Pearson
Edexcel

Examiners' Report
June 2023

International Advanced Level Biology WBI16 01

ResultsPlus

Introduction

The paper tested the practical skills developed over the whole course. Candidates were expected to have carried out the core practicals. The questions may be set in a new context, however the practical details are based on the requirements of the core practicals.

Question one asked candidates to consider the practical aspects of investigating the effect of caffeine on mitosis using their knowledge of a core practical.

Question two was based on a core practical, an ecological investigation. This question focused on some aspects of a suitable method and data handling.

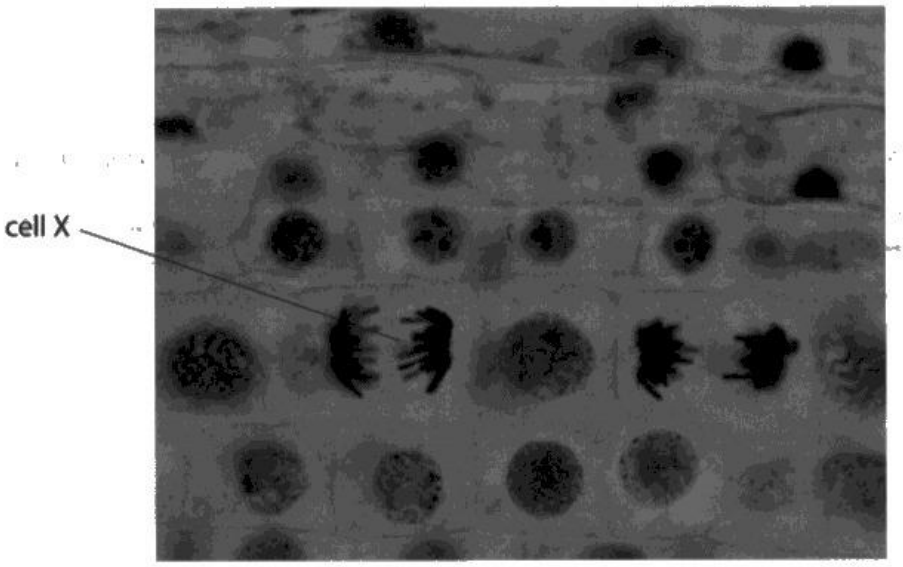
Question three can be based around any biological context, but the key parts of the question are always the same – data presentation and analysis.

Question four is based on a core practical. In general candidates showed knowledge of the core practical methods. Candidates clearly identified variables that needed to be controlled but their descriptions as to how the control could be achieved frequently lacked the precision required for this examination. However, most candidates did try to tailor their answers to the context of each investigation.

Question 1 (a)

Candidates were asked to identify the stage of mitosis labelled in the photograph.

1 The photograph shows cells undergoing mitosis in the root of an onion plant.



(Source: © blickwinkel/Alamy Stock Photo)

(a) Name the stage of mitosis shown in cell X.

(1)

Anaphase

Prophase Metaphase Anaphase Telophase

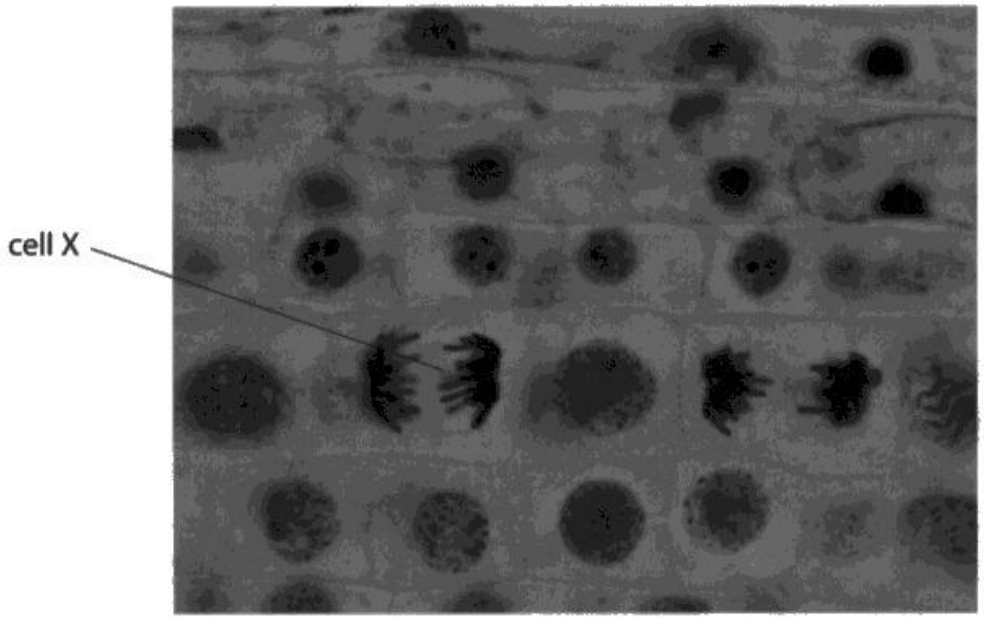
ResultsPlus
Examiner Comments

The correct answer.

ResultsPlus
Examiner Tip

Make sure images of mitosis are studied.

1 The photograph shows cells undergoing mitosis in the root of an onion plant.



(Source: © blickwinkel/Alamy Stock Photo)

(a) Name the stage of mitosis shown in cell X.

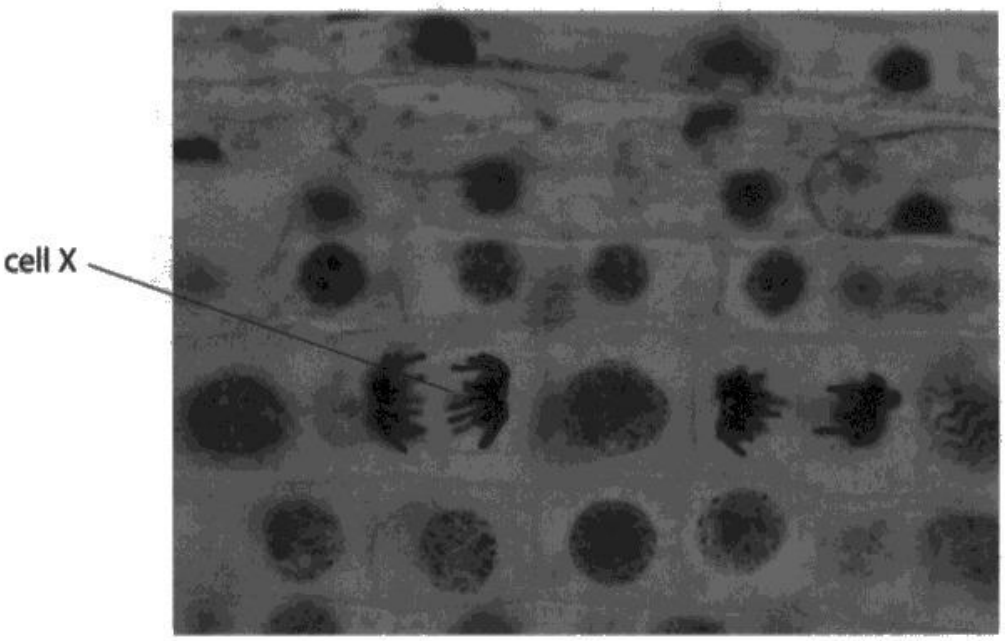
(1)

Anaphase Metaphase Anaphase

ResultsPlus
Examiner Comments

An incorrect stage identified.

1 The photograph shows cells undergoing mitosis in the root of an onion plant.



(Source: © blickwinkel/Alamy Stock Photo)

(a) Name the stage of mitosis shown in cell X.

(1)

replication

ResultsPlus
Examiner Comments

This answer is not a stage of mitosis.

Question 1 (b)(i)

The questions asked for a description of an experiment to measure the mitotic index of cells from onion roots treated with different concentrations of caffeine solution.

(b) A student read a scientific report that stated:

'Cell division was reduced when plant cells were treated with a caffeine solution.'

(i) Describe an experiment to measure the mitotic index of cells from onion roots treated with different concentrations of caffeine solution.

(6)

Take six different samples from the same onion root, and place them each in solution. One should be without any caffeine, and the others should have varying concentrations of caffeine (for example, 0·02 mol dm^{-3}, 0·04 mol dm^{-3}, 0·06 mol dm^{-3}, 0·08 mol dm^{-3}, 0·10 mol dm^{-3}). Allow all of them to rest in the solution for two hours, and ensure they all have the same volume of solution (by measuring it out using a graduated measuring cylinder), and temperature (by using an electric water bath). After the two hours, crush the tips of the roots and view them under the microscope, counting what percentage of the cells are actively dividing (to calculate a mitotic index). Repeat the entire experiment at least twice and obtain means for each concentration of caffeine solution.

ResultsPlus
Examiner Comments

The root tip is part of any method to observe mitosis.

ResultsPlus
Examiner Tip

The context of this experiment was not widely appreciated. The onions needed to be suspended over a caffeine solution to allow the roots time to grow.

(b) A student read a scientific report that stated:

'Cell division was reduced when plant cells were treated with a caffeine solution.'

(i) Describe an experiment to measure the mitotic index of cells from onion roots treated with different concentrations of caffeine solution.

(6)

Independant variable- Caffeine concentration.

Dependend variable - Mitotic inden.

Obtain different concentrations of catteine solution : 0.2%, 0.5%, 1%, 1.5% and 2%.

Place the onion roots in a beaker containing 0.2% catteine solution for 24 hours at room temperature. After 24 hours, remove the routs and cut them into 5mm long pieces and place it on a microscope slide Add a few drops of an acetate solution and place a coverslip over it Cover the coverslip with a tissue and press gently until no air bubbles are seen. Place the microscope slide in the microscope, focus and count the total number of cells visible. Count the number of cells that have begun mitosis. Repeat thrice to get a mean. Repeat with the remaining concentrations of catteine solution. Ensure to keep constant temperature, using an incubator, keep pH constant using a pH butter and also keep humidity constant throughout the experiment

Calculate the mitotic index using the equation:

$$\text{mitotic index} = \frac{\text{Number of cells undergoing mitosis}}{\text{Total number of cells visible.}}$$

ResultsPlus
Examiner Comments

This answer was clearly laid out and gained 4 marks.

(b) A student read a scientific report that stated:

'Cell division was reduced when plant cells were treated with a caffeine solution.'

(i) Describe an experiment to measure the mitotic index of cells from onion roots treated with different concentrations of caffeine solution.

(6)

Take ~~pte.~~ a few Onion roots of the same size and from the same onion. Take five test tubes, with different caffeine concentrations. Each tube with a different concentration rangeng from 0.1 mol dm^{-3}, 1 mol dm^{-3}, 2 mol dm^{-3}, 3 mol dm^{-3} and 4 mol dm^{-3}. Take an onion root and keep in each of the test tubes and let it stay for one week, in the same room at the same temperature using a thermostahe room control. After a week, extract the roots from each tube and cut the ~~top of the~~ root into 0.5 cm bits. Make sure all are cut the same size. Then for each root ~~from~~ for its own concentration, take and squash on a magnefying glass using the back of a glass rood. Stain the squashed root hp using a stain hyrpen blue and using cover slip put on top of it Let the dye stain the cells using a bit of heat from a bunsen burner. Then place the slide on a ~~microscope~~ light microscope and observe/count the number of cells going through mihosis and the total number of cells present. Do this for every root hp for each caffeine concentration and record on a table. To calculate the index, take number of cells going through mihosis ÷ total number of cells seen and record. Repeat this 2 more times for reliability.

ResultsPlus
Examiner Comments

The onion root would not have survived for a week in the test tube.
The rest of the answer was appropriate.

(b) A student read a scientific report that stated: toluiden blue

'Cell division was reduced when plant cells were treated with a caffeine solution.'

(i) Describe an experiment to measure the mitotic index of cells from onion roots treated with different concentrations of caffeine solution.

(6)

A stock solution of caffeine is made with 2% caffeine which is diluted into different concentrations. Solutions are made with 2%, 1%, 0.5%, 0.25% and 0% caffeine. 0% is just distilled water and use a waterproof marker to label the beakers and a control set up. Onions of the same type are placed in these solutions for a week allowing the roots to grow. Then the onions are placed on a white tile where the root tips are cut with a scalpel. The root tips are cut into equal lengths and are then placed in concentrated hydrochloric acid, the root tips are the picked with tweezers and placed on a glass slide and a drop of toluidien blue is added. A cover slip is placed and with a smasher the root tips are smashed, thereafter using the corner of a tissue, excess dye is absorbed and using tongs the glass slide is passed over a flame. Then it is viewed using a light microscope where the student can count cells undergoing mitosis for the different concentrations of caffeine. Repeat the same for the different concentrations and make sure to wear eye safety goggles and gloves when handling the chemicals and while using the scalpel point down and towards the white tile.

ResultsPlus
Examiner Comments

This answer gained maximum marks.

ResultsPlus
Examiner Tip

The context of this particular experiment had been appreciated by the candidate.

Question 1 (b)(ii)

The question asked for a description of a cellulose molecule.

(ii) The scientific report suggested that caffeine affected the production of the cellulose molecules needed for cell division.

Describe the structure of a cellulose molecule.

(3)

it is a poly saccharide molecule made up of monomers beta glucose joined by 1,4 glycosidic bond, cellulose are joined by pectin to form fibrils.

This answer identified the type of glucose and the correct bonding.

(ii) The scientific report suggested that caffeine affected the production of the cellulose molecules needed for cell division.

Describe the structure of a cellulose molecule.

(3)

A cellulose molecule contains a long chain of glucose compacted together with ethier ends containing inorganic phosphate molecules.
It is a large molecule and hence does not leave the cell membrane unless broken down.
It is a store of energy as it contains large amounts of glucose.

ResultsPlus
Examiner Comments

This answer did not gain any credit.

(ii) The scientific report suggested that caffeine affected the production of the cellulose molecules needed for cell division.

Describe the structure of a cellulose molecule.

(3)

→ Cellulose is composed of glucose molecules joined by ~~α-1,4 γ~~ glycosidic bonds formed through a condensation reaction. The glucose molecules are joined via α-1,4 glycosidic bonds.

ResultsPlus
Examiner Comments

This answer only gained the bonding mark.

(ii) The scientific report suggested that caffeine affected the production of the cellulose molecules needed for cell division.

Describe the structure of a cellulose molecule.

(3)

Cellulose molecules are made up of only β-glucose molecules. they are joined ~~together~~ together by 1,4 glycocidic bonds. Each molecule is inverted compared to the one before it. Cellulose ~~e~~ have a straight chain (they are unbranched).

ResultsPlus
Examiner Comments

This answer gained 3 marks.

ResultsPlus
Examiner Tip

Read the question carefully. This question asked about a single cellulose molecule rather than the structure of a cellulose cell wall.

Question 2 (a)

The question asked for a suggested benefit to cactus plants of growing near mimosa trees.

Question 2 (b)

The question asked for one possible risk when carrying out this investigation and a method of reducing the risk.

(b) Suggest **one** risk the scientist might encounter when carrying out this investigation and how you could reduce this risk.

(2)

Risk

The cactus contains sharp needles on it's surface

How to reduce the risk

Wear gloves

ResultsPlus
Examiner Comments

Cacti spines were a frequently identified risk.

ResultsPlus
Examiner Tip

There are different risks undertaking fieldwork. The context is important, generic statements are unlikely to gain marks.

(b) Suggest **one** risk the scientist might encounter when carrying out this investigation and how you could reduce this risk.

(2)

Risk

irritation or allergy in the skin if it touch any of the plants

How to reduce the risk

wear gloves to prevent the hand contact with ~~eat~~ plants.

ResultsPlus
Examiner Comments

Another frequently identified risk.

(b) Suggest **one** risk the scientist might encounter when carrying out this investigation and how you could reduce this risk.

(2)

Risk

Heat strokes due to high temperatures in ~~deserts~~ deserts.

How to reduce the risk

Keeping Hydrated and wearing light clothing.

ResultsPlus
Examiner Comments

A less common but appropriate risk and reduction of risk.

Question 2 (c)(i)

The question asked for the odds ratio to be calculated and the answer given to two significant figures.

(c) The table shows the results of this investigation.

Mimosa trees	Number of quadrats	
	Cactus plants present	Cactus plants absent
Present in quadrat	60	4
Absent in quadrat	16	20

(i) An odds ratio can be used to determine if the presence of mimosa trees has an effect on the presence of the cactus plants.

Calculate an odds ratio using the following steps.

Give your answer to **two** significant figures.

$$\text{Step 1} = \frac{\text{Number of quadrats in which mimosa trees and cactus plants are present}}{\text{Number of quadrats in which mimosa trees are absent and cactus plants are present}}$$

$$\text{Step 2} = \frac{\text{Number of quadrats in which mimosa trees are present and cactus plants are absent}}{\text{Number of quadrats in which both mimosa trees and cactus plants are absent}}$$

Odds ratio = Step 1 ÷ Step 2

(3)

Step 1 = $\frac{60}{16}$ = 3.75

Step 2 = $\frac{4}{20}$ = 0.2

Odds ratio = $\frac{3.75}{0.2}$ = 18.75 = 19

Odds ratio 19 :1

ResultsPlus
Examiner Comments

The correct answer.

(c) The table shows the results of this investigation.

Mimosa trees	Number of quadrats	
	Cactus plants present	Cactus plants absent
Present in quadrat	60	4
Absent in quadrat	16	20

(i) An odds ratio can be used to determine if the presence of mimosa trees has an effect on the presence of the cactus plants.

Calculate an odds ratio using the following steps.

Give your answer to **two** significant figures.

$$\text{Step 1} = \frac{\text{Number of quadrats in which mimosa trees and cactus plants are present}}{\text{Number of quadrats in which mimosa trees are absent and cactus plants are present}}$$

$$\text{Step 2} = \frac{\text{Number of quadrats in which mimosa trees are present and cactus plants are absent}}{\text{Number of quadrats in which both mimosa trees and cactus plants are absent}}$$

Odds ratio = Step 1 ÷ Step 2

(3)

Step 1 = $\frac{60+4}{16+4} = \frac{64}{20} = 3.2$

Step 2 = $\frac{60+20}{16+20} = \frac{80}{36} = 2.22$

$\rightarrow \frac{3.2}{2.22}$

$\downarrow$

1.44/2

Odds ratio 1.44/2 :1

ResultsPlus
Examiner Comments

The given data has been used incorrectly.

ResultsPlus
Examiner Tip

Look carefully at any given formula.

(c) The table shows the results of this investigation.

Mimosa trees	Number of quadrats	
	Cactus plants present	Cactus plants absent
Present in quadrat	60	4
Absent in quadrat	16	20

(i) An odds ratio can be used to determine if the presence of mimosa trees has an effect on the presence of the cactus plants.

Calculate an odds ratio using the following steps.

Give your answer to **two** significant figures.

$$\text{Step 1} = \frac{\text{Number of quadrats in which mimosa trees and cactus plants are present}}{\text{Number of quadrats in which mimosa trees are absent and cactus plants are present}}$$

$$\text{Step 2} = \frac{\text{Number of quadrats in which mimosa trees are present and cactus plants are absent}}{\text{Number of quadrats in which both mimosa trees and cactus plants are absent}}$$

Odds ratio = Step 1 ÷ Step 2

(3)

Step ①: $\frac{60}{16} = 3.75$ Step ②: $\frac{4}{20} = 0.2$

$3.75 \div 0.2$

$= 18.75$

Odds ratio 18.75

ResultsPlus
Examiner Comments

The candidate did not give the answer to two significant figures as required.

ResultsPlus
Examiner Tip

Read the question carefully to check for the final answer requirements.

Question 2 (c)(ii)

The question asked for a conclusion that can be made from the results of this investigation.

(ii) The table shows how the odds ratio can be used in this investigation.

Odds ratio	Presence of mimosa trees
< 1	Reduces the likelihood of cactus plants being present
= 1	Has no effect on the likelihood of cactus plants
> 1	Increases the likelihood of cactus plants being present

Give a conclusion that can be made from the results of this investigation.

(1)

The presence of mimosa trees increases the likelihood of cactus plants being present

ResultsPlus
Examiner Comments

This answer clearly links the presence of mimosa trees to the likelihood of finding cactus plants.

(ii) The table shows how the odds ratio can be used in this investigation.

Odds ratio	Presence of mimosa trees
< 1	Reduces the likelihood of cactus plants being present
= 1	Has no effect on the likelihood of cactus plants
> 1	Increases the likelihood of cactus plants being present

Give a conclusion that can be made from the results of this investigation.

(1)

It increases the likelyihood of cactus plants being present

ResultsPlus
Examiner Comments

There is no mention of mimosa trees so this is not a conclusion.

(ii) The table shows how the odds ratio can be used in this investigation.

Odds ratio	Presence of mimosa trees
< 1	Reduces the likelihood of cactus plants being present
= 1	Has no effect on the likelihood of cactus plants
> 1	Increases the likelihood of cactus plants being present

Give a conclusion that can be made from the results of this investigation.

(1)

odds ratio = 18·75 > 1 so it can be concluded that presence of mimosa trees increases the likelihood of cactus plants being present

ResultsPlus
Examiner Comments

A clearly stated conclusion.

Question 2 (d)(i)-(ii)

The question asked for two abiotic variables that might affect this investigation and the effect it could have on the results if the values of one of the measured variables were not similar.

(d) Abiotic variables in the soil cannot be controlled in this investigation.

However, these variables can be measured to confirm that these plants are growing in similar conditions.

(i) State **two** abiotic variables in the soil that could affect this investigation.

(2)

First variable

Temperature

Second variable

pH

(ii) Choose **one** of the variables you have identified in (i).

State the effect it could have on the results if the measured values were not similar.

(1)

Variable

Temperature

The effect it could have on the results if the values were not similar.

The results will not be valid as one plant may benefit more than the other if it grows in optimum temperature and the other plant does not.

ResultsPlus
Examiner Comments

Appropriate abiotic variables and effect if similar values not measured.

(d) Abiotic variables in the soil cannot be controlled in this investigation.

However, these variables can be measured to confirm that these plants are growing in similar conditions.

(i) State **two** abiotic variables in the soil that could affect this investigation.

(2)

First variable

water content of soil

Second variable

presence of ~~insects~~ microorganisms.

(ii) Choose **one** of the variables you have identified in (i).

State the effect it could have on the results if the measured values were not similar.

(1)

Variable

water content of soil.

The effect it could have on the results if the values were not similar.

It will give results that are not valid since some plants will have more water than others.

ResultsPlus
Examiner Comments

Only one abiotic variable identified.

(d) Abiotic variables in the soil cannot be controlled in this investigation.

However, these variables can be measured to confirm that these plants are growing in similar conditions.

(i) State **two** abiotic variables in the soil that could affect this investigation.

(2)

First variable

water content of soil.

Second variable

pH of the soil

(ii) Choose **one** of the variables you have identified in (i).

State the effect it could have on the results if the measured values were not similar.

(1)

Variable

pH of the soil.

The effect it could have on the results if the values were not similar.

The ~~s~~ results are not valid if the pH of the soil is not kept constant, because this can result in either more or less cactus growing.

(Total for Question 2 = 10 marks)

ResultsPlus
Examiner Comments

Another correct answer.

Question 3 (a)

Fruit flies were allowed to lay eggs in a medium with or without pyrethrum.

The question asked for the null hypothesis to be stated.

The photograph shows fly pupae in one of the flasks.

(Source: © Sundry Photography/Alamy Stock Photo)

After five days, the number of pupae in each flask was counted.

The results were:

Number of pupae from untreated culture medium (A)

72 68 81 56 43 52 60 64 - 8

Number of pupae from treated culture medium (B)

45 56 39 40 29 38 35 46

(a) State a suitable null hypothesis for this investigation.

(1)

There is no significant difference in the mean number of pupae from the untreated culture medium (A) and the treated culture medium (B).

ResultsPlus
Examiner Comments

An appropriate answer.

The photograph shows fly pupae in one of the flasks.

(Source: © Sundry Photography/Alamy Stock Photo)

After five days, the number of pupae in each flask was counted.

The results were:

Number of pupae from untreated culture medium (A)

72 68 81 56 43 52 60 64 8 62

Number of pupae from treated culture medium (B)

45 56 39 40 29 38 35 46 8 41

(a) State a suitable null hypothesis for this investigation.

(1)

the number of pupae are not affected by the culture medium being treated (there is no significant correlation between treating culture medium and the number of pupae present.)

ResultsPlus
Examiner Comments

For this data the reference to correlation meant a mark could not be awarded.

ResultsPlus
Examiner Tip

Candidates need to write precise answers related to the data given.

Question 3 (b)-(c)

The question asked for a table of data to be drawn and means calculated. A graph was then drawn to display the means and the variability of the data.

The photograph shows fly pupae in one of the flasks.

(Source: © Sundry Photography/Alamy Stock Photo)

After five days, the number of pupae in each flask was counted.

The results were:

Number of pupae from untreated culture medium (A)

72 68 81 56 43 52 60 64

Number of pupae from treated culture medium (B)

45 56 39 40 29 38 35 46

(a) State a suitable null hypothesis for this investigation.

(1)

There is no significant change in the number of pupae after adding an Organic pesticide, eg ~~eg~~ pyrethrum.

(b) Draw a suitable table to display these **data** and the calculated **means** for the number of pupae from the flasks containing the untreated and treated culture medium.

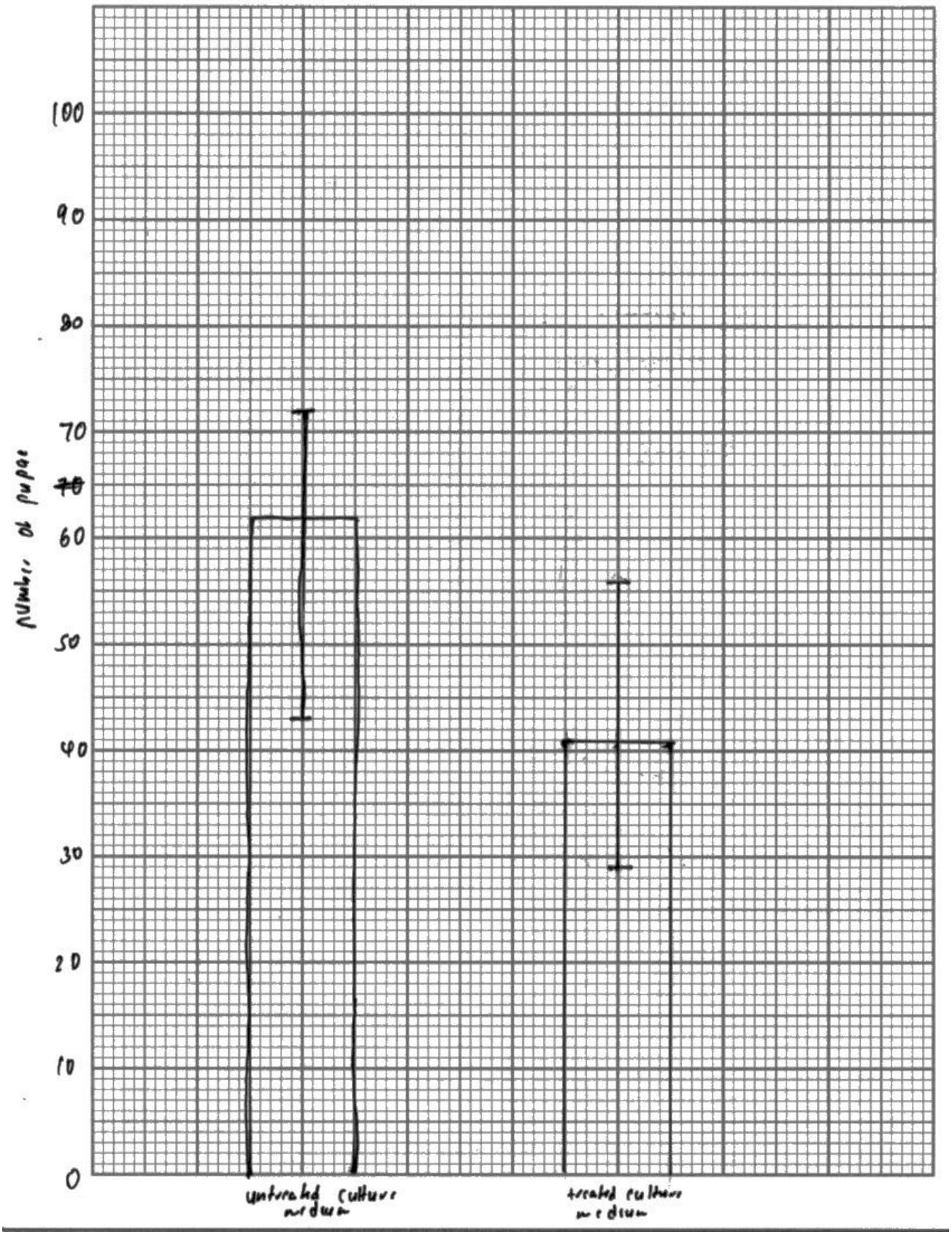
(2)

number of pupae	
untreated culture medium	treated culture medium
72	45
68	56
81	34
56	40
43	29
52	38
60	35
64	46
mean 62	41

(c) Draw a suitable graph to show the mean number of pupae from the untreated culture medium and treated culture medium.

Include an indication of the variability of the data.

(3)



ResultsPlus
Examiner Comments

The tabulation was correct but the graph had two errors, incomplete y axis label and an error bar wrongly plotted.

The photograph shows fly pupae in one of the flasks.

(Source: © Sundry Photography/Alamy Stock Photo)

After five days, the number of pupae in each flask was counted.

The results were:

Number of pupae from untreated culture medium (A)

72 68 81 56 43 52 60 64

Number of pupae from treated culture medium (B)

45 56 39 40 29 38 35 46

(a) State a suitable null hypothesis for this investigation.

(1)

There is no significant difference between the number of pupae hatched from an untreated culture medium and culture medium treated with pyrethrum.

(b) Draw a suitable table to display these **data** and the calculated **means** for the number of pupae from the flasks containing the untreated and treated culture medium.

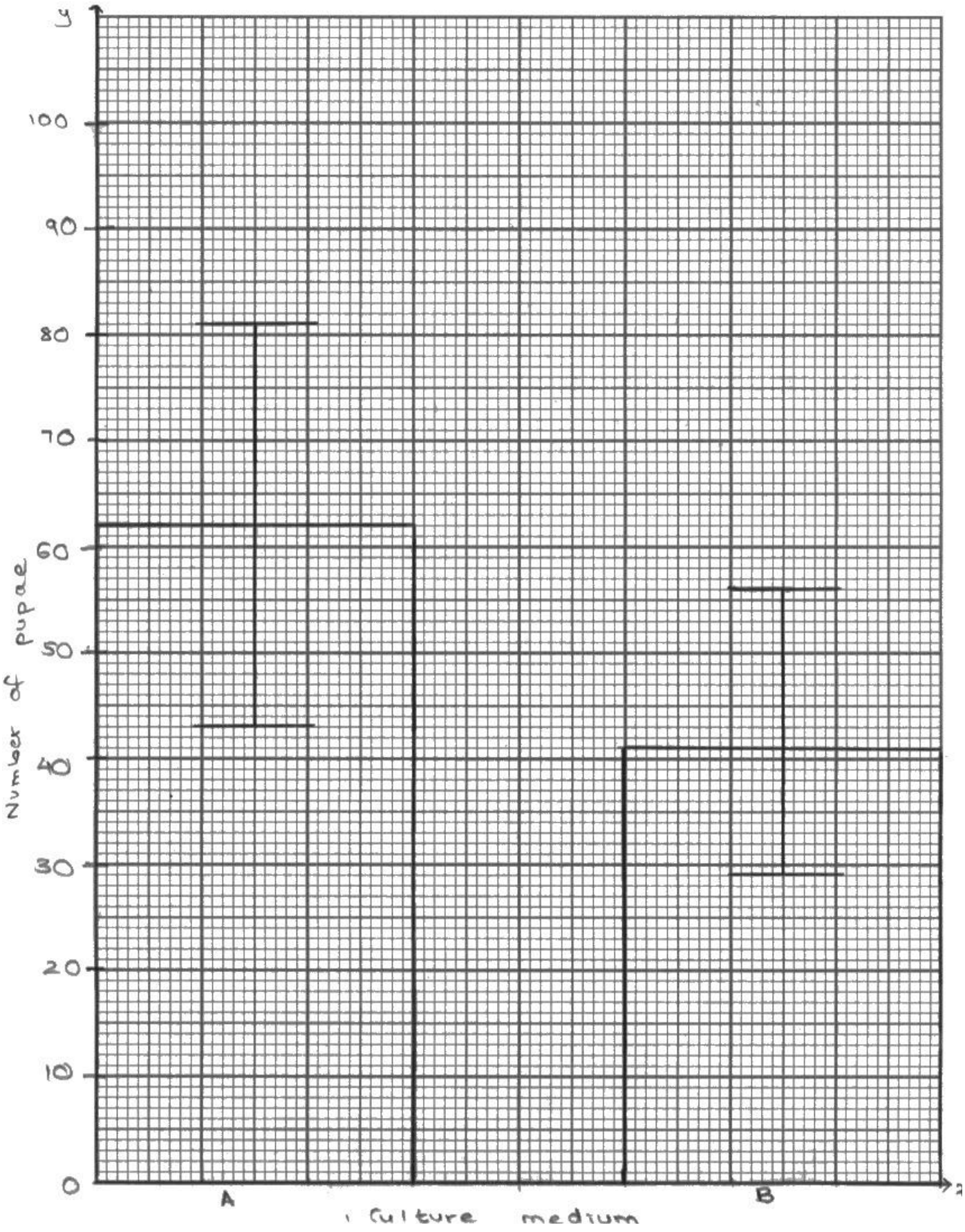
(2)

Sample	Number of pupae from culture medium	
	A (Untreated)	B (Treated)
1	72	45
2	68	56
3	81	39
4	56	40
5	43	29
6	52	38
7	60	35
8	64	46
Mean	62	41

(c) Draw a suitable graph to show the mean number of pupae from the untreated culture medium and treated culture medium.

Include an indication of the variability of the data.

(3)



ResultsPlus
Examiner Comments

Both axes need to be fully labelled.

ResultsPlus
Examiner Tip

Both axes need to be fully labelled. The plot is of mean number of pupae.

The photograph shows fly pupae in one of the flasks.

(Source: © Sundry Photography/Alamy Stock Photo)

After five days, the number of pupae in each flask was counted.

The results were:

Number of pupae from untreated culture medium (A)

72 68 81 56 43 52 60 64

Number of pupae from treated culture medium (B)

45 56 39 40 29 38 35 46

(a) State a suitable null hypothesis for this investigation.

(1)

There is no significant difference between the mean number of pupae in the untreated culture medium and the treated culture medium.

(b) Draw a suitable table to display these **data** and the calculated **means** for the number of pupae from the flasks containing the untreated and treated culture medium.

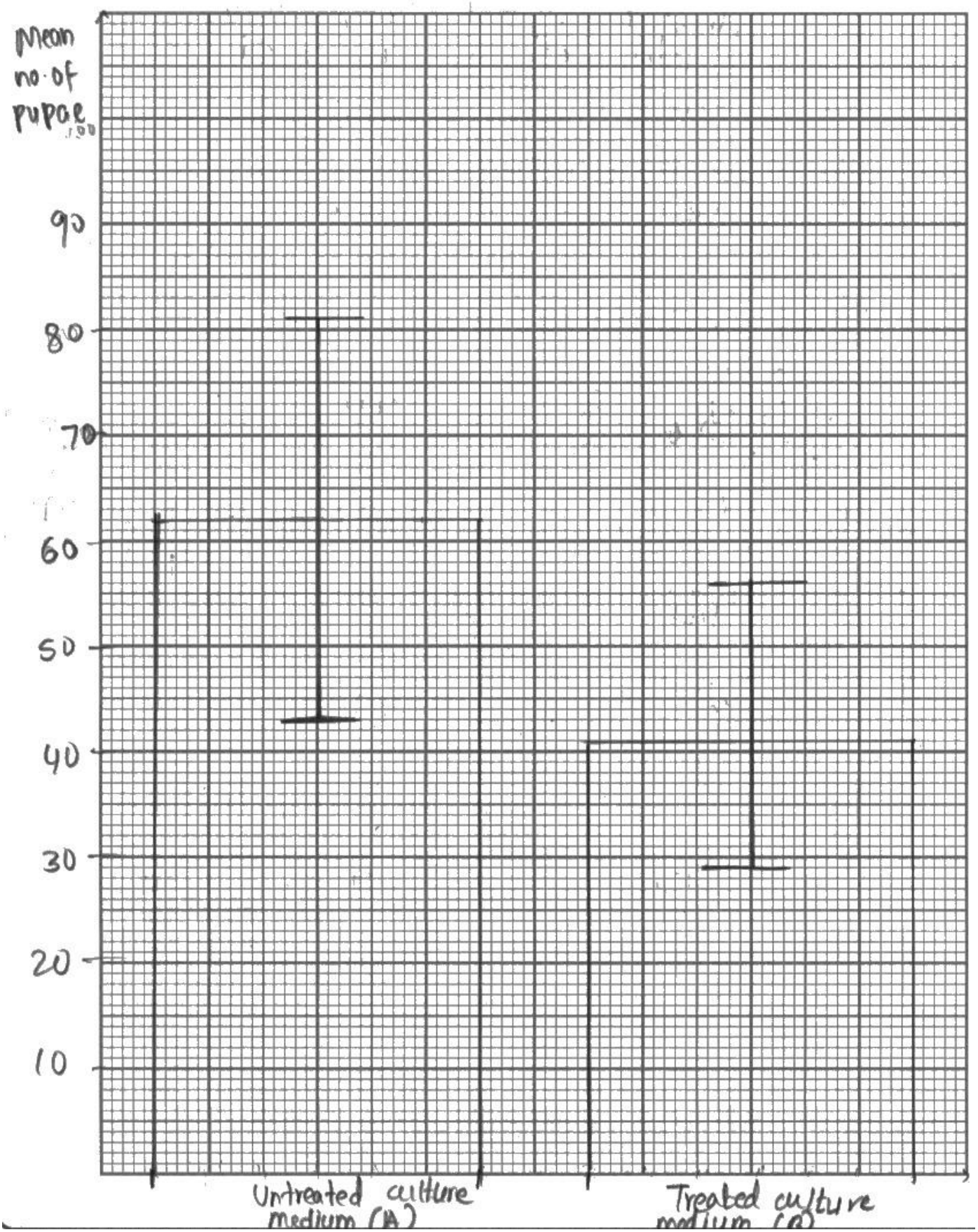
(2)

	Number of pupae	
	Untreated culture medium (A)	Treated culture medium (B)
	72	45
	68	56
	81	39
	56	40
	43	29
	52	38
	60	35
	64	46
Mean	62	41

(c) Draw a suitable graph to show the mean number of pupae from the untreated culture medium and treated culture medium.

Include an indication of the variability of the data.

(3)



ResultsPlus
Examiner Comments

A correct table and graph.

Question 3 (d)(i)

The question asked for a calculation using the formula provided to find the value of t.

(d) The student analysed the data with a *t* test using the formula:

$$t = \frac{(\bar{x}_A - \bar{x}_B)}{\sqrt{\frac{(S_A)^2}{n_A} + \frac{(S_B)^2}{n_B}}}$$

where:

$\bar{x}$ is the mean value for each treatment

n is the number of samples for each treatment

$(S_A)^2 = 143.1$ and $(S_B)^2 = 65.7$

(i) Calculate the value of *t*.

(2)

n_A and n_B are both 8

$$t = \frac{62 - 41}{\sqrt{\frac{143.1}{8} + \frac{65.7}{8}}} = 4.1105 = 4.11$$

Answer 4.11

ResultsPlus
Examiner Comments

An example of the correct use of the formula. The value was given to two places to match the usual critical values given in tables.

(d) The student analysed the data with a *t* test using the formula:

$$t = \frac{(\bar{x}_A - \bar{x}_B)}{\sqrt{\frac{(S_A)^2}{n_A} + \frac{(S_B)^2}{n_B}}}$$

where:

$\bar{x}$ is the mean value for each treatment

n is the number of samples for each treatment

$(S_A)^2 = 143.1$ and $(S_B)^2 = 65.7$

(i) Calculate the value of *t*.

(2)

$$t = \frac{62 - 41}{\sqrt{\frac{(143.1)^2}{8} + \frac{(65.7)^2}{8}}} = \frac{21}{77.40647} = 0.27129$$

Answer 0.2713

ResultsPlus
Examiner Comments

The candidate did not use the given formula correctly.

ResultsPlus
Examiner Tip

Look carefully at the formula given in the question. The given values did not need to be squared as they were already given as squared values.

Question 3 (d)(ii)

The question asked what could be deduced from this investigation.

Deduce the conclusions that can be drawn from this investigation.

Use the information in this table to support your answer.

(2)

The critical value is 2.14. The calculated t value is greater than the critical value, Hence, reject null hypothesis. There is a significant difference in number of pupae between untreated culture medium and treated culture medium.

ResultsPlus
Examiner Comments

This answer has used the critical value correctly and given a correct conclusion.

Deduce the conclusions that can be drawn from this investigation.

Use the information in this table to support your answer.

(2)

The critical value of t at 14 (degrees of freedom) at 5% is 2.14 which is less than the t value of 4.11. 4.11 > 2.14 therefore the null hypothesis is rejected.

ResultsPlus
Examiner Comments

The critical value was used correctly but the answer is incomplete. Simply rejecting the null hypothesis is not sufficient for the second mark.

Deduce the conclusions that can be drawn from this investigation.

Use the information in this table to support your answer.

(2)

p value is 2.14. The value of t we calculated is 4.11 which is greater than the p value; therefore, we reject the null hypothesis. There is significant correlation between the number of pupae in the treated and untreated culture.

ResultsPlus
Examiner Comments

The reference to correlation is incorrect.

Question 3 (e)

The question asked for two ways this investigation could be extended to collect more data.

(e) Describe **two** ways this investigation could be extended to collect more data to either support or reject the hypothesis.

(2)

let pupae develop into adult flies. Leave pupae in culture for 24 hours more and count number of fruit flies developed. Use different concentrations of pyrethrum to see if more of it affects growth of fruit flies.

ResultsPlus
Examiner Comments

There is one reference to increasing the time, ie collecting after six days and of using different concentrations of pyrethrum.

(e) Describe **two** ways this investigation could be extended to collect more data to either support or reject the hypothesis.

(2)

Sample size can be increased. The experiment can be repeated again and the means can be calculated.

ResultsPlus
Examiner Comments

This is an example of a generic answer that does not relate to this investigation.

ResultsPlus
Examiner Tip

Candidates should always avoid generic answers without development to the context of the question.

(e) Describe **two** ways this investigation could be extended to collect more data to either support or reject the hypothesis.

(2)

conduct the experiment for longer time period so instead of 24hrs to lay the eggs and the counting pupae after 5. Leave the fly to hatch eggs for 8/ days ~~and~~ more time and then count the pupae after more than 5 days (1 week). use more than 16 flys (flasks) to obtain more data.

ResultsPlus
Examiner Comments

This answer described two different increases for time before collection, as shown on the mark scheme.

Question 3 (f)

The question asked for two suggestions as to why applying pyrethrum in fields might not reduce the damage to fruits.

(f) Pyrethrum is applied to fruit crops growing in fields.

Suggest **two** reasons why applying pyrethrum to fruit crops in fields might not reduce damage to fruits.

(2)

Some fruit flies can undergo mutation, Hence change in sequence of DNA which can lead to resistance gene to pyrethrum and so it is unaffected by pyrethrum. Other insects may not be affected by pyrethrum and so they feed on the fruit. pyrethrum can contaminate fruit

ResultsPlus
Examiner Comments

The idea of resistance to pyrethrum and the fruits being eaten by other pests were quite frequently suggested.

(f) Pyrethrum is applied to fruit crops growing in fields.

Suggest **two** reasons why applying pyrethrum to fruit crops in fields might not reduce damage to fruits.

(2)

The flies lay eggs under the skin off the fruit

Pyrethrum cannot reach under the skin as it is sprayed externally.

ResultsPlus
Examiner Comments

This candidate made use of the information given to make one valid suggestion.

(f) Pyrethrum is applied to fruit crops growing in fields.

Suggest **two** reasons why applying pyrethrum to fruit crops in fields might not reduce damage to fruits.

(2)

- Damage due to other factors such as animals feeding on fruits.
- Fruit crops may develop resistance to pyrethrum so it is not effective.
- Pyrethrum may be washed away by rain.

ResultsPlus
Examiner Comments

There are three suggestions worthy of credit in this example.

Question 4 (a)

The question asked for a description of suitable preliminary work needed to investigate the antimicrobial effects of a plant extract.

4 The photograph shows some leaves of *Piper betle*, a plant that grows in the Philippines and other countries in southeast Asia.

(Source: © Bowonpat Sakaew/Alamy Stock Photo)

The leaves are eaten as a traditional cure for human digestive disorders.

The leaves are thought to prevent the growth of some species of bacteria.

A student formed the following hypothesis:

The leaves of Piper betle contain antibacterial compounds that reduce bacterial growth.

Plan an investigation to find evidence to support or reject this hypothesis.

Your answer should give details under the following headings.

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

(2)

- Find a suitable method to measure clear zone (reduction in bacterial growth).
- Find a suitable concentration of bacterial culture to use.
- Find a suitable incubation temperature.

ResultsPlus
Examiner Comments

The marks were given for finding a suitable method of measuring the zone of inhibition and a temperature for incubation.

4 The photograph shows some leaves of *Piper betle*, a plant that grows in the Philippines and other countries in southeast Asia.

(Source: © Bowonpat Sakaew/Alamy Stock Photo)

The leaves are eaten as a traditional cure for human digestive disorders.

The leaves are thought to prevent the growth of some species of bacteria.

A student formed the following hypothesis:

The leaves of Piper betle contain antibacterial compounds that reduce bacterial growth.

Plan an investigation to find evidence to support or reject this hypothesis.

Your answer should give details under the following headings.

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

(2)

find a suitable way to measure bacterial growth
find a suitable time interval for bacterial growth
Find suitable Temprature for bacetrial growth.

ResultsPlus
Examiner Comments

This only gained the mark for finding a suitable temperature for incubation.

4 The photograph shows some leaves of *Piper betle*, a plant that grows in the Philippines and other countries in southeast Asia.

(Source: © Bowonpat Sakaew/Alamy Stock Photo)

The leaves are eaten as a traditional cure for human digestive disorders.

The leaves are thought to prevent the growth of some species of bacteria.

A student formed the following hypothesis:

The leaves of Piper betle contain antibacterial compounds that reduce bacterial growth.

Plan an investigation to find evidence to support or reject this hypothesis.

Your answer should give details under the following headings.

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

(2)

practice a method to check if it works, find a suitable age for ~~bacteria~~ leaves to be the same, find a suitable range of temperature, find a suitable PH for the growth, find a suitable concentration for antibacterial compounds, find a suitable size of leaves, find a suitable species of leaves to be the same

ResultsPlus
Examiner Comments

This only gained one mark for finding a suitable concentration of antibacterial compounds.

Question 4 (b)

The question asked for a detailed method that could be used to investigate the antibacterial properties of a plant extract.

Many candidates were familiar with the method from a core practical and gave accounts that were clear. All the points on the mark scheme were seen regularly.

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

(9)

* Independent variable : Presence of Piper betle leaves
* Dependent variable : Clear zone diameter
* Controlled variables : ~~Data~~ Species of bacteria used (control by obtaining bacteria from same culture), temperature (control using thermostatically controlled room, volume of culture added (control with pipette)
* Method:

* Prepare an agar plate on a Petri Dish that had been autoclaved (to sterilise Petri Dish)
* heat neck of bottle containing a bacterial culture, and add the culture using sterile pipette
* Use sterile spreader to make a lawn of bacteria
* Crush and grind leaves of Piper betle, and add distilled water to make an extract
* Add this extract onto lawn of bacteria
* Incubate at 25°C for 2 days, with a loosely-fit lid having been placed over Petri Dish
* Measure diameter of clear zone ; if it is even, use vernier calliper, if it is uneven use graphing paper

* the larger the clear zone diameter, the more bacteria had been killed
* repeat experiment, this time instead of adding extract from leaves, add an equal volume of distilled water to bacteria (control experiment)
* compare sizes of clear zone diameters

* repeat whole experiment 3 times under same conditions and calculate mean.

ResultsPlus
Examiner Comments

All the points on the mark scheme were seen.

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

(9)

dependant variable is growth of bacteria (change in bacterial population). Independant variable is concentration of antimicrobial extract. Prepare an antimicrobial extract by crushing the leaves of piper betle and then add propanone (or any solvent) and the filter. Get known mass of bacterial culture using a Spring balance and add the same mass of bacterial culture to 6 different test tubes (clean tube) then add ~~water~~ only water to the first test tube and other test tubes add 0.2 mol dm^{-3}, 0.4 mol dm^{-3}, 0.6 mol dm^{-3}, 0.8 mol dm^{-3} and 1.0 mol dm^{-3} of antimicrobial extract. then control temperature by placing test tubes in thermostatically controlled Incubator at 25°c and all test tubes should have same PH which is controlled using buffer. Leave test tubes for 3 days then calibrate the colorimeter using water in cuvette, then add bacterial culture from test tube to clean cuvette and measure the percentage absorbance of each bacterial culture and compare. repeat expirement and calculate mean absorbance using values obtained from colorimeter

ResultsPlus
Examiner Comments

This example gained 6 marks. With some extra details it could have scored maximum marks.

*temp *pH *bacteria *aseptic technique *repeat *number of leaves *antimicrobial properties *nutrient broth *safety tips

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

(9)

Number of leaves used is the dependent variable. Number of bacteria is the independent variable. Control the pH and the temperature using a buffer and a thermostatically controlled waterbath. Take ~~different~~ 1, 5, 10 and 20 leaves and crush them and take the plant extract using a mortar and pestle. Take a known volume and concentration of bacteria found in the digestive system. Work near a bunsen burner with yellow flames to create a current for airborne bacteria. Apply bacteria to four different agar plates using the streaking method. Soak ~~the~~ each filter paper ~~paper~~ onto the plant extract then apply onto the agar and seal each plate but not fully to prevent anaerobic conditions. Incubate the agar plates for 24 hours at ~~36~~ 25°C. Zero a colourimeter then compare the bacteria transmission in the agar plates. The lighter the transmission, the more effective the antimicrobial properties of the plant is. Repeat the experiment at each leaf number or repeat the whole experiment and calculate the mean. Wear goggles and gloves to prevent ~~contam~~ contamination. Try different types of bacteria in the digestive system. Apply known and controlled amount of nutrient broth to allow ~~plant~~ bacteria to grow before adding the plant extract.

A good answer gaining 7 marks.

Question 4 (c)

This question asked for a description of how results could be recorded and analysed.

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

(3)

No. of days	Mean diameter of zone of inhibition

* By drawing a suitable table to show the mean diameter of zone of inhibition for no. of days.

* A graph is also drawn to show the mean diameter against time

* And for the analysis use statistical t-test.

ResultsPlus
Examiner Comments

This answer lacks important details. The table should have a column for raw results and units given.

The graph suggested is not clearly a scatter or line graph.

The statistical test is not appropriate for the data collected.

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

(3)

Sample	Diameter of clear zone / mm	
	Control	Bettle extract
1		
2		
3		
Mean		

Figure A

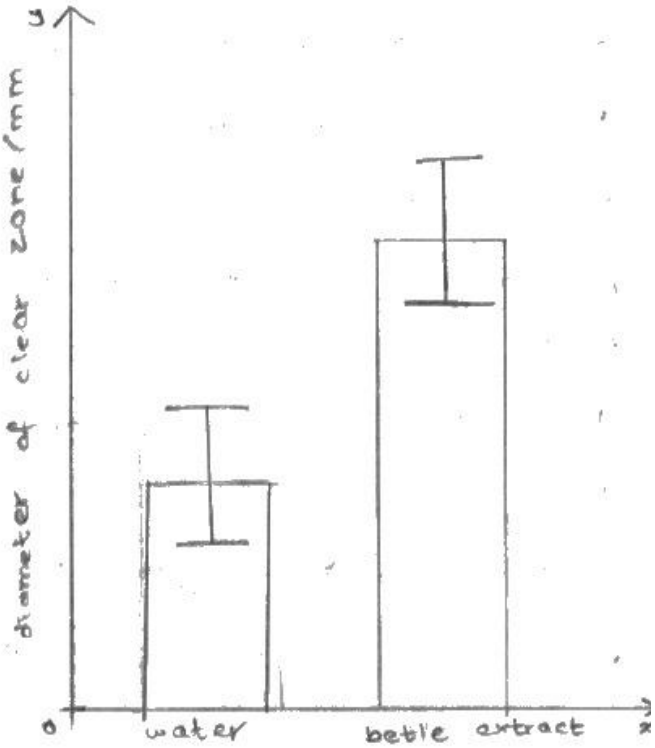


Figure B

Analyse the results using a statistical test such as the student's t-test.

Record the data in a table such as in Figure A the one above and present the data in a graph such as in Figure B.

The table, sketch graph and statistical test were all appropriate.

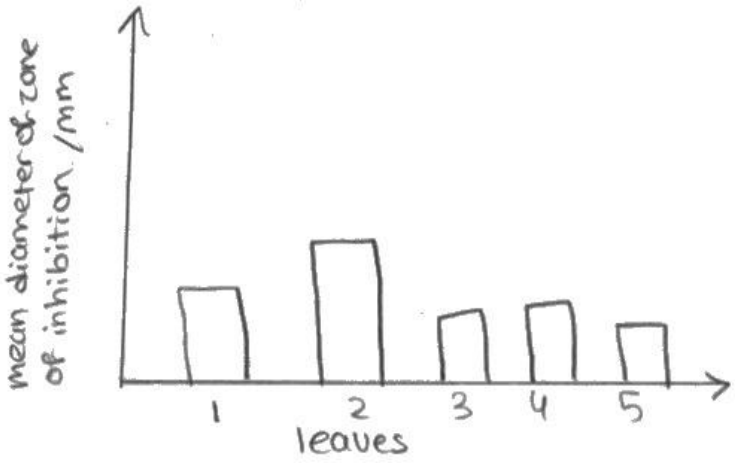
This question can be answered in writing only if enough detail is given for each element.

The majority of candidates used the space to sketch a table and graph.

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

(3)

leaves	diameter of zone of inhibition/mm			mean
	Trial 1	Trial 2	Trial 3	
1				
2				
3				
4				
5				



plot a bar graph using x-axis (leaves) and y-axis (diameter of zone of inhibition) use t-test to show if there is significant different between leaves and mean diameter of zone of inhibition.

ResultsPlus
Examiner Comments

The table gained a mark, however the graph and statistical test did not fit the data collected in the table.

Question 4 (d)

The question asked for two limitations of the proposed method.

Candidates were asked to describe two limitations of their proposed method.

(d) Describe **two** limitations of your proposed method.

(2)

- Possibility of contamination with fungi and bacteria as its optimum temperature
- Hard to control all variables (ex: ~~p~~hard to prevent bacteria from breathing aneorobically)

ResultsPlus Examiner Comments

Two appropriate limitations were described in this example.

(d) Describe **two** limitations of your proposed method.

(2)

~~Difficult to prevent growth of other~~ Other bacteria from surroundings can grow in petri dish. And zone of inhibition can sometimes be an uniform shape so difficult to measure area.

ResultsPlus Examiner Comments

This answer gave two appropriate limitations.

(d) Describe **two** limitations of your proposed method.

(2)

Asceptic technique isn't 100% efficient so difficulty in preventing contamination where contamination limits bacterial growth so affect Results

Zone of inhibition isn't circular so it is quite difficult to measure area of inhibition zone; also there is difficulty to evenly distribute bacteria

The extraction method affect the effectiveness of antimicrobial substance

ResultsPlus
Examiner Comments

This example gained two marks.

Paper Summary

Based on their performance on this paper, candidates should:

- 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.
- Think, when studying core practicals, 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.
- Ensure that if you are given the procedure for a practical technique, you 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.