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June 2024

IAL Biology WBI16 01

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Introduction

For the paper this session, candidates faced the following questions:

Question 1 asks candidates to consider the practical aspects of investigating the effect of temperature on the respiration of yeast.

Question 2 is based on a core practical, habituation in organisms. This question requires describing a method to investigate habituation in woodlice followed by data handling and control of variables.

Question 3 is based on an aspect of ecology, namely habitat preference.

Question 4 is based on a core practical, measuring the respiration rate of germinating seeds.

In general, candidates showed knowledge of the methods used for this investigation. They clearly identified variables that needed to be controlled but their descriptions as to how the control could be achieved, frequently lacked the necessary precision required.

Question 1 (a)(i)

The question asks candidates to state the location in the mitochondria where oxidative phosphorylation takes place.

(i) State the location in the mitochondria where oxidative phosphorylation takes place.

(1)

Cristae

ResultsPlus Examiner Comments

A correct location is given to achieve the mark.

(i) State the location in the mitochondria where oxidative phosphorylation takes place.

(1)

Intermembrane space

ResultsPlus Examiner Comments

An example of an incorrect response.

(i) State the location in the mitochondria where oxidative phosphorylation takes place.

(1)

inner mitochondrial membrane

ResultsPlus Examiner Comments

This was the most frequent correct answer given by candidates.

Question 1 (a)(ii)

This question asks for a named molecule that carries hydrogen for use in oxidative phosphorylation.

(ii) Name **one** molecule that carries hydrogen for use in oxidative phosphorylation.

(1)

NADP

ResultsPlus
Examiner Comments

An example of an incorrect answer.

ResultsPlus
Examiner Tip

Good recall of the process of oxidative phosphorylation is required to name an appropriate molecule.

(ii) Name **one** molecule that carries hydrogen for use in oxidative phosphorylation.

(1)

NAD

ResultsPlus
Examiner Comments

A correct answer

(ii) Name **one** molecule that carries hydrogen for use in oxidative phosphorylation.

(1)

ATP Synthase Protein channel.

ResultsPlus
Examiner Comments

This candidate does not seem to have read the question carefully enough as they appear to be thinking about movement across a membrane.

Question 1 (b)

This question asks candidates to describe an experiment to investigate the effect of temperature on the rate of respiration in yeast, using an artificial hydrogen acceptor.

(b) Describe an experiment to investigate the effect of temperature on the rate of respiration in yeast, using an artificial hydrogen carrier (redox indicator).

(5)

The dependent variable in this investigation is the time taken for DCPIP to change color from blue to colorless. Produce 5 solutions of glucose and add yeast suspension to it. Ensure that you add the same mass of yeast suspension and that the concentration of glucose in each solution is kept constant by adding same mass of glucose in each. Produce 5 water baths of 5 varying temperatures i.e; 0°C, 10°C, 20°C, 30°C, 40°C and 50°C. Place test tubes containing yeast suspension within water baths and measure the time taken for color to change from blue to colorless. Repeat to obtain mean values of time at each temperature range. Ensure that the ph remains constant using a buffer solution. To calculate the rate of respiration use the formula, rate = $\frac{1}{\text{time taken}}$ for each temperature. Ensure that you Ensure that you work near a bunsen flame to maintain a sterile environment and prevent contamination of yeast suspension.

ResultsPlus
Examiner Comments

This answer does not describe how to control temperature adequately, however, four aspects of the method are given credit.

(b) Describe an experiment to investigate the effect of temperature on the rate of respiration in yeast, using an artificial hydrogen carrier (redox indicator).

(5)

Independent variable:- Use 5 different temperature (5°C, 15°C, 20°C, 25°C, 30°C).

Dependent variable:- Measure the time taken for the color of TTC to change from colorless to red.

Methadology → Get yeast of same concentration, mass. Add suitable amount of yeast & water. Bring 5 testtubes add suitable amount of yeast & distilled water. Bring another 5 testtubes add ttc & distilled water. Then Add each testtube into a water bath & leave it to incubate at 38°C different temperatures. Then leave them for a suitable period of time. Then add the yeast to ttc keep mixing for a suitable period of time until the color changes into red. Measure the time taken for color to change from colorless to red. Measure the color the change using a colorimeter.

Control → Same pH → buffer, same age of yeast, same volume of distilled water, same conc. of ttc. same conc. of yeast

Repeat the experiment with different temperatures under the same conditions. Repeat the experiment at least 5 times & get the mean, draw error bars &

ResultsPlus
Examiner Comments

A clear method is described using five degree temperature intervals. This response gains maximum marks.

(b) Describe an experiment to investigate the effect of temperature on the rate of respiration in yeast, using an artificial hydrogen carrier (redox indicator).

(5)

Independant Variable: ~~Dep~~ 5 different temperatures (15, 20 25 30°c, 35°C) using Thermostatically controlled Waterbath. Dependant Variable Time taken for the redox indicator TTC to turn red. ~~Sep~~ Set up the first water bath also ~~5~~. Prepare yeast suspension CAdd 10g of dried yeast and 50g of glucose to 100 cm^3 distilled water mix thaurogly. Pipette 10 cm^3 yeast suspension in one test tube and 1 cm^3 TTC in a different test tube, ~~pt~~ the place both test tube into the water & leave them for 5 minutes to allow them to reach Temperature of the water, the start stopwatch. ~~St~~ stirring once the solution was turned record. Record the time taken in a suitable table. Repeat the above steps with 4 remaining temperatures. Repeat experiment several. Controlled Variables: volume of yeast suspension, volume & Concentration of TTC, Mass of glucose added, ~~sp~~ Mass of dried yeast, Volume of distilled water, Source of yeast). Repeat experiment several times at each temperature and calculate mean and SD, plot a graph of the results. Statistical test - Spearman Rank correlation.

ResultsPlus
Examiner Comments

Another clear answer gaining maximum marks.

ResultsPlus
Examiner Tip

If water baths are required for an investigation they should be thermostatically controlled.

Question 1 (c)

Candidates are asked to explain why temperature affects the rate of respiration of yeast.

(c) Explain why temperature affects the rate of respiration in yeast.

(3)

The higher temperature, the higher kinetic energy. There are more successful collision to form enzyme-substrate complex. ~~the maximum~~ the maximum rate of respiration in yeast at optimum temperature. But the rate of respiration will be reduced above the optimum temperature. Because the enzymes have denatured.

ResultsPlus
Examiner Comments

This answer shows a clear understanding of the response of enzymes to changes in temperature.

ResultsPlus
Examiner Tip

Most candidates realised that this biological sequence of reactions were mediated by enzymes. So how temperature alters enzyme action unlocked the answer.

(c) Explain why temperature affects the rate of respiration in yeast.

(3)

when temperature increases, the rate of collision between substrate and enzyme will increase. In this case rubisco activity will increase producing more NADH and ATP. Kinetic energy will increase so more enzyme substrate complex.

ResultsPlus
Examiner Comments

This answer does not describe the denaturing of enzymes above their optimum temperature.

ResultsPlus
Examiner Tip

The mark allocation for each question is a guide to the number of points for maximum marks.

(c) Explain why temperature affects the rate of respiration in yeast.

(3)

As the temperature increases, the rate of respiration in yeast increases. This is because the kinetic energy of the molecules increases ~~and so there are more~~ as well as metabolism of the cells increases. Furthermore, enzymes activity increases at higher ~~temper~~ temperatures due to which the rate of respiration increases. However, if the temperature is too high, the enzyme is denatured and ~~there~~ rate of respiration then decreases as there are no enzymes to help respire.

ResultsPlus
Examiner Comments

This answer does not clearly explain how the increase in kinetic energy would lead to a change of enzyme activity.

Question 2 (a)

Candidates are given the context of woodlice that can display learning by habituation. The question asks for a description of a method to investigate habituation in woodlice.

Describe how you could investigate habituation in woodlice.

(4)

by touching the woodlouse with the same force by using a glass rod one time every minute and observing the change, whether they will curl up or not, record the results in a table and see whether the woodlouse get used to it with time or not

ResultsPlus
Examiner Comments

This answer only gains a mark for applying the stimulation in a standardised manner. The remaining comments are too vague.

ResultsPlus
Examiner Tip

Always make specific statements in a description of a method.

Describe how you could investigate habituation in woodlice.

(4)

Bring woodlice of the same length and mass and make sure they are not already habituated. Place them on a clean damp firm surface and provide them with a fixed mass of food. Control the room temprature using AC in a closed room and light intensity by placing a light bulb at a fixed distance. Use a sterile glass rod to touch the wood louse. Start the stop watch as soon as it curls up then stop the stop watch as soon as it returns to its orgiinal length. Repeat using more touches but make sure to fix the time interval between each touch, One minute between touches for example. Repeat using other woodlice of the same mass and length and calculate the change in time over the number of touches. It will be habituated when time reaches 0 (not affected)

ResultsPlus
Examiner Comments

This answer is a description of a method with the details required to gain maximum marks.

Describe how you could investigate habituation in woodlice.

(4)

Dependent variable is the time it ~~takes~~ takes for it to re-emerge back to its original position. By using a glass rod - touch the woodlice gently - without causing it harm. Record the time & frequency of touches it takes for the woodlice to re-emege back. Record the time intervals. Allow it to acclimatise between touches. Make sure to use the same ~~force~~ force for every touch & control temperature using an incubator or AC & ~~pH using pH~~ light intensity using light meter/probe. Repeat experiment with different animal - make sure to ~~not~~ touch the woodlice until it has become completely habituated.

ResultsPlus
Examiner Comments

This answer makes the first three points on the mark scheme but does not give any detail as to how habituation is going to be recorded.

Question 2 (b)(i)

Candidates are asked to calculate the percentage decrease in mean distance travelled.

(i) The mean distance travelled by the fish decreased from 5.2 cm to 1.5 cm after five stimuli.

Calculate the percentage decrease in mean distance travelled.

(1)

$\frac{1.5}{5.2} = \frac{x}{100}$

$\frac{150}{5.2} = x$

$28.8462 = x$

Answer 71.2 %

$100 - 28.8462 = 71.1538 \approx 71.2$

ResultsPlus
Examiner Comments

A correct answer.

ResultsPlus
Examiner Tip

The question does not specify the number of significant figures. So correct rounding to one or two places was the approach nearly all candidates took.

(i) The mean distance travelled by the fish decreased from 5.2 cm to 1.5 cm after five stimuli.

Calculate the percentage decrease in mean distance travelled.

(1)

$$\frac{5.2 - 1.5}{5.2}$$

Answer 71.15 %

ResultsPlus
Examiner Comments

A correct answer given to two places.

(i) The mean distance travelled by the fish decreased from 5.2 cm to 1.5 cm after five stimuli.

Calculate the percentage decrease in mean distance travelled.

(1)

$$\frac{5.7}{5.7+1.5} = \frac{5.7}{6.7} = 0.8507$$

$$0.8507 \times 100 = 85.07\%$$

Answer 85.07 %

ResultsPlus
Examiner Comments

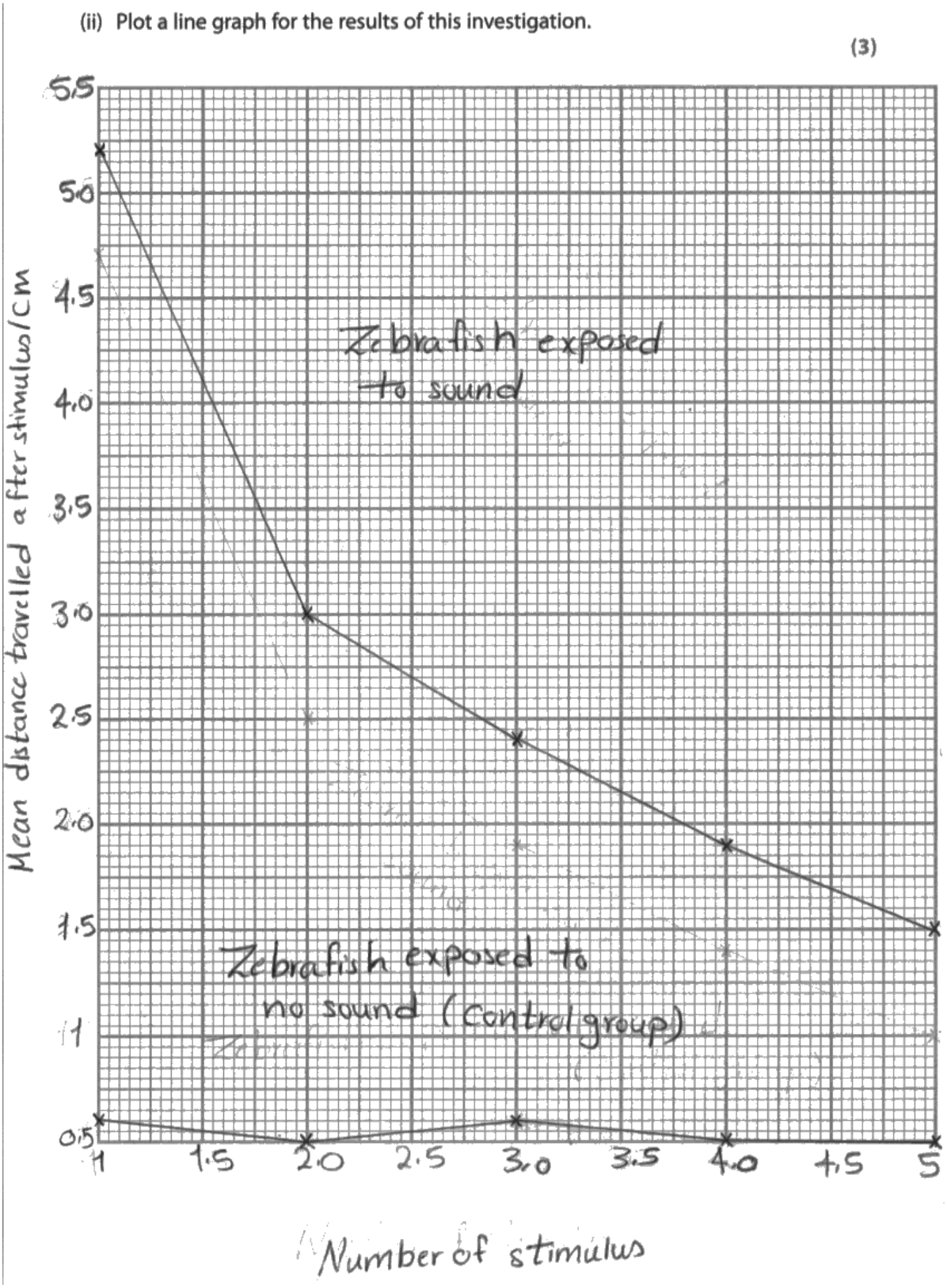
This candidate seems to have used 5.7 instead of 5.2 as well as giving an incorrect calculation.

ResultsPlus
Examiner Tip

The space is given to help candidates and many do complete calculations on the paper. For this style of question we mark the answer rather than inspect the working.

Question 2 (b)(ii)

Candidates are asked to plot a line graph of the results of the investigation.



ResultsPlus
Examiner Comments

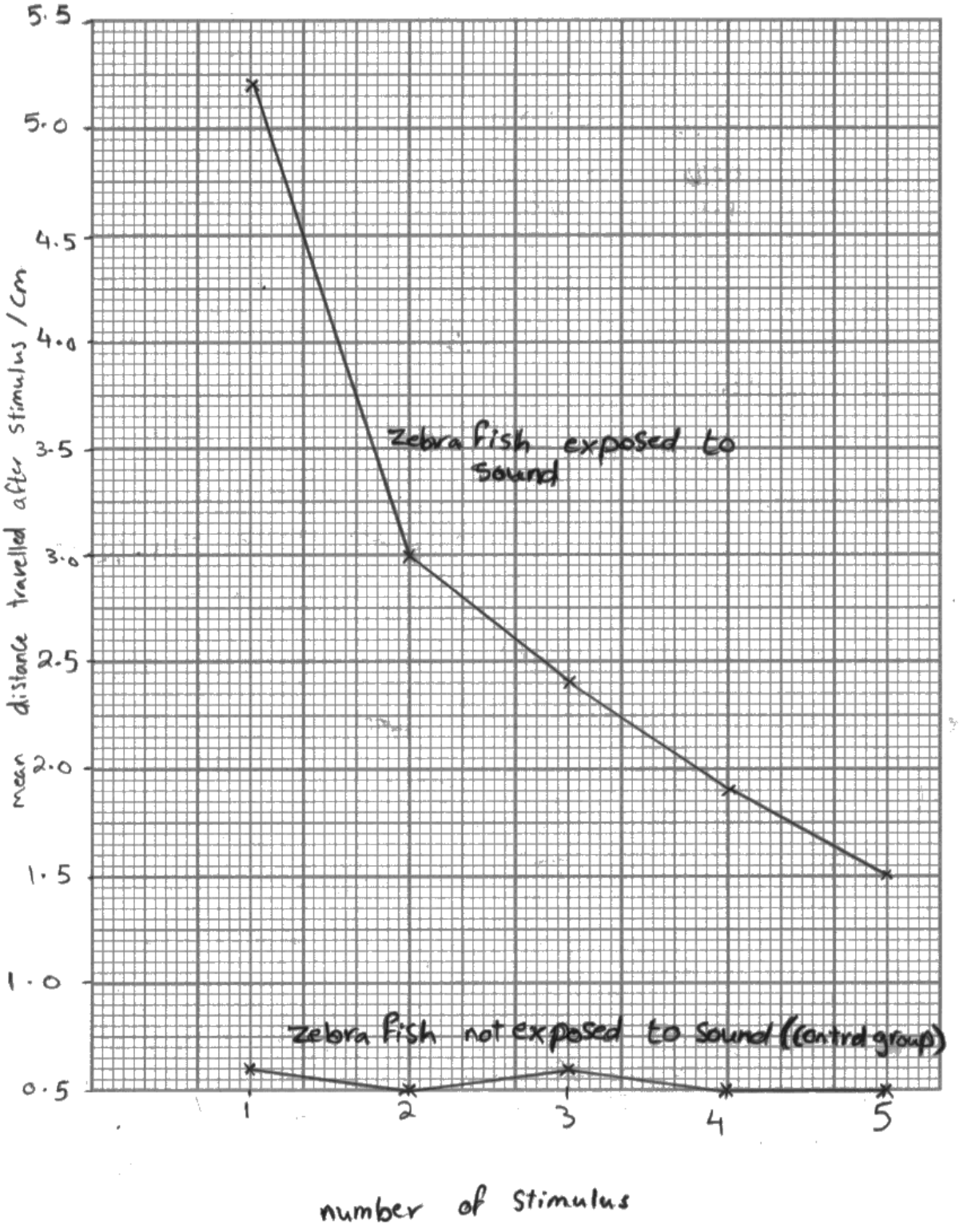
This presentation gains 3 marks. Both sets of data are plotted with straight lines between points, the scales are appropriate and fully labelled. A key is given to identify each plot.

ResultsPlus
Examiner Tip

Candidates sometimes forget to give the complete y axis label with units.

(ii) Plot a line graph for the results of this investigation.

(3)



ResultsPlus
Examiner Comments

This answer gains maximum marks.

Question 2 (b)(iii)

Candidates are asked to give one way the investigation should be conducted to avoid harming the fish.

(iii) Give **one** way that this investigation should be conducted to avoid harming the fish.

(1)

The sound must be not very loud that the fish's hearing is affected.

ResultsPlus Examiner Comments

Many candidates, like this one, suggested very loud sounds should be avoided.

ResultsPlus Examiner Tip

Candidates are not expected to have done this investigation, rather they just need to think about the context of the investigation described.

(iii) Give **one** way that this investigation should be conducted to avoid harming the fish.

(1)

keep fish in large tank with optimum conditions and lots of space to prevent fish swimming into tank wall when startled.

ResultsPlus Examiner Comments

An adequate size of tank is given credit.

(iii) Give **one** way that this investigation should be conducted to avoid harming the fish.

(1)

limits the sound intensity in a safe range.

ResultsPlus Examiner Comments

Another appropriate answer.

(iii) Give **one** way that this investigation should be conducted to avoid harming the fish.

(1)

ethical problems (fish feel pain)

ResultsPlus Examiner Comments

This response does not answer the question. A few candidates suggested returning the fish to their natural environment; examiners did not give this credit.

Question 2 (b)(iv)

Candidates have to state one abiotic and one biotic variable for this investigation.

(iv) State **one abiotic** and **one biotic** variable that could affect this investigation of habituation in zebrafish.

(2)

Abiotic variable

Temperature.

~~Temperature of water~~ ~~Current / stillness of water~~

Biotic variable

Presence of food / other microorganisms.

ResultsPlus
Examiner Comments

Nearly all candidates stated appropriate variables. Stating a variable in the wrong category was very rarely seen.

ResultsPlus
Examiner Tip

Make sure you have command of the terms abiotic and biotic.

(iv) State **one abiotic** and **one biotic** variable that could affect this investigation of habituation in zebrafish.

(2)

Abiotic variable

Temprature

Biotic variable

Age of fish

ResultsPlus
Examiner Comments

This was the most frequent response gaining both marks.

(iv) State **one abiotic** and **one biotic** variable that could affect this investigation of habituation in zebrafish.

(2)

Abiotic variable

pH

Biotic variable

age of Zebrafish

ResultsPlus
Examiner Comments

This response gains 2 marks.

Question 2 (b)(v)

This question asks candidates to describe how a variable could be controlled and the effect it would have if it was not controlled.

(v) Choose **one** of the variables you have identified in (iv).

Describe how this variable could be controlled and the effect it would have on the results if it is not controlled.

(2)

Variable

Temperature

How this variable could be controlled.

using a thermostatically stable waterbath set at 25°C

The effect it would have on the results if it was not controlled.

invalid results. As higher temperature than optimum, leads to enzymes denaturing, so fish will die.

ResultsPlus
Examiner Comments

A correct method of control is described. The effect of results being invalid is always given credit here. As an alternative, a directional description of an expected effect gains credit.

ResultsPlus
Examiner Tip

Do not just give a vague response to the last part of the question.

(v) Choose **one** of the variables you have identified in (iv).

Describe how this variable could be controlled and the effect it would have on the results if it is not controlled.

(2)

Variable

loudness of sound (amplitude)

How this variable could be controlled.

use a machine device that makes sound of uniform amplitude and frequency

The effect it would have on the results if it was not controlled.

results would not be valid

ResultsPlus
Examiner Comments

Many candidates controlled the loudness of sound. Any reasonable method, as in this example, gained credit.

(v) Choose **one** of the variables you have identified in (iv).

Describe how this variable could be controlled and the effect it would have on the results if it is not controlled.

(2)

Variable

species of zebrafish

How this variable could be controlled.

collect zebrafish from same area and examine their species to ~~se~~ select only ones with ~~so~~ same species.

The effect it would have on the results if it was not controlled.

No valid results will be found

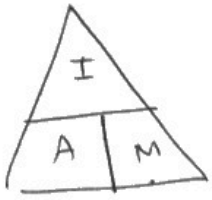
ResultsPlus
Examiner Comments

The species of zebrafish is not an appropriate variable as this is specified in the introduction. However the effect can still gain credit as the results would still be invalid.

Question 3 (a)

Candidates are asked to calculate a magnification.

(a) Calculate the magnification of this photograph. (1)



$M = \frac{I}{A} = \frac{2.5}{1} = 2.5$

Answer 2.5 X

ResultsPlus Examiner Comments

The majority of candidates gave a correct answer.

(a) Calculate the magnification of this photograph. (1)

$M = \frac{1}{A}$

$= \frac{1}{2.5} = 0.4\text{ cm}$

Answer 0.4 cm

ResultsPlus Examiner Comments

Units, if given, were ignored, however the numerical answer here is wrong.

Question 3 (b)(iii)

This question asks candidates to justify three improvements to the investigation. After having identified a suitable improvement, candidates are then expected to give some reasoning for their improvement. Unfortunately most candidates only gave a list of improvements without any justification.

(iii) Justify **three** improvements that could be made to this investigation.

(3)

- use of seaweed to better replicate area
- use of water to mimic rock pools and shores
- ~~more topshells~~ increasing number of topshells
- topshells left for more than 5 minutes.

ResultsPlus
Examiner Comments

This example includes some factors beyond the investigation.

ResultsPlus
Examiner Tip

Make sure you know what all the command words are asking you to do. Here an improvement is needed with a sensible reason as to why it's an improvement.

(iii) Justify **three** improvements that could be made to this investigation.

(3)

allow the snails to move around for longer than 5 minutes: check their location at timed intervals. adjust the temperature that better suits the snails.

ResultsPlus
Examiner Comments

This is an example of an improvement with a supporting comment. This was the most common answer to gain a single mark.

(iii) Justify **three** improvements that could be made to this investigation.

(3)

More trials to increase sample size.
waiting longer time before counting number, as this would show clear preference.
Controlling variables like age of top shell and size.

ResultsPlus
Examiner Comments

More trials to increase sample size is not given credit. Increasing the time to show habitat preference is given a mark.

ResultsPlus
Examiner Tip

Why does increasing sample size improve an investigation? More data that can be analysed.

Question 3 (b)(i-ii)

Candidates are asked to calculate the Chi squared value using the formula and then comment on the results.

(i) Calculate the Chi-squared value using the formula:

(3)

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

$\chi^2 = \sum (12-20)^2$

$\frac{(12-20)^2}{20} + \frac{(15-20)^2}{20} + \frac{(24-20)^2}{20} + \frac{(29-20)^2}{20}$

$\chi^2 = 9.3$

Answer 9.3

(ii) The table shows some critical values for Chi-squared at different degrees of freedom.

Degrees of freedom	*p* value = 0.050
1	3.841
2	5.991
3	7.815
4	9.488

$(n-1)$

$(4-1) = 3$

Comment on the results of this investigation.

Use the null hypothesis, your calculated Chi-squared value and the table of critical values to support your answer.

(3)

The calculated value of (9.3) is higher than the critical value (7.815).

So, reject the null hypothesis as there is a significance in a topshells habitat preference.

ResultsPlus
Examiner Comments

Most candidates worked the formula correctly for 3 marks.

The calculated value is compared to a critical value from the table. If it was larger than the critical value the null hypothesis is rejected and the topshells shows a habitat preference.

ResultsPlus
Examiner Tip

Always clearly select one critical value to compare with your calculated value.

(i) Calculate the Chi-squared value using the formula:

(3)

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

$$\chi^2 = \frac{(12-20)^2 + (19-20)^2 + (24-20)^2 + (29-20)^2}{20}$$

$$= \frac{64 + 1 + 16 + 81}{20} = \frac{162}{20} = 8.10$$

Answer 8-10

(ii) The table shows some critical values for Chi-squared at different degrees of freedom.

Degrees of freedom	*p* value = 0.050
1	3.841
2	5.991
3	7.815
4	9.488

Comment on the results of this investigation.

Use the null hypothesis, your calculated Chi-squared value and the table of critical values to support your answer.

(3)

The chi squared value of 8.10 is less than the critical value of 9.488 and so the null hypothesis is accepted. Therefore, there is no significant difference between the topshells and habitat preference.

- chi squared value = 8.10
- critical value = 9.488

ResultsPlus
Examiner Comments

This calculation gives the wrong answer, however it still gains 2 marks as the candidate had worked through the formula correctly.

ResultsPlus
Examiner Tip

If space is provided show your working. In this example, had there only been the answer 8.10 it would have gained no marks.

The next section still gained 3 marks for using the calculated value in an appropriate way.

(i) Calculate the Chi-squared value using the formula:

(3)

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

$$\chi^2 = \frac{(12-20)^2}{20} + \frac{(15-20)^2}{20} + \frac{(24-20)^2}{20} + \frac{(29-20)^2}{20}$$

$$= 3.2 + 1.25 + 0.8 + 4.05$$

$$= 9.3$$

Answer 9.3

(ii) The table shows some critical values for Chi-squared at different degrees of freedom.

Degrees of freedom	*p* value = 0.050
1	3.841
2	5.991
3	7.815
4	9.488

5 degrees
4 area
4 significant

Comment on the results of this investigation.

Use the null hypothesis, your calculated Chi-squared value and the table of critical values to support your answer.

(3)

Critical vale of 9.488. Since our vale of χ^2 (9.3) is less than the critical vale so null hypothesis is accepted and there is no significant difference in the habitat preference of dipstelli.

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Examiner Comments

This example gains 3 marks for each section.

Question 4 (a)

Candidates are asked to describe preliminary practical work that might be needed to produce a method that would give quantitative results.

(a) Describe preliminary practical work that you might undertake to ensure your proposed method would provide quantitative results.

(3)

- Find suitable conditions needed for germination, such as suitable temperature and pH
- Find suitable time period for movement of the dye that would allow easier ~~measurem~~ measurment of distance moved by the dye
- Find suitable method to measure the distance moved by the dye
- Find suitable mass of seeds that would allow ~~noticible~~ measurable distance moved by dye

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Examiner Comments

This candidate gives thought to the need to produce measurable volumes from germinating seeds.

ResultsPlus
Examiner Tip

Avoid giving a general list of variables without describing how they need to be manipulated to conduct a successful investigation.

(a) Describe preliminary practical work that you might undertake to ensure your proposed method would provide quantitative results.

(3)

find suitable temperature for germination • find suitable pH for germination • find suitable time / way of measuring the time • ~~suitable m~~ find suitable method of measuring the respiration (RQ)

ResultsPlus
Examiner Comments

This example does not move on beyond finding a suitable temperature for germination so gains 1 mark.

(a) Describe preliminary practical work that you might undertake to ensure your proposed method would provide quantitative results.

(3)

- Find a suitable method to measure the rate of respiration.
- Find a suitable time span to measure rate of respiration.
- Find a suitable environment to germinate both types of seeds.
- Find the suitable conditions to germinate the seeds.
- Find how fast the seeds germinate and ~~or~~ adapt experiment time accordingly.

ResultsPlus
Examiner Comments

This candidate considers the conditions for germination and the time span required for germination.

Question 4 (b)

This question asks for a detailed method of how to measure the rate of respiration in two different species of seeds.

(b) Devise a detailed method, including how you would control and monitor important variables.

(8)

The independent variable is using same mass of mung bean seeds and pea seeds. The dependent variable is measuring the distance moved by the coloured dye drop per unit time. Set up the respirometer by adding excess sterile the seeds to avoid respiration of bacteria ~~Known~~ Known mass of soda lime. Add Known mass of ~~seeds~~ mung bean seeds on a mesh in the test tube. Connect the test tube to a capillary tube with a scale and a drop of coloured dye. Open the 3-way tap to allow air in. Close the 3-way tap to prevent further gas exchange. Leave the ~~beans~~ seeds 5 minutes to acclimatise then start the stopwatch. Leave the ~~b~~ seeds for 20 minutes to respire then stop the stopwatch and ~~see~~ measure the distance moved by the dye. Repeat the investigation with pea seeds and repeat several times with each type of seeds. They should be of the same mass, use sensitive digital balance. Same temperature using thermostatically controlled water bath. Same mass of excess soda lime using digital balance Same age of the seeds. To repeat reset the apparatus by opening the 3-way tap to reset the dye drop back to zero. The volume of O_2 used is $\pi r^2 L$. Calculate the mean ~~volume of~~ distance moved by the dye and mean (mean) volume of O_2 used. Rate of respiration = $\frac{\text{volume of } O_2 \text{ used}}{\text{time}}$.

To avoid photosynthesis if a shoot ~~grows~~ is present Cover the sides of the test tube with black cover.

Calculate standard deviation and do statistical analysis.

An excellent response that nearly gains full marks.

Question 4 (c)

Candidates are asked to describe how results should be recorded, presented and analysed.

(c) Describe how your results should be recorded, presented and analysed in order to draw conclusions from your investigation.

(3)

	Distance moved by coloured liquid in 5 minutes /mm			Mean /mm	Mean rate of oxygen uptake /cm³ min⁻¹
	1	2	3		
Mung bean seeds					
Pea seeds					
Control					

The mean for each seed will be compared using ~~The~~ t-test to determine if there is any significant difference between the means. The hypothesis is correct if mung bean seeds have a higher mean rate of oxygen uptake than pea seeds and the t-test values are significantly different.

ResultsPlus
Examiner Comments

This candidate describes, using a drawn table, how to record the results. The t test is an appropriate analysis for the data collected.
2 marks achieved.

The candidate needs to draw, or describe in detail, a suitable bar graph for this data.

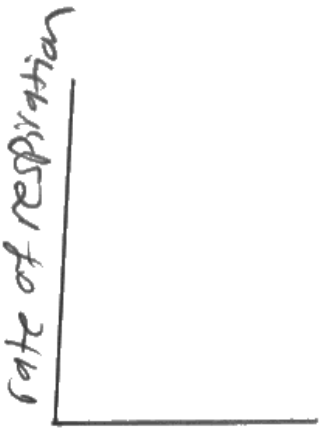
ResultsPlus
Examiner Tip

Tables should always have raw data shown as repeats. Additional columns for processing, such as calculating a rate or mean, are often included.

(c) Describe how your results should be recorded, presented and analysed in order to draw conclusions from your investigation.

(3)

	rate of respiration	
	mung beans	peas
mean		



use ~~F~~ student (t) test, and draw a graph where x-axis is the ~~rate~~ type of the seeds and y-axis is the rate of ~~re~~ respiration, and draw a table.

ResultsPlus
Examiner Comments

This candidate gives an incomplete table. The raw results are not the rate of respiration. The type of graph is not clearly stated.

However, analysis by t test is given credit.

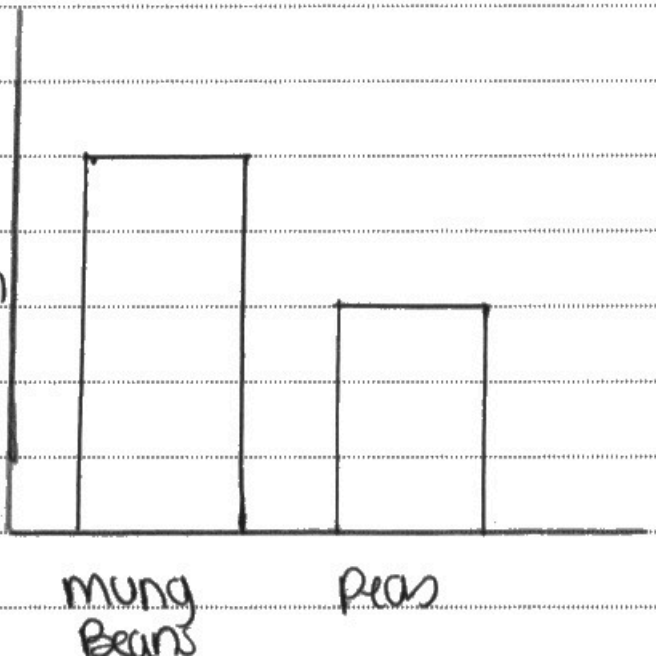
(c) Describe how your results should be recorded, presented and analysed in order to draw conclusions from your investigation.

(3)

type of seed	Distance moved in capillary tubing / mm					mean distance / mm	Rate of respiration
	1	2	3	4	5		
mung bean							
peas							

t-test for statistical analysis as independant variable is discontinuous.

Bar graph to compare Rate of respiration



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Examiner Comments

A clear answer that fully satisfies the mark scheme.

Question 4 (d)

Candidates are asked to suggest three limitations for their proposed method.

(d) Suggest **three** limitations of your proposed method.

(3)

It is difficult to measure small distances travelled by liquid drop. It is difficult to control all variables affecting rate of ~~photo~~ respiration, e.g. temperature. seeds can get contaminated with bacteria and can turn from aerobic to anaerobic respiration.

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This candidate makes two good suggestions.

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Examiner Tip

Candidates should avoid comments such as 'it is difficult to control all the variables' as this is too generic without any further details being given.

(d) Suggest **three** limitations of your proposed method.

(3)

Risk of seed being contaminated with bacteria

Seed may shift and respire anaerobically instead of aerobic respiration, which doesn't use O_2 so there will be no indication about oxygen

Difficulty to get the distance moved by O_2 exactly as it may be small distance.

Hard to control age & genetic variability of ~~the~~ both seeds.

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Examiner Comments

Candidates that suggested the seeds may change from aerobic to anaerobic respiration were thinking about the experimental context.

(d) Suggest **three** limitations of your proposed method.

(3)

- Difficult to measure small volume gas produced.
- ~~Difficult to~~ possibility of contamination from the seed.
- Not all variable can be controlled ~~such as~~ age
- Difficult to control age of the seeds.
- Difficult to mimic outdoor conditions ~~as~~ as the conditions outside will be different inside the lab therefore results may vary.

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Examiner Comments

The suggestion of contamination of seeds is not given credit for this investigation. If unsterilised seeds had been used, the time period would be too short for microbes to impact the results.

Paper Summary

Based on their performance on this paper, candidates are offered the following advice:

- Read the whole question before you start to answer, and check that your answer covers everything the question asks for.
- Make sure your answer relates to the specific context of the question.
- When studying Core Practicals, think about what the techniques might be used for and the types of scientific question they might help to answer.
- Carry out every Core Practical for yourself, so you understand how it works and any difficulties that might be encountered.
- If you are given the procedure for a practical technique, put yourself in the shoes of the person writing the procedure: how would they have worked out the details – such as volumes, concentrations, and times? They will have used preliminary practical work.
- Consider the strengths and limitations of each Core Practical technique.
- Practice writing null hypotheses for experiments you carry out, even if you will not necessarily be applying a statistical test.

Grade boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

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