

**GCSE (9–1) Biology A (Gateway Science)**  
**J247/04 Paper 4 (Higher Tier)**  
Sample Question Paper

**H**

**Date – Morning/Afternoon**

Version 2.1

Time allowed: 1 hour 45 minutes



**You may use:**

- a scientific or graphical calculator
- a ruler



<b>First name</b>					
<b>Last name</b>					
<b>Centre number</b>					
<b>Candidate number</b>					

**INSTRUCTIONS**

- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

**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 consists of **28** pages.

**SECTION A**

Answer **all** the questions.

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

- 1** Different diseases are caused by different pathogens.

Which row in the table shows the type of pathogen that causes each disease?

	<b>HIV/AIDS</b>	<b>Tobacco Mosaic Disease</b>
<b>A</b>	virus	virus
<b>B</b>	bacterium	virus
<b>C</b>	bacterium	fungus
<b>D</b>	virus	fungus

Your answer

**[1]**

- 2** Which of these examples of human defence mechanisms against disease is non-specific?

- A** antibodies in the blood system
- B** memory cells
- C** hydrochloric acid in the stomach
- D** lymphocytes

Your answer

**[1]**

3 New medicines are tested before they can be used.

There are people that object to some forms of testing.

Which form of testing is likely to cause the **least** objection?

- A animal testing
- B computer simulation testing
- C human tissue testing
- D microbial testing

Your answer

[1]

4 There are different levels of organisation within an ecosystem.

What is the correct order of these levels?

- A individual, community, population, ecosystem
- B community, individual, ecosystem, population
- C individual, population, community, ecosystem
- D population, community, ecosystem, individual

Your answer

[1]

- 5 Eva investigates the number of daisy plants growing on the school playing field. She uses a quadrat to count the number of daisy plants growing in different areas of the field.

The table shows her results.

quadrat	number of daisy plants
1	8
2	2
3	7
4	5

Each quadrat has an area of  $0.25\text{m}^2$ .

The school playing field has an area of  $15000\text{m}^2$ .

Estimate the population of daisy plants growing on the school field.

- A 682  
 B 82500  
 C 330000  
 D 1320000

Your answer

[1]

- 6 Look at the information about a food chain.

Organism	Number	Biomass
Oak tree	1	500,000
Aphids	10,000	1,000
Ladybirds	200	50

Calculate the percentage biomass of the aphids transferred to the ladybirds.

- A 0.05%  
 B 20%  
 C 5%  
 D 2000%

Your answer

[1]

- 7 Palm oil is used in the manufacture of biscuits, crisps, cereals and many other processed foods.

Palm oil production has a negative effect on the environment.

Which statement identifies a **negative** effect of palm oil production?

- A Palm oil plantations are found in countries with tropical rainforest.
- B Palm oil production has increased due to the demand for more processed food.
- C Palm oil plantations support a low biodiversity.
- D Palm oil production provides jobs for the local community.

Your answer

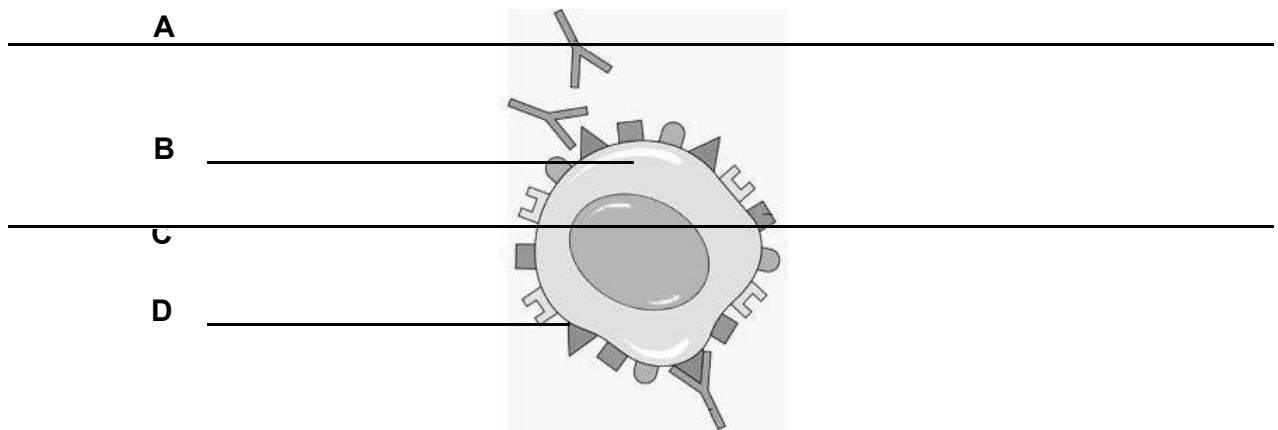
[1]

- 8 Monoclonal antibodies can be used to treat some kinds of cancer.

Look at the diagram of a cancer cell.

It is being treated using monoclonal antibodies.

Which label, **A, B, C or D**, shows the monoclonal antibodies?



Your answer

[1]

9 Stem cells are used in treating some medical conditions because they:

- A are unspecialised
- B bind to and immobilise pathogens
- C destroy cancer cells
- D differentiate into many different types of cell.

Your answer

[1]

10 A mouse has a diploid chromosome number of 40.

Which row in the table shows the correct number of chromosomes in each cell?

	Number of chromosomes in	
	a mouse egg cell	a mouse eye cell
<b>A</b>	40	40
<b>B</b>	20	20
<b>C</b>	20	40
<b>D</b>	40	20

Your answer

[1]

11 Scientists have tested the genes of a number of people who have diabetes.

They have found that there are about four different versions of a gene that can cause diabetes.

Why might this discovery be important?

- A Diabetes cannot be treated at the current time.
- B Different patients with diabetes can be given different drugs.
- C All types of diabetes can be treated by changing the diet.
- D Glucagon injections will be able to treat these four types of diabetes.

Your answer

[1]

**12** FOP is a disorder that causes soft tissue in the body to turn to bone.

It is caused by a dominant allele.

People who have this condition are often infertile.

Natural selection predicts that the number of children born with the condition will go down.

Which explanation can explain why the number of people with FOP is staying constant?

- A** The allele is being produced regularly by mutation.
- B** Dominant alleles can remain hidden for generations.
- C** The allele may increase the rate of meiosis.
- D** The allele has no effect on a person's phenotype.

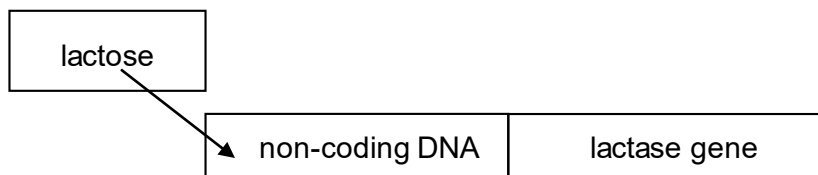
Your answer

**[1]**

**13** Bacteria can produce an enzyme called lactase which digests lactose.

The enzyme is only made when lactose is present.

This is because there is a non-coding area of DNA which switches the lactase gene on.



Bacteria can have a mutation in the non-coding DNA.

What is a possible effect of such a mutation?

- A** Lactase cannot be made even if lactose is present.
- B** Lactase is made but will have a different order of amino acids.
- C** Lactase is made but it will be the wrong shape to digest lactose.
- D** Lactose is made rather than lactase.

Your answer

**[1]**

**14** Bacteria are used in genetic engineering.

A plasmid is used to transfer the required DNA into the bacterium.

What is the term used to describe role of the plasmid in this technology?

- A** enzyme
- B** host
- C** transgenic
- D** vector

Your answer

[1]

**15** Some plants have been genetically engineered so that they grow larger.

Each cell of the plant has a new gene inserted so that it produces a different protein.

What does genetic engineering do to the plant?

- A** It changes the phenotype and the genotype.
- B** It changes the genotype but not the phenotype.
- C** It changes the phenotype but not the genotype.
- D** It changes neither the genotype nor the phenotype.

Your answer

[1]



**SECTION B**

Answer **all** the questions.

**16** Some students are investigating lichens.

Lichens are often studied because they are sensitive to pollution.

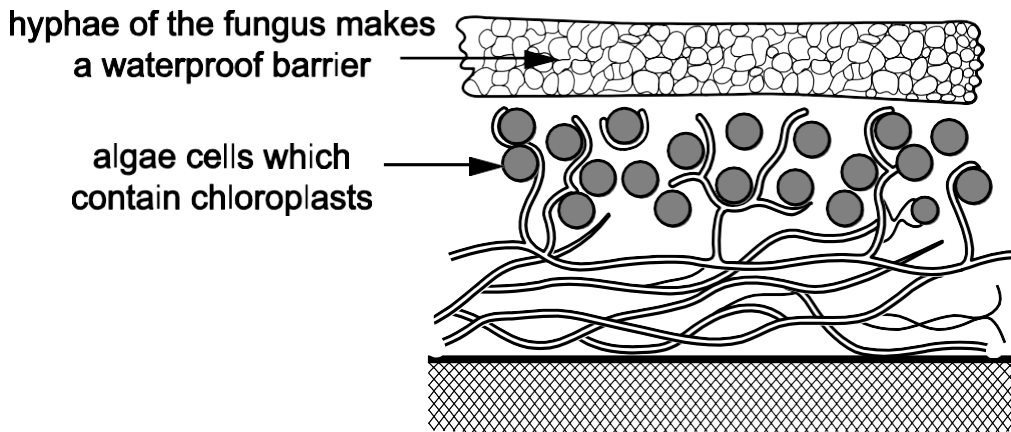
**(a)** Lichens are made up of two different organisms: a fungi and algae.

Both the fungus and the algae gain from living together.

What biological name is given to a relationship where both organisms gain?

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

**(b)** The students find a diagram of a lichen.



Using the information from the diagram suggest what the algae and fungi each gain from their relationship.

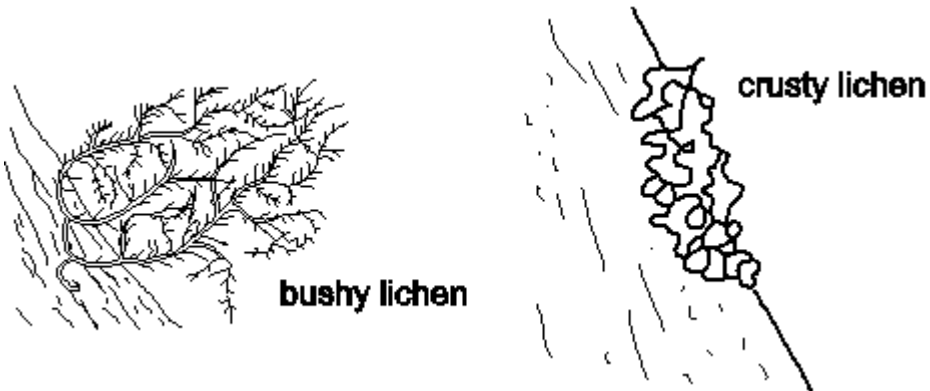
algae.....

.....

fungus.....

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

- (c) Lichens are sensitive to pollution because they take up chemicals from the air.  
The diagram shows a 'bushy' species of lichen and a 'crusty' species of lichen.



Bushy lichens are usually more sensitive to pollution than crusty lichens.

Use the diagrams to suggest why.

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

- (d) The students decide to use lichens to try and work out how polluted their school grounds are.

They read about a scale called the Lichen Diversity Value (LDV).

It is worked out in this way:

- choose four trees in the area
- hold a quadrat on the north side of the trunk of one tree
- count the total number of all the lichens in the quadrat
- then do this on the east, south and west side of the tree
- repeat this for each tree.

- (i) Suggest how the students could choose four trees.

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

(ii) The students put their results into a table.

Number of individual lichens found in each quadrat				
Tree number	North	East	South	West
1	3	11	18	7
2	4	12	17	8
3	5	10	15	12
4	4	15	12	9
mean	4.0	12.0	15.5	

The LDV is found by adding together the four mean values.

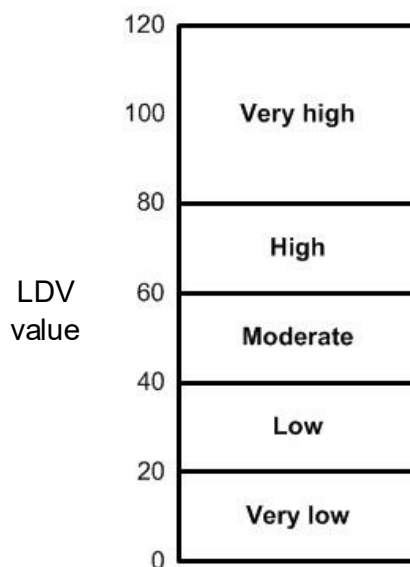
The students calculate the mean number of lichens on the north, east and south sides of the trees.

Calculate the mean for the west side and use this to calculate the LDV.

LDV = .....

[2]

(iii) This scale shows the diversity of the lichens shown by the LDV.



What does the LDV show about the diversity of lichens in the school grounds?

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

(iv) LDV is calculated by counting all the lichens present.

What else about the lichens could the students look for to make a better assessment of pollution?

.....

.....

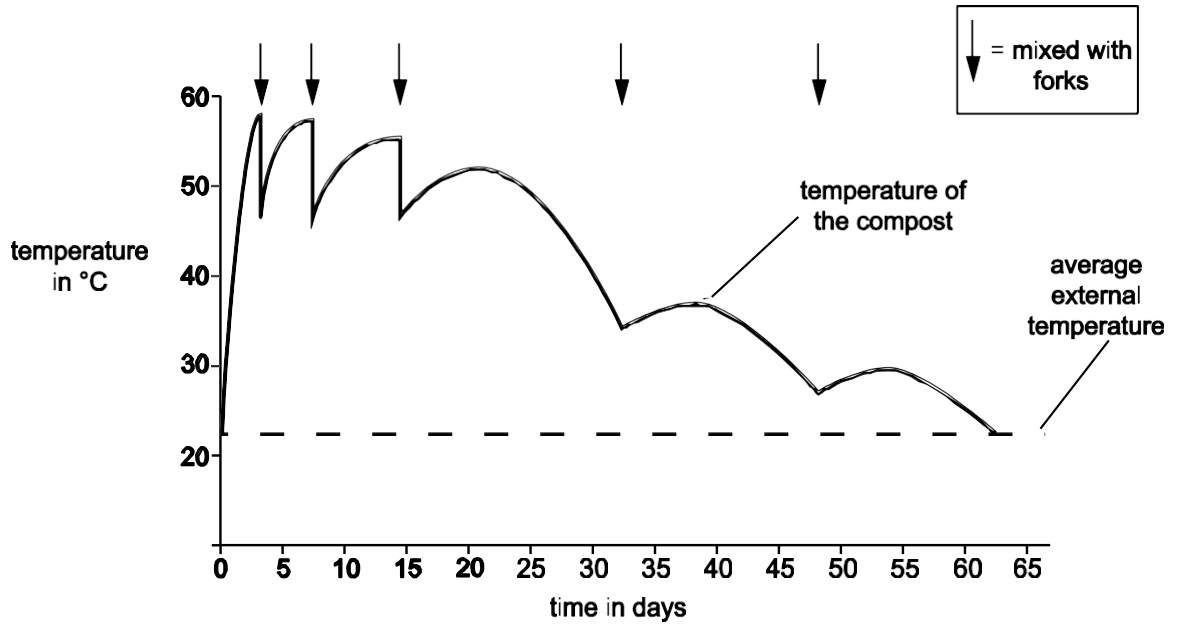
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..... **[3]**

17 Some students measured the temperature inside a compost heap. They also measured the external temperature. On five occasions they mixed up the compost heap with garden forks. The graph shows their results.



(a) (i) The compost took 63 days to completely decompose.

Explain how the students could tell this from their graph.

.....

.....

..... [1]

(ii) The rate of temperature increase is greatest before the compost is mixed for the first time.

Explain how the rate of temperature change can be calculated.

.....

.....

..... [1]

**(b)** Compost decomposes more slowly above 60°C or below 30°C.

Use ideas about enzymes and decomposition to explain why this is.

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

**(c)** Use the graph to describe how the forking helps to provide the best temperature for decomposition.

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

18 Erythromycin is an antibiotic drug.

(a) What is an antibiotic?

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

(b) It is important to get the dose of erythromycin right.

Too much erythromycin can be harmful.

However, recently some strains of bacteria have developed resistance to low concentrations of erythromycin.

To see how effective erythromycin is, it is tested using bacteria grown on agar plates.

This method is used:

- A petri dish is used that has the bacteria growing evenly over the surface.
- A disc of filter paper is soaked in erythromycin.
- The disc is placed on the agar in the centre of the petri dish using sterile forceps.
- The dish is incubated at 37°C.

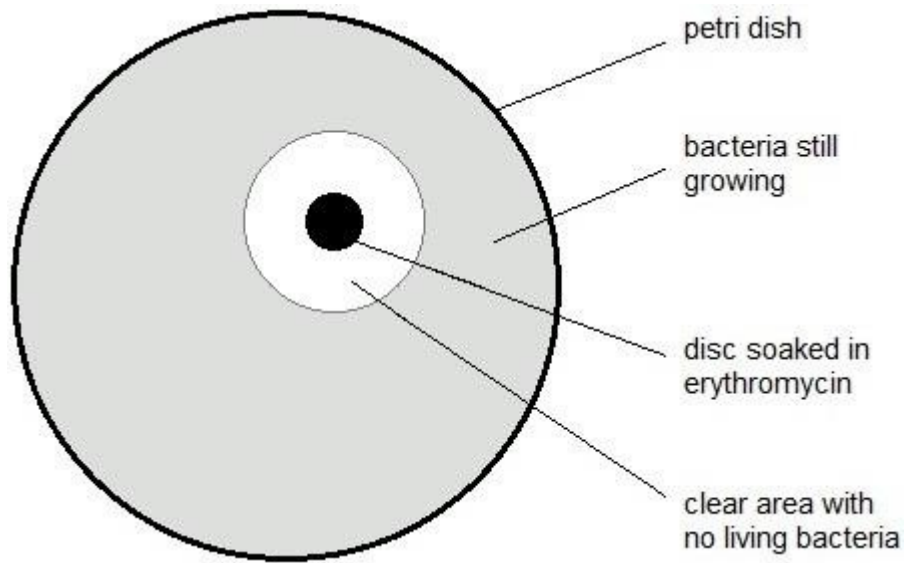
(i) Why did the scientists incubate the dish at 37°C rather than at higher or lower temperature?

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

(ii) Why is the filter paper disc moved using sterile forceps?

..... [1]

(c) (i) The diagram shows the actual size of the dish after incubation.



This table is used to analyse the results of the experiment.

Area clear of bacteria including the area of the disc in mm <sup>2</sup>	Level of resistance
less than 133	resistant
133 to 416	intermediate resistance
more than 416	not resistant

Use the results of the experiment and the table to judge the level of resistance in this strain of bacteria. (The area of a circle =  $\pi r^2$  and  $\pi = 3.14$ .)

answer= ..... mm<sup>2</sup> [3]

(c) (ii) Suggest any limitations to measuring the level of resistance with this method.

.....

.....

..... [2]

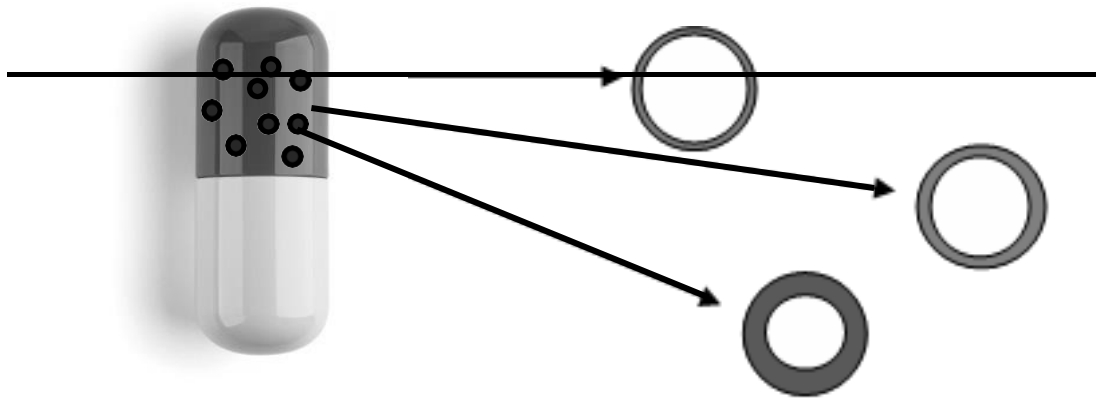


(d) Erythromycin is usually given to patients in a capsule.

The capsule has lots of small spheres containing the drug.

The walls of the spheres are different thicknesses.

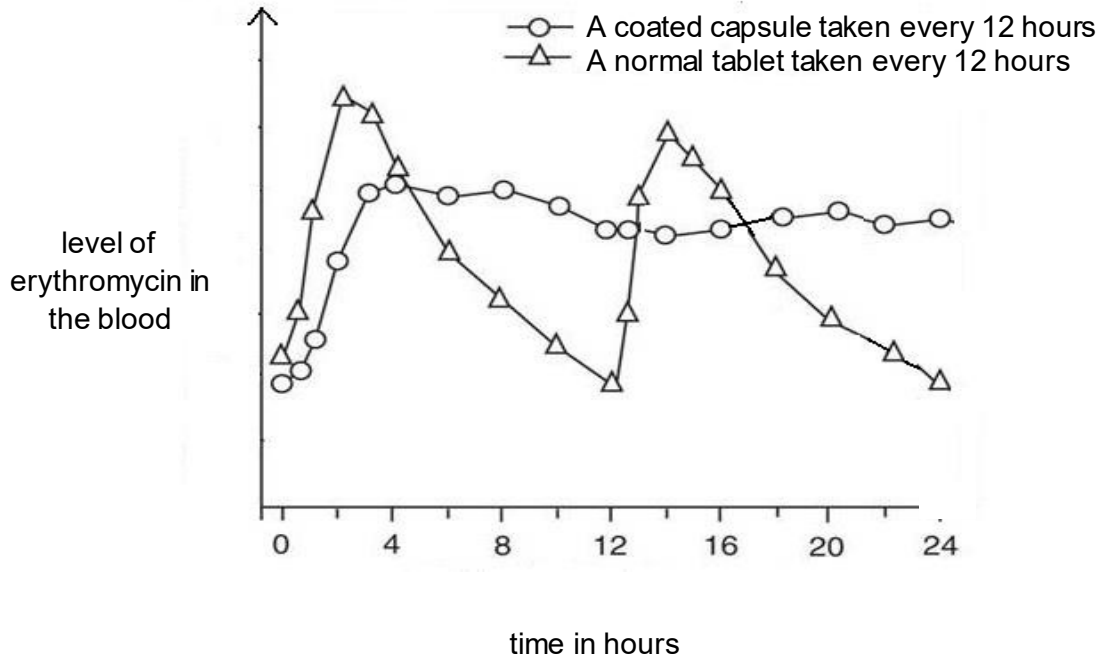
They are made of a carbohydrate polymer.



(i) Explain why the drug is released from the spheres in the small intestine.

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

- (ii)\* The graph shows the levels of erythromycin in the blood when given using this capsule and in a normal tablet.



Explain the shape of the two graphs and why it is better to give erythromycin in capsules.

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**[6]**

19 Wolfram’s Syndrome is a genetic disorder.

It is caused by a recessive allele (n).

In people with Wolfram’s syndrome, a protein does not function correctly.

(a) Explain how a change in an allele can stop a protein functioning correctly.

.....

.....

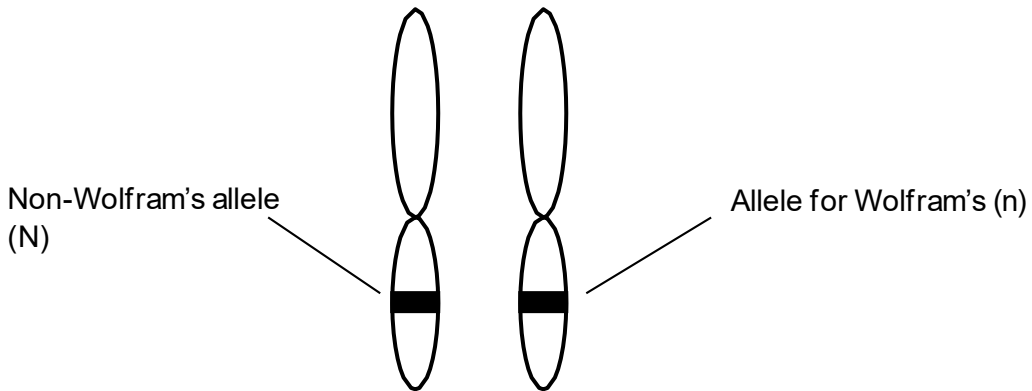
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.....

.....

**[4]**

(b) The diagram shows a pair of chromosomes from a person called Tim.



Fill in the table to show Tim’s genotype and phenotype.

Choose your answers from this list.

- does not have Wolfram’s syndrome
- has Wolfram’s syndrome
- heterozygous
- homozygous dominant
- homozygous recessive

genotype	
phenotype	

**[2]**

(c) (i) Meena is expecting a baby.

Tim is the father.

Complete this genetic diagram.

		Tim	
Meena	N		
	n		

[2]

(ii) Wolfram’s syndrome can affect the pancreas.

Meena and Tim’s doctor tells them that there is a chance that their baby will have problems controlling their blood glucose level.

Explain why the doctor thinks this.

Use information from part (c) (i) and your biological knowledge.

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[4]

**20** In many countries people rely on bananas for food.

Black sigatoka is a disease of banana plants.

It is caused by a fungus.

**(a)** Explain how the food security/growth of bananas could be improved:

**(i)** by using fungicide.

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

**(ii)** by using selective breeding.

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

- (b) Scientists have been investigating the conditions needed for the fungus to grow.

They compiled this data.

Conditions needed for fungus to grow		
	Temperature in °C	Percentage humidity (%)
Grows well	25 - 28	>90
Some growth	20 – 25 or 28 - 35	90 - 80
Will not grow	< 20 or >35	<70

Write in the boxes how well the fungus will grow in these conditions.

25 °C and a humidity of 85%	
27 °C and a humidity of 92%	

[2]

- (c) Scientists have tried to predict the effect of climate change on the growth of the fungus.

They have used four different predictions for how the climate might change, **A, B, C** and **D**.

They then tried different ways of calculating where the fungus cannot grow.

Their results are shown in the table.

Climate model	Percentage area of the world where fungus cannot grow (%)			
	1 <sup>st</sup> calculation	2 <sup>nd</sup> calculation	3 <sup>rd</sup> calculation	4 <sup>th</sup> calculation
<b>A</b>	87.6	87.9	87.7	87.8
<b>B</b>	88.4	88.6	89.0	88.8
<b>C</b>	91.1	91.5	91.4	91.3
<b>D</b>	88.4	88.9	89.5	89.2

- (i) Which climate model produces the lowest **range** of results in the four calculations? Choose from **A, B, C** or **D**.

..... [1]

- (ii) At present the fungus **cannot** grow over 86.4% of the World.

What do the calculations predict about the effect of climate change on the fungus?

..... [1]

(d) Scientists are developing a genetically engineered banana plant.

This would be resistant to black sigatoka.

Look at the newspaper headline from an African newspaper.

**Trouble at the genetic research station**

Police have been called to a research station.

They are needed to guard the genetically modified plants.

This is because people have been trying to steal the plants to grow themselves.

In Europe, police have been used to guard genetically engineered crops from protesters.

Suggest why the protesters in Europe want to destroy the crops and why the response in Africa is so different.

.....

.....

..... [2]

21 Strokes are a type of cardiovascular disease.

One cause of a stroke is an artery in the brain bursting.



(a) (i) When a person has a stroke, why are arteries more at risk of bursting than veins?

..... [1]

(ii) How are arteries adapted to try and prevent them bursting and causing a stroke?

..... [1]

(b) Strokes can have many risk factors.

Scientists are trying to investigate whether the risk of having a stroke is increased by pollution.

They looked at data from 28 different countries, involving six million people.

They looked at the number of people who had a stroke soon after an increase in pollution.

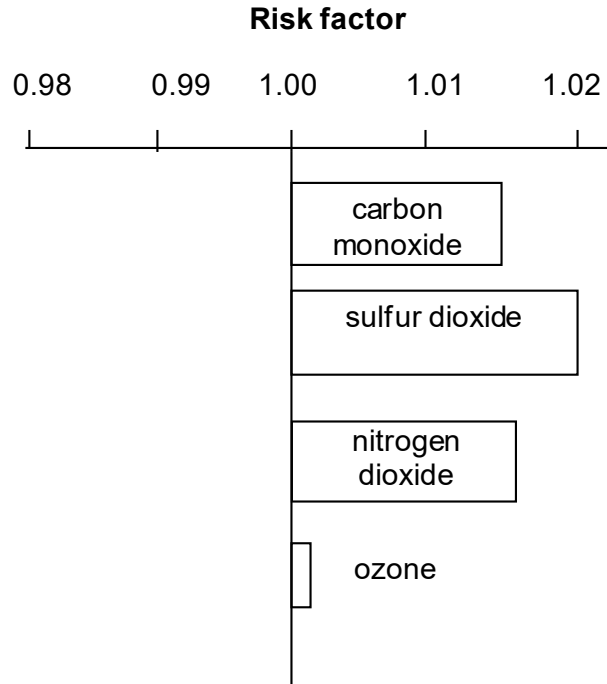
They compared this to the number of people who had a stroke after no increase in pollution.

This formula was used to produce a risk factor:

$$\text{risk factor} = \frac{\text{number of people who had a stroke soon after an increase in pollution}}{\text{number of people who had a stroke after no increase in pollution}}$$

The graph shows their results.





(i) If the risk factor for a pollutant was 1.00, what conclusion could the scientists make?

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

(ii) Which pollutant is least likely to be a risk factor for a stroke?

..... [1]

(iii) The risk factors calculated by the scientists are quite small.

However, they still think that pollution is an important factor in strokes.

How did the nature of the data they used help to convince them of this?

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

**22** The rock pocket mouse is a small grey coloured mouse that lives in Mexico.



These mice are the main food for owls.

Rattlesnakes also feed on these mice.

The mice get most of their food from grass plants and grass seeds.

**(a) (i)** How many trophic levels are there in the feeding relationships described?

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

**(ii)** Draw a labelled pyramid of biomass for these feeding relationships.

**[2]**



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