Biology

Higher Level

Paper 1B — Mock Examination

Mock Exam 2

Calculator required

Time allowed: **55 minutes**

Maximum mark: **35 marks**

Candidate information

Candidate name: .....

Session number: .....

Date: .....

Topic emphasis: enzymes and metabolism, homeostasis and the control of blood glucose, sampling and statistical testing in ecology, and biotechnology. This is a data-based paper: it assesses experimental design, data analysis and the interpretation of unfamiliar biological information alongside syllabus content.

Instructions to candidates

- Write your session number in the box on the cover.
- Do not open this examination paper until you are told to do so.
- Answer **all** questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- A clean copy of the biology data booklet is required for this paper.
- The maximum mark for this examination paper is **[35 marks]**.

The mark allocation is shown in square brackets at the end of each question. Where a calculation is required, show your working; marks may be awarded for a correct method even if the final answer is incorrect. Units and an appropriate number of significant figures should be given where relevant. Diagrams may be used in answers where they communicate the required biological detail clearly.

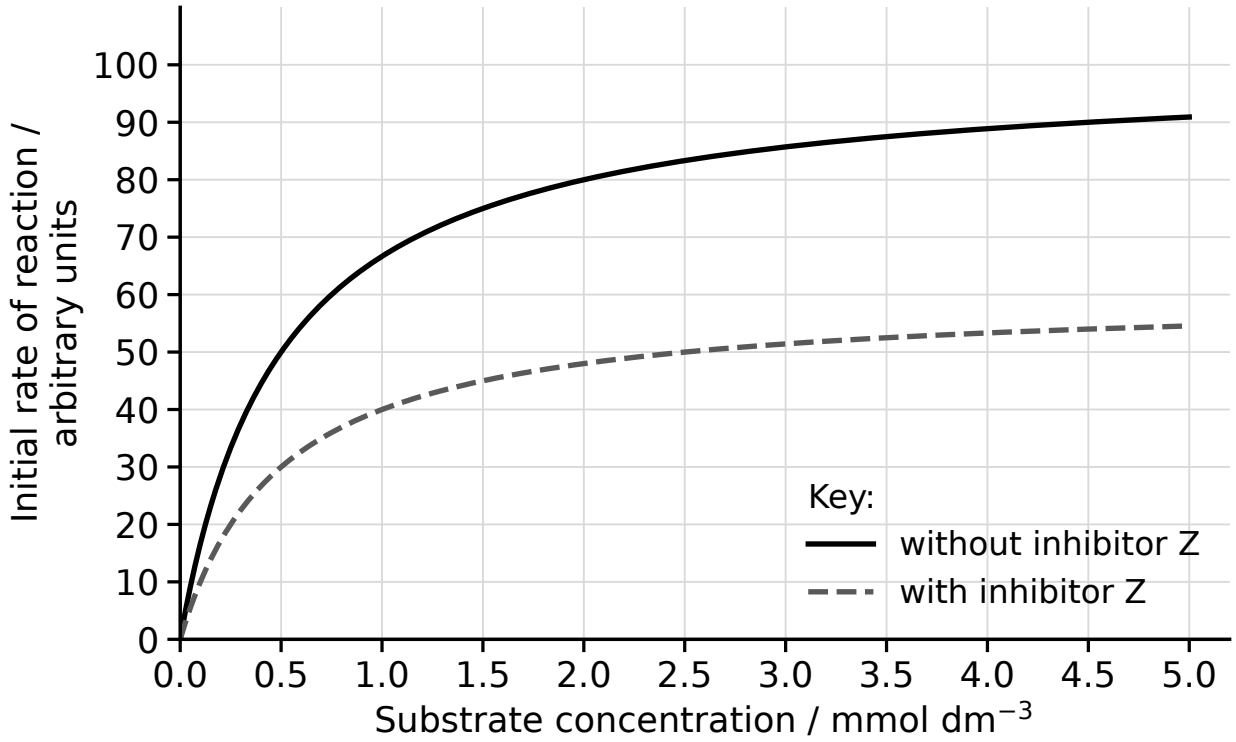
Mark allocation

Question	**Marks**
1 Enzymes and inhibition	[9 marks]
2 Control of blood glucose	[9 marks]
3 Ecology and the chi-squared test	[9 marks]
4 Gel electrophoresis	[8 marks]
Total	**[35 marks]**

Answer **all** questions. Answers must be written within the answer boxes provided.

Question 1

The enzyme sucrase catalyses the hydrolysis of sucrose. The initial rate of reaction was measured at a range of substrate concentrations, first with the enzyme alone and then with the same concentration of enzyme in the presence of inhibitor Z. Temperature and pH were kept constant throughout.



(a) (i) State the independent variable in this investigation. **[1]**

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(ii) Using the graph, deduce whether inhibitor Z is a competitive or a non-competitive inhibitor. Give a reason for your answer. **[2]**

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(b) Calculate the percentage decrease in the initial rate of reaction caused by inhibitor Z at a substrate concentration of 2.0 mmol dm^{-3}. **[1]**

Working:

Answer: . . . . . .

(c) Explain the shape of the curve obtained without inhibitor Z. **[3]**

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(d) Outline how the initial rate of reaction could be determined in this investigation. **[2]**

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Question 2

After fasting overnight, volunteers drank a solution containing 75 g of glucose. Blood glucose concentration was then measured every 30 minutes for two hours. Group A consisted of 24 volunteers without diabetes and group B consisted of 21 volunteers with type 2 diabetes.

The table shows the mean blood glucose concentration and the standard deviation (SD) for each group.

	Group A (no diabetes)		**Group B (type 2 diabetes)**	
Time / minutes	**Mean blood glucose /** $\mathrm{mmol\,dm^{-3}}$	**SD /** $\mathrm{mmol\,dm^{-3}}$	**Mean blood glucose /** $\mathrm{mmol\,dm^{-3}}$	**SD /** $\mathrm{mmol\,dm^{-3}}$
0	5.1	0.4	7.6	1.2
30	7.8	0.9	12.1	2.4
60	6.9	0.8	13.8	2.9
90	5.9	0.6	12.9	3.1
120	5.6	0.5	11.4	3.3

(a) Calculate the difference in mean blood glucose concentration between the two groups at 120 minutes. **[1]**

Working:

Answer: . . . . . .

(b) Suggest **one** reason why the SD is greater in group B than in group A. **[1]**

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(c) Compare and contrast the changes in blood glucose concentration in the two groups over the 120 minutes. **[2]**

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(d) Explain how blood glucose concentration is returned to its normal level after a meal in a person without diabetes. **[3]**

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(e) Suggest **one** reason why people with type 2 diabetes have a raised blood glucose concentration even though they still produce insulin. **[2]**

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Question 3

Two species of limpet, *Patella* P and *Patella* Q, live on a rocky shore. Students placed 60 quadrats at randomly generated coordinates on the upper shore and 60 quadrats on the lower shore, and counted every limpet of each species inside the quadrats.

The table shows the total number of limpets of each species counted in each zone.

	Upper shore	**Lower shore**
Number of species P	148	62
Number of species Q	54	176

A chi-squared (χ^2) test was carried out on these data. The calculated value of χ^2 was 96.4. The critical value at a significance level of $p = 0.05$ is 3.84.

(a) State the sampling technique used by the students. **[1]**

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(b) State the null hypothesis for this chi-squared test. **[1]**

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(c) Calculate the number of degrees of freedom for this test. **[1]**

Working:

Answer: . . . . . .

(d) Deduce the conclusion that can be drawn from the result of the chi-squared test. **[2]**

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(e) Suggest **two** abiotic factors that could account for the distribution of the two species. **[2]**

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(f) Explain how competition between the two species could also contribute to this pattern of distribution. **[2]**

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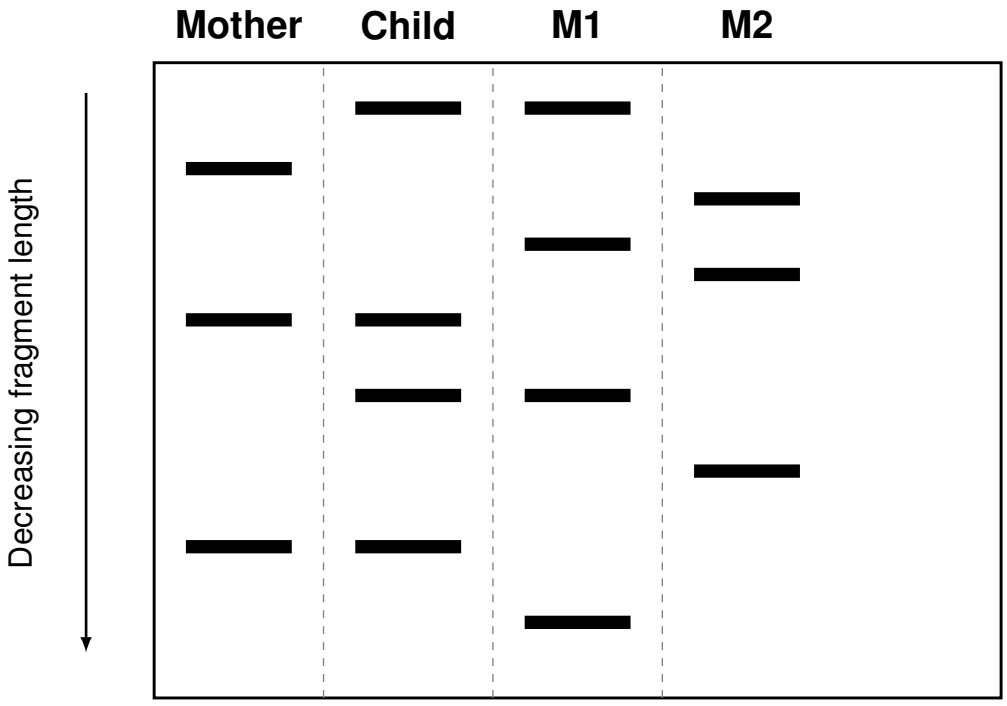
Question 4

DNA was extracted from a mother, her child and two men, M1 and M2, one of whom is the biological father of the child. The DNA samples were cut into fragments and separated according to fragment length. The diagram shows the resulting banding pattern.



(a) State the name of the technique used to separate the DNA fragments. **[1]**

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(b) Deduce which man is the biological father of the child. Use the banding pattern to support your answer. **[2]**

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(c) Explain how the DNA fragments become separated during this procedure. **[3]**

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(d) State the type of enzyme used to cut the DNA into fragments. **[1]**

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(e) Suggest **one** application of this technique other than identifying the parents of a child. **[1]**

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End of examination. Total: **35 marks**