



Biology

Standard level

Paper 1B — Mock Examination

Mock Exam 3

Calculator required

Time allowed: **40 minutes**

Maximum mark: **25 marks**

Candidate information

Candidate name:

Session number:

Date:

Topic emphasis: surface area to volume ratio and diffusion, the inheritance of a single-gene condition and the use of pedigree charts and Punnett grids, ventilation and gas exchange in humans, and the growth of populations. Data processing, experimental design and the evaluation of method are assessed throughout.

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.
- The maximum mark for this examination paper is **[25 marks]**.

The mark allocation is shown in square brackets at the end of each question or part question. Where a numerical answer is required, show all of your working. Unless otherwise stated, all measurements were made at 293 K and 100 kPa.

Mark allocation

Question 1 (surface area to volume ratio)	[6 marks]
Question 2 (inheritance and pedigree analysis)	[7 marks]
Question 3 (ventilation and gas exchange)	[6 marks]
Question 4 (population growth)	[6 marks]
Total	[25 marks]

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

1. Cubes were cut from a block of agar containing a pink dye that turns colourless in alkali. Cubes of three different sizes were placed in a beaker of sodium hydroxide solution for ten minutes. Each cube was then removed and cut in half, and the percentage of the volume that had turned colourless was calculated.

Length of side / cm	Surface area / cm ²	Volume / cm ³	Volume turned colourless / %
1.0	6.0	1.0	100
2.0	24.0	8.0	70
3.0	54.0	27.0	51

- (a) Calculate the surface area to volume ratio of the cube with sides of 3.0 cm. [1]

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- (b) Explain the relationship between the size of the cube and the percentage of the volume that turned colourless. [2]

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(Question 1 continued)

- (c) Using the results of this investigation, explain why multicellular organisms require specialized gas exchange surfaces. **[2]**

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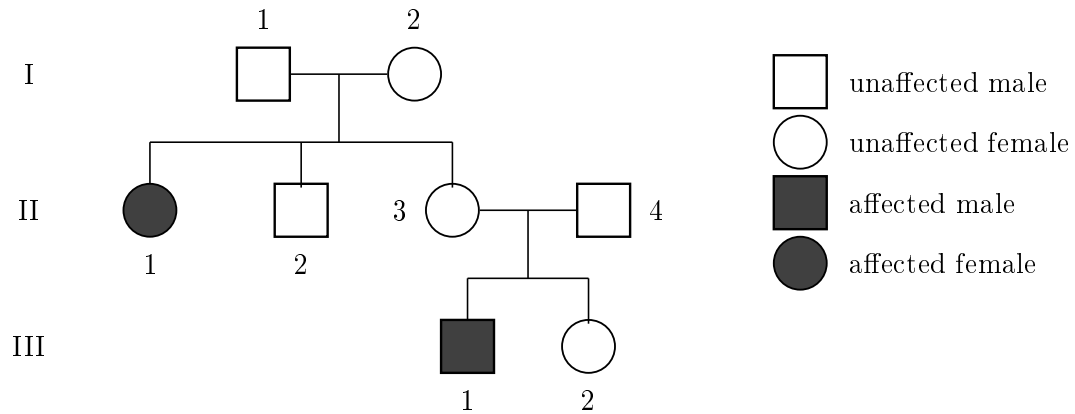
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- (d) State **one** variable, other than the size of the cube, that should be kept constant in this investigation. **[1]**

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2. Cystic fibrosis is a condition in humans caused by a single gene. The pedigree chart shows the inheritance of cystic fibrosis in one family. Shaded symbols represent individuals affected by the condition.



- (a) Deduce, with a reason, whether the cystic fibrosis allele is dominant or recessive. [2]

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(Question 2 continued)

- (b) State the genotype of individual II-3, using the symbols **F** for the unaffected allele and **f** for the cystic fibrosis allele. **[1]**

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- (c) Determine, using a Punnett grid, the probability that the next child of II-3 and II-4 will be affected by cystic fibrosis. **[3]**

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(Question 2 continued)

- (d) Suggest why the cystic fibrosis allele remains present in the human population even though affected individuals often have a reduced life expectancy. **[1]**

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3. The ventilation of a student was measured at rest and again during moderate exercise. Tidal volume is the volume of air taken in with each breath.

	At rest	During exercise
Tidal volume / dm^3	0.50	2.50
Ventilation rate / breaths min^{-1}	12	30

- (a) Calculate the volume of air taken into the lungs in one minute at rest and during exercise. **[2]**

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- (b) Explain the change in ventilation rate during exercise. **[2]**

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(Question 3 continued)

(c) Outline the changes that take place in the thorax to cause air to move into the lungs. **[2]**

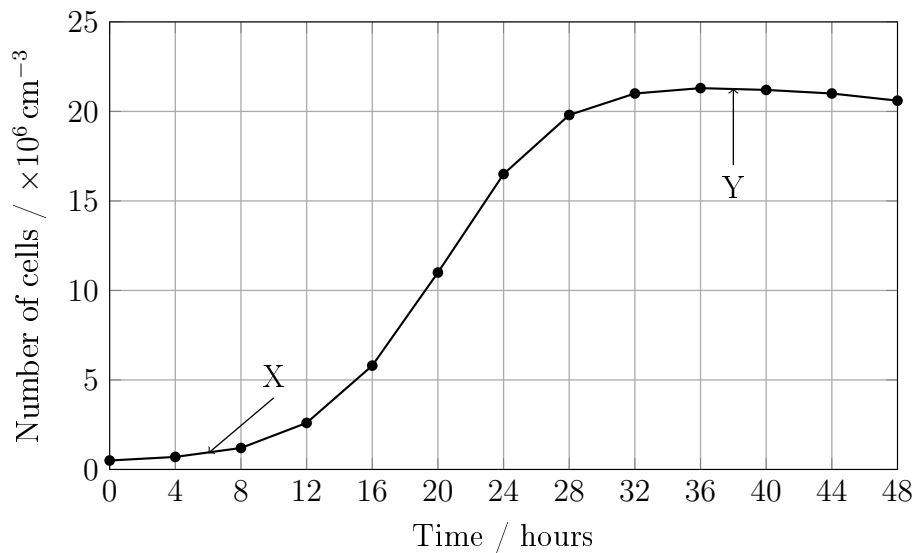
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4. A culture of the yeast *Saccharomyces cerevisiae* was grown in a closed flask containing a fixed volume of nutrient medium at 30 °C. A sample was removed at intervals and the number of cells in the sample was counted using a haemocytometer. The graph shows the mean results of three cultures.



- (a) State the name of the phase of population growth labelled X.

[1]

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- (b) Calculate the mean rate of increase in the number of cells, in $\times 10^6 \text{ cm}^{-3} \text{ h}^{-1}$, between 16 and 28 hours.

[2]

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(Question 4 continued)

(c) Explain the shape of the curve in the region labelled **Y**. **[2]**

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(d) Suggest **one** limitation of using a haemocytometer to estimate the number of living yeast cells. **[1]**

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End of examination.

Total: 25 marks