OCR
Oxford Cambridge and RSA

Friday 10 May 2024 – Morning

GCSE (9–1) Combined Science B (Twenty First Century Science)

J260/05 Biology (Higher Tier)

Time allowed: 1 hour 45 minutes

H

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

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

* J 2 6 0 0 5 *

* 1 3 7 8 7 6 7 4 1 0 *

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 **95**.
- 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.

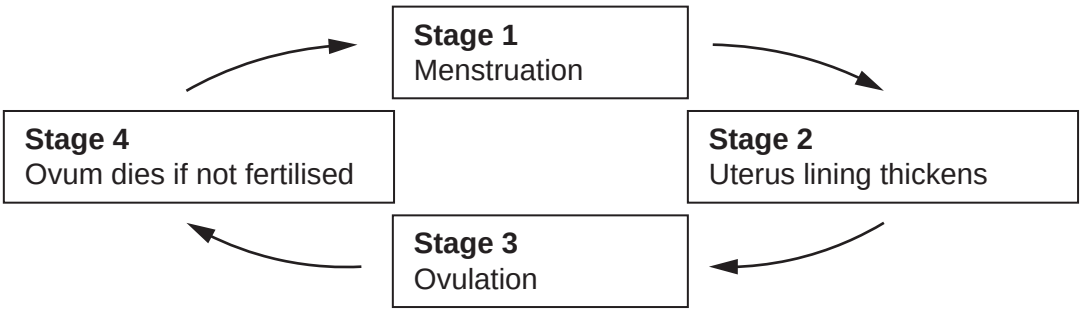
1 Charlie knows that hormones are important in human reproduction.

(a) Describe **one** role of hormones in human reproduction.

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

(b)

(i) The diagram shows four stages in the menstrual cycle.



Charlie has a contraceptive implant under their skin. The implant releases hormones.

Complete the sentence to explain why the hormones released by the implant disrupt the menstrual cycle.

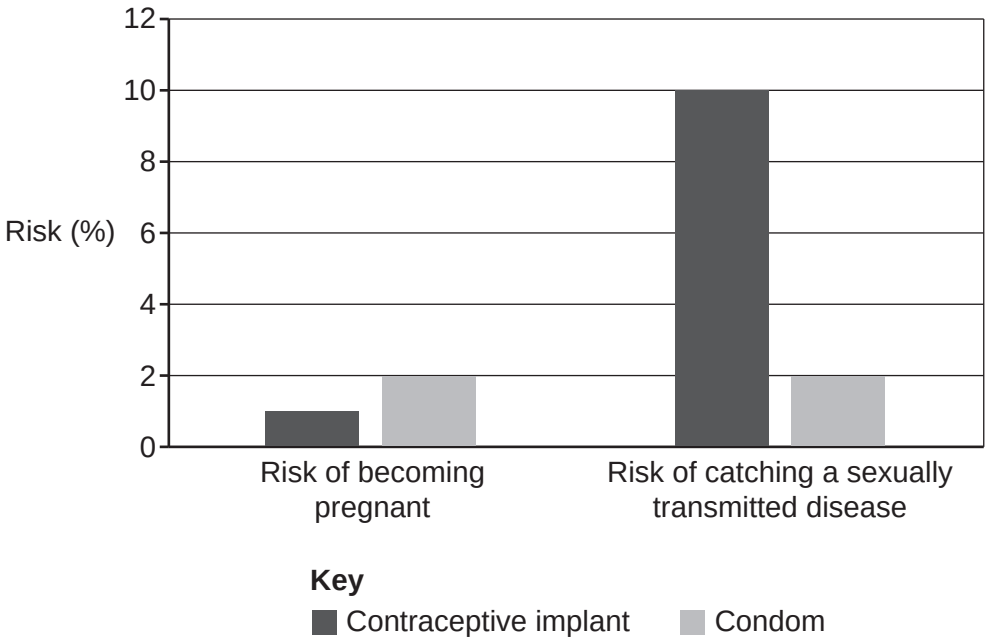
Put a (ring) around the correct option.

The hormones prevent stage **1 / 2 / 3 / 4** from taking place. **[1]**

(ii) A clinical trial compared the contraceptive implant with a condom.

The trial compared:

- the risk of becoming pregnant
- the risk of catching a sexually transmitted disease.



Charlie looks at the chart and decides to use a condom instead of the contraceptive implant.

Evaluate Charlie's decision, using the information from the chart.

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

(iii) Suggest why the risk of becoming pregnant and the risk of catching a sexually transmitted disease are equal when using a condom.

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

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2 Alex has cereal for breakfast.

(a)

(i) The cereal is made of carbohydrate.

Which small molecule does the body get by breaking down the carbohydrate from the cereal?

Put a (ring) around the correct option.

Amino acid **Fatty acid** **Glycerol** **Sugar**

[1]

(ii) Small molecules are used by cells in aerobic respiration.

Complete the table.

Tick (✓) **one** box in each row.

Small molecule	**Needed** for aerobic respiration	**Produced** by aerobic respiration	**Not** needed for or produced by aerobic respiration
Oxygen			
Urea			
Water			

[2]

(b) Explain how the partially-permeable cell membrane controls movement of small molecules into and out of a cell.

Put a (ring) around each correct option.

Gases such as oxygen and carbon dioxide move across the cell membrane by **active transport / diffusion / osmosis**.

When water moves across the cell membrane by diffusion, we call it **active transport / osmosis / translocation**.

Molecules can be moved against a concentration gradient using energy in a process called **active transport / diffusion / osmosis**.

[3]

(c) Small molecules move into and out of the blood.

Which statements about how this happens are **true**, and which are **false**?

Tick (✓) **one** box in each row.

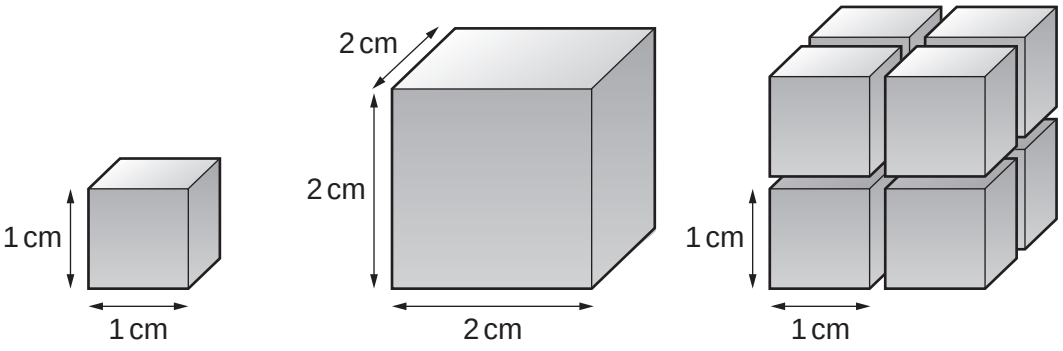
	True	False
Carbon dioxide and urea move out of cells into the blood.	☐	☐
Oxygen and carbon dioxide move between blood in capillaries and air in alveoli.	☐	☐
Urea is filtered into the blood by the kidneys.	☐	☐
Water and food molecules are absorbed from the digestive system into blood in capillaries.	☐	☐

[3]

(d) Exchange surfaces affect the surface area:volume ratio of multicellular organisms.

Alex uses cubes as models for different organisms.

Organism **A** represents a small organism.
Organism **B** represents a large organism **without** exchange surfaces.
Organism **C** represents a large organism **with** exchange surfaces.



A **B** **C**

(i) Calculate the surface area:volume ratio of organism **B**.

Give your answer in its simplest form.

Surface area:volume ratio = ... : ..... **[4]**

(ii) The surface area:volume ratio of organism **A** is 6:1.

Explain why the surface area:volume ratio of organism **C** is also 6:1.

.....

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

3

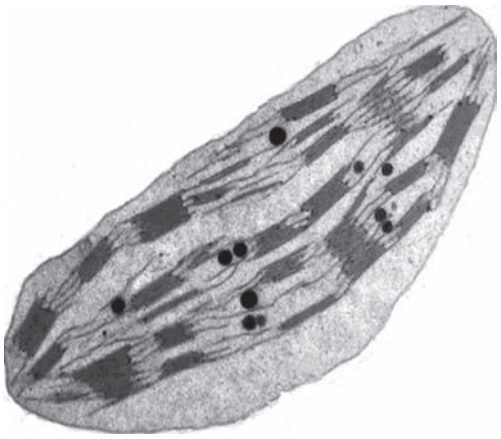
(a) Complete the table about sub-cellular structures.

Tick (✓) **one** box for each row.

Structure	**Only** found in eukaryotic cells	**Only** found in prokaryotic cells	Found in **both** types of cell
Chloroplast			
Mitochondria			
Nucleus			
Plasmid			

[3]

(b) The image is of a chloroplast.



(i) Draw a scientific drawing of the chloroplast in the box.

[2]

(ii) An electron microscope was used to create the image of the chloroplast.

Explain why electron microscopy is needed to increase our understanding of sub-cellular structures.

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

(c) The chloroplast has been magnified 11 500 times. In the image, the length of the chloroplast is 65 mm.

Calculate the actual length of the chloroplast in **µm**.

Use the equation: magnification = $\frac{\text{image length}}{\text{actual length}}$

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

1 mm = 1000 µm

Actual length of chloroplast = ... µm **[4]**

4 Scientists study communicable diseases.

(a) Describe what is meant by **communicable disease**.

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

(b) HIV is a communicable disease.

Complete the sentences to explain how HIV is spread.

HIV is a .....-transmitted disease.

HIV is transmitted in ..... .

[2]

(c) The table shows the number of people living with HIV/AIDS and the number of deaths due to HIV/AIDS, from 1990 to 2020.

Year	Number of people living with HIV/AIDS (millions)	Number of deaths due to HIV/AIDS (millions)
1990	7.5	0.3
1995	17.6	0.9
2000	25.7	1.6
2005	28.3	1.8
2010	29.9	1.4
2015	33.6	1.0
2020	37.5	0.9

(i) Calculate the percentage change in the number of people living with HIV/AIDS from 1990 to 2020.

Percentage change = ... % **[2]**

(ii) A doctor reports that people living with HIV/AIDS have had access to better medicines for their condition over the last 20 years.

Identify evidence from the table that supports the doctor's statement.

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

(iii) The number of new infections with HIV has been decreasing since 1995.

Suggest **one** reason why.

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

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5 Organisms need to detect and respond to changes in their internal and external environment to survive.

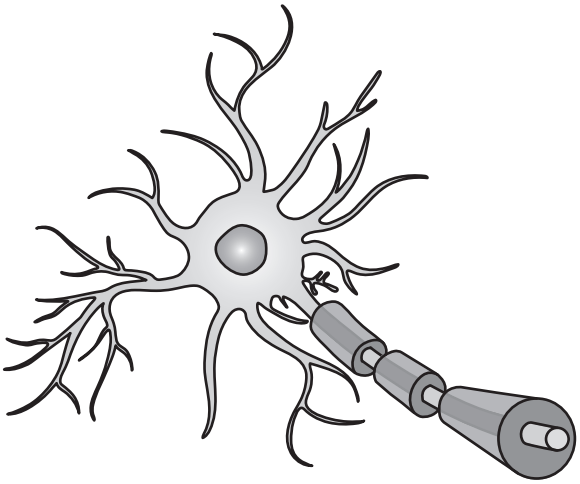
(a)* Multiple sclerosis (MS) is a condition that affects motor neurons.

Symptoms of MS include:

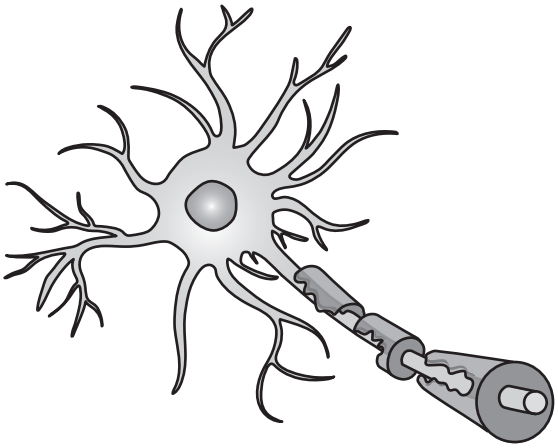
- slow muscle contractions in the arms and legs
- unwanted muscle contractions.

The images show a healthy motor neuron and a motor neuron affected by MS.

Healthy motor neuron



Motor neuron affected by MS



Explain how the structure of a motor neuron relates to its function **and** why MS causes the symptoms described.

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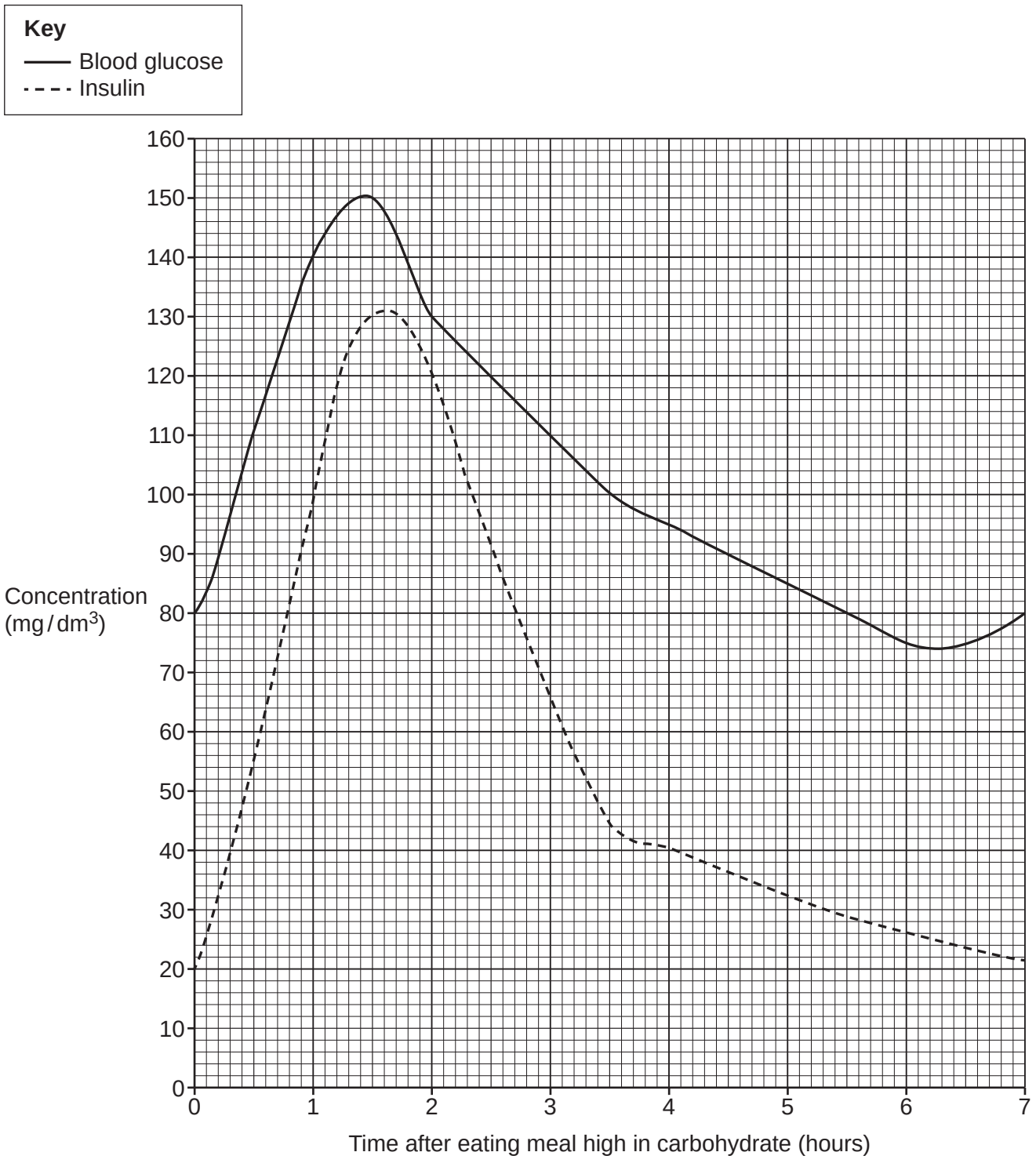
..... **[6]**

(b) The pancreas responds to changes in blood glucose concentration.

The graph shows the blood glucose and insulin concentration after eating a meal high in carbohydrate.



(i) Calculate the **rate** of change in insulin concentration during the first hour after the high carbohydrate meal was eaten.

Give your answer to **2** decimal places.

Rate = ... mg / dm^3 / min **[3]**

(ii) Describe the relationship between the blood glucose and insulin concentrations between hours **6** and **7**.

.....

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

(iii) Explain why the glucose concentration changes between hours **6** and **7**.

Use ideas about insulin and glucagon in your answer.

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

6 Biological washing powders contain digestive enzymes.

Washing powders need to remove food stains from clothes.

(a) Explain how digestive enzymes remove food stains.

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

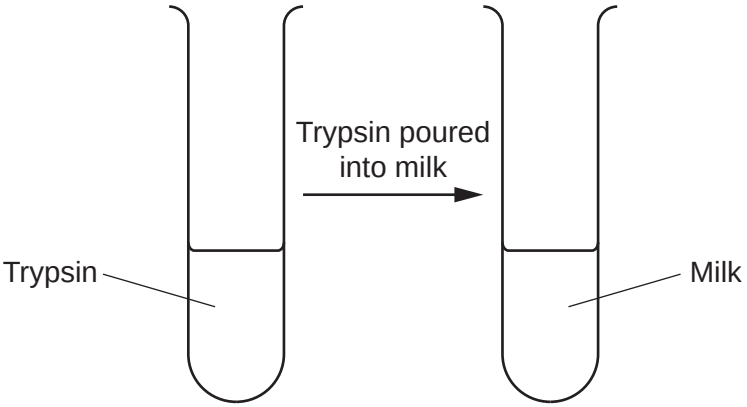
(b) Trypsin is a digestive enzyme which can remove milk stains.

When trypsin digests milk, the appearance of the milk changes from cloudy white to clear and colourless.

A student investigates the effect of temperature on the rate of digestion of milk by trypsin.

They write this method:

- Put 2 cm^3 of milk and 2 cm^3 of trypsin into test tubes.
- Pour the trypsin into the milk.
- Time how long it takes for the milk to go clear and colourless.
- Repeat the test at 10 °C, 20 °C, 30 °C, 40 °C and 50 °C.
- Test each temperature three times.



(i) Suggest **one** reason for repeating the test three times at each temperature.

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

(ii) Identify **three** different variables in this investigation:

Independent variable .....

Dependant variable .....

A variable that should be controlled .....

.....

[2]

(iii) Explain **two** improvements to the student's method that would help to increase the accuracy of the results.

1 .....

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2 .....

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[2]

(c) The milk went clear and colourless fastest at 40 °C.

Explain why some washing powders containing trypsin are recommended to be used at 40 °C.

Use ideas about enzyme action in your answer.

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

(d) Aerobic respiration in living cells is catalysed by enzymes.

(i) Which sub-cellular structure does aerobic respiration take place in?

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

(ii) Explain why respiration occurs continuously in all living cells.

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

7 All organisms contain genetic material.

(a) Complete the sentences to explain how the genetic material controls how cells develop and function.

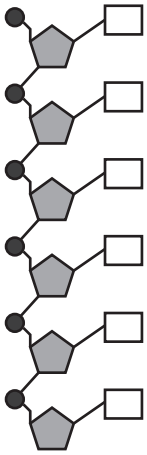
The entire genetic material of an organism is called the ..... .

The genetic material is stored in pairs of structures called ..... , which are made of a polymer called ..... .

Genes are instructions for the production of ..... , which are made of chains of ..... .

[3]

(b) The diagram shows one strand of the polymer that makes up the genetic material.



Put a (ring) around **one** nucleotide on the diagram. **[1]**

(c) Over the past 150 years several new populations of wild dogs have evolved to be more genetically similar to wolves.

This has happened even though wild dogs separated from their wolf ancestor 18 000 years ago.

Explain how some populations of wild dogs are developing wolf-like features.

Use ideas about natural selection in your answer.

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

(d) All pet dogs are descendants of wolves.

Pet dogs are a product of selective breeding.

Describe how humans have produced pet dogs from wolves.

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

(e) Humans have produced 22 new breeds of dogs in the last 10 years.

New breeds can be produced even faster using genetic engineering.

(i) Describe what is meant by **genetic engineering**.

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

(ii) Describe the **four** main steps in the process of genetic engineering.

1 .....

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2 .....

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3 .....

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4 .....

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[4]

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8

(a) The world's human population is due to reach 10 billion by 2050.

Farmers need to produce more food to feed all those people.

(i) Explain why increasing the rate of photosynthesis would increase the amount of food available for humans.

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

(ii) Temperature and water can be limiting factors of photosynthesis.

Complete the table to describe **two other** limiting factors and explain why increasing the amount of each factor increases the rate of photosynthesis.

Limiting factor	**Why increasing the amount of this factor increases the rate of photosynthesis**
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.....	....

[2]

(b) Explain how chemicals used in farming can affect local biodiversity.

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

9

(a) Describe **two** ways in which fossils have provided evidence of evolution.

1 .....

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2 .....

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[2]

(b) Scientists have discovered a new species of dinosaur called *Natovenator polydontus*.

(i) The discovery was published in a scientific journal.

Explain why it is important for scientific ideas and research to be published in scientific journals.

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

(ii) Some students discuss how the discovery of this dinosaur changes our understanding of the ecosystem in which the dinosaur lived.

Which **two** statements are correct?

Tick (✓) **two** boxes.

The discovery of a single fossil will not tell you how abundant the species was. ☐

Discovering this new species causes a large increase in the known biodiversity. ☐

This fossil tells us exactly how the species was distributed within the ecosystem. ☐

We now know the biodiversity of the ecosystem was greater than we thought. ☐

When the dinosaur was alive, the new species was an abiotic component of the ecosystem. ☐

[2]

(c) The rapid development of antibiotic resistance in bacteria is an example of modern day evolution.

Bacteria reproduce by simple cell division. This can happen every 20 minutes.

Explain why bacteria can evolve quickly.

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..... **[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.