Biology

Higher Level

Paper 1B — Mock Examination

Mock Exam 3

Calculator required

Time allowed: **55 minutes**

Maximum mark: **35 marks**

Candidate information

Candidate name: .....

Session number: .....

Date: .....

Topic emphasis: water potential and membrane transport, gas exchange and exercise physiology, limiting factors in photosynthesis, and molecular evidence for evolutionary relationships. 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

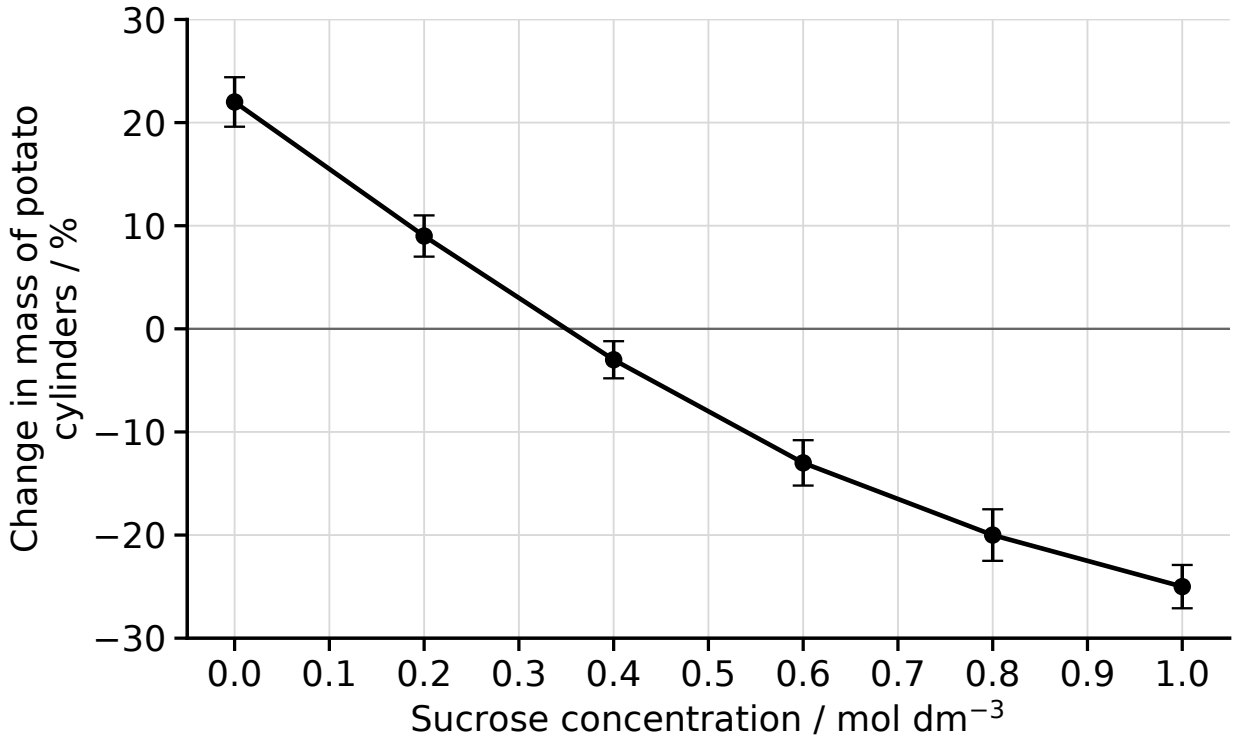
Question	**Marks**
1 Osmosis and water potential	[9 marks]
2 Ventilation and exercise	[9 marks]
3 Limiting factors in photosynthesis	[9 marks]
4 Molecular evidence for evolution	[8 marks]
Total	**[35 marks]**

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

Question 1

Cylinders of potato tissue of equal length and diameter were blotted dry, weighed and then placed in sucrose solutions of different concentrations for 24 hours. Each cylinder was then blotted dry and reweighed. Five cylinders were used at each concentration.

The graph shows the mean percentage change in mass. The error bars show the standard deviation (SD).



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

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(ii) Using the graph, determine the concentration of sucrose solution that is isotonic to the potato tissue. **[1]**

Working:

Answer: . . . . . .

(b) Explain the change in mass of the potato cylinders placed in the 1.0 mol dm^{-3} sucrose solution. **[3]**

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(c) Suggest why the percentage change in mass was calculated rather than simply recording the change in mass in grams. **[2]**

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(d) List **two** variables, other than sucrose concentration, that must be kept constant in this investigation. **[2]**

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Question 2

The effect of exercise intensity on ventilation rate was investigated using two groups of adult volunteers: 15 endurance-trained athletes and 15 untrained individuals of the same age range. Each volunteer exercised on a cycle ergometer at five fixed workloads, and the ventilation rate was recorded during the final minute at each workload.

The table shows the mean ventilation rate and the standard deviation (SD) for each group.

	Trained		**Untrained**	
Workload / W	**Mean ventilation rate /** $\mathrm{dm^3\,min^{-1}}$	**SD /** $\mathrm{dm^3\,min^{-1}}$	**Mean ventilation rate /** $\mathrm{dm^3\,min^{-1}}$	**SD /** $\mathrm{dm^3\,min^{-1}}$
0	9.5	1.1	10.2	1.4
50	25.4	2.6	30.1	3.5
100	42.3	3.8	52.4	5.1
150	68.0	5.4	78.3	7.7
200	96.2	7.2	84.1	9.4

(a) State the name of the apparatus used to measure ventilation rate. **[1]**

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(b) Compare and contrast the ventilation rates of the trained and untrained groups across the range of workloads. **[2]**

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(c) Calculate the percentage difference between the mean ventilation rates of the two groups at a workload of 200 W. **[1]**

Working:

Answer: . . . . . .

(d) Explain how ventilation rate is increased during exercise. **[3]**

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(e) Suggest **one** reason why endurance-trained athletes usually have a lower resting heart rate than untrained individuals. **[2]**

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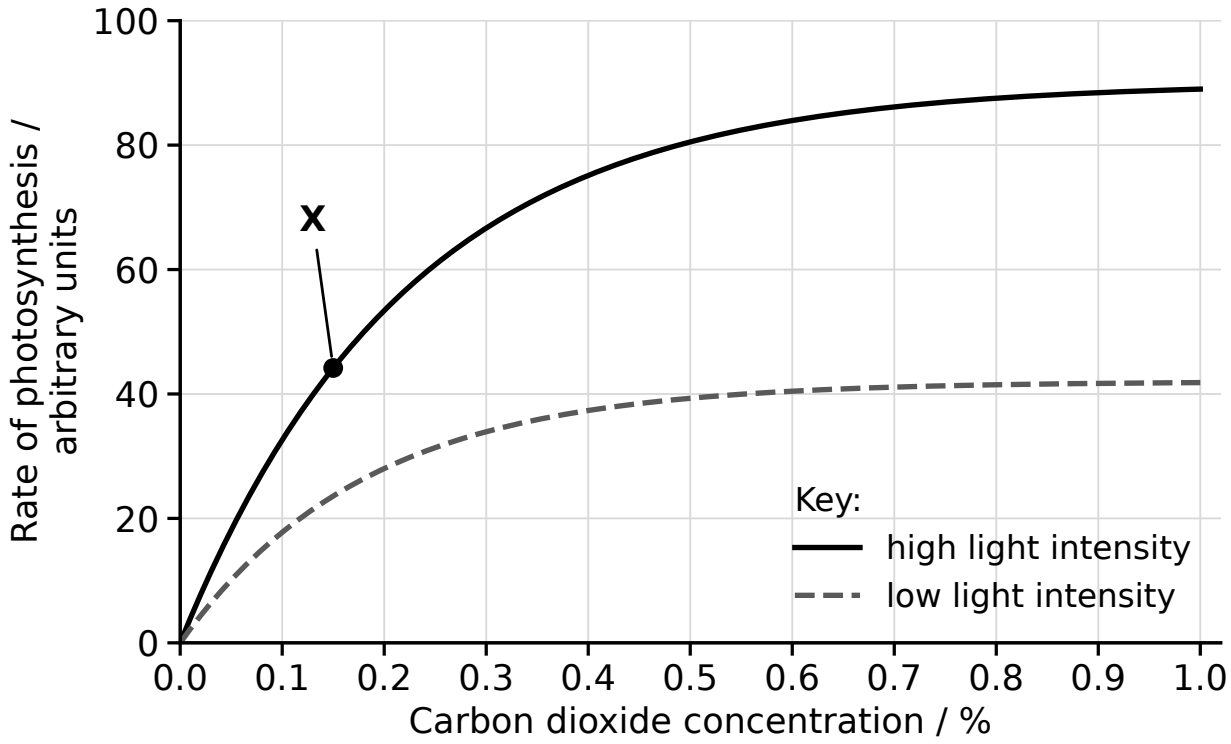
Question 3

The rate of photosynthesis of a species of pondweed was measured at a range of carbon dioxide concentrations, at two different light intensities. The temperature was kept constant at 25 °C throughout.



(a) Suggest a method that could be used to measure the rate of photosynthesis in this investigation. **[1]**

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(b) Identify the factor that is limiting the rate of photosynthesis at point **X**. **[1]**

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(c) Deduce, with a reason, the factor that is limiting the rate of photosynthesis at a carbon dioxide concentration of 0.9 % at low light intensity. **[2]**

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(d) Explain the effect of increasing carbon dioxide concentration on the rate of photosynthesis at high light intensity. **[3]**

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(e) Outline the role of the Calvin cycle in the fixation of carbon dioxide. **[2]**

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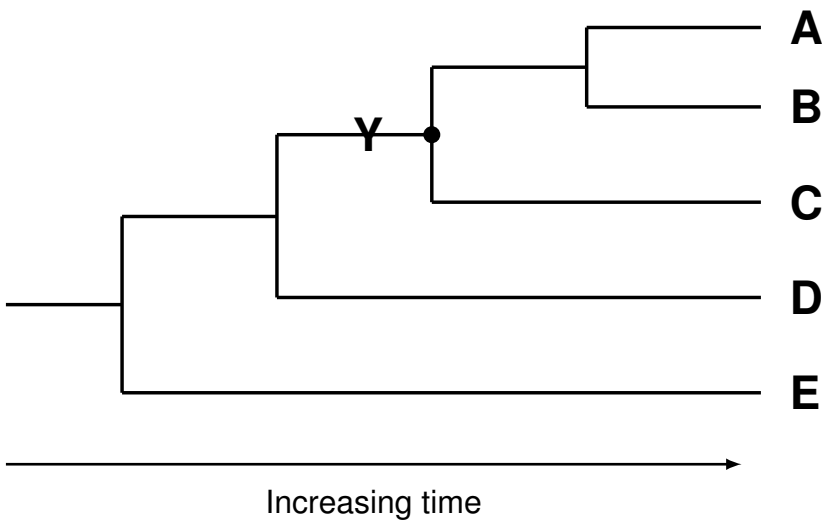
Question 4

The amino acid sequence of the same protein was determined in five species, labelled A to E. The table shows the number of amino acid differences between each pair of species.

Species	B	C	D	E
A	4	12	18	26
B	–	13	19	27
C	–	–	17	25
D	–	–	–	24

The cladogram below was constructed using these data.



(a) Deduce which two species are the most closely related. **[1]**

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(b) State what is represented by the point labelled **Y** on the cladogram. **[1]**

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(c) Outline how differences in the amino acid sequence of the same protein arise between species. **[2]**

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(d) Explain how molecular data such as these are used to determine evolutionary relationships between species. **[4]**

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