i) Explain why sugar in the mistletoe becomes radioactive.

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

(ii) Explain the relationship between the chlorophyll content and the percentage of radioactive sugar in each species of mistletoe.

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

20 Bacteria are found in milk.

They can cause the milk to decompose.

Enzymes from the bacteria convert sugar in the milk into lactic acid.

Some students investigate the effect of temperature on the decomposition of milk.

This is the method the students use:

- Pour 20 cm^3 of milk into 3 different beakers.
- Keep each beaker in a water bath at a different temperature: 15 °C, 25 °C and 35 °C.
- Measure the pH of the milk at different times over 4 days.

The table shows their results.

	pH of milk				
Temperature (°C)	at the start	after 12 hours	after 24 hours	after 48 hours	after 72 hours
15	6.5	6.4	6.3	6.1	5.8
25	6.5	6.3	6.2	5.9	5.5
35	6.5	6.3	6.1	5.5	4.9

(a) Explain why the students measured the pH of the milk.

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

(b) Describe how the students should display their results in a graph.

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

(c) Explain the effect of increasing the temperature on the decomposition of the milk in the experiment.

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

(d) The students plan a further experiment where they boil the milk first before placing it in the beaker.

Predict what effect this would have on the results.

Explain your answer.

Prediction .....

.....

Explanation .....

.....

.....

[2]

21 Acrylamide is a chemical that is formed when bread is toasted.

(a) Experiments have shown that significant doses of acrylamide can cause cancer in animals.

(i) Describe the effects of cancer on cells.

.....

.....

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

(ii) Some scientists concluded that, 'acrylamide could also cause cancer in humans'.

Other scientists are **not** sure about the effect of acrylamide on humans, despite the results of the animal experiments.

Suggest **one** reason why.

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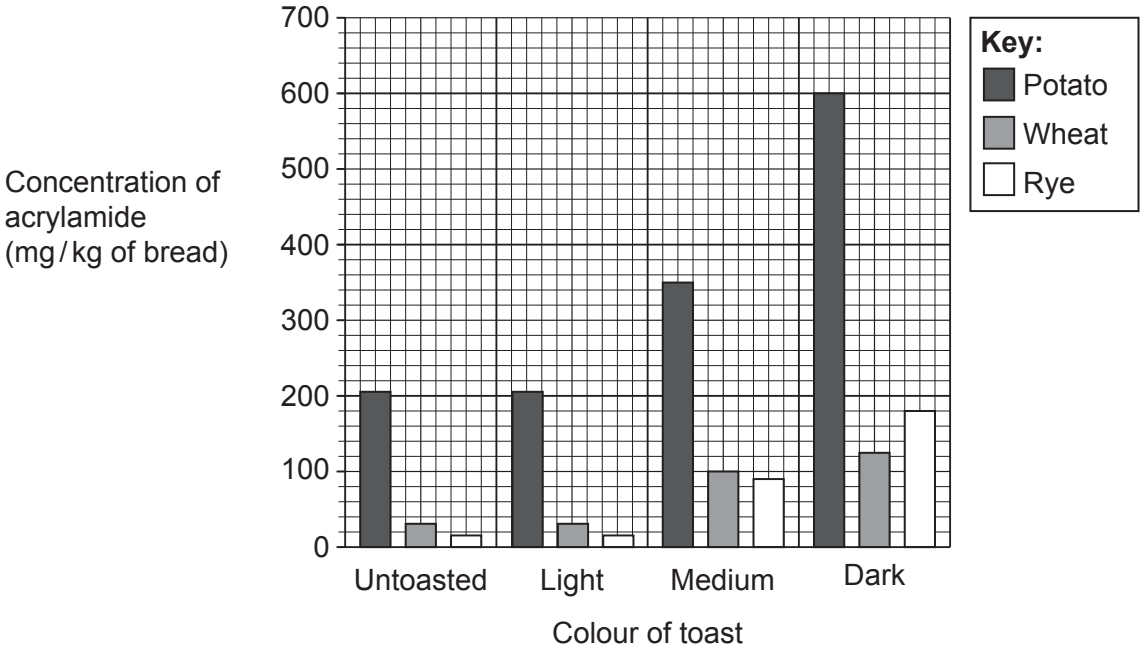
..... **[1]**

(b) Scientists measured the concentration of acrylamide in toast made from three different types of bread: potato, wheat and rye.

They heated the bread for different lengths of time to get different colours of toast.



(i) Give **two** conclusions that the scientists could make from their investigation.

1 .....

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2 .....

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[2]

(ii) The daily recommended maximum intake for acrylamide is 195 mg.

A slice of toast has a mass of 50 g.

A person eats toast that is dark and made from potato bread.

Calculate the maximum number of **whole** slices of toast the person can eat without exceeding the recommended maximum intake.

Use the graph.

Number of whole slices = ... **[3]**

(iii) Give **one** reason why another group of scientists would find it difficult to replicate the experiment using just the information in the graph.

.....

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

(c) During toasting, acrylamide is made from a chemical called asparagine.

Asparagine is produced in plant cells by an enzyme called asparagine synthetase.

The gene coding for asparagine synthetase needs to be switched on by other proteins.

(i) Complete these sentences about how genes are expressed.

Use words from the list.

coding DNA	**denaturing**	**non-coding DNA**
nucleus	**ribosomes**	**transcription**
translation	**tRNA**	

Gene expression can be switched on by the action of other proteins on ..... .

When a gene is expressed, ... occurs which makes mRNA.

The mRNA then moves to the ..... .

Proteins, such as asparagine synthetase are then made by the process of ..... .

[4]

(ii) Scientists want to produce a variety of wheat that contains less asparagine.

This is done by preventing expression of the gene that codes for asparagine synthetase.

Describe the difference between this process and genetic engineering.

.....

.....

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

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22 The table shows some details of three genetic diseases that can affect humans.

Disease	Cause	Number of UK cases	Effect
Huntington's	a dominant allele	12 in 100 000 people	The mutation produces a protein that stops the cerebrum communicating with the spinal cord.
Muscular dystrophy (MD)	a recessive allele	1 in 4 000 males	The mutation prevents a muscle protein being made.
Spinal muscular atrophy (SMA)	a recessive allele	1 in 10 000 people	The mutation prevents a protein being made that is needed for motor neurones to work.

(a) There are 66 million people in the UK.

Calculate the number of cases of Huntington's disease in the UK.

Number of cases = ... **[2]**

(b) All three diseases affect proteins in different parts of the body.

Explain why each of these diseases cause difficulty in moving the legs.

Huntington's .....

.....

MD .....

.....

SMA .....

.....

[3]

(c) Suggest why the mutation that causes Huntington's is dominant but the mutation that causes MD and SMA is recessive.

Use the information in the **effect** column of the table.

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.....

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

(d) Scientists are trying to develop treatments for Huntington's using stem cells to replace cells damaged by the protein.

Describe **two** risks of using stem cells to treat patients.

1 .....

.....

2 .....

.....

[2]

END OF QUESTION PAPER

EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.