

2023 Paper 3 Answers

S/N	Possible solutions	Marks	Cambridge Comments
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a	Carbon dioxide produced during respiration is acidic ; The acidity will change the colour of the indicator ;	1 1	Generally, responses were good as the majority of candidates correctly identified carbon dioxide as the acidic gas in the exhaled air that caused the pH indicator solution to change colour. Weaker responses simply paraphrased the information provided, 'pH indicator changed colour when it became acidic', without explanation.
b	Example of values: 35 °C with 15 % glucose solution test-tube Time at start Time at end in Length of time Mean time for in min and s		The majority of candidates followed the instructions to record the temperatures of both the yeast suspension and the start and end times in Table 1.1 and Table 1.2. Varied ways of

	min and s / s		recording the start and end times
		the pH indicator solution to turn yellow / s	

	13.504.283820.7 24.495.1021 35.205.4020 45.496.1021 56.276.4215 35°C with 10% glucose solution test-tube Time at start Time at end in Length of time Mean time for in min and s min and s /s the pH indicator solution to turn yellow/s 113.4914.516235.0 214.5915.3536 315.4616.1933 416.3417.0733 517.2518.0338		were observed. The majority of candidates presented time in a clear format, e.g. 12:08. Some candidates reset the time when conducting the experiment with 10% glucose solution despite the instruction to leave the stop-watch running throughout the investigation. Most candidates converted the recorded time to seconds correctly. A significant number of candidates did not follow the instructions to circle the results they had chosen to calculate the mean time for the pH indicator to turn yellow. Some of these candidates used all five results to calculate the mean. Better
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			performing candidates showed clear understanding of the considerations when choosing appropriate results for calculating the mean time.
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c	From Table 1.1, values from test-tube 1 and 2 were 38 and 15 and from Table 1.2, test tube 1 value of 68. These values do not follow the general trend of the other values / are anomalies ; These results will either increase or decrease the mean which makes the mean value unreliable ;	1 1	This question asked candidates to use their results in Table 1.1 and Table 1.2. Stronger responses included appropriate use of results in the explanation.
d	1 m for correct calculation for 10 % glucose 1m for correct calculation for 15 % glucose	1 1	Most candidates calculated the mean rate of respiration correctly and presented their answers to three significant figures as required

e	Scale - size of graphs have to be bigger than 50 % space provided Line - two distinct bar graphs that are separated from each other Axes - labelled accurately with units Plot - accurately plotting mean rate	1 1 1 1	Most candidates could draw a bar chart, using bars of equal width with a space between them. Labelling of axes was good overall. A common error observed was not presenting the concentration of glucose as a categorical variable on the horizontal axis. Some candidates labelled each bar with '%'. In most cases, plotting was accurately done at the correct height. In some
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			cases, plotting was made difficult when inappropriate scales were used on the vertical axis.
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fi	Temperature affects the activity of enzymes involved in respiration ; Higher temperature would increase the rate of respiration while lower temperature would decrease the rate of respiration ;	1	Stronger responses showed a clear linkage between temperature and the rate of respiration. Some candidates did not answer the question and instead provided explanations on how to keep the temperature constant.
fii	Yellow colouration is dependent on the individual's perspective of yellow ; OR It takes time for someone to see the yellow colour and then look at the stopwatch to record the time of colour change ; The change of colour could either be longer or shorter than the actual value to measure rate of respiration of yeast ; There could be different concentrations of oxygen in the syringe If there is low oxygen concentration, yeast will conduct more anaerobic respiration resulting in longer time taken for change in colour of indicator as lesser carbon dioxide is produced ; OR If there is a higher oxygen concentration, yeast will conduct more aerobic respiration than anaerobic respiration, resulting in more carbon dioxide released and a shorter time taken for a change in colour of indicator ;	1 1	There was a wide range of responses. Better performing candidates were able to identify a significant error in the method to determine the rate of respiration of yeast and state its effect on the accuracy of the results. Weaker responses gave examples of human error or slowness of human reaction time
fiii	Glucose is needed for respiration to occur. The higher the glucose concentration, the higher substrate concentration available to increase the rate of respiration ;	1	Most candidates paraphrased the given information

			such as 'rate
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			of respiration was faster when 15% glucose was used' instead of giving an explanation
fiv	Use a datalogger with a carbon dioxide probe to measure volume of carbon dioxide produced ;	1	The majority of candidates were able to correctly suggest how they used a gas syringe to collect carbon dioxide gas. Weaker responses made reference to the use of limewater.

gi	Replace the mitochondria suspension with distilled water ; This is to determine that the breakdown of glucose during respiration occurs with the presence of mitochondria and not because glucose breaks down on its own ;	1 1	Stronger responses included the use of an appropriate substitution for the mitochondria suspension. The reasons given to explain the need for control experiments in the investigation were vague at times, e.g., to ensure other factors do not affect the experiment. A common error was to vary the temperature of the mitochondria suspension
gii	pH of solution ; Concentration of mitochondria ; Concentration of glucose ; Any two valid points	2	This was generally well answered. Some candidates incorrectly referred to yeast in their responses.

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a	Size and Line Accuracy Proportion	1 1 1	Better performing candidates produced accurate drawings of a reasonable size in the space provided, with well-defined outlines. Weaker responses did not reflect the correct shapes and proportions. Textbook-style drawings were observed occasionally
b	Protection of inner linings of small intestine from being digested by the presence of digestive enzymes ; AVP	1	Candidates found this question challenging. Some candidates provided irrelevant responses relating to the function of mucus in the trachea instead of the function of mucus in the small intestine.

ci	P : 42 mm Q: 39 mm R: 40 mm		Most candidates correctly measured and recorded the length of all three microvilli in millimetres. Errors in conversion from centimetres to millimetres were observed occasionally. Despite clear instructions, some
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			candidates recorded lengths in centimetres rather than millimetres.
cii	Mean length = $(42+39+40) / 3$ = 40.3 mm (3sf)	1 1	The majority of candidates were able to calculate the mean length using values from (c)(i). Some candidates did not present their answers to one significant figure as required.

ciii	Actual mean length = $20000 / (40.3 / 0.001)$ = $0.5 \mu\text{m}$ Actual mean width = $20000 / (3 / 0.001)$ = $6 \mu\text{m}$	1 m for conversion 1m for correct working 1m for correct answers	Most candidates calculated magnification well and showed clear working in the conversion from mm to μm. Some candidates did not heed the instruction to present the answer to one significant figure.
d	Long length of small intestine which gives enough time for absorption of digested products (Fig. 2.1) ; Presence of villi at the inner linings of the small intestine to increase the surface area to volume ratio for increased absorption of digested products (Fig. 2.2) ; Presence of microvilli to increase surface area to volume ratio of the small intestinal cells, to increase rate of absorption by individual small intestinal cells (Fig. 2.4) ; Presence of mitochondria in small intestine cells to release energy for active transport of digested products (Fig. 2.4) ; Presence of lacteal and blood capillaries to transport digested products away from the small intestine to always provide a steep concentration gradient for absorption	1 1 1 1 1	This question was generally well answered. Stronger responses made reference to information visible in the four figures such as 'villus having a good blood supply' and 'intestinal walls having many folds and villi'. Weaker responses made

	(Fig. 2.3) ;		reference to features that were not visible in any of the four figures. A number of responses appeared confused with microvilli
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			containing mitochondria