Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

S24-3430UD0-1

3430UD0-1

FRIDAY, 10 MAY 2024 – MORNING

SCIENCE (Double Award)
Unit 4 – BIOLOGY 2
HIGHER TIER

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**9**	
3.	**10**	
4.	**5**	
5.	**13**	
6.	**11**	
7.	**6**	
Total	**60**	

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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. Do not use gel pen or correction fluid.

You may use pencil for graphs and diagrams only.

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.

If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

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

Question **7** is a quality of extended response (QER) question where your writing skills will be assessed.

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Answer **all** questions

1. (a) State the meaning of the term phenotype. [1]

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(b) The ability to roll the tongue into a U–shape is controlled by a dominant allele (**T**). The recessive allele is represented by **t**.

A man heterozygous for tongue rolling has a child with a woman who is recessive for the characteristic.

(i) Use the letters given above to give the genotype of: [1]

the man .....

the woman .....

(ii) Complete the Punnett square below to show the possible genotypes of their children. [2]

(iii) Complete the following to show the **ratio** of the genotypes of the children. [1]

Homozygous dominant	:	Heterozygous	:	Homozygous recessive
.....	:	.....	:	.....

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(c) In 1952 Professor Philip Matlock investigated tongue rolling in 33 pairs of genetically **identical** twins. Professor Matlock published the data shown in **Table 1.1**.

Table 1.1

Feature	Number of pairs of identical twins
both can roll their tongues	18
neither can roll their tongues	8
one twin can roll their tongue but the other cannot.	7
Total	33

[Source: Philip Matlock, Ohio State University]

State the evidence from **Table 1.1** which suggests that tongue rolling is not controlled entirely by a gene. [1]

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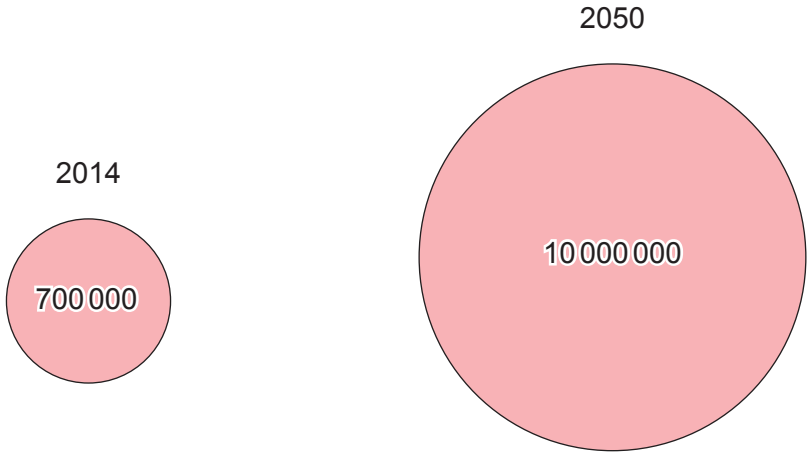
2. The term superbug is used to describe disease-causing (pathogenic) bacteria that are no longer killed by certain antibiotics. These bacteria have developed antibiotic resistance.

Image 2.1 shows the actual deaths from superbugs in the world in 2014 and the predicted deaths in 2050.

Image 2.1



[Source: United Nations]

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(a) (i) Use the equation below to calculate the percentage increase in predicted deaths from superbugs in the world between 2014 and 2050.
Give your answer to **the nearest whole number**. [3]

$$\frac{\text{number in 2050} - \text{number in 2014}}{\text{number in 2014}} \times 100$$

Percentage increase in deaths = ...

(ii) State the main reason for the increase of antibiotic resistance in some pathogenic bacteria. [1]

.....

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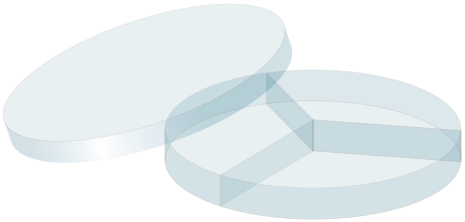
(b) Health scientists were experimenting on the effect of the antibiotic methicillin on three different species of pathogenic bacteria. They used a triple compartment Petri dish in their experiment.

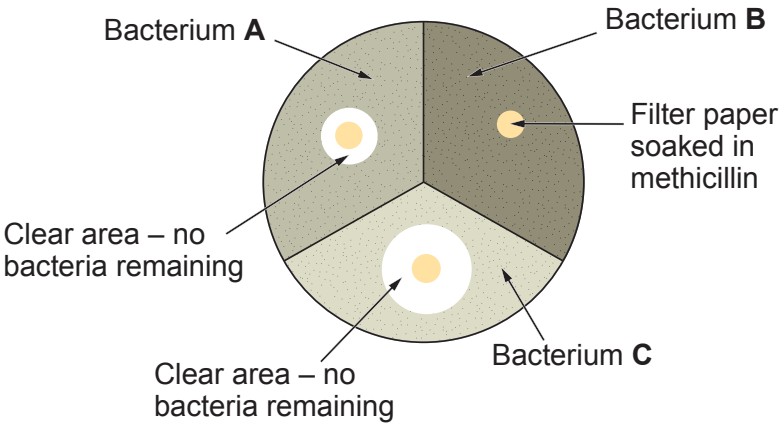


The method they used is shown below:

- Each compartment was filled with a nutrient jelly (agar), which allows bacteria to grow.
- Bacteria species **A**, **B** and **C** were each placed in a different compartment.
- A disc of filter paper containing the antibiotic methicillin was placed in the centre of each compartment.
- The Petri dish lid was used to close the dish. The dish was then placed in an incubator at 37 °C.
- After two days the Petri dish was examined.

Image 2.2 shows the surface view of the Petri dish after 2 days. The shaded areas show where bacteria were living. The clear areas show where there were no bacteria remaining.

Image 2.2



(i) Use **Image 2.2** to identify which bacterium is the superbug MRSA. Circle your answer. [1]

A **B** **C**

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(ii) Explain your answer. [1]

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(c) Sir Alexander Fleming discovered penicillin, the first antibiotic, in 1928. However, it was not used on a patient until 1942. There is still a long delay between the discovery of new drugs and their use in treating disease today.

(i) State the source of the penicillin discovered by Sir Alexander Fleming. [1]

.....

(ii) State **one** reason for the long delay between the discovery of new drugs and their use in treating disease in humans. [1]

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(iii) Suggest why it is important to **medical science** that global biodiversity is maintained. [1]

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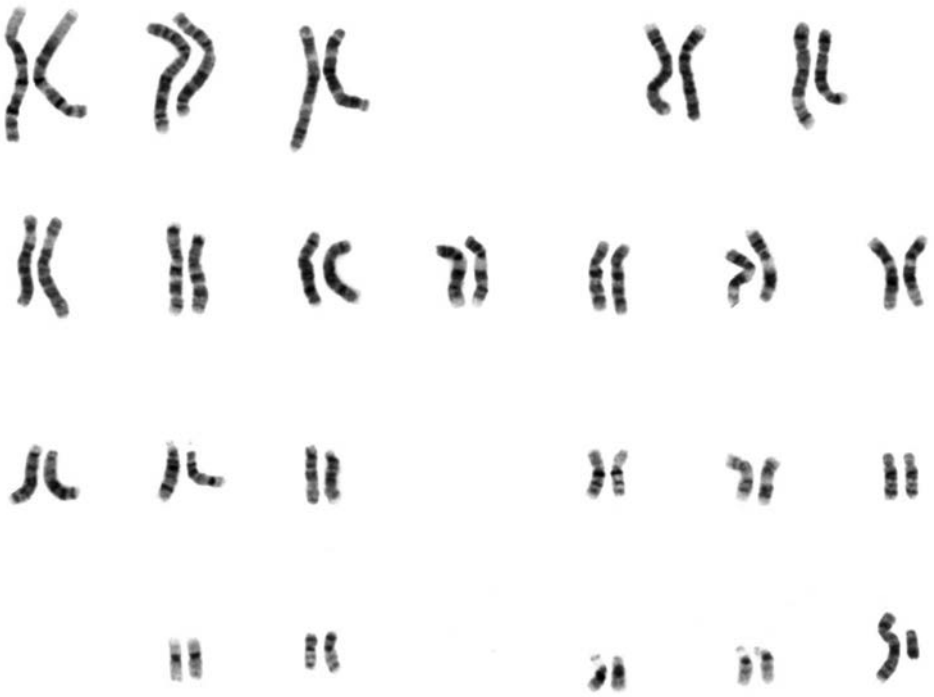
3. **Image 3.1** shows a complete set of chromosomes from the cell of an organism.

Image 3.1



(a) (i) State the evidence, shown in **Image 3.1**, that suggests that the set of chromosomes may have come from a **human** cell. [1]

.....

(ii) Suggest a reason why it is not possible to be certain that the set of chromosomes came from a human cell. [1]

.....

(iii) I. **On Image 3.1**, **draw a** (circle) around the sex chromosomes. [1]

II. State the sex of the organism from which these chromosomes were taken. [1]

.....

(iv) State how **Image 3.1** would differ if the cell from this organism had been produced by meiosis. [1]

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(b) State the disease caused by uncontrolled mitosis. [1]

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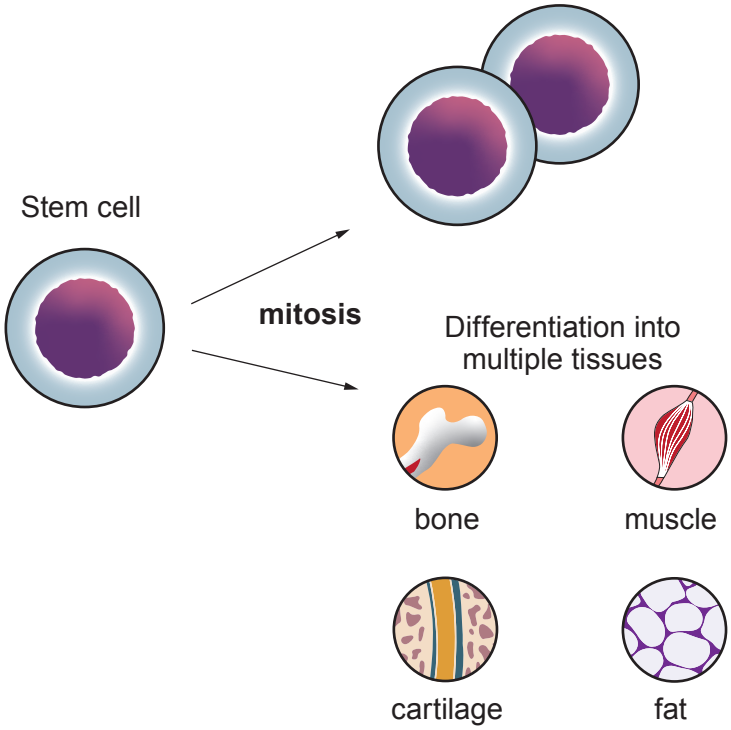
(c) **Image 3.2** shows some information about human cells.

Image 3.2



(i) Using the information from **Image 3.2**, explain what is meant by the term stem cell. [1]

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(ii) Researchers at the Washington State University are working on stem cells to transform them into insulin-secreting pancreas cells. They hope that these cells can be used to cure diabetes. However, they have been unable to regulate how much insulin these new pancreas cells produce. Sometimes they produce too much and other times they produce too little.

Describe the effect of the new pancreas cells producing too much insulin in the body. [3]

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4. Biological control agents can be effective in controlling some crop pests.

(a) Underline the **two** statements in the list below which correctly relate to biological control agents. [2]

They can reduce the need for chemical pesticides.

They cause damage to crop plants.

Pests develop resistance to biological control agents.

They are specific to certain pests.

They cannot be used on human food plants where chemical pesticides are banned.

(b) XenTari® WG is a biological control agent which contains inactive forms of the bacterium *Bacillus thuringiensis*.

When water is added to the XenTari® WG the bacteria are activated. The bacteria are then sprayed onto food crops such as cucumbers, sweet peppers and tomatoes that are being attacked by certain insect pests.

(i) Explain what effect the spraying of the bacteria on a crop of tomatoes would have on the crop yield. [2]

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(ii) XenTari® WG is not yet approved for use in the UK. Explain why it is important that scientists field-test XenTari® WG before it is approved for use by the UK government. [1]

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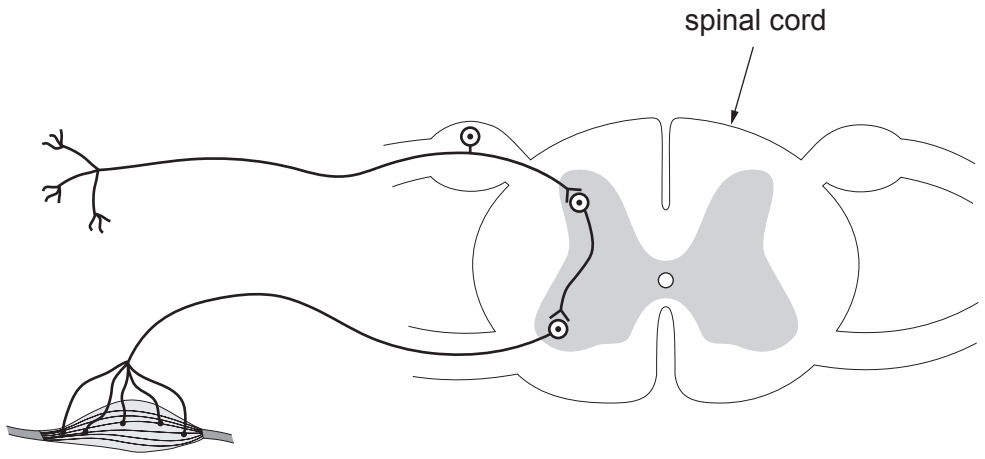
5. **Image 5.1** shows a reflex arc.

Image 5.1



(a) **On Image 5.1** of the reflex arc **label**:

(i) the sensory neurone; [1]

(ii) the effector. [1]

(b) State **two** properties of a withdrawal reflex action. [2]

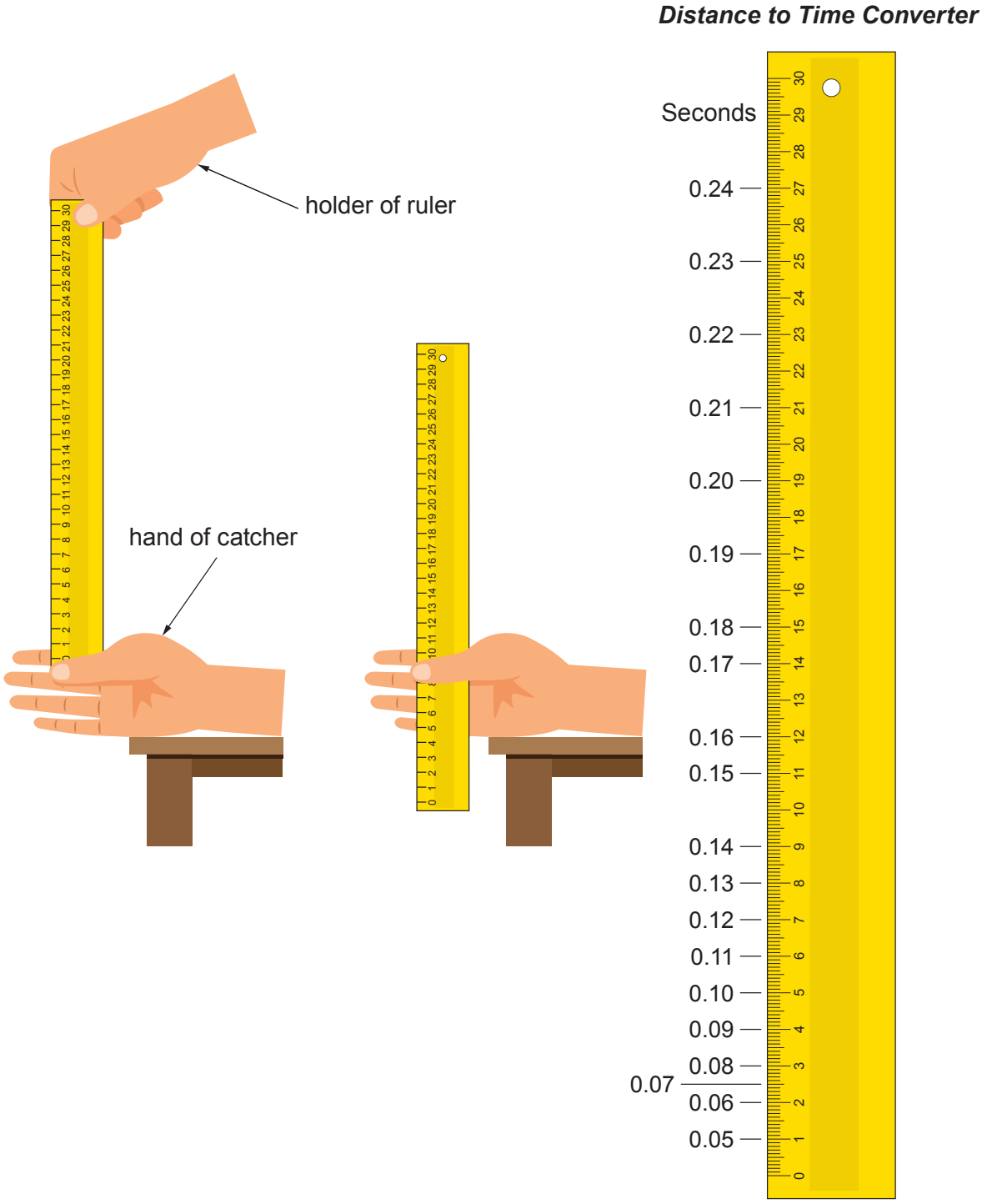
1. .....

2. .....

(c) A group of Year 11 students carried out an experiment to measure reaction time. The group was divided into five pairs of students (Pairs A to E). One member of each pair (the holder) held a 30 cm ruler with the 0 cm reading between the index finger and thumb of the other member (the catcher). This is shown in **Image 5.2**.

Also shown in **Image 5.2** is a ***Reaction Timer – Distance to Time Converter***.

Image 5.2



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- The holder would, without warning, release the ruler and the catcher should catch it as quickly as possible.
- The distance the ruler fell was read against the top surface of the catcher's thumb.
- This was repeated a further 4 times for each pair of students.
- The distance the ruler fell was converted to a reaction time by reading off the time, in seconds, on the ***Distance to Time Converter***.

The results are recorded in **Table 5.3**.

Table 5.3

Results

	Pair A		Pair B		Pair C		Pair D		Pair E	
Reading	Distance (cm)	Time (s)	Distance (cm)	Time (s)	Distance (cm)	Time (s)	Distance (cm)	Time (s)	Distance (cm)	Time (s)
1	15	0.18	19	0.20	27	0.24	15	0.18	21	0.21
2	12	0.16	19	0.20	27	0.24	12	0.16	17	0.19
3	11	0.15	15	0.18	25	0.23	9	0.14	15	.....
4	11	0.15	12	0.16	23	0.22	27	0.24	.....	0.15
5	9	0.14	11	0.15	19	0.20	7	0.12	8	0.13
Mean	12	0.16	15	0.18	24	0.23	14	0.17	.....	.....

(i) Complete the distance and time columns for **Table 5.3** by reading off the ***Distance to Time Converter*** and calculating the means for both the distance and time for **Pair E**. [3]

Space for working

(ii) I. Identify the anomalous reading in **Table 5.3** for **Pair D** and give its value below. [1]

Anomalous reading: ..... cm

II. Suggest **one** reason for this anomalous reading. [1]

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(iii) State which of the **Pairs A – D** had the fastest mean reaction time. [1]

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(iv) State the effect of repeat readings on speed of reactions. [1]

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(d) Coffee contains caffeine, which is a natural stimulant. The students extended their experiment by investigating the effect of drinking coffee on reaction times. The students wanted to make sure that their investigation into the effects of caffeine was a fair test.

Suggest **two** variables the students should have controlled to ensure a fair test. [2]

1. .....

2. .....

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6. (a) State the meaning of the term ***variation*** and give its **two** main causes. [3]

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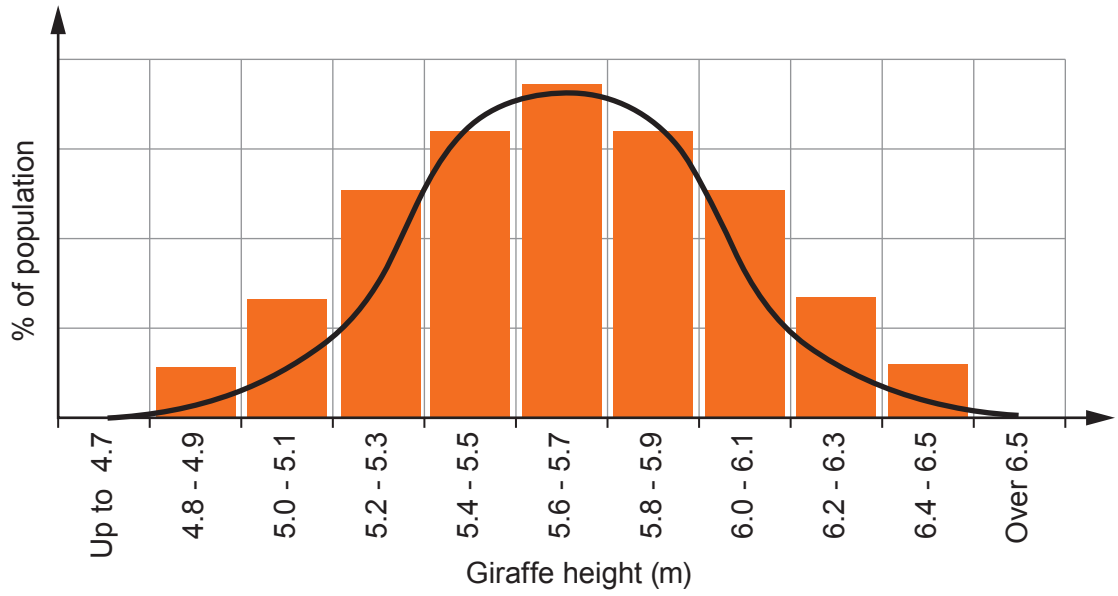
(b) **Image 6.1** shows a giraffe (Giraffa sp.) feeding on the leaves of a tree. Their height allows them to feed on the leaves both low down and high up in trees.

Image 6.1

Graph 6.2 shows the range of heights, in metres, of adult giraffes against the percentage of the population at each height range. Each giraffe was measured to the nearest 0.1 m.

Graph 6.2



(i) Name the type of variation shown in **Graph 6.2**. [1]

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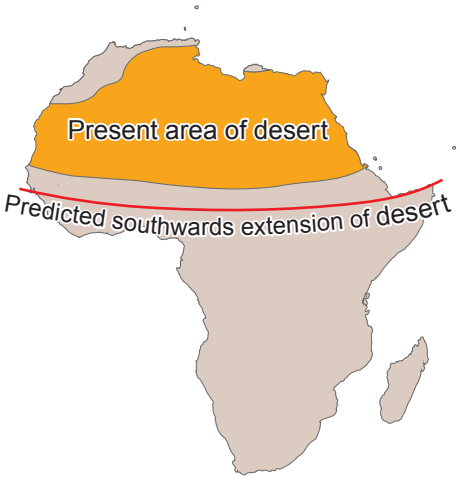
(ii) Desertification is where a relatively dry area of land becomes a desert. It is caused by a variety of factors, such as climate change and global warming. Since 1920 the Sahara Desert has increased in area by 10 %, extending south by over 250 km. This southwards extension of the Sahara Desert is continuing at the present time. One effect of this is that trees become fewer and further apart.

Image 6.3 shows a map of the regions (in red) occupied by the different species of giraffe in Africa

Image 6.3

Image 6.4 shows a map of the present area of Africa occupied by the Sahara Desert and that predicted for the future

Image 6.4



I. Suggest how the predicted southwards extension of the Sahara Desert would affect the **distribution** of the giraffe in Africa. [1]

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II. Explain, **in terms of natural selection**, how the southwards extension of the Sahara Desert would affect the **height ranges** of the giraffe. Include in your answer how **Graph 6.2** would change. [4]

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(c) Modern classification of the giraffe identifies four different species. Their common and scientific names are shown in **Table 6.5**.

Table 6.5

Common name	Scientific name
Southern or Angolan or South African giraffe	*Giraffa giraffa*
Masai or Rhodesian or Thornicroft's giraffe	*Giraffa tippelskirchi*
Reticulated giraffe	*Giraffa reticulata*
Northern or Kordofan or Nubian or West African or Rothschild's giraffe	*Giraffa camelopardalis*

The common names shown in **Table 6.5** are anglicised (English) names. The local African peoples also have their own common names, in their own languages, for the giraffe.

(i) Explain the importance of the use of scientific names as opposed to common names. [1]

.....

.....

(ii) Suggest how the modern classification of the giraffe affects the validity of **Graph 6.2**. Give a reason for your answer. [1]

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7. Describe the structure of DNA.
State the names of the bases and describe the complementary arrangement of these bases.
Explain the purpose of the triplet code formed by these bases.

(Diagrams will not gain credit) [6 QER]

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