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Centre number

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Surname

StemUp Model Solution

Forename(s)

Candidate signature

I declare this is my own work.

A-level BIOLOGY

Paper 2

Friday 13 June 2025

Morning

Time allowed: 2 hours

Materials

For this paper you must have:

- a ruler with millimetre measurements
- a scientific calculator.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Show all your working.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for the questions are shown in brackets.
- The maximum mark for this paper is 91.

For Examiner's Use	
Question	Mark
1	
2	
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TOTAL	



J U N 2 5 7 4 0 2 2 0 1

Answer **all** questions in the spaces provided.

0 1 . 1 In the following passage, the numbered spaces can be filled with biological terms.

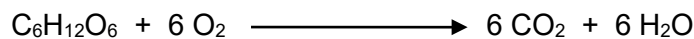
Glycolysis is the first stage of respiration. It occurs in the ____ (1) ____ of cells and is an anaerobic process. Glycolysis involves the ____ (2) ____ of glucose to glucose phosphate, using ATP. The oxidation of triose phosphate to ____ (3) ____ results in the net gain of ATP and reduced ____ (4) ____.

Write the correct biological term beside each number below that matches the space in the passage.

[2 marks]

- 1 Cytoplasm
- 2 Phosphorylation
- 3 Pyruvate
- 4 NAD

0 1 . 2 The equation for the aerobic respiration of glucose is:



Six carbon dioxide molecules are produced from each glucose molecule.

Use your knowledge of the link reaction **and** Krebs cycle to explain why.

[2 marks]

Each glucose gives two pyruvate, so the link reaction and Krebs cycle
each happen twice per glucose.

Each time, one CO₂ is released in the link reaction and two CO₂ in the
Krebs cycle (decarboxylation).

So overall 2 CO₂ come from the link reaction and 4 CO₂ from the Krebs
cycle, making six.



0 1 . 3

An inhibitor of the electron transfer chain was added to aerobically respiring yeast cells.

As aerobic respiration was inhibited, the following changes occurred:

- oxygen uptake decreased
- ATP production decreased
- ethanol was produced.

Explain the changes in the yeast cells following the addition of the inhibitor.

[3 marks]

Oxygen uptake decreased *Oxygen is the final electron acceptor at the end of the electron transfer chain, so less oxygen is needed to join with electrons and protons.*

ATP production decreased *There is less proton movement across the inner mitochondrial membrane, so no proton gradient and less chemiosmosis, so less oxidative phosphorylation.*

Ethanol was produced *Anaerobic respiration occurs instead: pyruvate is reduced to ethanol (and CO₂) by reduced NAD, regenerating NAD so glycolysis can continue.*

7

Turn over for the next question

Turn over ►



0 2 . 1

What term is used to describe the maintenance of a stable internal environment?

[1 mark]

Homeostasis

0 2 . 2

A high blood glucose concentration can cause dehydration of body cells.

Explain why.

Do **not** refer to ADH or the role of the kidneys in your answer.

[2 marks]

*The high glucose concentration lowers the water potential of the blood**(it becomes more negative), so the water potential of the cells is higher than that of the blood.**So water moves out of the body cells into the blood by osmosis, down the water potential gradient, and the cells become dehydrated.*

0 2 . 3

The hormone glucagon is involved in maintaining a stable blood glucose concentration.

Which is **not** a result of the action of glucagon?Tick (✓) **one** box.

[1 mark]

Activation of a protein kinase enzyme

☐

Activation of cyclic AMP hydrolysis

☒

Gluconeogenesis

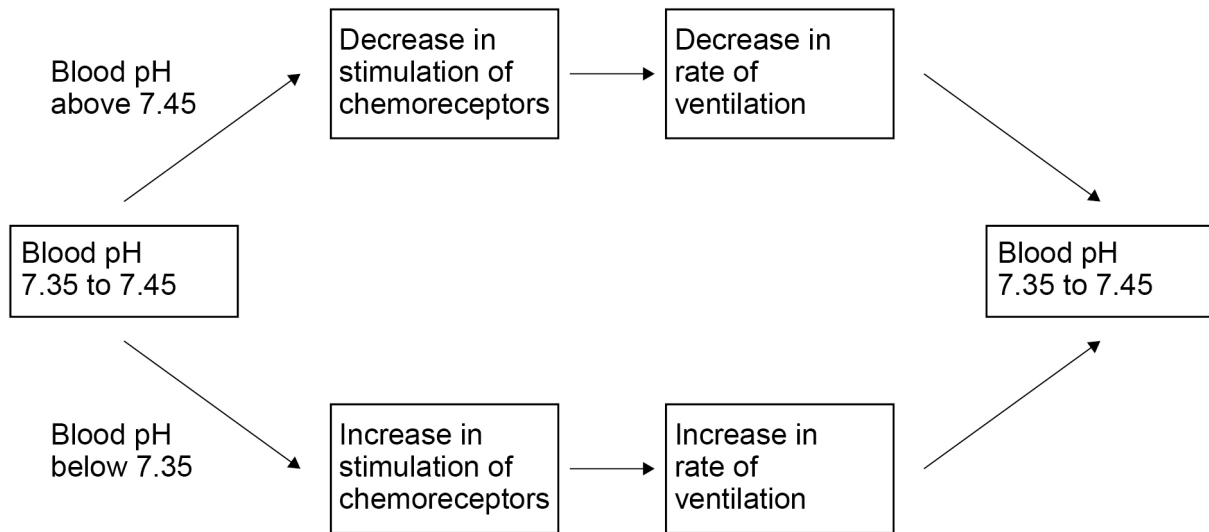
☐

Glycogenolysis

☐

0 2 . 4 Figure 1 shows one of the physiological systems involved in controlling blood pH.

Figure 1



Use the information in **Figure 1** to outline the principles of negative feedback.

[2 marks]

A change in blood pH away from the normal range (7.35 to 7.45) is detected by chemoreceptors, e.g. a fall in pH increases their stimulation. There are separate mechanisms for an increase and a decrease in pH, which give a greater degree of control, and the response (change in ventilation rate) restores the pH back to the set point of 7.35 to 7.45.

0 2 . 5 Vigorous exercise causes a change in blood pH and in the rate of ventilation.

Use **Figure 1** to describe and explain these changes.

[2 marks]

During vigorous exercise more aerobic respiration takes place in the muscles, producing more carbon dioxide (and anaerobic respiration produces lactate). This lowers the blood pH below 7.35, which increases stimulation of the chemoreceptors, so the rate of ventilation increases to remove the extra carbon dioxide.



03.1

A student determined the dry mass of lettuce leaves. The equipment used was an oven and a weighing balance.

Describe how the student could use this equipment to determine the dry mass of lettuce leaves.

[2 marks]

Weigh the lettuce leaves, then heat them in the oven at about 80 °C

(without burning them) to evaporate the water.

Reweigh them at regular intervals and keep heating and reweighing until the mass stays constant. This constant mass is the dry mass.

03.2

The student then used a calorimeter to determine the chemical energy stored in a sample of lettuce leaves with a dry mass of 1.50 g

The 1.50 g sample was fully combusted in a calorimeter.

The volume of water in the calorimeter was 150 cm³

The increase in temperature of the water was 18.2 °C

4.18 J of heat energy are required to increase the temperature of 1 cm³ of water by 1 °C

Use this information to calculate the heat energy released, in kJ g⁻¹, of dry mass of lettuce leaves.

Show your working.

[2 marks]

$$\text{Heat energy} = 150 \times 4.18 \times 18.2 = 11\,411.4 \text{ J}$$

$$\text{Per gram} = 11\,411.4 \div 1.50 = 7607.6 \text{ J g}^{-1}$$

$$= 7.6076 \text{ kJ g}^{-1}$$

Answer 7.61 kJ g⁻¹



0 3 . 3

Biomass can be measured as the dry mass of tissue per given area. Some crop plants are grown in large greenhouses (glasshouses) where optimum growing conditions can be maintained.

Growing crop plants at higher temperatures than their optimum temperature can decrease their biomass.

Use your knowledge of net primary production to explain why.

[2 marks]

Net primary production is gross primary production minus respiratory losses ($NPP = GPP \text{ minus } R$).

Above the optimum temperature the enzymes for photosynthesis work less well, so GPP decreases, while the rate of respiration increases, so respiratory losses rise. So NPP decreases and less biomass is produced.

6

Turn over for the next question

Turn over ►



0 4 . 1

People with the inherited blood disorder haemophilia A (HA) have a reduced ability to clot blood. One variant of HA is due to an inversion mutation in the *F8* gene. This mutation causes the production of a non-functional form of the protein, factor VIII. Factor VIII is **not** an enzyme.

Explain how an inversion mutation can cause the production of non-functional factor VIII.

[4 marks]

An inversion mutation means a section of the DNA base sequence is reversed, e.g. TATGC becomes CGTAT, so the triplets (codons) are changed.

This changes the sequence of amino acids in the polypeptide, i.e. the primary structure of factor VIII (it may also produce a stop codon so the polypeptide is shorter).

So the hydrogen, ionic and disulfide bonds form in different places.

This alters the tertiary structure (3D shape) of factor VIII, so it cannot carry out its function in blood clotting.

0 4 . 2

Currently, the most effective treatment for HA is weekly or monthly injections of factor VIII. Scientists investigated the effectiveness of a gene therapy product, Roctavian, as a treatment for HA. Roctavian contains a viral vector that has the DNA coding for factor VIII.

The scientists:

- selected 112 male volunteers with severe HA, who were at least 18 years of age
- treated each volunteer with a single injection of Roctavian into their blood
- recorded the number of bleeding episodes (internal bleeding) in these volunteers over a two-year period (set **A** results)
- compared these data with the number of bleeding episodes per year in the volunteers **before** receiving Roctavian (set **B** results).



Table 1 shows the scientists' results.

A value of $\pm 2 \times \text{SD}$ from the mean includes over 95% of the data.

Table 1

Volunteer set	Mean number of bleeding episodes per year ($\pm 2 \times \text{SD}$)
A (Received Roctavian)	$0.8 \pm (1.2)$
B (Received factor VIII)	$4.8 \pm (0.6)$

Use all the information provided to evaluate the use of Roctavian as a treatment for HA.

[5 marks]

For: the mean number of bleeding episodes per year fell from 4.8 with factor VIII to 0.8 with Roctavian. The $\pm 2 \times \text{SD}$ ranges (0.0 to 2.0 and 4.2 to 5.4) do not overlap, so this is a significant decrease, not due to chance.

Also only a single injection of Roctavian is needed, rather than weekly or monthly injections of factor VIII, and the study compared the same volunteers before and after, so individual differences are controlled.

Against: only males were treated, so we do not know if it works in females. Only people aged 18 or over were used, so it may not be suitable for children.

Only volunteers with severe HA were treated, so it may not work for mild HA, and possible side effects of the viral vector (e.g. an immune response) were not reported.

Question 4 continues on the next page

Turn over ►



0 4 . 3

Haemophilia C is an **autosomal** recessive condition.

Two parents are both heterozygous for the haemophilia C allele.

Calculate the probability of these parents producing a son who has haemophilia C.

[1 mark]

$$P(\text{affected}) = 1/4, P(\text{son}) = 1/2$$

$$1/4 \times 1/2 = 1/8$$

Probability = 0.125 (1 in 8)

10



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0 5 . 1 Explain what is meant by the term **phenotype**.

[2 marks]

*The phenotype is the observable characteristics or traits of an organism,
e.g. flower colour.*

*It results from the expression of the organism's genotype (alleles) and
its interaction with the environment.*

0 5 . 2 In genetic crosses, the observed phenotypic ratios obtained in the offspring are often **not** the same as the expected ratios.

Suggest **two** reasons why.

Do **not** refer to sex-linkage or autosomal linkage in your answer.

[2 marks]

1 *The sample size is small, and fusion of gametes at fertilisation is
random, so the results are affected by chance.*

2 *Epistasis, where one gene affects the expression of another gene, or the
presence of lethal genotypes.*



0 5 . 3

In sweet pea plants, the **F** allele for purple flowers is dominant to the **f** allele for red flowers. The **L** allele for long pollen is dominant to the **l** allele for round pollen.

A scientist carried out a genetic cross between a plant with purple flowers and long pollen (heterozygous for both genes) and a plant with red flowers and round pollen.

Table 2 shows the results of this cross.

Table 2

Phenotype of offspring	Percentage of total offspring
Purple flowers and long pollen	48.6
Red flowers and round pollen	47.5
Purple flowers and round pollen	2.1
Red flowers and long pollen	1.8

Use your knowledge of autosomal linkage to explain the results in **Table 2**.

Your answer should include:

- an explanation of what is meant by autosomal linkage
- a comment about the relative proportions of the different genotypes of gametes produced in this cross.

[3 marks]

Autosomal linkage means the two genes are on the same autosome (not a sex chromosome), so their alleles are usually inherited together. The parent has F and L on one chromosome and f and l on the other.

So most gametes from this parent are FL or fl, giving mostly purple long (48.6%) and red round (47.5%) offspring.

Only a few gametes are Fl and fL, which are recombinants produced by crossing over between the two genes in meiosis, so very few purple round (2.1%) and red long (1.8%) offspring are produced.

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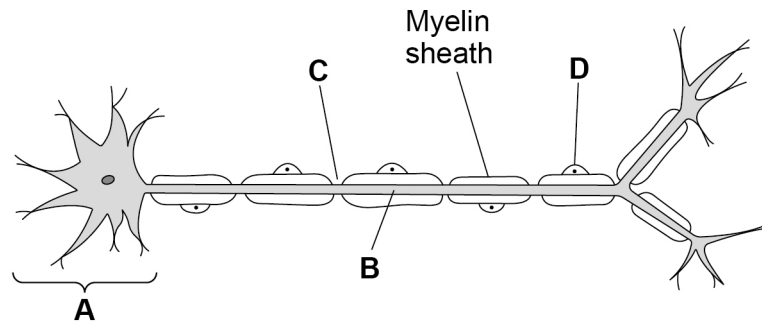
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0 6 . 1

Figure 2 shows a drawing of a myelinated motor neurone.

Figure 2



Name the parts labelled **A** to **D**.

[2 marks]

- A** Cell body
- B** Axon
- C** Node of Ranvier
- D** Schwann cell

0 6 . 2

Osmotic demyelination syndrome (ODS) results in destruction of the myelin sheath of neurones in the brain.

ODS can **increase** reflex response times.

Explain why.

[3 marks]

Without the myelin sheath there is no saltatory conduction: depolarisation
can no longer jump from node to node, so it has to occur along the
whole length of the axon.

So the nerve impulses are slowed down and take longer to travel.

The reflex involves relay neurones and transmission to motor neurones
and then the effector (muscle), so the impulses take longer to reach
the effector and the response time increases.



0 6 . 3

The parasympathetic nervous system (PNS) uses acetylcholine as its neurotransmitter. Atropine is an anticholinergic drug that attaches to postsynaptic receptors.

Atropine can be used to increase the heart rate in patients with bradycardia (a slower than normal heart rate).

Use the information provided to explain how atropine causes an increase in the heart rate.

[3 marks]

The parasympathetic nervous system slows the heart by releasing acetylcholine at the sinoatrial node (SAN).

Atropine attaches to the acetylcholine receptors, so less acetylcholine can bind to the receptors.

So fewer action potentials are produced by the PNS and there is less inhibition of the SAN, so the SAN sends out impulses more frequently and the heart rate increases.

Question 6 continues on the next page

Turn over ►



0 6 . 4

One study has suggested that the atropine dosage for severely obese male patients should be 0.01 mg kg^{-1} of lean body weight (LBW).

LBW is determined by using this equation.

$$\text{LBW} = \frac{9.27 \times 10^3 \times \text{TBW}}{(6.68 \times 10^3) + (216 \times \text{BMI})}$$

where TBW = total body weight

BMI = body mass index

Calculate the suggested dosage of atropine, in mg, for a severely obese male patient whose:

- TBW = 115.2 kg
- BMI = 41

Give your answer to 3 significant figures.

Show your working.

[2 marks]

$$\text{Denominator} = 6680 + (216 \times 41) = 6680 + 8856 = 15\,536$$

$$\text{LBW} = (9270 \times 115.2) \div 15\,536 = 1\,067\,904 \div 15\,536 = 68.737 \text{ kg}$$

$$\text{Dose} = 0.01 \times 68.737 = 0.68737 \text{ mg}$$

Answer 0.687 mg

10



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0 7 . 1 Figure 3 shows *Gammarus pulex*, commonly known as a freshwater shrimp.

Figure 3



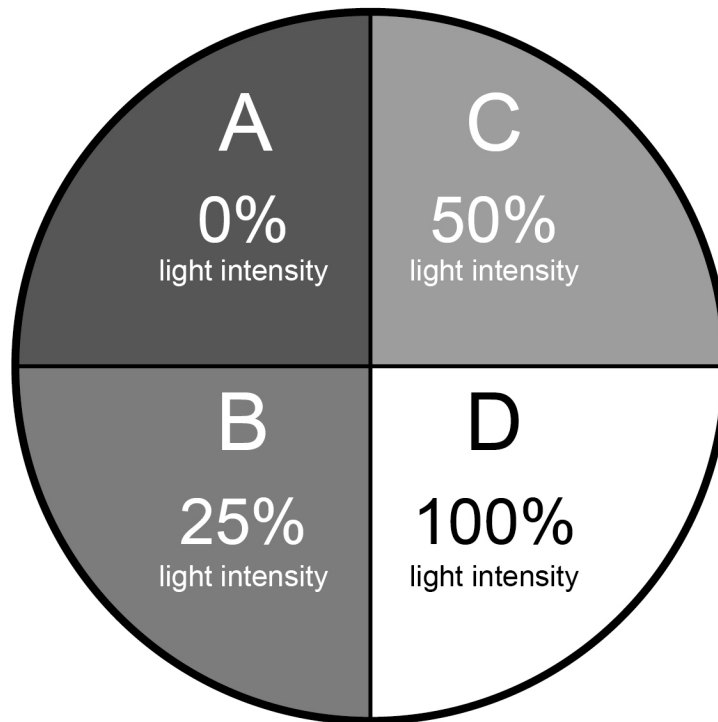
A student used a choice chamber to investigate the effect of light intensity on the movement of *G. pulex*.

The student:

- collected 30 shrimps from a freshwater stream
- added freshwater and gravel substrate from the same stream to each segment
- used layers of black paper on the lid of the choice chamber to reduce the percentage light intensity in 3 segments of the choice chamber as shown in **Figure 4**
- placed 30 shrimps at the centre of the choice chamber
- waited 10 minutes before counting the number of shrimps in each segment.



Figure 4



The student stated that 'the procedure used in this investigation helps to ensure the validity of any conclusions made'.

Suggest and explain **three** features of this investigation that justify this statement.

[3 marks]

- 1 *Water and gravel from the same stream were used, so the shrimps are in their normal habitat and behave normally, and other variables (e.g. pH, oxygen) are controlled so light is the only variable.*
- 2 *A large sample of 30 shrimps was used, so the results are more representative and the effect of anomalies is reduced.*
- 3 *They were placed at the centre, so they were the same distance from each segment (no bias), and the 10 minute wait let them acclimatise and have time to respond.*

Question 7 continues on the next page

Turn over ►



0 7 . 2 Table 3 shows the student's results.

Table 3

Segment of choice chamber	Percentage light intensity	Number of <i>G. pulex</i> counted after 10 minutes
A	0	15
B	25	8
C	50	4
D	100	3

The student observed directional movement by *G. pulex*.

Name the type of behaviour shown by *G. pulex* **and** suggest an advantage to *G. pulex* of this behaviour.

Use the information in **Table 3** in your answer.

[2 marks]

Type of behaviour Negative phototaxis

Advantage Most shrimps (15) moved to segment A with 0% light, so in darkness they are less visible to predators and less likely to be eaten.



0 7 . 3 The student analysed the results in **Table 3** using the chi-squared test (χ^2) and calculated a χ^2 value of 11.87

Table 4 shows the critical values of χ^2 at different probability (**P**) values for different degrees of freedom.

Table 4

Degrees of freedom	Critical values of χ^2 at different P values				
	P = 0.95	P = 0.5	P = 0.05	P = 0.01	P = 0.005
1	0.00	0.46	3.84	6.64	7.88
2	0.10	1.39	5.99	9.21	10.60
3	0.35	2.37	7.82	11.35	12.84
4	0.71	3.36	9.49	13.28	14.86
5	1.15	4.35	11.07	15.09	16.75

State a null hypothesis for this investigation **and** explain why the χ^2 test was the appropriate statistical test to use.

[2 marks]

Null hypothesis *There is no significant difference in the number of shrimps found at the different light intensities (light intensity has no effect on their distribution).*

Explanation for using a χ^2 test *The data are categoric (counts in segments), and the test shows whether there is a significant difference between observed and expected numbers.*

Question 7 continues on the next page

Turn over ►



07.4

Using the calculated χ^2 value of 11.87 and the information in **Table 4**, what can you conclude from this investigation?

You should include the terms **probability** and **chance** in your answer.

[4 marks]

There are 4 segments so there are 3 degrees of freedom. The calculated chi-squared value of 11.87 is greater than the critical value of 7.82 at $P = 0.05$ (and also greater than 11.35 at $P = 0.01$).

So the probability of the difference between the observed and expected numbers being due to chance is less than 1% (0.01).

So there is a significant difference in the distribution of shrimps at different light intensities, and we reject the null hypothesis: the shrimps move towards the darker segments.

11



08.1

A study of cells from a human embryo found that $2.66 \times 10^{-7} \%$ of the genome of one cell had changed due to mutation.

You can assume that:

- the genome contains 3×10^9 nucleotides
- the mean rate of mutation is 1.14 mutations per cell cycle
- the cell cycle lasts 24 hours.

Use this information to calculate the age of the embryo in days.

Show your working.

[2 marks]

$$\text{Mutations} = (2.66 \times 10^{-7} \div 100) \times 3 \times 10^9 = 7.98$$

$$\text{Cell cycles} = 7.98 \div 1.14 = 7$$

Each cycle 24 hours = 1 day, so 7 days

Answer 7 days

The genome of the bacterium *Escherichia coli* is approximately 4.6 million base pairs in length and contains around 4000 genes.

08.2

The analysis of the genome of *E. coli* allows the proteome to be determined more easily than that of eukaryotes.

Explain why.

[2 marks]

The E. coli genome does not have introns (non-coding DNA), it is mostly coding DNA (exons), so the genes and therefore the proteins they code for are easy to identify.

Eukaryotes contain introns and many more regulatory genes, so it is harder to work out the proteome from their genome.

Question 8 continues on the next page

Turn over ►



0 8 . 3

Determining the proteomes of bacteria has helped provide protection for individuals and populations against some infectious diseases.

Explain how.

[2 marks]

Determining the proteome allows antigens (surface proteins) of the bacteria to be identified and isolated.

These antigens can be used to develop vaccines, giving active immunity and herd immunity, or to develop monoclonal antibodies and antitoxins for treatment.

Scientists investigated the relationship between one type of variable number tandem repeat (VNTR) and the risk of breast cancer occurring in women.

The scientists determined the risk of breast cancer occurring in women:

- with 2, 3 or 4 repeats of the VNTR
- **without** the VNTR.

They calculated the odds ratio (OR) of breast cancer occurring with 2, 3 or 4 repeats of the VNTR.

An OR is a measure of how strongly an outcome is associated with a risk factor.

The OR formula is:

risk of breast cancer occurring **with** the VNTR : risk of breast cancer occurring **without** the VNTR

Table 5 shows the scientists' results.

Table 5

Number of VNTR repeats	Odds ratio
2	0.55 : 1
3	1.58 : 1
4	1.94 : 1



08.4

A student concluded that the number of repeats of the VNTR is associated with the risk of breast cancer occurring in women.

Evaluate the student's conclusion.

[4 marks]

The data partly support the conclusion: 2 repeats is associated with a decreased risk of breast cancer (OR 0.55 : 1), while 3 and 4 repeats are associated with an increased risk (1.58 : 1 and 1.94 : 1), so more repeats are linked to a higher risk.

However, only 2, 3 and 4 repeats were studied, with no results for 1 repeat or more than 4 repeats, so the trend cannot be extended.

An association does not show causation: other factors such as age, diet or BRCA mutations also affect the risk of breast cancer. Breast cancers are not all the same type.

The sample size is not known, and there is no statistical test, so we cannot tell if the differences are significant.

10

Turn over for the next question

Turn over ►



0 9

Cystic fibrosis (CF) is a recessive inherited disorder caused by a defective *CFTR* gene.

Table 6 shows the number of people with CF and the estimated population of the UK in 2020 and 2022.

Table 6

Year	Number of people with CF	Estimated population of the UK $\times 10^6$
2020	10 837	67.06
2022	11 148	67.51

0 9

. 1

Calculate how many more people had CF than was expected in 2022.

You can assume the relative frequency of CF in a population remains constant.

Show your working.

[2 marks]

$$\text{Frequency} = 10\,837 \div 67.06 \times 10^6 = 1.616 \times 10^{-4}$$

$$\text{Expected 2022} = 1.616 \times 10^{-4} \times 67.51 \times 10^6 = 10\,910$$

$$\text{Additional} = 11\,148 - 10\,910 = 238$$

Additional number of people 238



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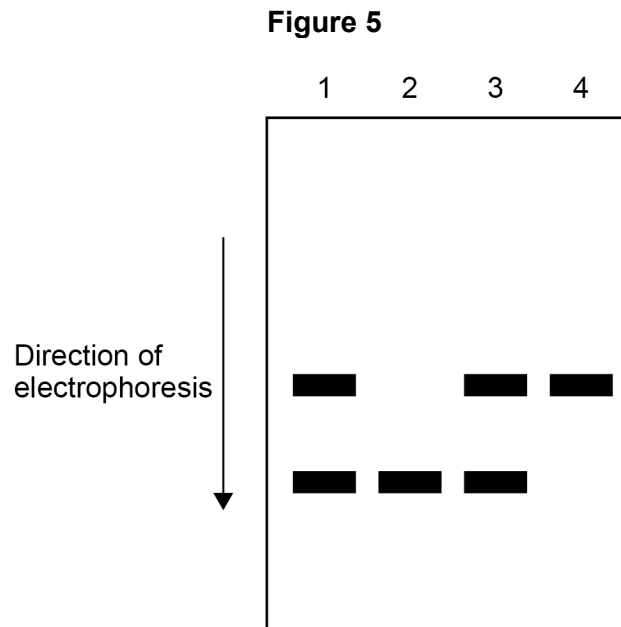
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CF can be caused by a three-base deletion mutation in the *CFTR* gene. This deletion creates a recessive allele called F508del.

DNA probes and gel electrophoresis were used to screen two parents and their two children for the F508del allele. One of the children was diagnosed with CF.

Figure 5 shows the results.



0 9 . 2 What is a DNA probe?

[2 marks]

A DNA probe is a short, single-stranded piece of DNA, often labelled with a fluorescent or radioactive marker.

Its base sequence is complementary to the base sequence of the target allele (gene), so it binds to it by complementary base pairing.



0 9 . 3

The identity of each family member can be determined from the relative position of the bands shown in **Figure 5**.

Use information in **Figure 5** to:

- complete **Table 7**
- explain how you identified the child with CF.

You can use **F** to represent the dominant *CFTR* allele and **f** to represent the recessive F508del *CFTR* allele.

[3 marks]

Table 7

Lanes	Parent or child	Genotype
1	Parent	Ff
2	Child	ff
3	Parent	Ff
4	Child	FF

Explanation Lane 2 only contains the recessive F508del (f) allele, which travels further because the deletion of 3 bases makes it smaller (fewer bases), so this child is ff and has CF.

7

Turn over for the next question

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1 0

Read the following passage.

Tropical rainforests are among the most biologically diverse ecosystems in the world. Their varied plant communities support a high biodiversity of animal species. Tropical rainforests form in parts of the world with high annual rainfall and high mean temperatures providing moist, warm conditions. Nutrient recycling occurs rapidly on the ground of these rainforests. The recycling of nitrogen-containing compounds from dead organic matter sustains the growth of plants.

5

Each year, large areas of rainforests are lost due to fires. Natural regeneration of rainforests occurs slowly by secondary succession. Secondary succession is similar to primary succession but occurs in areas previously inhabited. There is conflict between the needs of humans and conservation of rainforests. Deforestation by humans is removing large areas of rainforests. Farming practices have prevented the natural regeneration of rainforests by secondary succession.

10

Use the information in the passage and your own knowledge to answer the following questions.

1 0

. 1

In tropical rainforests, there is a high biodiversity of animal species (lines 1–3).

Explain why.

[3 marks]

Rainforests have a large number and variety of plant species, because the warm, moist conditions suit plant growth.

This provides many different habitats and niches for animals, e.g. different layers of the canopy.

The variety of plants also provides a greater variety of food sources, so many different animal species can coexist.



1 0 . 2

Nutrient recycling occurs rapidly on the ground of tropical rainforests (lines 4–5).

Explain how **two** abiotic factors in these rainforests enable the rapid rate of recycling.

[2 marks]

1 *High temperature: it is near the optimum for the enzymes of saprobionts and nitrifying bacteria, so decomposition and nitrification are fast.*

2 *High rainfall gives moisture (water) needed for enzyme reactions such as hydrolysis by saprobionts, and for their respiration.*

1 0 . 3

The recycling of nitrogen-containing compounds from dead organic matter sustains the growth of plants (lines 5–7).

Describe the roles of bacteria in this recycling.

[4 marks]

Saprobionts (saprobiotic bacteria) decompose dead organic matter: they secrete enzymes that digest proteins, amino acids, DNA and urea, and release ammonia / ammonium ions. This is ammonification.

Nitrifying bacteria then oxidise the ammonium ions into nitrite ions, and then the nitrite into nitrate ions (nitrification), e.g. Nitrosomonas and Nitrobacter.

These nitrate ions are absorbed by plant roots and used to make amino acids, proteins and DNA, so plant growth is sustained.

Question 10 continues on the next page

Turn over ►



1 0 . 4

Natural regeneration of rainforests occurs by secondary succession (lines 8–10).

Describe the process of secondary succession.

[4 marks]

After a fire, the soil, humus and seeds are already present, so the area is first colonised by pioneer species, such as fast-growing grasses and small plants.

The pioneer species change the environment, e.g. when they die and decompose they add more humus and nutrients to the soil, so it holds more water.

This makes conditions less hostile and more suitable for new species such as shrubs and then trees, which outcompete the previous species, so the biodiversity increases.

Eventually a stable climax community of rainforest is reached.

1 0 . 5

Farming practices have prevented the natural regeneration of rainforests by secondary succession (lines 12–14).

Suggest **two** farming practices that prevent the natural regeneration of rainforests by secondary succession.

[2 marks]

1 *Growing crops on the land, e.g. a monoculture of maize or oil palm, with ploughing of the land.*

2 *Cattle farming, where animals graze the land, and applying herbicides that kill young tree seedlings.*

15

END OF QUESTIONS



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