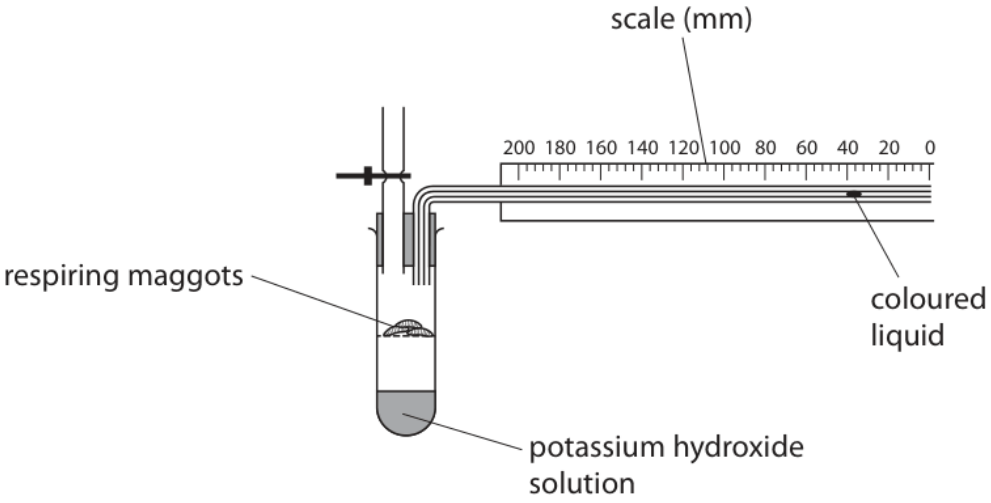
Respiration, Spirometer Traces and Habituation (Core Practicals 16 to 18): Edexcel SNAB A Level Biology Exam Que

19 questions · 56 marks · about 67 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 2 · June 2023 · Q6(b) · 2 marks

(b) Respiration in maggots is similar to respiration in humans.

In an investigation, three maggots were placed in a respirometer as shown.



The maggots respired aerobically for 20 minutes in this respirometer.

Explain why the coloured liquid moved to the left during the 20 minutes of this investigation.

(2)

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Question 2 · A level Paper 2 · June 2023 · Q6(c) · 5 marks

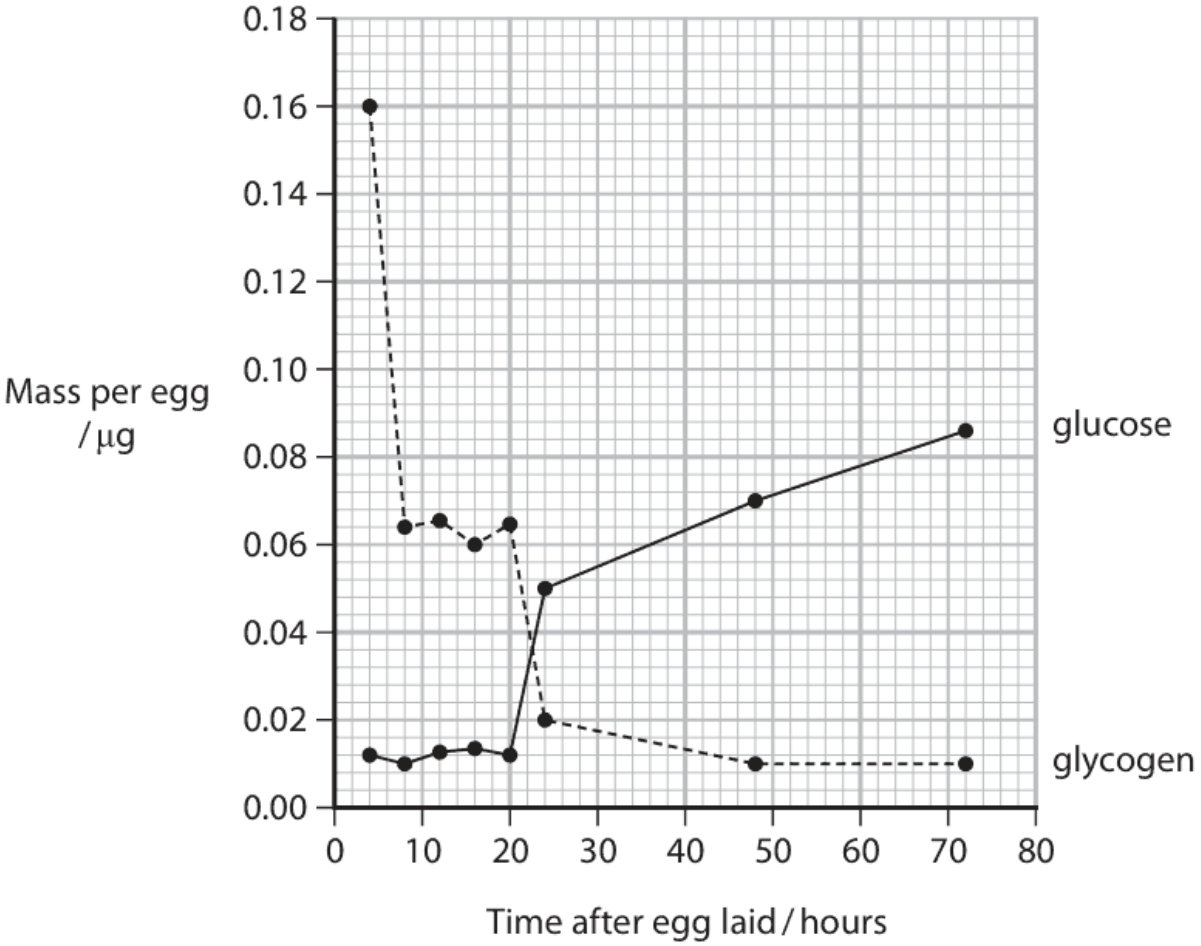
(c) Devise an investigation, using a respirometer, to find the optimum temperature for respiration in maggots.

(5)

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Question 3 · information from earlier in the question

(c) The graph shows the changes in mass of glucose and glycogen in the eggs of the red flour beetle during embryo development.



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Question 3 · A level Paper 3 · June 2022 · Q6(c)(ii) · 3 marks

(ii) A student suggested that between 20 and 24 hours the cells in the developing embryo switched from anaerobic to aerobic respiration.

Describe how a respirometer could be used to test this suggestion.

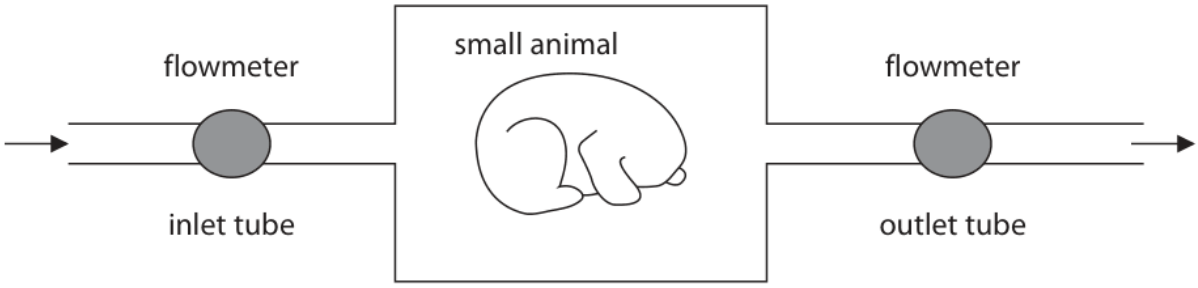
(3)

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Question 4 · A level Paper 2 · June 2018 · Q7(b)(iii) · 4 marks

(iii) The data for calculating metabolic rate are collected using a respirometer.

The rate of respiration for small mammals can be measured using a continuous flow respirometer. A continuous flow respirometer circulates air through a chamber containing the animal. The rate of air flow can be measured using flowmeters on the inlet and outlet tubes.



Devise a procedure using a continuous flow respirometer to collect the data required to calculate the metabolic rate of an arctic ground squirrel.

(4)

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Question 5 · A level Paper 2 · June 2025 · Q2(a) · 3 marks

2 A spirometer can produce a trace used to study breathing.

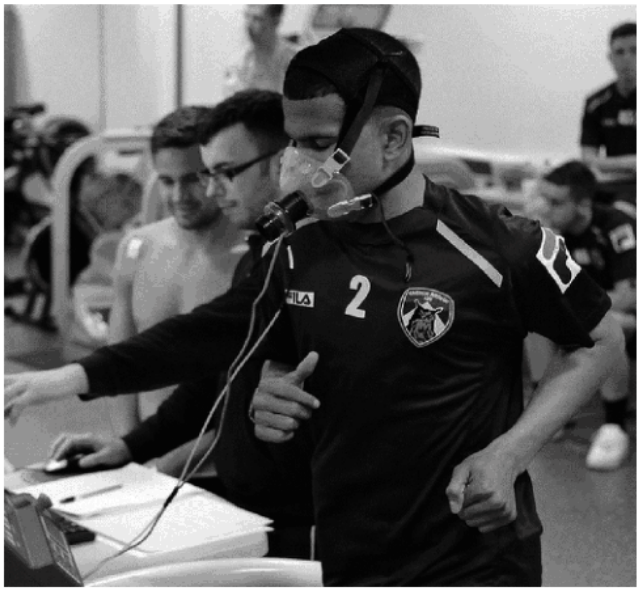
(a) When using a spirometer, the same air is repeatedly inhaled and exhaled. Before the air is inhaled from the spirometer, it passes through soda lime to remove carbon dioxide.

Explain the effect on breathing if the inhaled air is **not** passed through soda lime.

(3)

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2 A spirometer can be used to study the performance of an athlete.



snabbiology.wordpress.com

The trace produced by a spirometer can be used to determine the respiratory minute ventilation and the oxygen consumption of an individual.

(a) Describe how a spirometer trace can be used to calculate the respiratory minute ventilation and the oxygen consumption per minute.

(4)

respiratory minute ventilation

oxygen consumption per minute

Questions, mark schemes and examiners' report extracts © Pearson Education Ltd.

Question 7 · A level Paper 2 · October 2020 · Q2(b) · 2 marks

(b) A student compared the spirometer trace for a pair of healthy, genetically identical twins.

State two variables that would have to be controlled to make this a valid comparison.

(2)

.....

.....

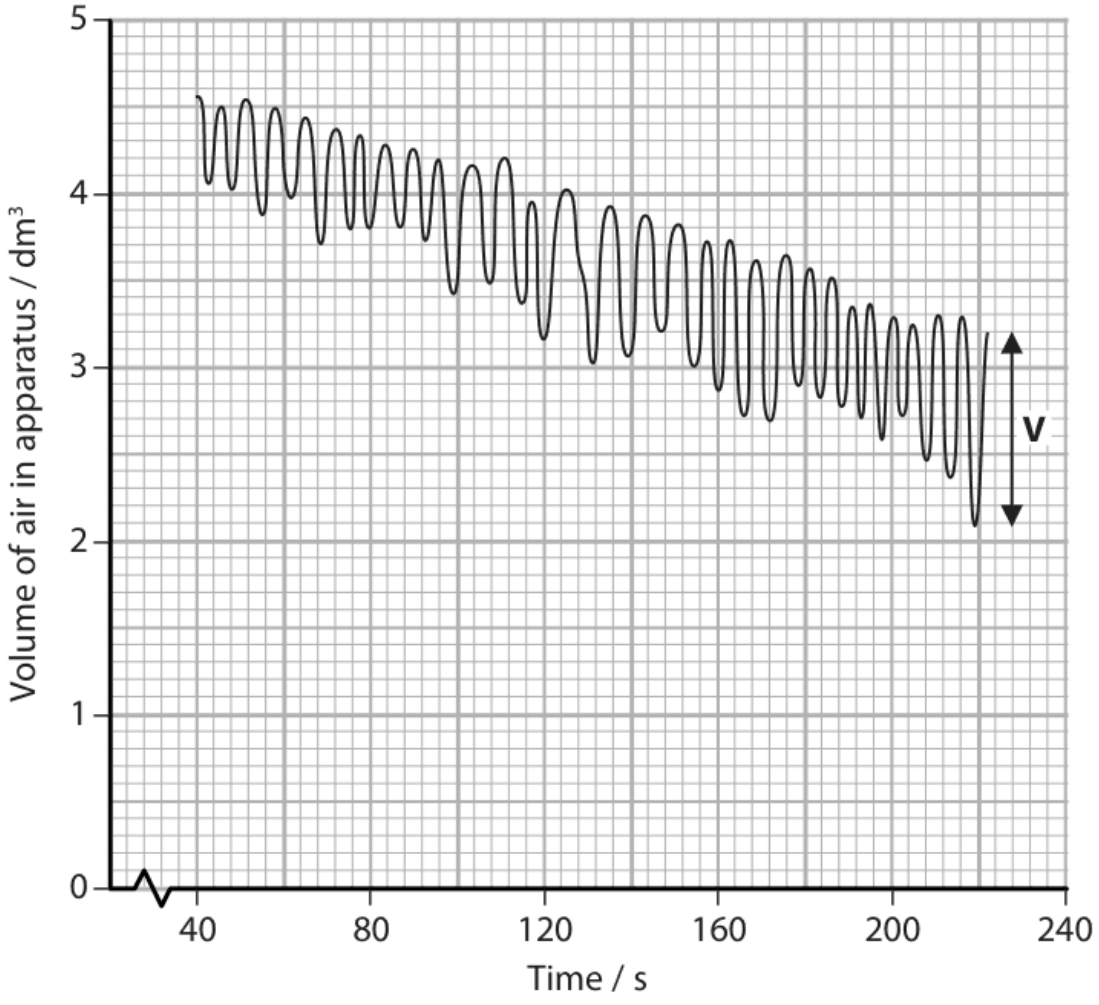
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Question 8 · information from earlier in the question

(b) A person breathed air in and out of the air chamber of a piece of apparatus.

Measurements were made of changes in the volume of air in the chamber. The carbon dioxide produced was removed from the chamber. The changes in volume were recorded on the trace shown in the diagram.



Questions, mark schemes and examiners' report extracts © Pearson Education Ltd.

Question 8 · A level Paper 2 · June 2017 · Q3(b)(iv) · 3 marks

(iv) Calculate the rate of oxygen uptake between 80 and 120 seconds.

(3)

Answer ..... $cm^3\ min^{-1}$

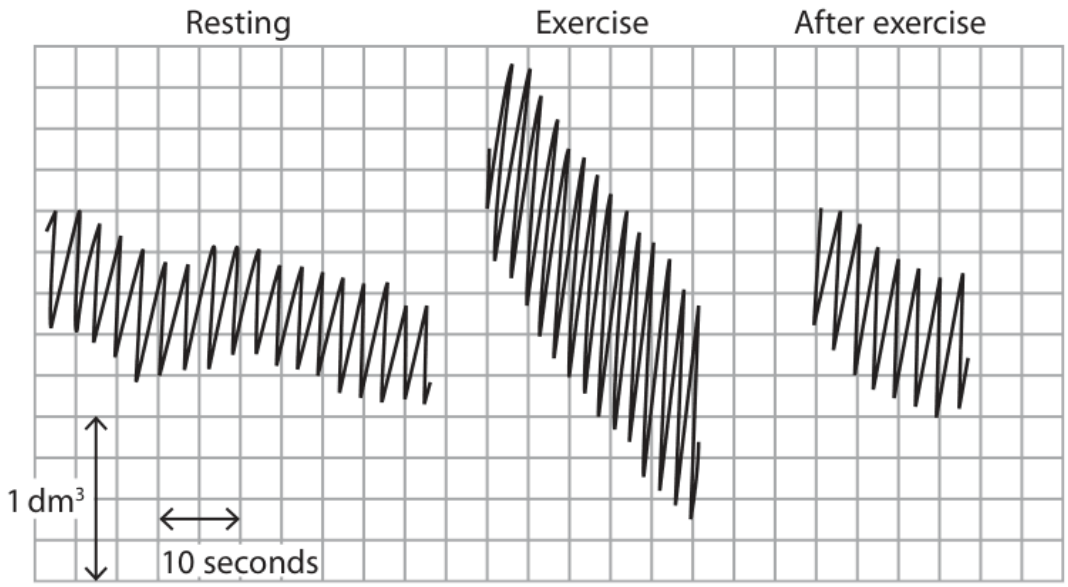
Question 9 · A level Paper 3 · June 2019 · Q3(a) · 2 marks

3 The demand for oxygen changes during exercise.

The change in demand affects the breathing rate.

(a) Changes in breathing can be investigated using a spirometer.

Spirometer traces taken from the same individual before, during and two minutes after exercise are shown.



Calculate the rate of oxygen consumption during exercise.

(2)

Question 10 · A level Paper 3 · June 2019 · Q3(b) · 4 marks

(b) Explain the effect of exercise on the changes in oxygen consumption.

(4)

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Question 11 · A level Paper 2 · June 2022 · Q5(b)(i) · 4 marks

(b) The availability of oxygen in the air is lower at high altitudes because of the lower air pressure.

Populations of humans that have lived at high altitude for many generations have adapted to these conditions.

One adaptation these people have is a larger thorax than people living at lower altitudes.

A student made the following hypothesis:

People with this adaptation will have a lower breathing rate as their tidal volume will be greater than those without the adaptation.

(i) Devise a valid investigation, using a spirometer, to test this hypothesis.

(4)

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Question 12 · A level Paper 2 · June 2025 · Q2(b)(iii) · 3 marks

(iii) Devise an investigation, using a spirometer, to find the change in the rate of oxygen uptake of a person during exercise compared with at rest.

(3)

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Question 13 · A level Paper 3 · June 2025 · Q2(b)(i) · 1 mark

(b) *Stentors* are found in fresh water attached to pebbles.

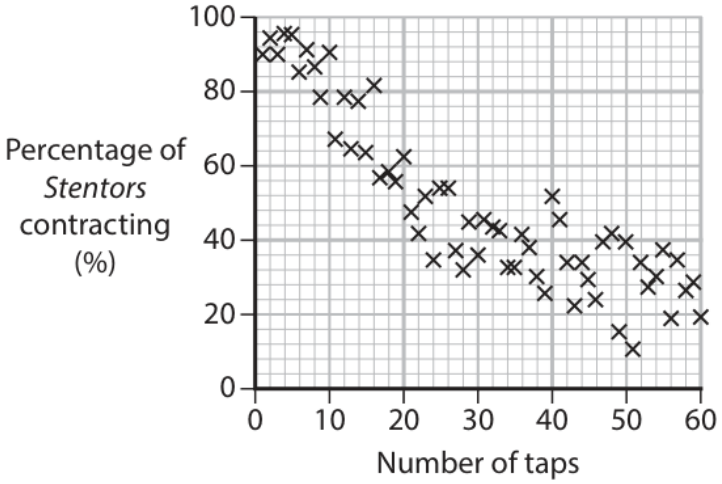
The response of *Stentors* to a stimulus was investigated.

A sample of 150 *Stentors* was allowed to attach to the bottom of a Petri dish filled with stream water. The *Stentors* were then given two hours to acclimatise.

The Petri dish was then tapped with a ruler once every minute.

After each tap, the percentage of *Stentors* that contracted was recorded.

The results are shown in the graph.



(i) The frequency of tapping the Petri dish was controlled.

Give **one other** variable of the tapping stimulus that should be controlled.

(1)

.....

Question 14 · A level Paper 3 · June 2025 · Q2(b)(iii) · 2 marks

(iii) Give **two** conclusions that can be drawn from the results of this investigation.

(2)

1 .....

.....

.....

2 .....

.....

.....

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(b) The 'light-off jump' assay can be used to study habituation in fruit flies.

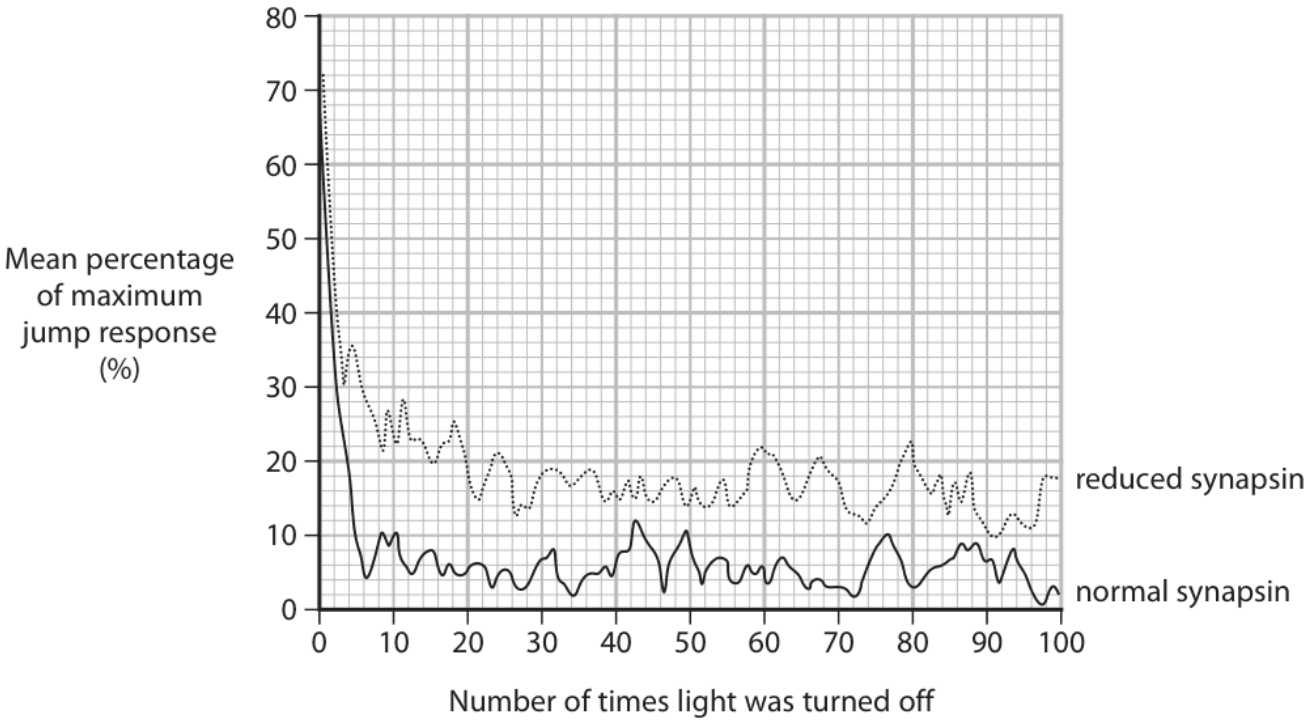
When the light is turned off the flies jump into the air and attempt to fly away.

The strength of this response can be measured by recording the noise made by the flies.

In one experiment, fruit flies with reduced expression of a protein called synapsin were compared with a control group.

Synapsin is a protein that inhibits the binding of presynaptic vesicles to the cell membrane.

The results of this experiment are shown in the graph.



(i) State two variables associated with the light-off stimulus that need to be controlled in this experiment.

(2)

.....

.....

.....

.....

.....

.....

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Question 16 · A level Paper 3 · June 2022 · Q5(b)(ii) · 3 marks

(ii) Determine the effect of reduced synapsin on the habituation of fruit flies in this experiment.

(3)

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Question 17 · A level Paper 2 · June 2019 · Q9(b)(i) · 2 marks

(b) The effect of being shown a cheeseburger on saliva production in a child was studied.

The mass of saliva produced by this child was measured.

The child was then shown a cheeseburger and the new mass of saliva produced was measured. The change in the mass of saliva produced was recorded.

This was repeated with the child being shown a cheeseburger on eight occasions, at five minute intervals.

The results in the table show the change in mass of saliva produced compared with the mass of saliva produced before the child being shown a cheeseburger.

Occasion	Change in mass of saliva produced / g
1	+ 0.30
2	+ 0.18
3	+ 0.05
4	+ 0.02
5	+ 0.02
6	– 0.08
7	– 0.18
8	– 0.19

(i) Describe the effect on saliva production shown by these results.

(2)

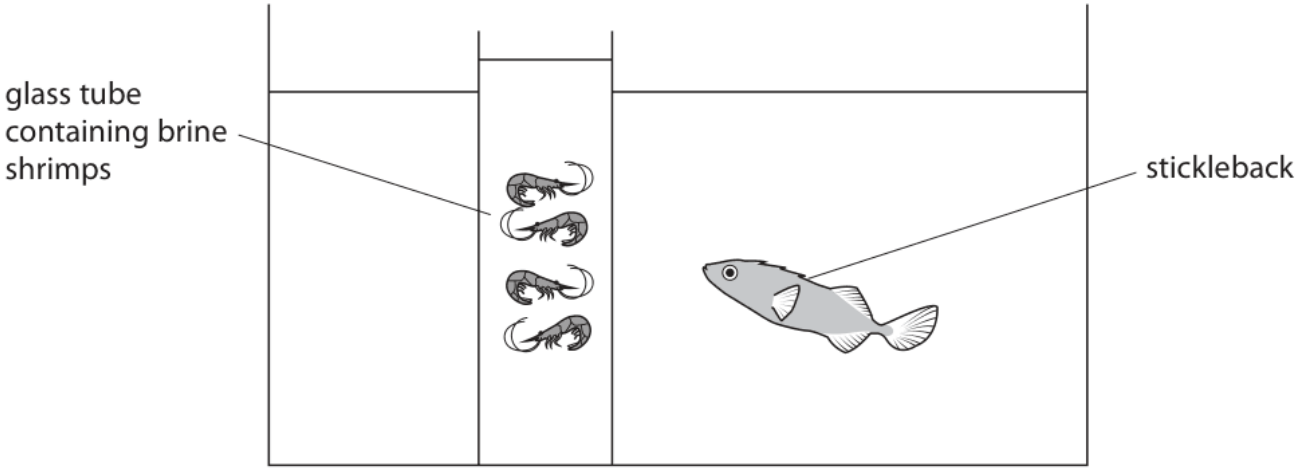
Questions, mark schemes and examiners' report extracts © Pearson Education Ltd.

Question 18 · information from earlier in the question

(b) An investigation studied the food biting response of the three-spined stickleback.

Individual fish were allowed to acclimatise in their own tanks.

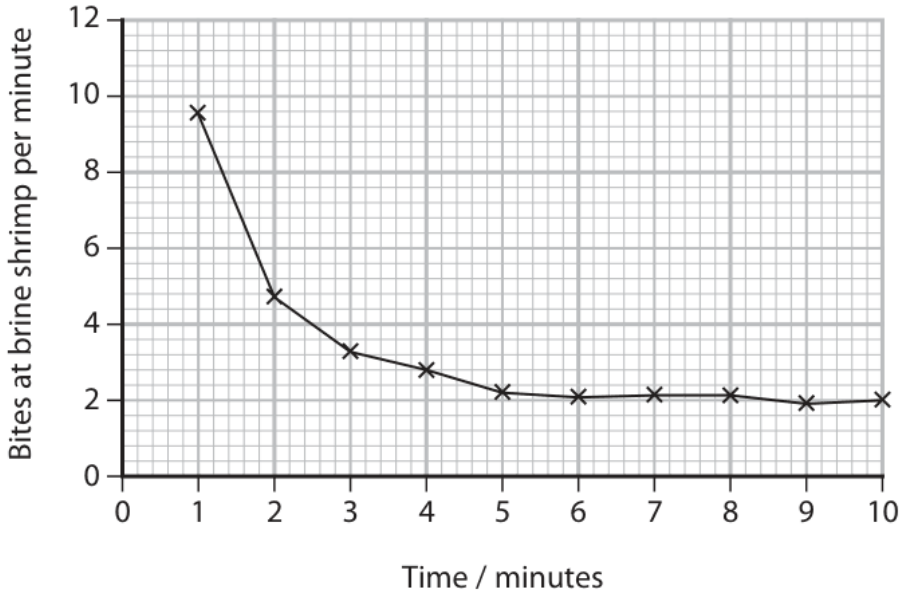
A glass tube containing several live brine shrimps was placed in the middle of the tank, as shown in the diagram.



The stickleback tried to bite the brine shrimps in the tube.

The number of bites made by the stickleback was recorded each minute for 10 minutes.

The graph shows the results of this investigation.



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Question 18 · A level Paper 3 · June 2023 · Q3(b)(ii) · 3 marks

(ii) Explain the results of this investigation.

(3)

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(c) Studies were carried out to investigate the withdrawal response in earthworms.

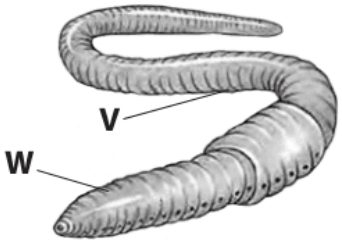
The duration of the withdrawal response is the length of time that the muscles remain contracted. If the stimulus is repeated, the withdrawal response is either reduced in duration or lost.

In one study, an earthworm was touched 20 times in one minute at point **V** as shown in the diagram. The shortening of the earthworm's body was measured after 20 stimuli.

The effect of touching point **W** in the same way was recorded and also the effect of alternating touches between points **V** and **W**.

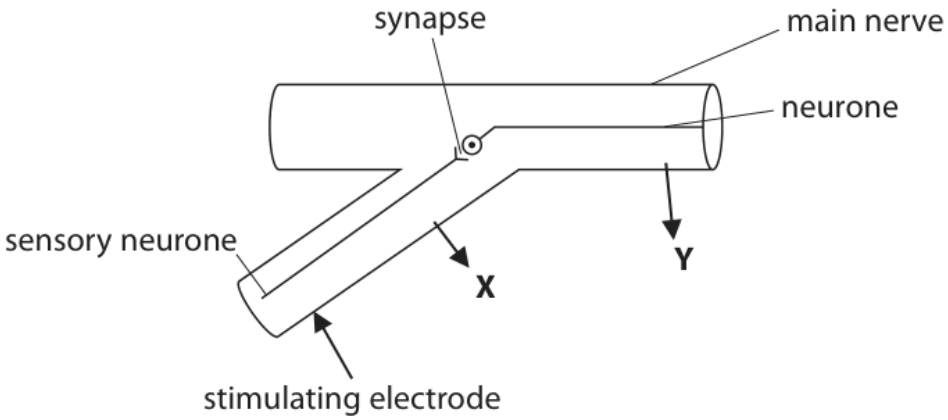
The results of this study are shown in the table.

Nature of stimulus	Change in body length after 20 stimuli / mm
All stimuli at point **V**	0
Stimuli alternating between points **V** and **W**	17
All stimuli at point **W**	0

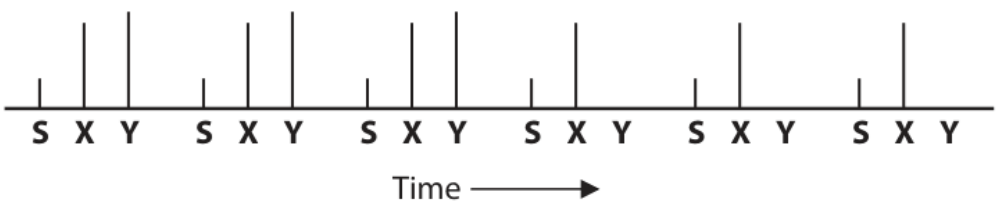


In another study, sensory neurones of an earthworm were stimulated by an electrode six times.

Nerve impulses were recorded at positions **X** and **Y** as shown in the diagram.



Nerve impulses recorded at **X** and **Y** are shown in the diagram below. The presence of a line indicates that an impulse was detected. **S** shows the stimulus.



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Question 19 · A level Paper 2 · June 2017 · Q8(c)(ii) · 4 marks

(ii) Devise an experiment to show that the frequency of the stimulation used in the first study should be 20 stimuli per minute.

(4)

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Mark schemes

Question 1 · A level Paper 2 · June 2023 · Q6(b) · 2 marks

Question Number	Answer
6(b)	An explanation that makes reference to two of the following: • decrease in {pressure/volume} (in the tube) (1) • as oxygen {used / taken out of tube / taken up by maggots} (1) • as carbon dioxide released is absorbed by potassium hydroxide (1)

Additional Guidance	Mark
	[2]

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Question Number	Answer
6(c)	An answer that makes reference to five of the following: • suitable range of temperatures (1) • control of a relevant biotic variable (1) • record distance bubble travels in a set time / record time taken to travel a set distance (1) • judgement of optimum (1) • details of respirometer set up (1) • repeats at each temperature to calculate a mean value (1)

Additional Guidance	Mark
e.g. 5- 50° C Range to be at least 3 temperatures. e.g. age, species, mass or size of maggots IGNORE number of maggots e.g. note first temperature where distance bubble moves is less, so previous highest temperature to this is the optimum ALLOW temperature at which rate is highest e.g. use water baths, soda lime, time for organisms to acclimatise ALLOW average for mean	[5]

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Question 3 · A level Paper 3 · June 2022 · Q6(c)(ii) · 3 marks

Question number	Answer
6(c)(ii)	A description that makes reference to three of the following: • comparison using sensible period of time before 20 hours and after 24 hours (1) • use of a carbon dioxide absorber (1) • {observe movement of / measure distance moved by} (coloured) liquid in {capillary tube / respirometer} (1) • (coloured liquid) does not move during anaerobic respiration and moves during aerobic respiration compared to (1)

Additional guidance	Mark
e.g. 0 to 20 hours compared with 24 to 30 hours / use 18 to 26 hours e.g. soda lime, sodium hydroxide ALLOW measure change in volume of gas in gas syringe (above embryos) ALLOW answers in terms of volume of gas produced / used	(3)

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Question 4 · A level Paper 2 · June 2018 · Q7(b)(iii) · 4 marks

Question Number	Answer
7(b)(iii)	An answer that makes reference to four of the following: • use of {potassium hydroxide / sodium hydroxide / soda lime} to remove carbon dioxide (1) • measure volumes of air entering and leaving the chamber (1) • decrease in volume of air represents oxygen taken up (by ground squirrel for respiration) (1) • control the temperature / measure mass of squirrel / measure for a stated period of time (1) • divide volume of oxygen used in a unit of time by the body mass of the ground squirrel to calculate its metabolic rate (1)

Additional Guidance	Mark
ALLOW a sensible specified time ALLOW volume of oxygen ÷ (mass × time)	**(4)**

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Question 5 · A level Paper 2 · June 2025 · Q2(a) · 3 marks

Question Number	Answer
2 (a)	An explanation that makes reference to three of the following: • depth of breathing increases / tidal volume would increase (1) • breathing rate would increase (1) • as carbon dioxide is not removed / carbon dioxide in air increases (1) • so {more carbon dioxide / reduced pH} in blood (1)

Additional Guidance	Mark
ALLOW as carbon dioxide in spirometer increases ALLOW: inhaling more carbon dioxide	**(3)**

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Question 6 · A level Paper 2 · October 2020 · Q2(a) · 4 marks

Question Number	Answer
2(a)	A description that makes reference to four of the following: Respiratory minute volume: • find the difference in peak to trough volume (to give the tidal volume) (1) • find ventilation rate (1) • multiply the tidal volume by ventilation rate (1) Oxygen consumption • difference in volume of one { peak / trough } compared to a subsequent one (1) • description of time calculation to produce a value per minute (1)

Additional Guidance	Mark
ALLOW reference to troughs instead of peaks e.g. count the number of peaks in a stated time and convert to per minute / count how many peaks in one minute ALLOW: breathing rate for ventilation rate e.g. divide by time between the two { peaks / troughs } and multiply by 60	**(4)**

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Question 7 · A level Paper 2 · October 2020 · Q2(b) · 2 marks

Question Number	Answer
2(b)	An answer that makes reference to two of the following: • level of fitness / physical activity (1) • body mass (1) • exposure to the same environmental conditions (1)

Additional Guidance	Mark
ALLOW same level of exercise / duration of exercise ALLOW same weight	(2)

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Question 8 · A level Paper 2 · June 2017 · Q3(b)(iv) · 3 marks

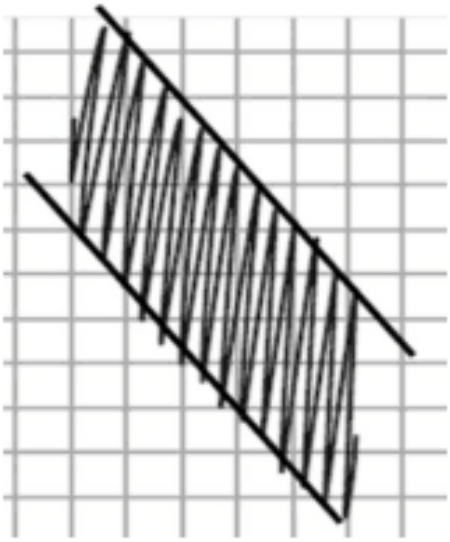
Question number	Answer
3(b)(iv)	• volume divided by time to produce rate (1) • conversion of volume measured from graph from dm^3 to cm^3 (1) • calculation of rate per minute (1)

Additional guidance	Mark
<u>Example of calculation</u> 0.65 ÷ 40 Multiplied by 1000 = 16.25 e.g. 16.25 x 60 Answer = **900- 975** 90.0-97.5 or 9000-9750 gains two marks as only one step incorrect Correct answer with no working gains full marks	(3)

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Question 9 · A level Paper 3 · June 2019 · Q3(a) · 2 marks

Question Number	Answer
3(a)	• correct slope drawn on the chart (1) • correct calculation (1)

Additional guidance	Mark
 e.g. 1 ÷ 15 = 0.0667 ALLOW 0.06 to 0.075 Correct answer with no working gains full marks	**(2)**

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Question 10 · A level Paper 3 · June 2019 · Q3(b) · 4 marks

Question Number	Answer
3(b)	An explanation that makes reference to four of the following: • (exercise will) increase oxygen consumption (1) • (because there is) increased aerobic respiration (1) • because (more) {energy / ATP} is needed by muscles (1) • oxygen required to convert { lactate / lactic acid } into { glucose / pyruvate } (1) • oxygen consumption begins to decrease after exercise (1)

Additional guidance	Mark
ALLOW more oxygen is needed with exercise ALLOW oxygen consumption after exercise is higher than at rest	**(4)**

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Question 11 · A level Paper 2 · June 2022 · Q5(b)(i) · 4 marks

5(b)(i)	An answer that makes reference to four of the following: • select people with different thorax sizes (1) • select people who are similar in other respects (1) • one relevant variable controlled (1) • measurement of tidal volume from spirometer trace (1) • measure breathing rate as number of {peaks / troughs} in a set time (1)

ALLOW with or without the adaptation, who lived at high altitude and low altitude

e.g. same age, same fitness level, same sex

e.g. temperature, same level of previous activity, data collected when subjects were at rest

ALLOW difference in peak to trough volume gives tidal volume

ALLOW – measure breathing rate by counting number of breaths in a set time **(4)**

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Question 12 · A level Paper 2 · June 2025 · Q2(b)(iii) · 3 marks

Question Number	Answer
2 (b)(iii)	An answer that makes reference to three of the following: • take measurements during rest and during exercise (1) • repeat when collecting {rest / exercise} data to calculate a mean (1) • calculate decrease in volume (1) • work out the change in rate of oxygen uptake (1)

Additional Guidance	Mark
	(3)

Question 13 · A level Paper 3 · June 2025 · Q2(b)(i) · 1 mark

Question number	Answer	Additional guidance	Mark
2(b)(i)	An answer that makes reference to the following: • strength / force of tap	ALLOW hardness	(1)

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Question 14 · A level Paper 3 · June 2025 · Q2(b)(iii) · 2 marks

Question number	Answer
2(b)(iii)	An answer that makes reference to the following: • (overall) as number of taps increases the {number / percentage} of Stentor contracting decreases (1) • the Stentors were becoming habituated (1)

Additional guidance	Mark
ALLOW negative correlation between number of taps and percentage of Stentors contracting IGNORE inversely proportional ALLOW not all Stentors habituated at 60 taps ALLOW Stentors can become habituated	(2)

Question 15 · A level Paper 3 · June 2022 · Q5(b)(i) · 2 marks

Question number	Answer
5(b)(i)	An answer that makes reference to two of the following: • frequency of light-off pulses (1) • duration of light-off pulse (1) • {wavelength / intensity} of light (1)

Additional guidance	Mark
ALLOW interval between {pulses / turning lights off}	(2)

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Question 16 · A level Paper 3 · June 2022 · Q5(b)(ii) · 3 marks

Question number	Answer
5(b)(ii)	An answer that makes reference to three of the following: • (with reduced synapsin) habituation is not as complete / there was a greater percentage of maximum jump response (1) • (with reduced synapsin) habituation takes place more slowly / jump-response decreases more slowly (1) • appropriate {manipulation / comparative use of data} (1)

Additional guidance	Mark
ALLOW converse for normal synapsin ALLOW higher jump-response / jumped-more e.g. jump response decreases by (14-4) 10% more with normal synapsin / takes (30-5) 25 more light-off stimuli to get maximum response for reduced synapsin after 100 light stimuli 16% higher with reduced synapsin	(3)

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Question 17 · A level Paper 2 · June 2019 · Q9(b)(i) · 2 marks

Question Number	Answer
9(b)(i)	A description that makes reference to two of the following: • being shown a cheeseburger increases saliva production (1) • repeated occasions results in less saliva production (1) • after six or more occasions there is less saliva produced than before being shown a cheeseburger (1)

Additional Guidance	Mark
ALLOW negative correlation appropriately qualified	(2)

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Question 18 · A level Paper 3 · June 2023 · Q3(b)(ii) · 3 marks

Question number	Answer
3(b)(ii)	An explanation that makes reference to three of the following: • as time increased number of bites decreased (1) • because the stickleback are unable to get to the brine shrimps (1) • therefore they have become **habituated** (1) • to avoid wasting energy (1)

Additional guidance	Mark
ALLOW up to 6 minutes the number of bites (per minute) decreases IGNORE over time fish stopped biting at the brine shrimp ALLOW because stimulus was not rewarded ALLOW fish realises it cannot {eat / get to} the shrimp IGNORE description of mechanism of habituation IGNORE reference to brine shrimp no longer being a threat	(3)

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Question 19 · A level Paper 2 · June 2017 · Q8(c)(ii) · 4 marks

Question number	Answer
8 (c)(ii)	An answer that makes reference to the following points: • description of suitable range of (at least five) frequencies (1) • a method for making application of stimuli consistent / control of recovery time between tests (1) • a method for checking for habituation in earthworms (1) • repeats with other earthworms of same { species / size } (1)

Additional guidance	Mark
ALLOW range of five different frequencies above and below 20 per minute e.g. (touch with a cotton bud) to same place each time e.g. give 2 minutes between each test e.g. observing for no response to touch / finding no change in length of earthworm (Maximum of 2 marks if investigation described in context of snails)	(4)

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