

**BIOLOGY
PERFECT
SCORE
MODULE
PAPER 3**

FORM 4 & FORM 5

NAME

: _____

SPM BIOLOGY (PAPER 3)

CORRECT ANSWERING TECHNIQUES

1. OVERVIEW

- Consist of 2 questions – 1 ½ hours
- 50 marks
- Question 1: 33 marks, Question 2: 17 marks
- Test of Scientific Skills
- Based on Practical / Experiments / Field Works

2. QUESTION 1 (33 MARKS)

Example of question:

Lemna minor is a species of free-floating aquatic plants from the duckweed family Lemnaceae. The plants grow mainly by vegetative reproduction: two daughter plants bud off from the adult plant.

An experiment is carried out to investigate the effect of abiotic factor such as pH on *Lemna* sp. growth. Experiment is done under controlled conditions: 12 hours a day light exposure and using the same Knop's solution.

Petri dish is filled with 20 ml Knop's solution with different pH value and 5 *Lemna* sp. each. The Knop's solution is treated by adding acid or alkali to achieve the pH value needed.

** **Knop's solution** is a solution which contains essential nutrient for plants growth.

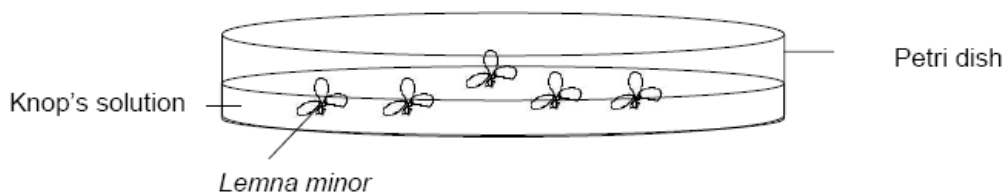


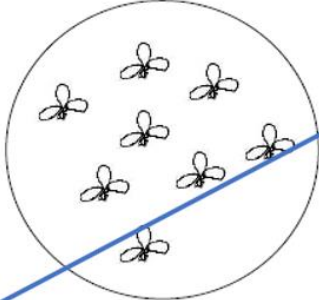
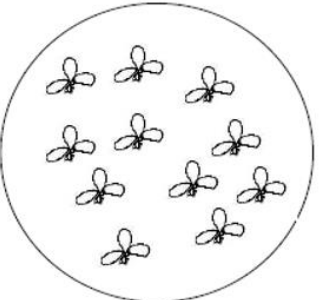
Figure 1

After 7 days, the observation is made and the result shown in Table 1.1

a) **Observation**

- State two **extreme** observations
- State the meaningful observations
- Consist of **MANIPULATED VARIABLES** and **RESPONDING VARIABLES**

- Observations can be in parallel / vertical form
- Preferable: Sentences which state the **VALUES** read from the given apparatus

pH value	Petri dish	Number of <i>Lemna</i> sp.
6		8
8		11

Sample answer (HORIZONTAL OBSERVATION)

(b) (i) Based on Table 1.1, state two observations that can be made in this experiment.

Observation 1:

Manipulated variable

Responding variable

At pH 8 (Knop solution), the number of *Lemna* sp is 11

Observation 2:

At pH 12 (Knop solution), the number of *Lemna* sp is 1

[3 mark

Sample answer (VERTICAL OBSERVATION)

(b) (i) Based on Table 1.1, state two observations that can be made in this experiment.

Observation 1:

Manipulated variable Responding variable

At pH 8 (Knop solution), the number of Lemna sp is more than at pH 2/4/6/8/10

Observation 2:

At pH 12 (Knop solution), the number of Lemna sp is 1 more than at pH 2/4/6/10/12

[3 mark

b) Making inference

- Inference 1 is for observation 1
- Inference 2 is for observation 2
- Inference is an early conclusion based on the experimental observations
- Inference may include reasons

Sample answer

(ii) State the inference for each observation made in (b) (i).

Inference for observation 1:

1. Strong acidic condition is not favorable for *Lemna* growth.
2. Weak/slight alkaline // neutral condition is most favorable for *Lemna* growth.
3. Strong alkaline is not favorable for *Lemna* growth.
4. Strong alkaline condition is the least favorable for *Lemna* growth compare with other conditions.
5. Neutral/Slight alkaline condition is the best/moss favorable condition for *Lemna* growth.

.....
.....
.....

[3 marks

c) Measuring and using numbers

- Record the reading of the thermometer, stopwatch, measuring tools, ruler, etc. from the given diagram
- Do not forget the UNITS
- Up to 2 decimal points

d) Communicating data

- Table must be completed with UNITS and TITLES for the column and row
- Fill up the complete information given
- Transfer the information correctly
- If there is calculation, show the method with complete unit/state the formula

Sample answer

pH of water	Number of Lemna sp
2	4
4	5
6	8
8	11
10	5
12	1

e) Interpreting data (Explain / State the relationship)

- ✓ Construct sentence that shows relationship between variables mentioned in a question
- ✓ State the details relationships

Sample answer:

In the acidic medium the Lemna sp. growth is less, and increase when the medium become neutral but decrease when alkali condition.

f) **Controlling variables**

- State only ONE variable for each type
- State how the variables are operated

VARIABLE (STATE)	Method to handle the variables (MUST BE VERB)
Manipulated	Use / state the values or different
Responding	By measuring / calculating and recording using State the apparatus used
Controlled	Use the same/Maintain/ Fixstate the values

Sample answer

Variables	Method to handle the variables
Manipulated: pH	Add / Use acid or alkali to the Knop solution to get different pH condition Use pH solution : pH 2, pH 4, Ph 6, pH 8, pH 10, pH 12 Change / alter : the medium condition
Responding: Number of <i>Lemna sp.</i>	Count and record the number of <i>Lemna sp.</i> plants after 7 days
Controlled Light exposure / Volume of Knop solution	Fix 12 hours light exposure every day Maintain the volume at 20ml

g) State hypothesis

- Able to state the hypothesis correctly based on the following criteria:
 - P1: state the MV
 - P2 : state the RV
 - H: relate P1 & P2
- The sentence that you write must show the relationship between MV and RV

- The more / the less Manipulated variables
.....the more / the less
.....responding variables

h) Predicting

- IF THE EXPERIMENT IS REPEATEDPREDICT THE OBSERVATION.....
- Predict by stating whether there will be an **increase** or **decrease?**
More?/ Less/ Same?
- May state the **values** which are suitable and will be accepted within the range
- And give the reason for predicting it so

Sample answer

Less / very small population of *Lemna sp*, because water is contaminated with soap / detergent that contain alkali which is not favourable for *Lemna sp* to grow

i) Defining operationally

- Answer must be based on experiment not theory
- Consist of the followings:
 - WHAT IT IS: State the phrase that is going to define
 - WHAT IT DOES: Indicators (apparatus used/responding variables)
 - AFFECTED BY WHAT : Influenced by manipulated variables

Sample answer

Abiotic factor is the pH of the medium that affect the Lemna sp. Growth in an ecosystem

j) Classifying

- Complete the given table according to the title
- If the table is not provided, construct the table according to the classification given
- Divide rows and columns according to types/different functions

Sample answer

Abiotic factors	Biotic factors
Humidity	Decomposer
Light intensity	Parasite
Soil texture	Symbiotic organism
Topography	Invertebrates

k) Correlating time and space

Able to draw the graph correctly:

- Axis : Correct the title with **units, uniform scale**
- All points **plotted correctly**
- Able to join points to form smooth graph

3. QUESTION 2 (17 MARKS)

After reading a question :

Step 1: Identify all the variables involved

Step 2: Construct hypothesis

Step 3 : Construct problem statement

Step 4 : Prepare planning

- Planning / Designing experiment
- 17 marks
- 9 aspects

a) Problem statement

- ✓ What is the effect ofMV..... onRV.....?
- ✓ **MUST BE IN QUESTION FORM**
- ✓ Does / Is / What / How does

.....?

b) Hypothesis

- ✓ The moreMV.... the more /less ...RV....?
- ✓ If the

- ✓ A statement that shows relationship between the two variables:
MV and RV

c) Variables

- ✓ Manipulated (MV)
- ✓ Responding (RV)
- ✓ Fixed (FV)
 - State only ONE variable for each

d) List of apparatus and materials

- List ALL functional MATERIALS and APPARATUS

e) Experimental procedure or method

- ✓ P1-Preparation of materials and apparatus
- ✓ P2-Operating control variables
- ✓ P3-Operating responding variables
- ✓ P4-Operating manipulated variables
- ✓ P5-Precautions / Accuracy of experiment

Meningful sentences:

1. Repeat steps 1-5 by using
2. Record result / mass / temperature in a table

f) Presentation of data (Result)

- ✓ Prepare a table which is complete with:
 - Title for column and row
 - Correct units
 - No result / data is required in the table

CHAPTER 2

QUESTION 1

Cells are basic units of living organism. They consist of cellular components and organelles that can be seen by using microscope.

Based on the above information, design an experiment to investigate the difference of structures in a plant cell and an animal cell that can be seen under a light microscope.

The planning of your experiment must include the following aspects:

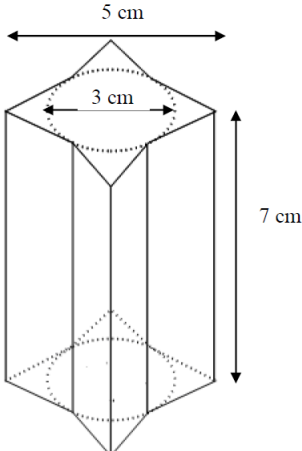
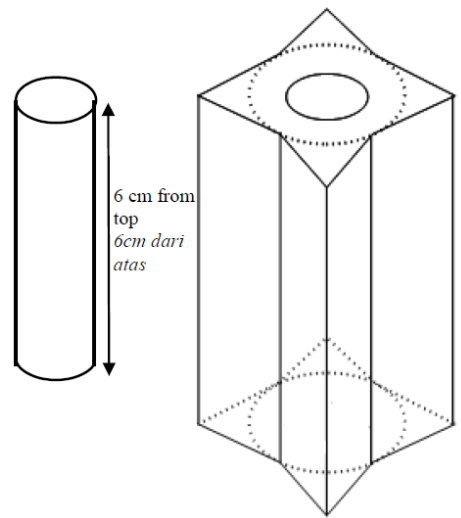
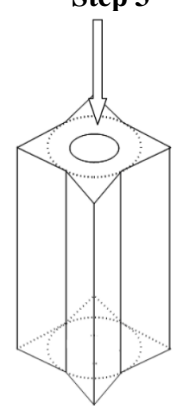
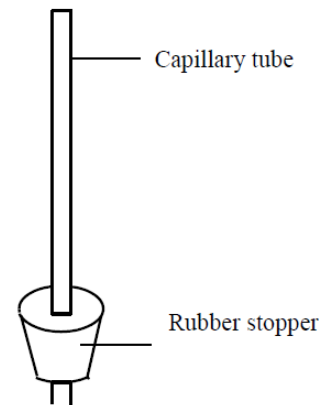
- Problem statement
- Hypothesis
- Variables
- List of apparatus and materials
- Experimental procedure
- Presentation of data

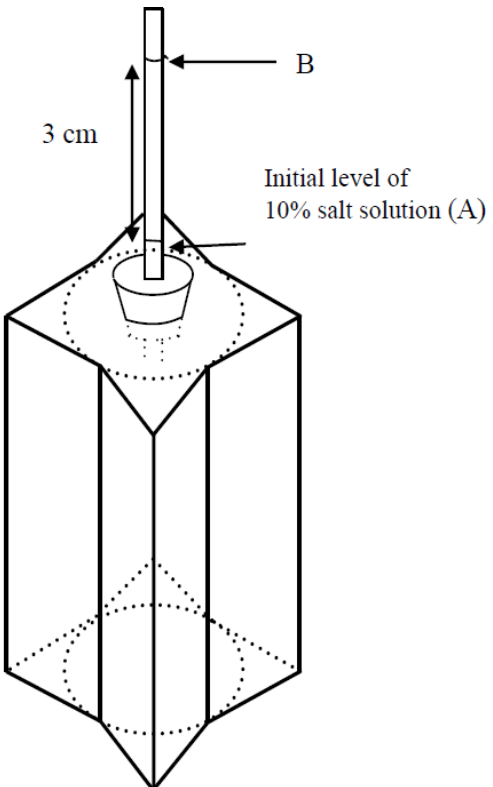
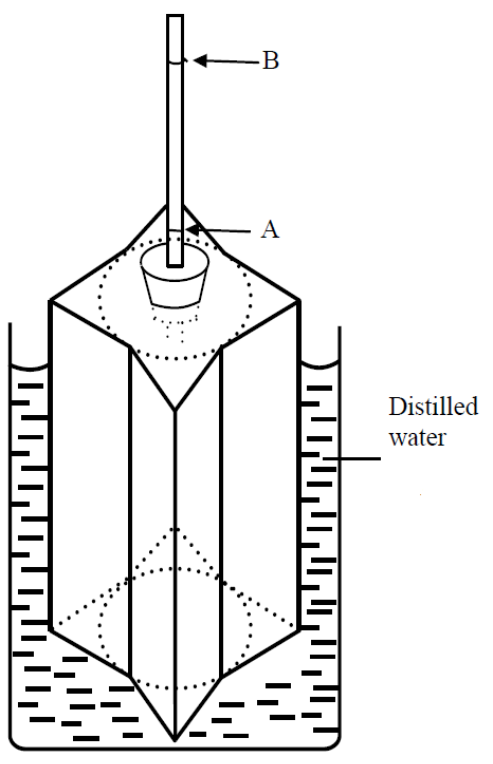
[17 marks]

CHAPTER 3

QUESTION 1

An experiment is carried out to investigate the effect of total surface area on the rate of diffusion of substances in an organ. Potato blocks with different number of triangular surfaces are used in the experiment. Preparation of the experiment is shown in the following diagrams.

<p style="text-align: center;">Step 1</p>  <p>A potato block is cut so that it will have four triangular surfaces, with the measurements shown.</p>	<p style="text-align: center;">Step 2</p>  <p>A cylindrical hole is made in the middle of potato block, 6 cm long, by cutting the potato block from top using a cork borer</p>
<p style="text-align: center;">Step 3</p>  <p>A 10% salt solution is poured into the hole in such a way that the height of the solution in the hole is 5 cm.</p>	<p style="text-align: center;">Step 4</p>  <p>A rubber stopper with a capillary tube inserted through it is prepared as shown in the figure above. The rubber stopper is used to close the hole containing salt solution.</p>

Step 5	Step 6
	
<ul style="list-style-type: none"> • The hole in the potato containing salt solution is covered with the stopper prepared in step 4. • Salt solution rises the capillary tube. Initial level of salt solution is marked as A. • Another mark is made on the capillary tube at a distance 3 cm above the point A. It is labelled as B. 	<ul style="list-style-type: none"> • Place the potato block complete with the rubber stopper and capillary tube in a beaker containing distilled water. • Make sure the potato block is not completely immersed in water. • Water molecules diffuse across the potato tissue from distilled water to salt solution • Record the time taken for the salt solution to travel from A to B

Steps 1 to 6 is repeated using potato blocks of the same size, but different number of triangular surfaces, that is potato block with 8 and 16 triangular surfaces.

Table 1.1 shows the results of this experiment.

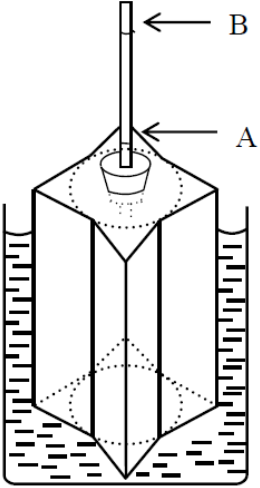
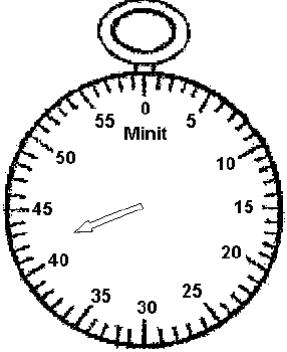
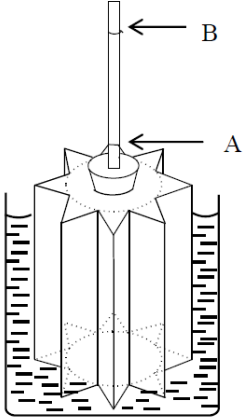
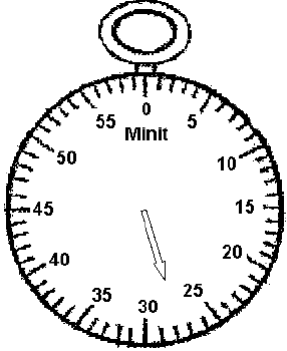
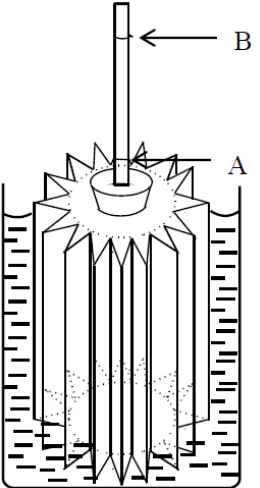
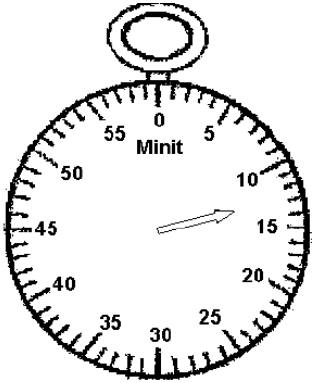
Shape of potato block	Number of triangular surfaces	Distance A to B	Time taken for salt solution to move from A to B / min.
	4	3 cm	 <p style="text-align: center;">Time:</p>
	8	3 cm	 <p style="text-align: center;">Time :</p>
	16	3 cm	 <p style="text-align: center;">Time:</p>

Table 1.1

(a) Record the time taken for the salt solution to move from A to B in the spaces provided in Table 1.1 [3 marks]

(b)(i) Based on Table 1.1, state two different observations. [3 marks]

Observation 1:

Observation 2:

(b)(ii) State two inferences which correspond to the observations in 1(b)(i) [3 marks]

Inference from observation 1:

Inference from observation 2:

(c) Complete Table 1.2 based on the experiment. [3 marks]

Variables	Method to handle the variable
Manipulated variable: ----- ----- ----- -----	----- ----- ----- -----

Responding variable: ----- ----- -----	----- ----- ----- -----
Constant variable: ----- ----- -----	----- ----- -----

Table 1.2

(d) State the hypothesis for the experiment. [3 marks]

(e)(i) Construct a table and record all the data collected from Table 1.1.
 Your table should have the following titles: [3 marks]

- Number of triangular surfaces
- Time taken for the salt solution to move from A to B.
- Rate of diffusion

$$\text{Rate of diffusion} = \frac{\text{Distance of salt solution move from A to B}}{\text{Time taken for the salt solution to move from A to B}}$$

(e)(ii) Use the graph paper provided, draw graph the rate of diffusion against the number of triangular surface. [3 marks]

(f) Based on graph in 1(e)(ii), explain the relationship between the number of triangular surface and the rate of diffusion. [3 marks]

(g) Based on the result of this experiment, state the operational definition for rate of diffusion. [3 marks]

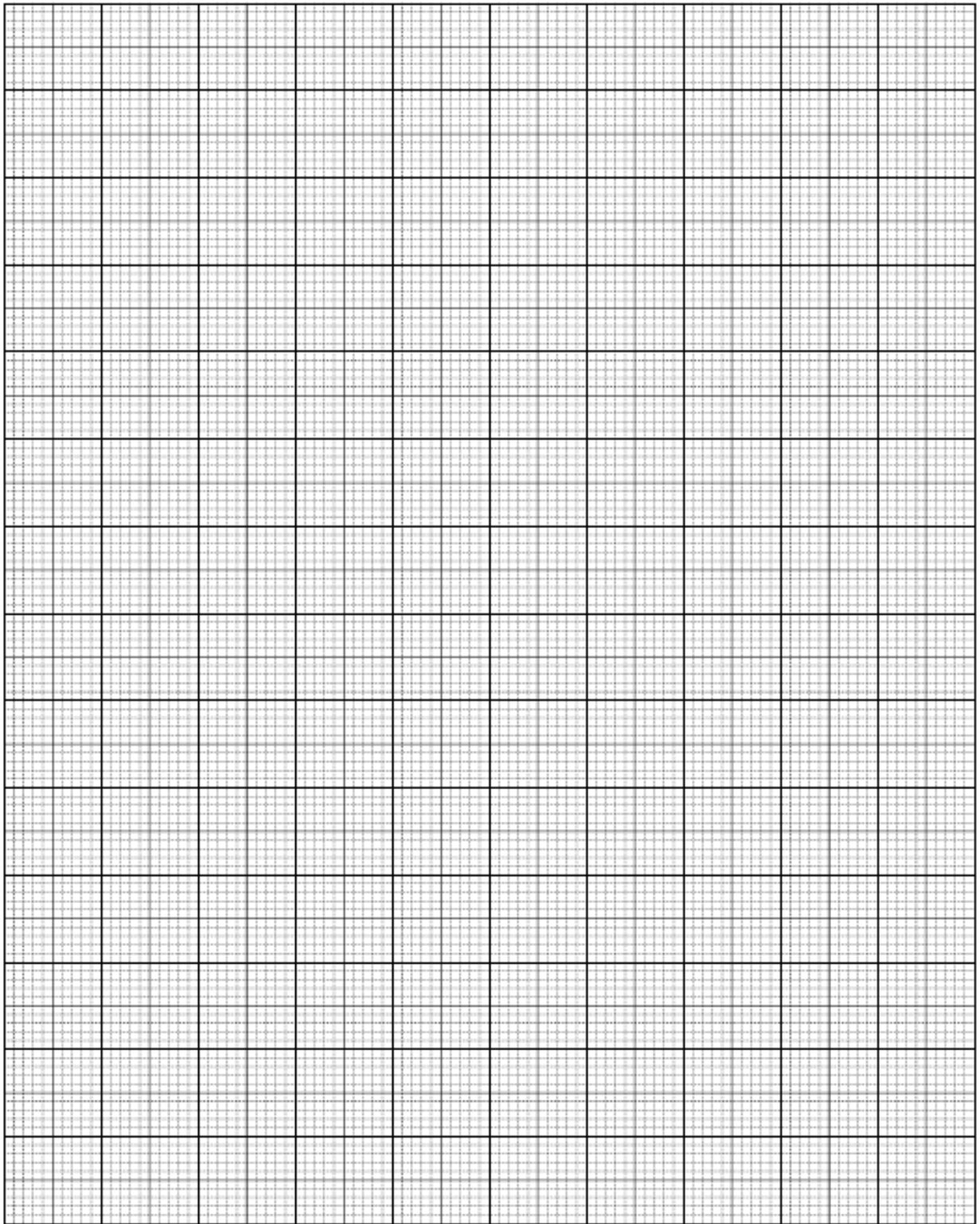
(h) The experiment was repeated by using 30% salt solution instead of 10% salt solution. Predict the outcome of this experiment if the student used number of triangular surface of potato block is 16. Explain your prediction. [3 marks]

(i) Which of the following organs can be classified as the organs that increase the total surfaces for their effective functions. [3 marks]

Small intestines Lungs Heart Esophagus Brain pancreas Liver

Organs having well adapted surfaces for their effective function	Organs without surfaces well adapted for their effective function

Table 1.3



QUESTION 2

An experiment was carried out to study the effect of different concentration of sucrose solution on the mass of visking tube.

The following steps were carried out:

- Step 1 : A visking tube is cut at 15 cm long. Then the visking tube is immersed in water for five minutes to soften it. One end of the visking tubing is tied by using a thread.
- Step 2 : The visking tubing is filled with 100cm³ of 10% concentration of sucrose solution. Then the other end of visking tubing is tied by using another thread.
- Step 3 : The outer surface of visking tubing is rinsed with water. The visking tubing is immersed in a beaker contains 200ml of distilled water for 30 minutes as shown in Diagram 1.1
- Step 4 : After 30 minutes the visking tubing is taken out and dried by using tissue. Then it is weight using electronic balance. The result was recorded in a table.
- Step 5 : The experiment is repeated by using different concentration of sucrose solution which are 20%, 30% and 40%



Diagram 1.1

Table 1 shows the result of the experiment.









Concentration of sucrose solution (%)	Mass of visking tubing (g)		Difference in mass of visking tubing after 30 minutes (g)
	Initial mass	Final mass	
10			
20			
30			
40			

Table 1

- (a) Record the difference in mass of the visking tubing in the space provided in Table 1.
[3 marks]

(b)(i) Based on Table 1, state two different observations. [3 marks]

Observation 1 :

Observation 2:

(ii) State the inferences which correspond to the observations in 1(b)(i). [3 marks]

Inference from observation 1:

Inference from observation 2:

(c) Complete Table 2 based on this experiment. [3 marks]

Variable	Method to handle the variable
Manipulated variable: ----- ----- -----	----- ----- ----- -----
Responding variable: ----- ----- -----	----- ----- ----- -----

Constant variable:	<hr style="border-top: 1px dashed black;"/> <hr style="border-top: 1px dashed black;"/> <hr style="border-top: 1px dashed black;"/> <hr style="border-top: 1px dashed black;"/>
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Table 2

(d) State the hypothesis for this experiment. [3 marks]

(e)(i) Construct a table and record all the data collected from this experiment. Your table should have the following titles: [3 marks]

- Concentration of sucrose solution
- Initial mass of visking tubing
- Final mass of visking tubing
- Difference in mass of visking tubing
- Rate of osmosis

$$\text{Rate of osmosis} = \frac{(\text{Final mass} - \text{Initial mass})(\text{gmin}^{-1})}{\text{time taken}}$$

(e)(ii) Use the graph paper provided to answer this question. Using the data in (e)(i), draw a graph of rate of osmosis against the concentrations of sucrose solution. [3 marks]

(f) Based on the graph in 1(e)(ii), state the relationship between the concentration of the sucrose solution to the rate of osmosis. Explain your answer. [3 marks]

- (g) The visking tubing with 20% concentration of sucrose solution is taken out and then being immersed in 200ml of 60% sucrose solution for 30 minutes. Based on the result of this experiment, predict the final mass of visking tubing. Explain your prediction. [3 marks]

- (h) Based on this experiment, state the operational definition for osmosis. [3 marks]

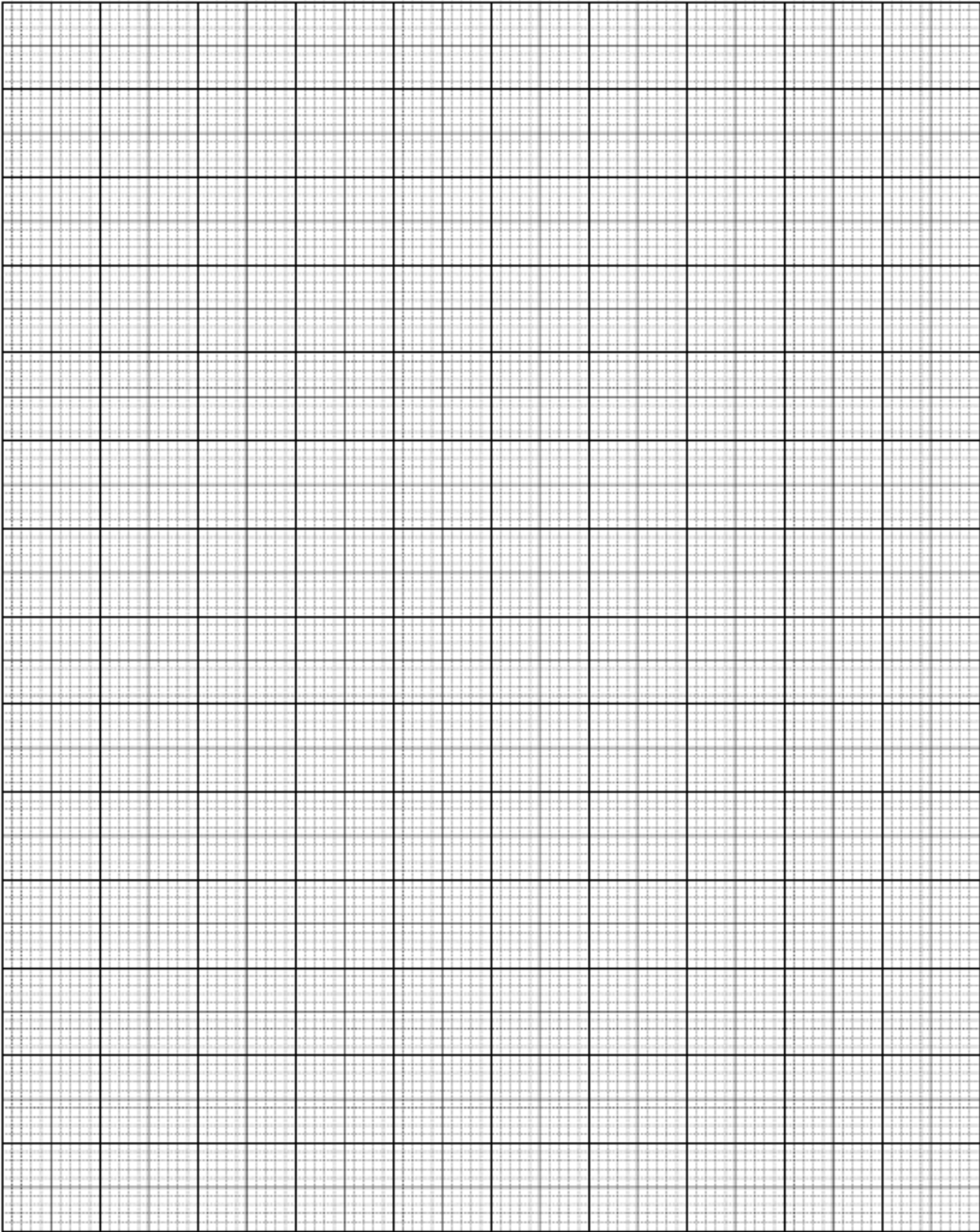
- (i) In another experiment, it was found that a mustard stem strip that was immersed in 0.80% sodium chloride did not undergo a change in mass. The following solutions are used in this experiment.

0.25% sodium chloride solution, 0.80% sodium chloride solution, 1.10% sodium chloride solution

Classify the above solution into Table 3.[3 marks]

Solution concentration (%)	Types of solution compared to the osmotic concentration of the cell sap

Table 3



QUESTION 3

Multicellular organisms are bigger and complex. The cells cannot depend on diffusion alone to obtain its requirements. Multicellular organisms need the transport system to transport respiration gaseous and nutrient to the inner part of the body. Whereas, unicellular organisms get their gaseous and nutrients supply by diffusion through their cell membrane because their total surface area per volume are big.

Based on the above information plan a laboratory experiment to study the relationship between the size of organisms and the rate of diffusion.

The planning of your experiment must include the following aspects:

- Problem statement
- Hypothesis
- Variables
- List of apparatus and materials
- Experimental procedure
- Presentation of data

[17 marks]

CHAPTER 4

QUESTION 1

An experiment was carried out to study the effect of enzyme concentration on the activity of amylase on starch. The following steps were carried out:

- Step 1: Three test tubes P, Q, and R were filled with 2 ml of 0.5%, 1.0% and 1.5% of amylase respectively.
- Step 2: 2 ml of 1% starch suspension were added into each test tube and the contents were stirred.
- Step 3: Every 2 minutes a drop of mixture from each test tube was mixed with a drop of iodine solution on a white tile.
- Step 4: All test tubes are immersed in a water bath at temperature of 37°C during the experiment as shown in diagram below

Diagram 1 shows the apparatus set-up used in this experiment.

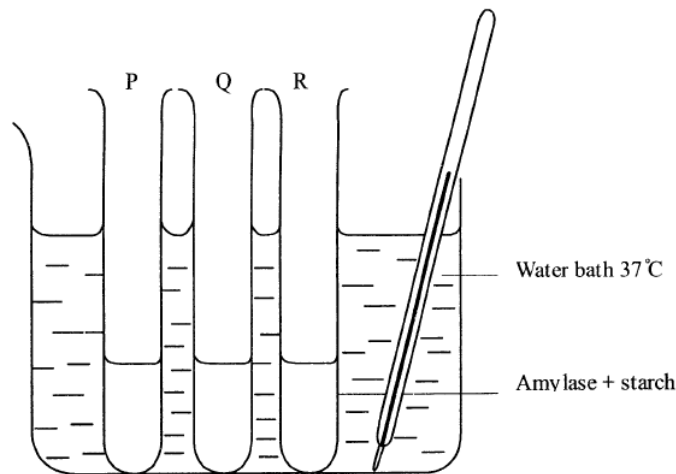


Diagram 1

Table 1 shows the results of the experiment.



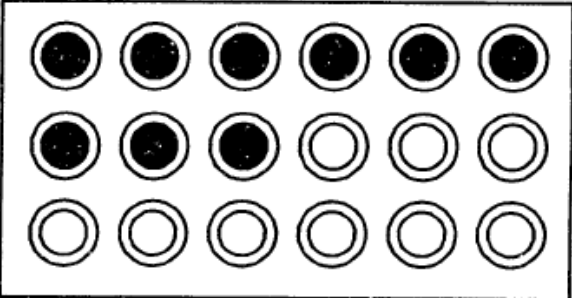
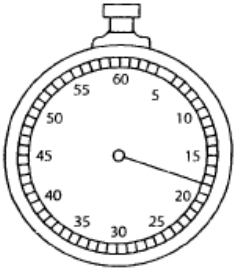
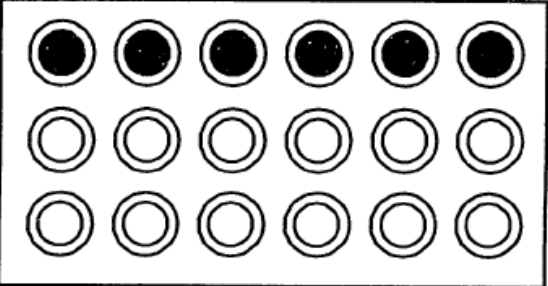
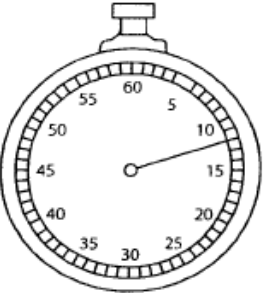
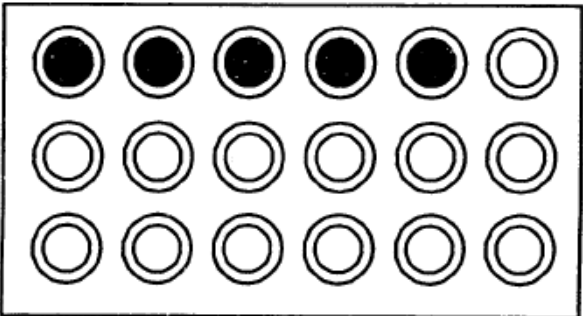
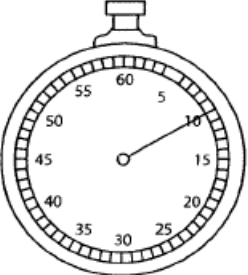
Test tube	The colour of iodine solution starting from minute 0				Time taken for the starch to be hydrolysed completely (min)
		Dark blue		Yellow (no change)	
P					 Time taken:(minutes)
Q					 Time taken: (minutes)
R					 Time taken: (minutes)

Table 1

(a) Record the time taken for the starch to be hydrolysed completely in the boxes provided in table above. [3 marks]

(b)(i) Based on Table 1, state two different observations. [3 marks]

Observation 1:

Observation 2:

(b)(ii) State the inference for each observation made in 1(b)(i). [3 marks]

Inference for observation 1:

Inference from observation 2:

(c) Complete Table 2 to show the variables involved in this experiment and how these variables are operated [3 marks]

Variable	Methods to handle variable
Manipulated variable: ----- ----- ----- ----- -----	----- ----- ----- ----- -----

Responding variable: <hr/> <hr/> <hr/> <hr/>	<hr/> <hr/> <hr/> <hr/>
Constant variable: <hr/> <hr/> <hr/> <hr/>	<hr/> <hr/> <hr/> <hr/>

Table 2

(d) State the hypothesis for this experiment. *[3 marks]*

(e)(i) Construct a table and record all the data collected in this experiment. Your table should have the following aspects: *[3 marks]*

- Enzyme concentration
- The time taken for starch to be hydrolysed completely, t(minute)
- The rate of enzyme amylase activity, $1/t$ (minutes⁻¹)

(e)(ii) Based on the data in 1(e)(i), draw a graph to show the relationship between the enzyme concentration and the rate of amylase activity. Use the graph paper provided to answer this question *[3 marks]*

(f) Based on the graph in (e)(ii), state the relationship between the enzyme concentration and the rate of amylase activity. Explain your answer *[3 marks]*

(g) Based on the experiment, define operationally what enzyme is. [3 marks]

(h) The experiment is repeated with test tube R immersed in water bath with temperature of 65°C during the experiment. Predict the time taken for starch to be hydrolysed completely in test tube R. Explain your answer [3 marks]

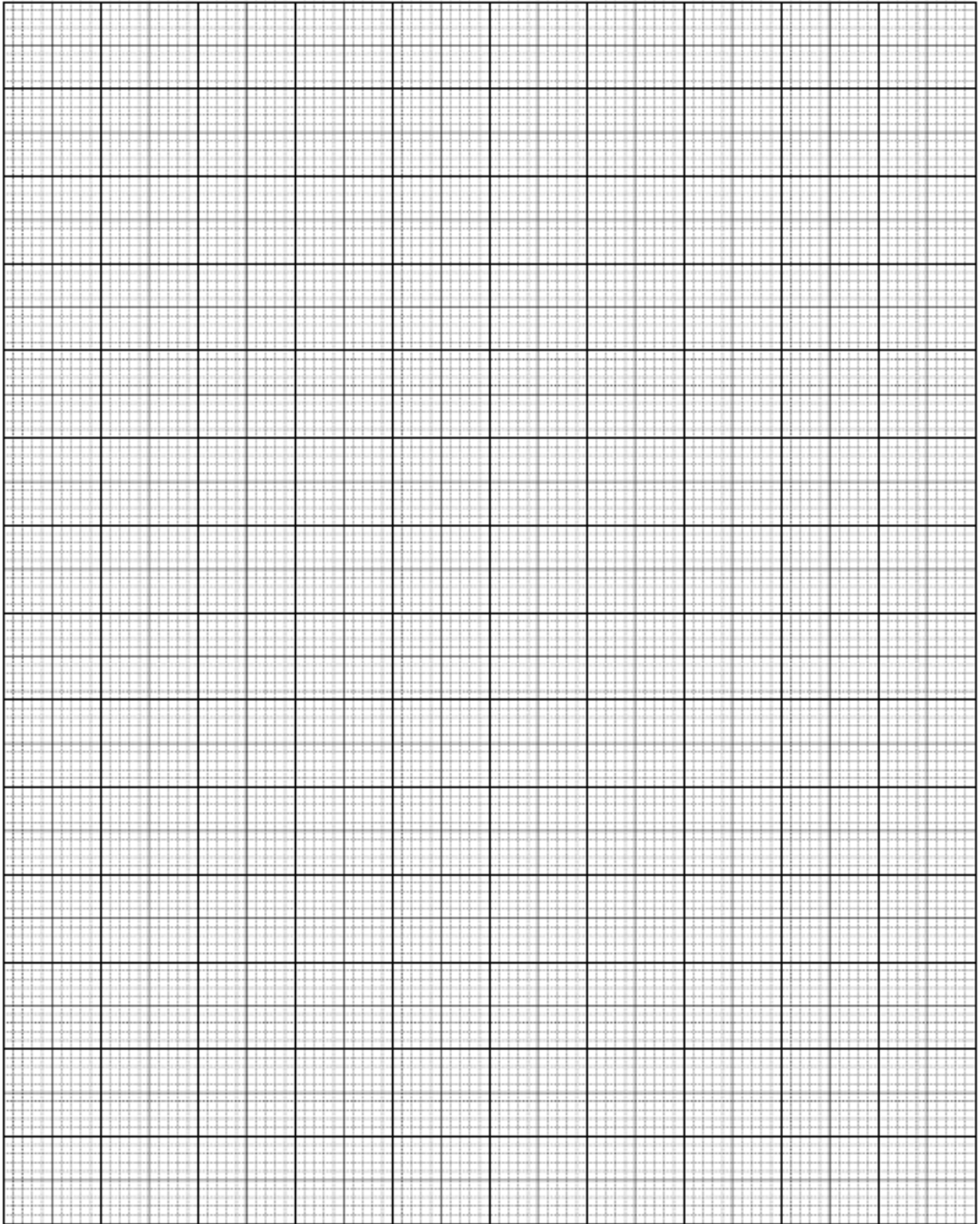
(i) The following are some of the materials used in the experiment to study the effect of pH on the enzyme activity. [3 marks]

- Sodium hydroxide solution
- Hydrochloric acid
- Distilled water

Complete the following table to classify the materials according to the type of medium

Material	Types of medium

Table 3



QUESTION 2

Situation A

A housewife used a product of detergent A to wash her clothes. She found that all the stains such as blood and grease are not easily vanished.

Situation B

Another housewife used a product detergent B to wash her clothes. She was so satisfied when all the stains such as blood and grease are easily vanished

Diagram 1 shows the information stated on both product of detergents.



Diagram 1

Based on the above situation, design a laboratory experiment to study the effect of enzyme concentration on the activity of salivary amylase.

The planning of your experiment must include the following aspects:

- Problem statement
- Hypothesis
- Variables
- List of apparatus and materials
- Experimental procedure
- Presentation of data

[17 marks]

CHAPTER 6

QUESTION 1

A group of students carried out an experiment to investigate the percentage of vitamin C in different type of fruit juices by using dichlorophenolindophenol (DCPIP) solution. The experiment was carried out by using the samples of fruit juice such as lime juice, lemon juice and orange juice.

The students carried out the following steps:

- Step 1: 1ml DCPIP solution was placed in a test tube.
Step 2: A few drops of 0.1% ascorbic acid was added to the DCPIP solution until the blue coloured of DCPIP solution turned colourless.

Figure 1 shows the method used in the experiment.

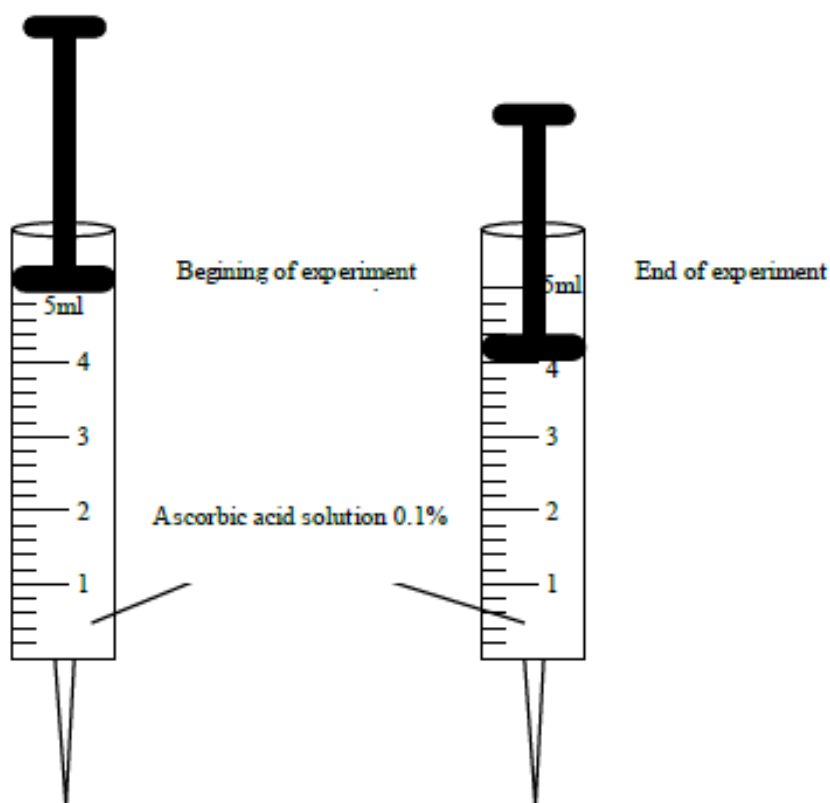
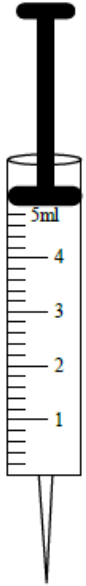
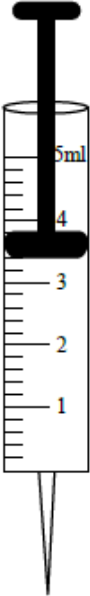
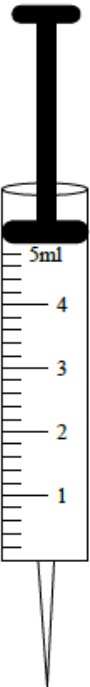
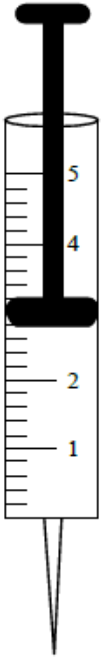


Figure 1

Based on Figure 1, the volume of 0.1% ascorbic solution used to decolourise 1ml DCPIP solution is 1 ml.

- Step 3: Step 1 and 2 were repeated by using lime, lemon and orange juices to replace the 0.1% ascorbic acid solution to decolourise 1ml DCPIP solution.

The volume of fruit juices used to decolourise 1ml DCPIP solution is shown in the Table 1.

Type of fruit juices	Volume of fruit juice (ml)		Volume of fruit juice used to decolourise DCPIP solution (ml)
	Initial volume	Final volume	
Lime juice			<input type="text"/>
Lemon juice			<input type="text"/>

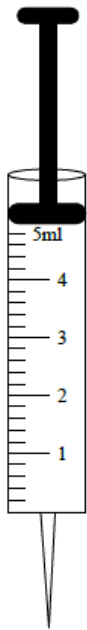
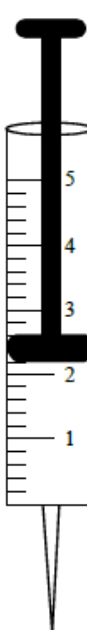

Orange juice			
--------------	---	---	---

Table 1

(a) Record the volume of fruit juice used to decolourise 1ml of DCPIP solution in the boxes provided in Table 1. *[3 marks]*

(b)(i) State two different observations made from Table 1. *[3 marks]*

Observation 1:

Observation 2:

(b)(ii) State the inferences which corresponds to the observations in 1(b)(i). *[3 marks]*

Inference from observation 1:

Inference from observation 2:

(c) Complete Table 2 based on this experiment. [3 marks]

Variable	Method to handle the variable
Manipulated variable: ----- ----- -----	----- ----- ----- -----
Responding variable: ----- ----- -----	----- ----- ----- -----
Constant variable: ----- ----- -----	----- ----- ----- -----

Table 2

(d) State the hypothesis for this experiment. [3 marks]

(e)(i) Construct a table and record all the data collected in this experiment. Your table should have the following titles: [3 marks]

- Sample of fruit juice
- Volume of fruit juice used to decolourise 1 ml DCPIP solution
- Percentage of vitamin C in fruit juice:

$$\text{Percentage of vitamin C in fruit juice} = \frac{\text{Volume of 0.1\% ascorbic acid solution}}{\text{Volume of fruit juice}} \times 0.1\%$$

(e)(ii) Use the graph paper provided to answer this question. Using the data in 1(e) (i), draw a bar chart to show the percentage of vitamin C in different type of fruit juices. [3 marks]

(f) Based on the bar chart in 1(e) (ii), explain the relationship between the volume of the fruit juices used to decolourise DCPIP solution with the percentage of vitamin C in the fruit juices. [3 marks]

(g) Based on the result of this experiment, state the operational definition for vitamin C. [3 marks]

(h) The experiment is repeated using lemon juice that placed in the beaker and prepared 5 hours before the experiment. Predict the outcome of this experiment. Explain your prediction. [3 marks]

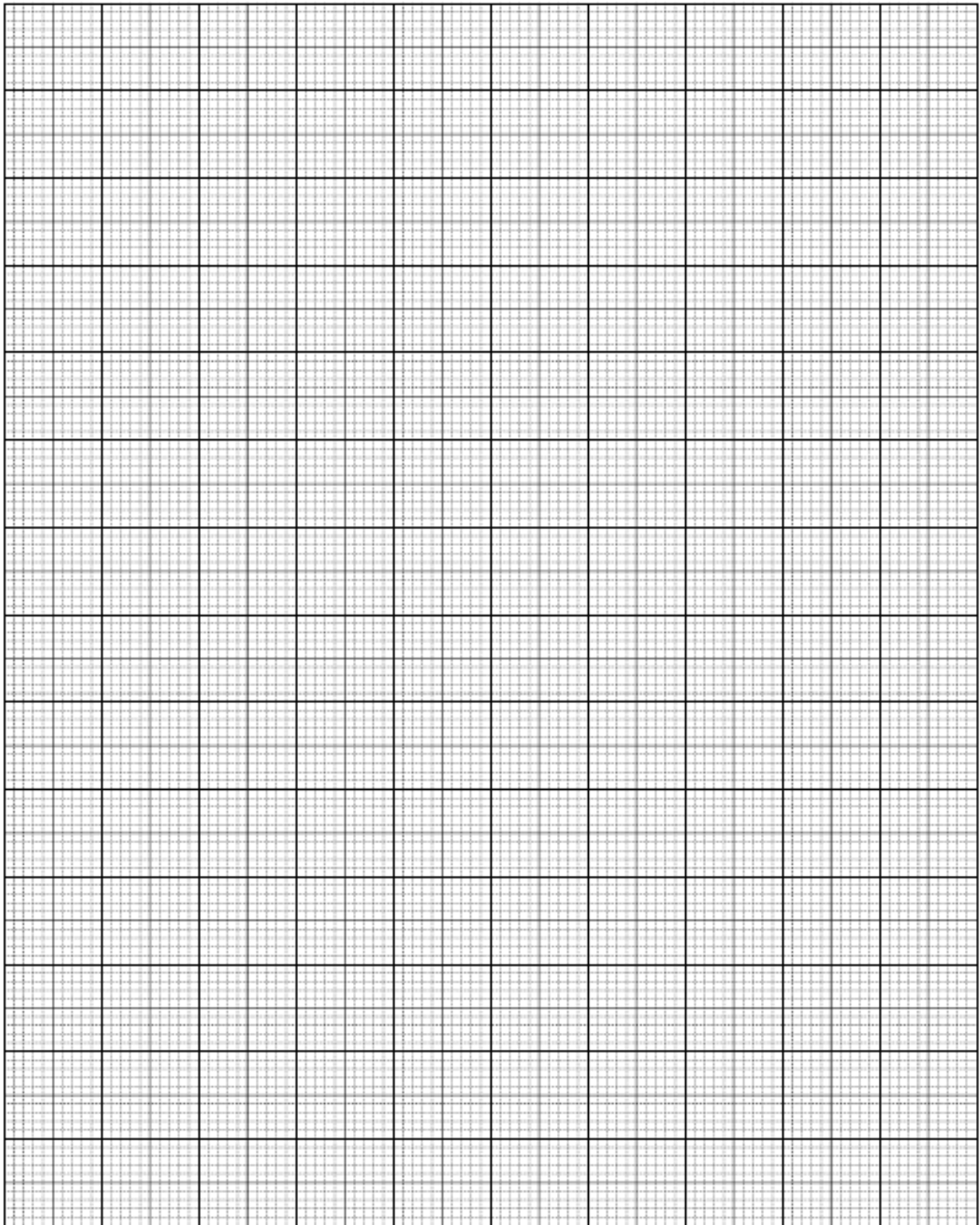
- (i) Another group of students carried out the experiment to determine the percentage of vitamin C but was provided with the following materials: [3 marks]

Apple juice Ascorbic acid solution 1.0% DCPIP solution 0.1% Pineapple juice
--

Classify the above list into materials to be tested and reagents based on their functions in the experiment in Table 3.

Materials to be tested	Reagent

Table 3



QUESTION 2

Minerals that are needed by plants can be divided into macronutrients and micronutrients. Macronutrients are elements required by plants in relatively large amounts. Micronutrients are elements that are required by plants in small quantity. Knop's solution is a complete solution contain all the elements needed by plants to grow well.

A group of students carried out an experiment to study the effects of incomplete Knop's solution on the growth of maize plant roots. The students used the Knop's solution (solution A) as a complete medium culture. Another solution which is solution B is incomplete Knop's solution. Potassium chloride and ferum (III) oxide is used to replace potassium dihydrogen phosphate and ferum (III) phosphate from the Knop's solution as in Table 1.

Solution	Calcium nitrate	Potassium nitrate	Potassium dihydrogen phosphate	Magnesium sulphate	Ferum(III) Phosphate
A Knop's solution	√	√	√	√	√
B Incomplete Knop's solution	√	√	X (replaced by potassium chloride)	√	X (replaced by ferum (III) oxide)

Table 1

Procedures:

- Step 1: Two jars labelled A and B are prepared with solution A (Knop's solution) and solution B (incomplete Knop's solution) as in Table 1.
- Step 2: Two seedlings with the same size and same length of roots are inserted into jar A and jar B. The jars are wrapped with black paper to prevent the growth of green algae and connected to air pump to provide aeration to the roots as in Diagram 1. The initial length is shown as in Diagram 1
- Step3: After 3 days the length of maize plant roots is recorded by using a ruler. The changes in length of maize plants roots is calculated. All the experiments are repeated once again to get the average reading of the changes in length of the maize plants roots

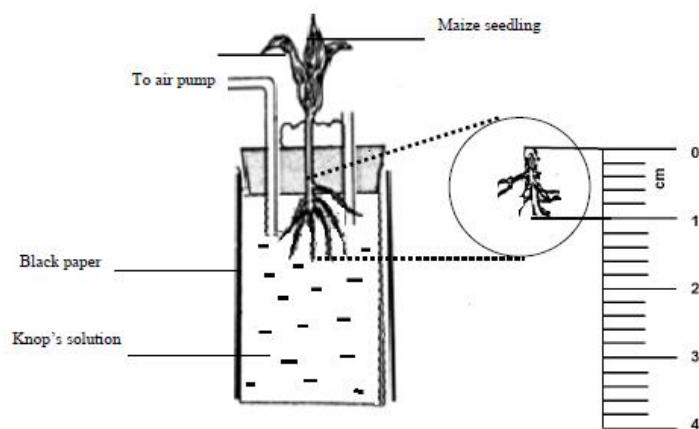


Diagram 1

Initial length of all maize plant roots = 1.0 cm

Table 1 shows the result of the experiments

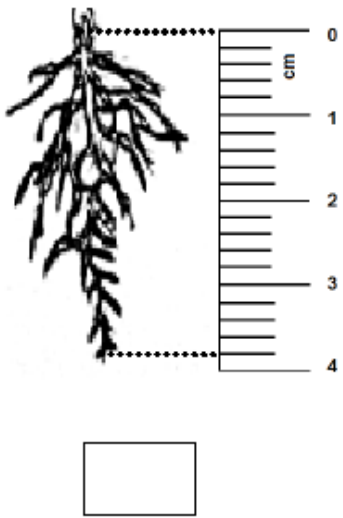
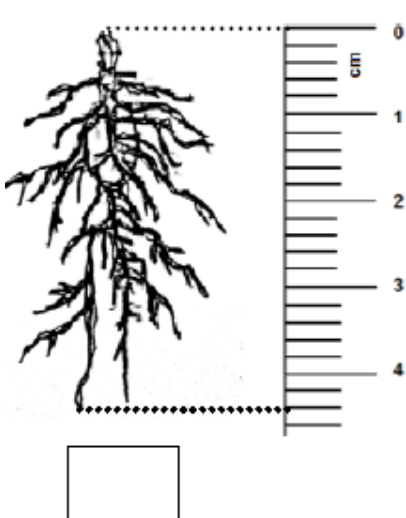
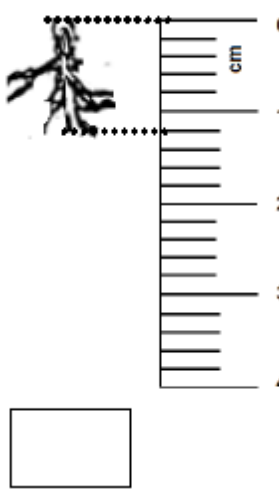
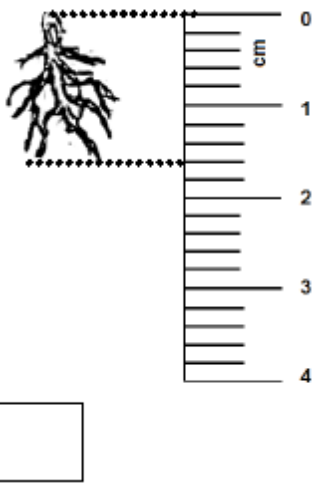
Solution	The final length of maize plants roots after 3 days	
	Maize Plant Roots 1	Maize plant Roots 2 (Repeated Set)
A Complete Knop's solution		
B Incomplete Knop's Solution		

Table 1

(a) Record the final length of the root of maize plant 1 and maize plant 2 in Table 1. [3 marks]

(b)(i) State two different observations made from Table 1. [3 marks]

Observation 1:

Observation 2:

(b)(ii) State the inferences which corresponds to the observations in 1(b)(i). [3 marks]

Inference from observation 1:

Inference from observation 2:

(c) Complete Table 2 based on this experiment. [3 marks]

Variable	Method to handle the variable
Manipulated variable: ----- ----- -----	----- ----- -----
Responding variable: ----- ----- -----	----- ----- -----
Constant variable: ----- -----	----- -----

Table 2

(d) State the hypothesis for this experiment. [3 marks]

(e)(i) Construct a table and record all the data collected in this experiment. Your table should have the following titles: [3 marks]

- The type of solution
- Final length of maize plant roots 1 and maize plant roots 2
- Change in length of maize plant roots 1 and maize plant root 2
- The rate growth of maize plant roots

$$\text{rate growth of maize plant roots} = \frac{\text{Average change in length of maize plants root}}{\text{Days}}$$

(e)(ii) Use the graph paper provided to answer this question. Using the data in 1(e)(i), draw a bar chart of the growth rate of maize plants root against the type of solution. [3 marks]

(f) Based on the bar chart in 1(e)(ii), state the relationship between the growth rate of maize plant root and the type pf solution. Explain your answer. [3 marks]

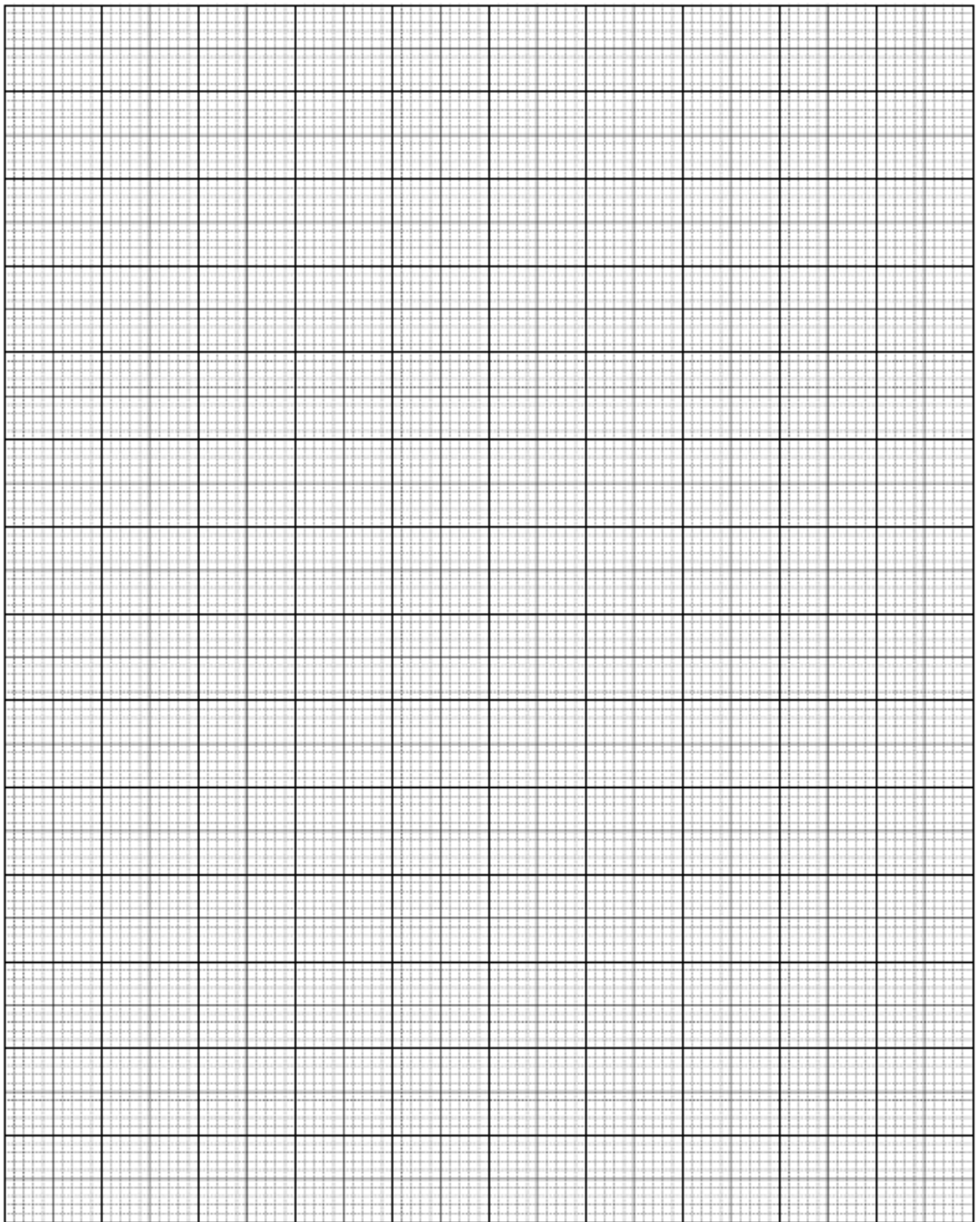
(g) State the operational definition for the growth. [3 marks]

- (h) Another experiment is carried out by using solution B. Predict the growth rate of maize plant roots if ferum (III) phosphate is added into solution B. Explain your prediction. [3 marks]

- (i) Below is a list of minerals required by plants. Classify the minerals into macronutrients and micronutrients. [3 marks]

Potassium	Calcium	Boron	Sulphur
Molybdenum	Magnesium	Copper	Ferum

Macronutrient	Micronutrient



QUESTION 3

Energy value or calorific value is the quantity of heat produced when one gram of food is completely oxidized or burnt down. This heat energy is then absorbed by the water in the boiling tube. Hence, the energy content in food varies among food samples according to their classes of food. A group of four students carried out an experiment to determine the energy value for the following food samples in Diagram 1.



Diagram 1

Diagram 2 shows the apparatus set-up used in this experiment showing the initial water temperature of 29° C.

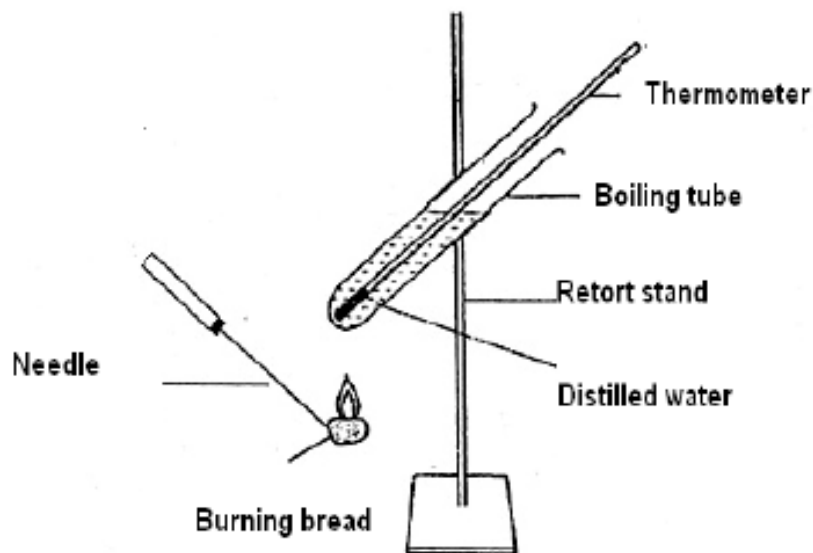
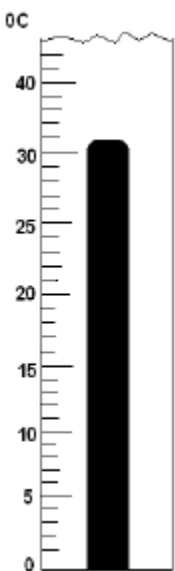



Diagram 2

The following steps were carried out:

- Step 1: Small pieces of bread (P) is cut off and the mass is weight and recorded using a balance
- Step 2: 20 ml of distilled water was placed into a clean boiling tube by using a measuring cylinder.
- Step 3: The boiling tube is clamped to a retort stand with thermometer placed in it.
- Step 4: The initial temperature of water in the boiling tube were measured and recorded by using a thermometer.
- Step 5: The bread (P) is attached to a pin and burnt in a labour gas flame.
- Step 6: When completely burnt, the burnt bread is placed below the boiling tube.
- Step 7: The water is stirred gently with the thermometer.
- Step 8: The final temperature of water is recorded using the thermometer
- Step 9: The energy value of bread is calculated using the following formula:
- $$\text{Energy value} = \frac{4.2 \text{ (Jg}^{-1}\text{ }^{\circ}\text{C)} \times \text{mass of water (g)} \times \text{temperature increase (}^{\circ}\text{C)}}{\text{mass of food sample (g)}}$$
- Step 10: Step 1 until 9 are repeated using anchovy (Q) and cashew nut (R)

Table 1 shows the highest water temperature after the food sample is completely burnt.

Type of food sample	Mass of food sample	Final temperature of water(°C)	Increase in water Temperature (°C)
P Bread	0.6		

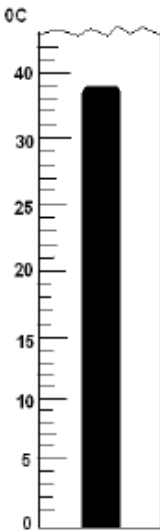

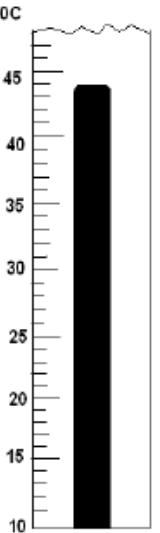

<p>Q Anchovy</p>	<p>0.8</p>		
<p>R Cashew nut</p>	<p>1.2</p>		

Table 1

(a) Record the increase in water temperature in Table 1. *[3 marks]*

(b)(i) State two different observations that can be made from Table 1. *[3 marks]*

Observation 1:

Observation 2:

(b)(ii) State two inferences related to the above observations. [3 marks]

Inference from observation 1:

Inference from observation 2:

(c) From Diagram 2, list out all the apparatus and materials used in this experiment. [3 marks]

Apparatus	Materials

Table 2

(d) Complete the variables in Table 3 based on this experiment. [3 marks]

Variable	Method to handle the variable
Manipulated variable: ----- ----- ----- -----	----- ----- -----
Responding variable: ----- ----- ----- -----	----- ----- ----- -----
Constant variable:	

-----	-----
-----	-----
-----	-----
-----	-----

Table 3

(e) State the hypothesis for this experiment. *[3 marks]*

(f) Construct a table and record all the data collected in this experiment.
Your table should have the following titles: *[3 marks]*

- Type of food sample
- Mass of food sample
- Increase in water temperature
- Energy value for each food sample.

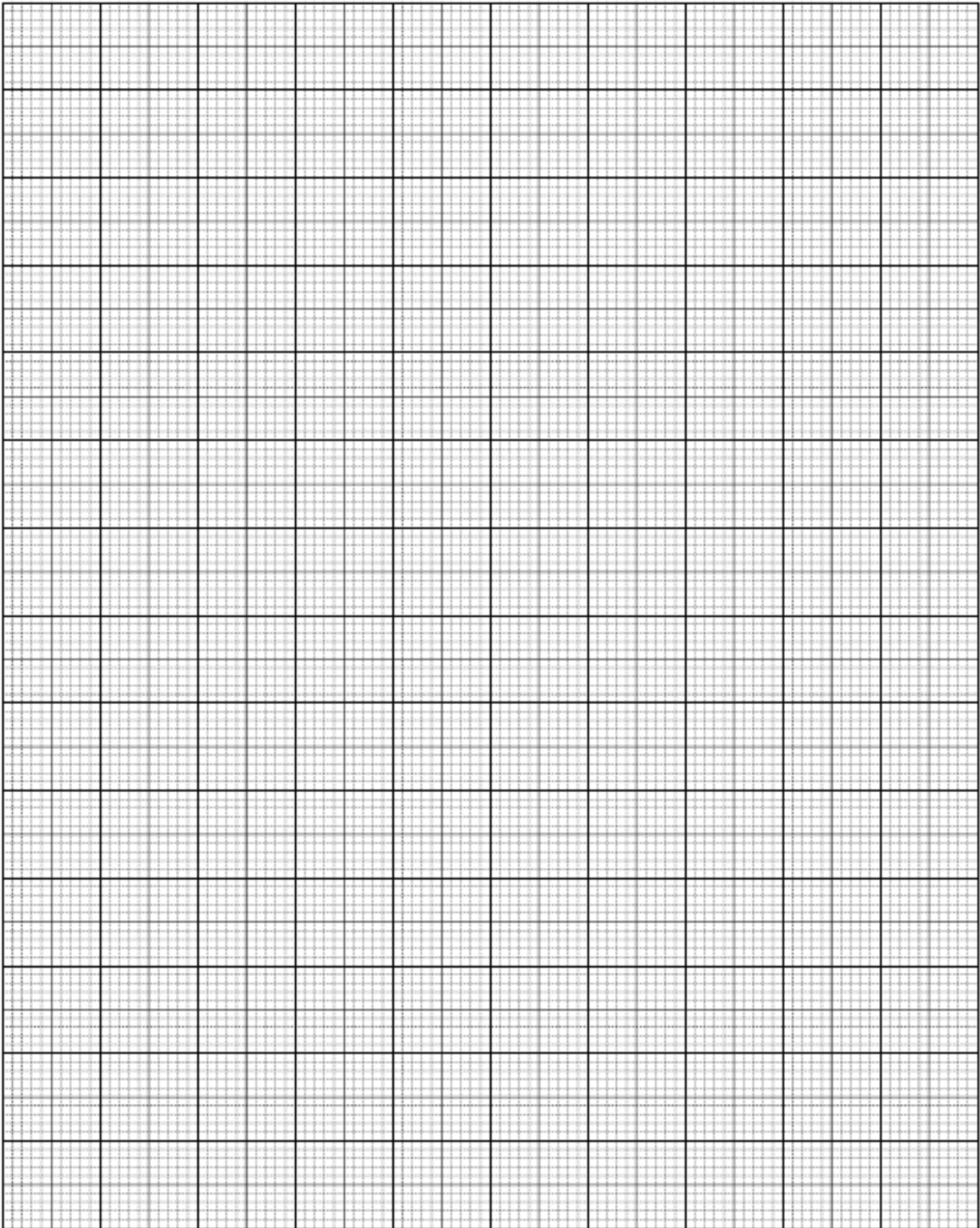
(g)(i) Used the graph paper provided to answer this question. By using the Table in 1(f), draw a bar chart graph on the energy value against the type of food sample. *[3 marks]*

(g)(ii) Based on the graph in 1(g)(i), state the relationship between the energy value and the type of food sample. Explain. [3 marks]

(h) If the food sample is replaced by S, predict the outcome of the experiment. Explain your prediction. [3 marks]



(i) Define operationally the energy value. [3 marks]



QUESTION 4

During photosynthesis carbon dioxide is absorbed by green plant while oxygen is released. In aquatic plants, the oxygen gas produced is released in the form of gas bubbles. Based on the information, design a laboratory experiment to investigate the effect of the concentration of carbon on the rate of photosynthesis of an aquatic plant.

Sodium hydrogen carbonate solution can be used in the experiment as the source of carbon dioxide for the aquatic plant. Any chemicals and scientific apparatus in the laboratory can be used in the planning the experiment.

The planning of your experiment must include the following aspects:

- Problem statement
- Hypothesis
- Variables
- List of apparatus and materials
- Experimental procedure
- Presentation of data

[17 marks]

CHAPTER 7

QUESTION 1

Smoking us a “deadly assault” on respiratory system

Tobacco smoke irritates the cell lining the bronchi, inhibiting or destroying the cilia. Continuous coughing – common in heavy smokers – cilia cannot move the mucus layer with its trapped bacteria. Noxious smoke particles also kill macrophages, defensive cells that reside in the respiratory tract, destroys fine particle and microorganisms of the respiratory systems. Allowing even more toxin-laden particles to reach the lung delicate alveoli.

Article 1

Based on the Article 1, a group of students took the initiative by conducting an experiment to study the effect of cigarettes smoke in the lungs, Diagram 1 shows the set-up apparatus to get the temperature reading during experiment. U-tube in the diagram representing the lungs.

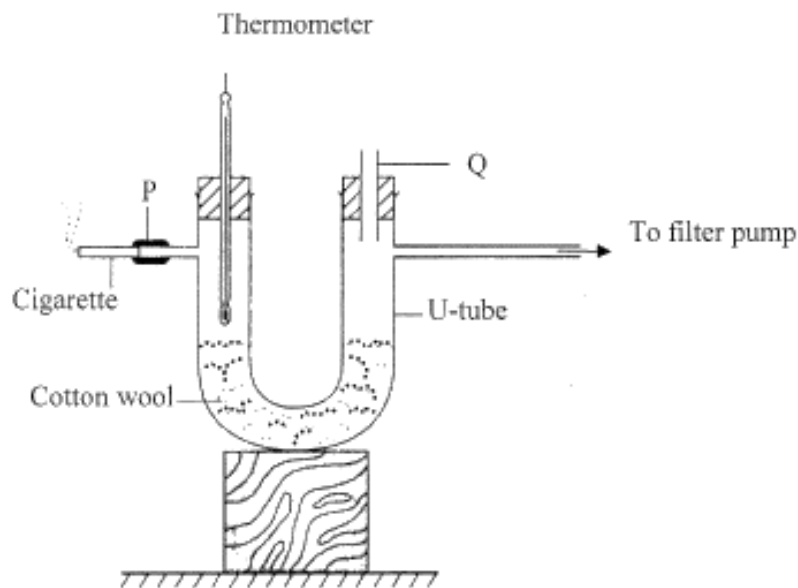


Diagram 1

The following steps were carried out.

- Step 1 : 1 cigarette is placed at P (can be adjusted based on the number of cigarettes)
- Step 2 : The cigarette is lighted, the filter pump is switched on
- Step 3 : Finger is place over tube Q to let the air to be drawn through the cotton wool, just like what happens in surrounding
- Step 4 : The temperature inside the U-tube is recorded after the cigarettes stopped burning
- Step 5 : Step 1 to step 4 repeated by using different number cigarettes

Diagram 2 shows the initial temperature inside the U-tube.

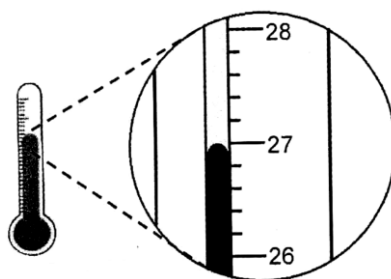


Diagram 2

Table 1 shows the result of the experiment.

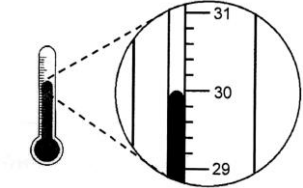
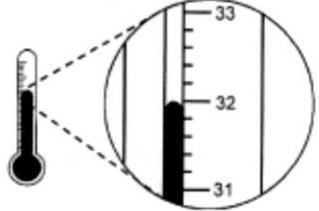
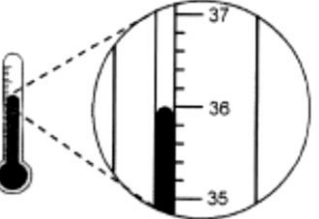
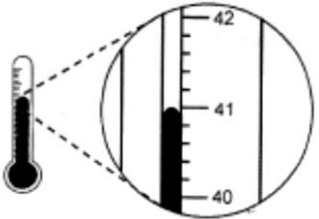
Number of burning cigarettes	Final temperature (°C)	
1		
3		
5		
7		

Table 1

(a) Record the final temperature in the boxes provided in Table 1 [3 marks]

(b)(i) Based on Table 1, state two different observations. [3 marks]

Observation 1:

Observation 2:

(ii) State the inferences which correspond to the observations in 1(b)(i). [3 marks]

Inference from observation 1:

Inference from observation 2 :

(c) Complete Table 2 based on this experiment. [3 marks]

Variable	Method to handle the variable
Manipulated variable: ----- ----- -----	----- ----- ----- -----
Responding variable:	

----- ----- -----	----- ----- -----
Constant variable: ----- ----- ----- -----	----- ----- ----- -----

Table 2

(d) State the hypothesis for this experiment. *[3 marks]*

(e)(i) Construct a table and record all the data collected from this experiment. Your table should have the following titles: *[3 marks]*

- Number of burning cigarette
- Initial temperature inside the U-tube
- Final temperature inside the U-tube
- Increase in temperature inside the U-tube
- Percentage increase in temperature

(e)(ii) Use the graph paper provided to answer this question. By using the data in 1(e)(i), draw a graph of percentage increase in temperature inside U-tube against the number of burning cigarettes. *[3 marks]*

(f) Based on the graph paper in 1(e)(ii), state the relationship between percentage increase in temperature inside the U-tube and the number of burning cigarettes. Explain your answer *[3 marks]*

(g) The experiment was repeated using 3 cigarettes without filter. Predict the final temperature inside the U-tube. Explain your prediction. [3 marks]

(h) State the operational definition of unhealthy respiratory system. [3 marks]

(i) Another experiment is carried out to study the effect of different lifestyle on the rate of gaseous exchange at the alveolus in four men P, Q, R and S.

P – Non-smoker who exercise regularly
Q – Non -smoker who does not exercise regularly
R – Has been smoking for two years and does not exercise
S – Has been smoking for 20 years and does not exercise

Diagram 3 shows a bar chart of the rate of gaseous exchange of these four men.

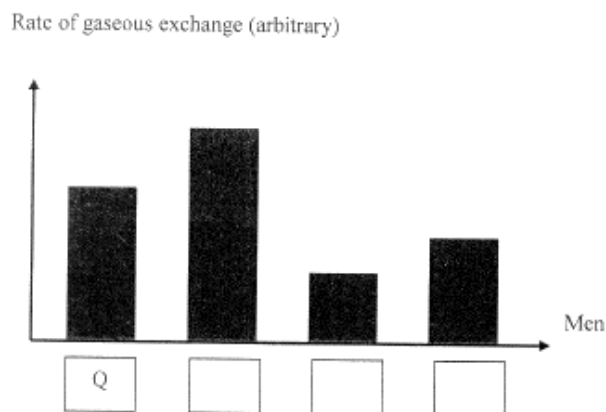
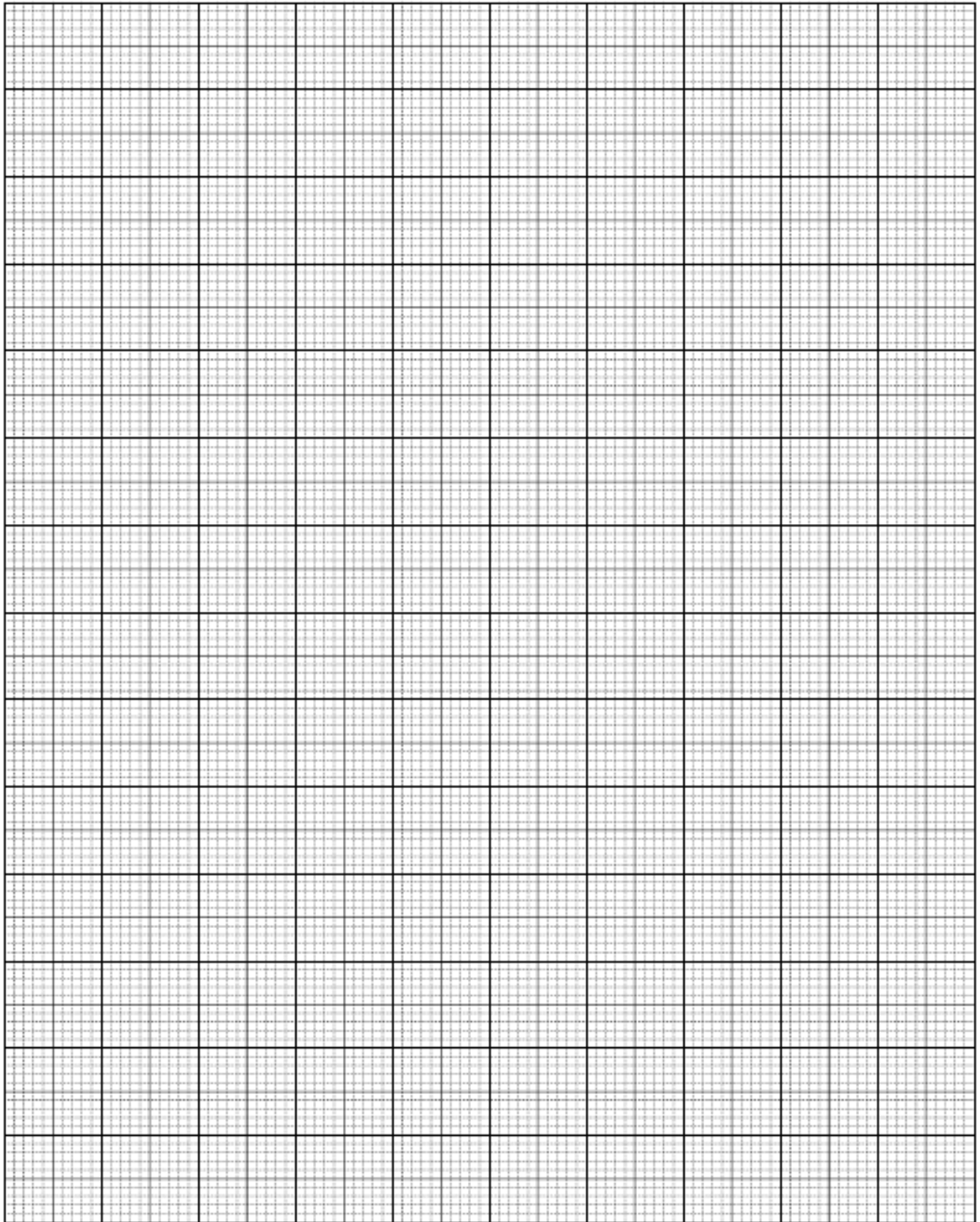


Diagram 3

Match men P, R, and S according to the correct rate of gaseous exchange in the boxes provided on bar chart in Diagram 3. [3 marks]



QUESTION 2

A group of students conducted an experiment to investigate the content of carbon dioxide in exhaled air for an athlete after doing three different levels of vigorous activity which lasted for 20 minutes. The athletes rested 15 minutes between each activity. The exhaled air was analyzed immediately to determine the amount of carbon dioxide produced with a J-tube. Diagram 1 shows the length of air column in the J-tube before treatment using 0.1% potassium hydroxide solution (KOH).

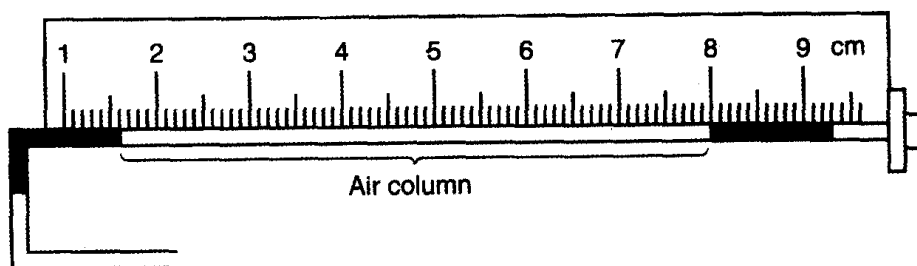


Diagram 1

Table 1 shows the lengths of air column in the J-tube after treatment with potassium hydroxide solution (KOH).

Levels of vigorous activity	Length of air column after treatment with potassium hydroxide / cm	Length of air column / cm
P		<input type="text"/>
Q		<input type="text"/>

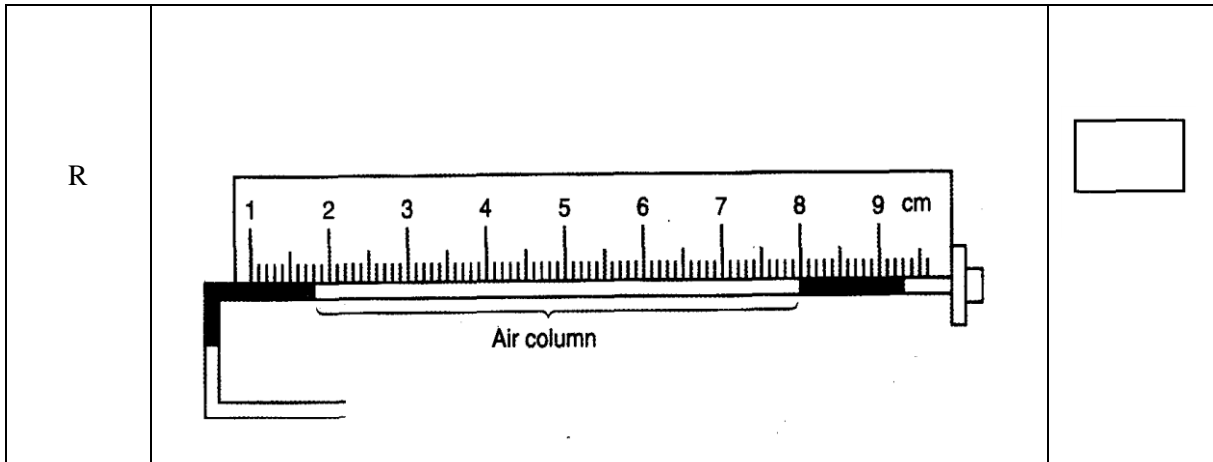


Table 1

(a) Record the lengths of the air column in the spaces provided in Table 1 [3 marks]

(b)(i) Based on Table 1, state two different observations. [3 marks]

Observation 1:

Observation 2:

(ii) State the inferences which correspond to the observations in 1(b)(i). [3 marks]

Inference from observation 1:

Inference from observation 2:

(c) Complete Table 2 based on this experiment. [3 marks]

Variable	Method to handle the variable
Manipulated variable: ----- ----- -----	----- ----- ----- -----
Responding variable: ----- ----- -----	----- ----- ----- -----
Constant variable: ----- ----- -----	----- ----- ----- -----

Table 2

(d) State the hypothesis for this experiment. [3 marks]

(e)(i) Construct a table and record all the data collected from this experiment. Your table should have the following titles: [3 marks]

- Initial length and final length of air column
- Change in the length of air column
- Percentage of carbon dioxide released

$$\text{Percentage of carbon dioxide released} = \frac{\text{Change in length of air column}}{\text{Initial length of air column}} \times 100\%$$

(e)(ii) Use the graph paper provided to answer this question. Using the data in 1(e)(i) draw a bar chart to show the relationships between percentage of carbon dioxide released and levels of vigorous activity. [3 marks]

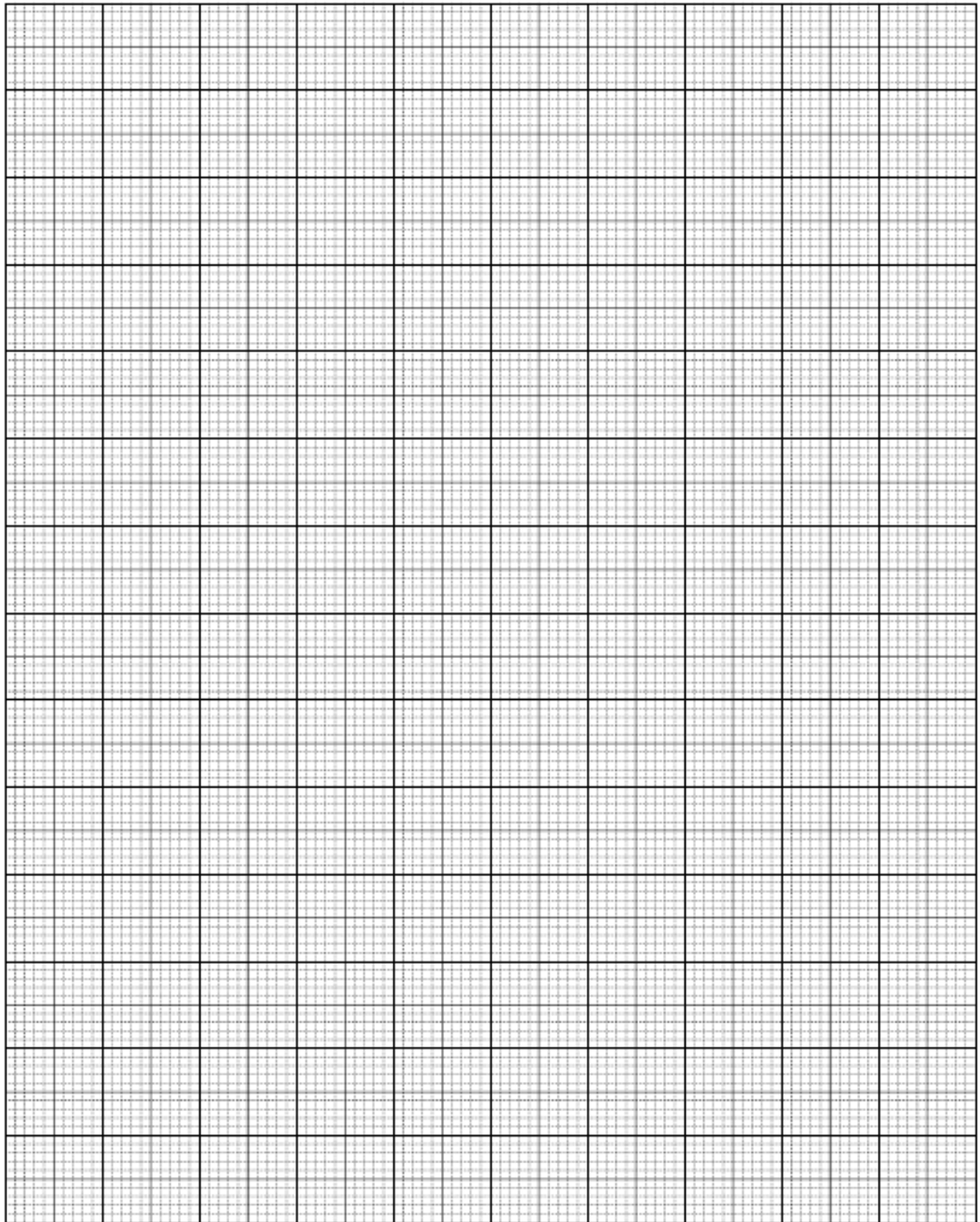
(f) Based on the bar chart in 1(e)(ii), explain the relationship between the levels of vigorous activity and the percentage of carbon dioxide released. [3 marks]

(g) State the operational definition of exhaled air based on this experiment. [3 marks]

(h) If the duration of activity P is extended to 40 minutes, predict the length of air column after treatment with potassium hydroxide. Explain your prediction. [3 marks]

- (i) Categorize the types of activity P, Q and R based on high, medium and low rate of respiration. [3 marks]

Levels of vigorous activity	Rate of respiration



QUESTION 3

Siti Salwani is making bread in her cooking class at Kolej Komuniti Pekan, Pahang. During the preparations, she found that when she added yeast to the wheat flour and kneaded them, it becomes elastic and stretchable like a balloon. When she added more sugar, the dough will double its size.



Based on above situation, plan a laboratory experiment to study the effect of glucose concentration on the rate of anaerobic respiration in yeast.

The planning of your experiment must include the following aspects:

- Problem statement
- Hypothesis
- Variables
- List of apparatus and materials
- Experimental procedure
- Presentation of data

[17 marks]

QUESTION 4

Respiration is the cellular process of releasing energy from food. The main food used by cells for respiration is glucose. If oxygen is present, the animal, plant and yeast cells can carry out aerobic respiration. The overall process of aerobic respiration is as follows:



If oxygen is absent then the cells carry out anaerobic respiration or fermentation.

Lisa:

I'm doing an experiment in school, "Does pH affect the rate of respiration in yeast?" I must know what to be controlled and what to be observed in the experiment, and how. They said I need to plan the experiment, but I'm not sure how. I'm very stuck, can anyone help me please?

You are requested to help Lisa. You need to know well about the experiment before helping Lisa. By using suitable materials and apparatus available in your school laboratory, write out the planning of the experiment.

The planning of your experiment must include the following aspects:

- Problem statement
- Hypothesis
- Variables
- List of apparatus and materials
- Experimental procedure
- Presentation of data

[17 marks]

CHAPTER 8

QUESTION 1

Lemna minor is a species of free-floating aquatic plants from the duckweed family Lemnaceae. The plants grow mainly by vegetative reproduction: two daughter plants bud off from the adult plant. An experiment is carried out to investigate the effect of abiotic factor such as pH on *Lemna sp.* growth. Experiment is done under controlled conditions: 12 hours a day light exposure and using the same Knop's solution. Petri dish is filled with 20 ml Knop's solution with different pH value and 5 *Lemna sp.* each. The Knop's solution is treated by adding acid or alkali to achieve the pH value needed.

** Knop's solution is a solution which contains essential nutrient for plants growth.

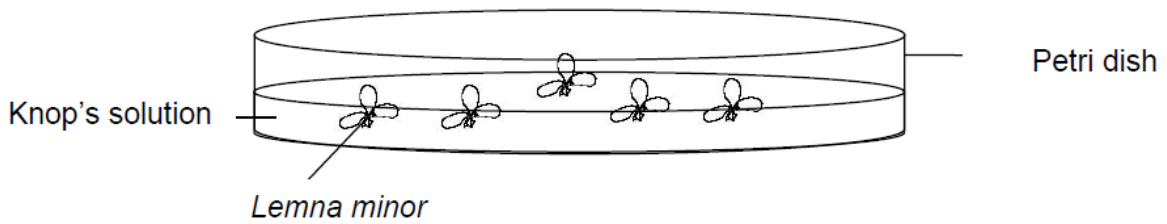
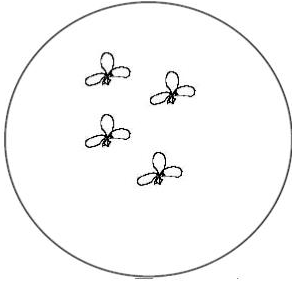
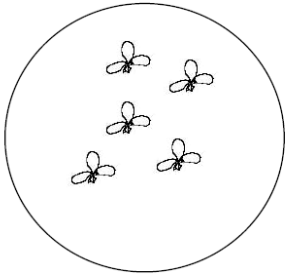


Diagram 1

After 7 days, the observation is made and the result shown in Table 1

pH value	Petri dish	Number of <i>Lemna sp.</i>
2		
4		

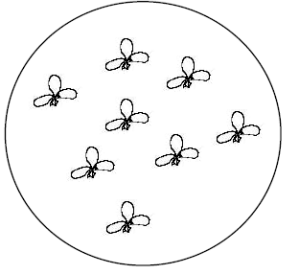
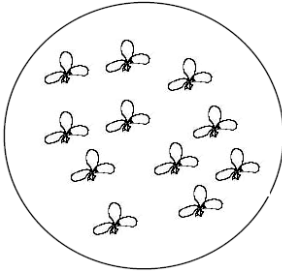
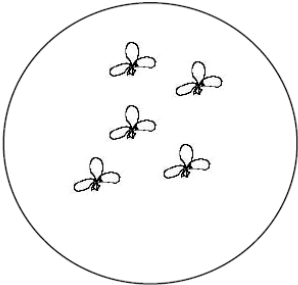
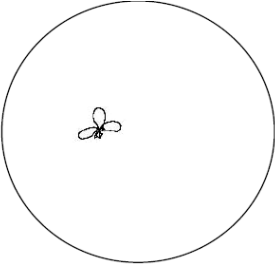
6		
8		
10		
12		

Table 1.1

(a) State the number of *Lemna sp.* in the spaces provided in Table 1.1 [3 marks]

(b)(i) Based on Table 1, state two different observations. [3 marks]

Observation 1 :

Observation 2:

(ii) State the inferences which correspond to the observations in 1(b)(i). [3 marks]

Inference from observation 1:

Inference from observation 2:

(c) Complete Table 2 based on this experiment. [3 marks]

Variable	Method to handle the variable
Manipulated variable: ----- ----- -----	----- ----- ----- -----
Responding variable:	----- -----

----- ----- -----	----- ----- -----
Constant variable: ----- ----- ----- -----	----- ----- ----- ----- -----

Table 2

(d) State the hypothesis for this experiment. [3 marks]

(e)(i) Construct a table and record all the data collected from this experiment. Your table should have the following titles: [3 marks]

- pH of water
- Number of *Lemna sp.*

(e)(ii) Use the graph paper provided to answer this question. By using the data in 1(e)(i), plot a graph showing the number of *Lemna sp.* against the pH. [3 marks]

(iii) Referring to the graph in (e)(ii), describe the relationship between the *Lemna sp* growth and the condition of the medium. [3 marks]

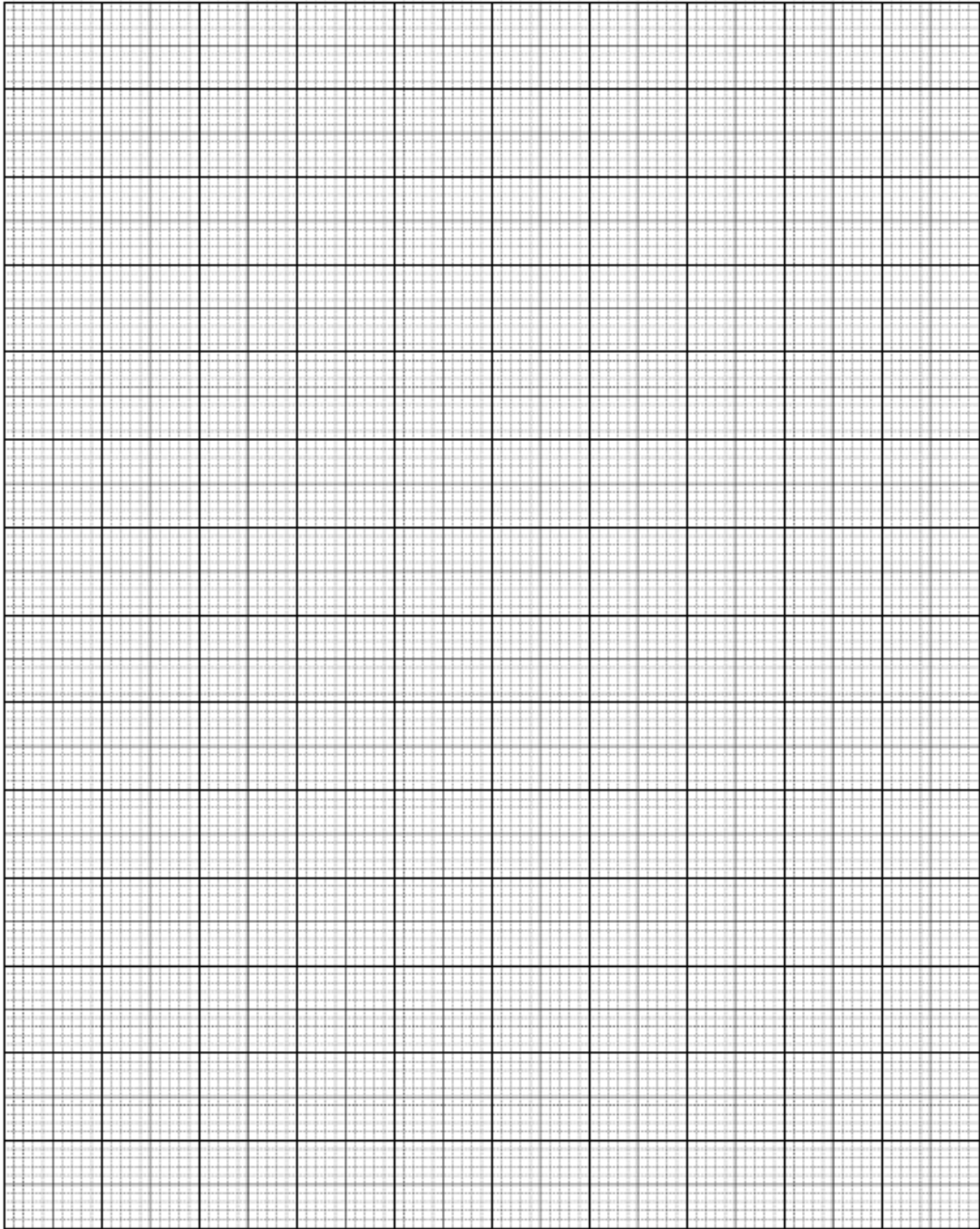
(f) Based on the experiment, define operationally the abiotic factor in an ecosystem. [3 marks]

- (g) The effluent from laundry shop flows into a pond nearby, predict the population of *Lemna sp* in the pond. Explain your answer. [3 marks]

- (h) Classify the abiotic and biotic factors from the list provided below. [3 marks]

Humidity, light intensity, decomposer, parasites, symbiotic organism, soil texture, invertebrates, topography

Abiotic factors	Biotic factors



QUESTION 2

A group of students carried out an experiment to study the effect of intraspecific competition on the growth of paddy seedlings. Diagram 1 shows the apparatus set-up of the experiment.

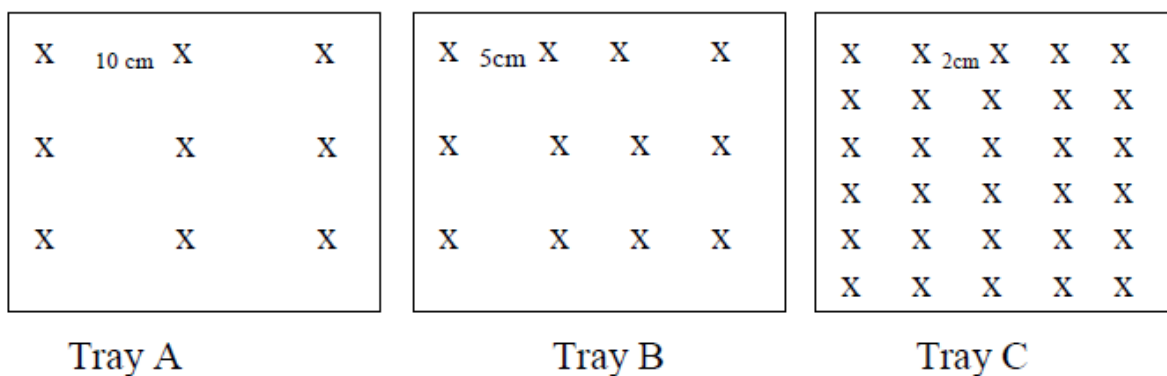



Diagram 1

- Step 1 : Three seedling trays are filled with 4 kg of garden soil
- Step 2 : The trays are labelled as A, B, and C
- Step 3 : In tray A, 30 paddy seedlings are planted at a distance of 10 cm intervals.
 In tray B, 30 paddy seedlings are planted at a distance of 5 cm intervals.
 In tray C, 30 paddy seedlings are planted at a distance of 2 cm intervals.
- Step 4 : Each tray is watered daily with the same amount of water for 30 days
- Step 5 : After 30 days, remove 10 paddy seedlings randomly from tray A, tray B and tray C.
 The roots of seedlings are washed and wipe dry
- Step 6 : The dry weight of the paddy seedlings is recorded in Table 1

Table 1 shows the result of the experiment.

Distance between paddy seedlings (cm)	Dry weight of 10 paddy seedlings / (g)	
10		


5		
2		

Table 1

(a) Record the dry weight of the paddy seedlings in the boxes provided in Table 1 [3 marks]

(b)(i) Based on Table 1, state two different observations. [3 marks]

Observation 1:

Observation 2:

(ii) State the inferences which correspond to the observations in 1(b)(i). [3 marks]

Inference from observation 1:

Inference from observation 2:

(c) Complete Table 2 based on this experiment. [3 marks]

Variable	Method to handle the variable
Manipulated variable: ----- ----- -----	----- ----- ----- -----
Responding variable: ----- ----- -----	----- ----- ----- -----
Constant variable: ----- ----- -----	----- ----- ----- -----

Table 2

(d) State the hypothesis for this experiment. [3 marks]

(e)(i) Construct a table and record all the data collected from this experiment. Your table should have the following titles: [3 marks]

- Distance between paddy seedlings
- Dry weight of 10 paddy seedlings
- Growth rate of paddy seedling

$$\text{Growth rate} = \frac{\text{Dry weight of paddy seedling}}{\text{Number of days}}$$

(e)(ii) Use the graph paper provided to answer this question. Using the data in 1(e)(i), draw the graph of the growth rate of paddy seedlings against the distance between paddy seedling. [3 marks]

(f) Based on the graph paper in 1(e)(ii), explain the relationship between the growth rate of paddy seedling and distance between seedling. [3 marks]

-

(g) The experiment is repeated by increasing the distance between the paddy seedlings to 20 cm. Predict the observation. Explain your prediction. [3 marks]

- (h) Based on the result from the experiment, state the operational definition of intraspecific competition. [3 marks]

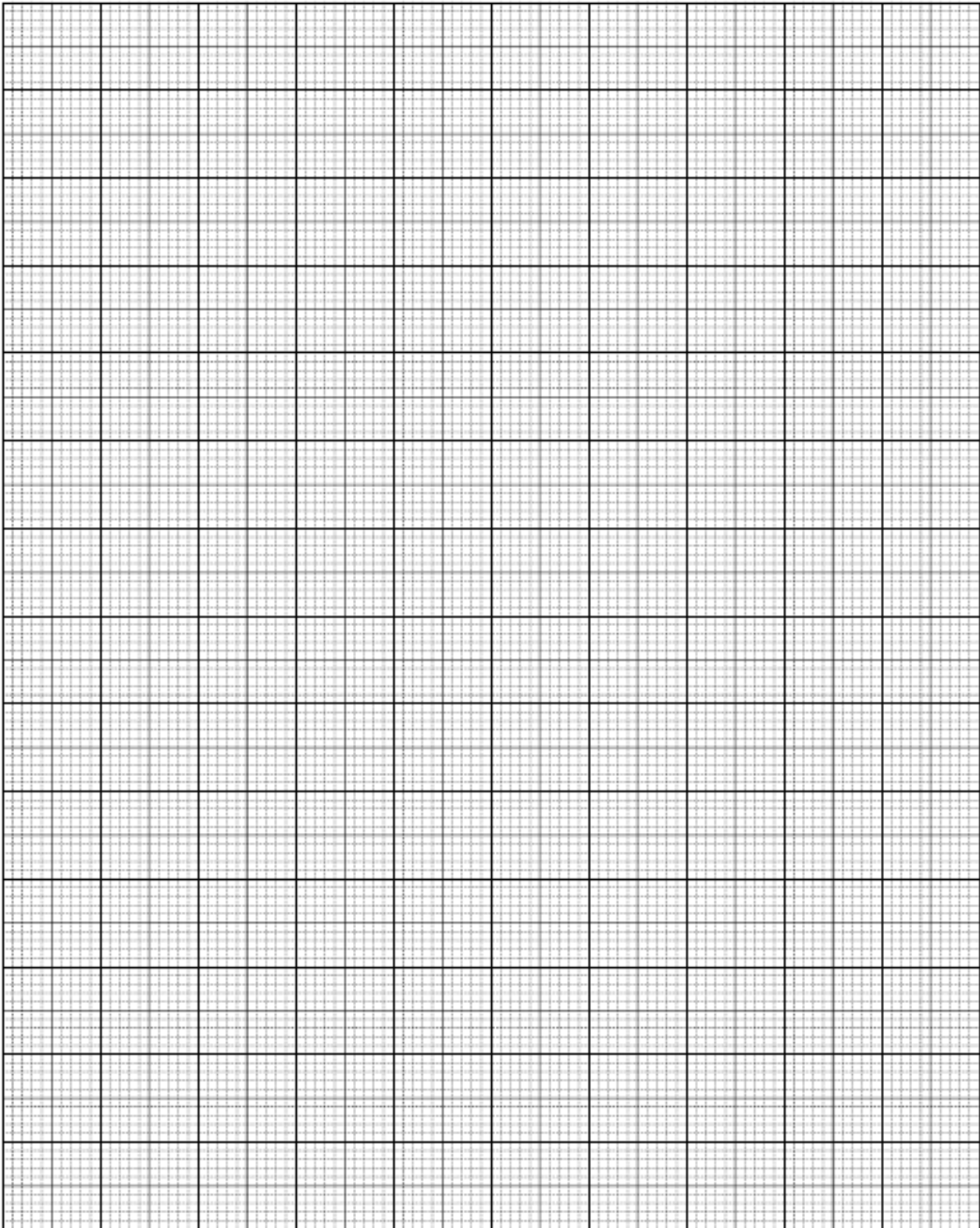
- (i) When resources are in limited supply, organisms living in the same habitat will compete for the same resources. The following is a list of the resources.

Food	Space	Light	Water	Breeding mate
------	-------	-------	-------	---------------

In Table 3, classify the resources given, according to what are the resources competed by animals and resources competed by plants. [3 marks]

Resources competed by animal	Resources competed by plant

Table 3



QUESTION 3

Diagram 1.1 shows dark winged moth and light winged moth lived in a forest habitat. The wing colour of the insects provides effective camouflage against the tree trunk.

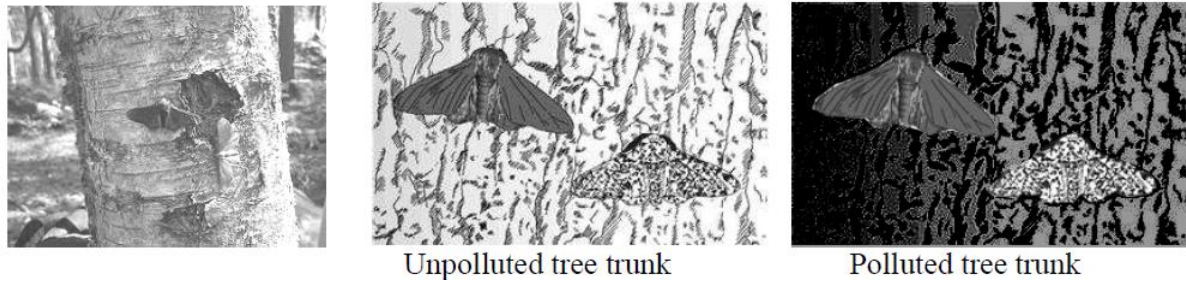


Diagram 1.1

Diagram 1.2 shows an industrial area which has been set up near to the forest. Plants which are near to the industrial area are badly affected. Leaves and trunk are covered by the smoke and soot released by the factories. The population of the moths are also affected.

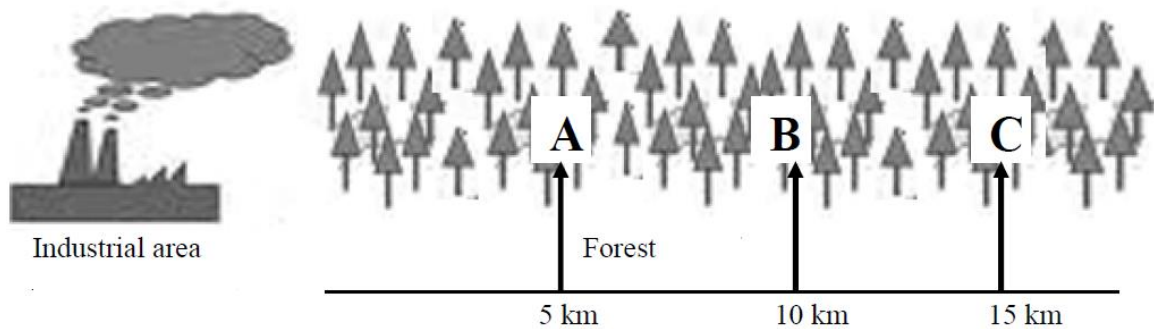


Diagram 1.2

A group of students carried out an experiment to investigate the effect of air pollution on the population of light winged moth in the forest.

The population of light winged moth is estimated in three different sites A, B and C by using 'Capture-mark-release and recapture' method. The results of the experiment are shown in Table 1.

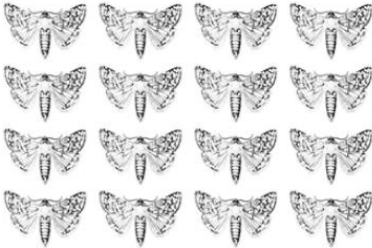
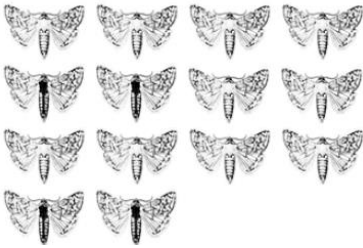
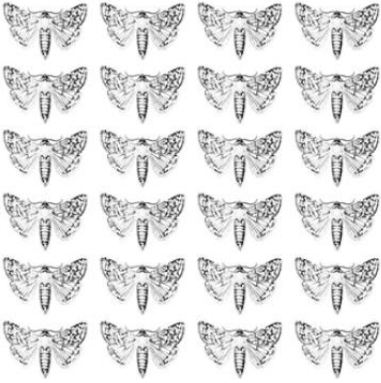
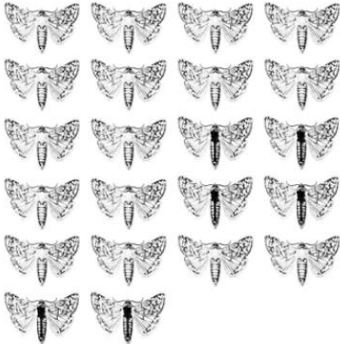
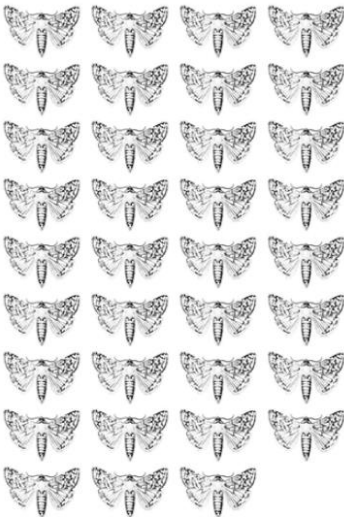
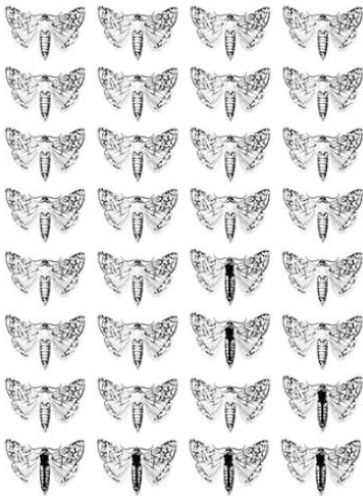


Site	Number of Light Wing Moth Captured		Number of moth captured
	First Capture (X)	Second Capture (Y)	
A			X:..... Y:.....
B			X:..... Y:.....
C			X:..... Y:.....
 Unmarked light winged moth		 Marked light winged moth	

Table 1

(a) Record the number of moth captured, X and Y in Table 1 [3 marks]

(b)(i) Based on Table 1, state two different observations. [3 marks]

Observation 1:

Observation 2:

(ii) State the inferences which correspond to the observations in 1(b)(i). [3 marks]

Inference from observation 1:

Inference from observation 2:

(c) Complete Table 2 based on this experiment. [3 marks]

Variable	Method to handle the variable
Manipulated variable: ----- ----- -----	----- ----- -----
Responding variable: ----- ----- -----	----- ----- -----

	----- -----
Constant variable: ----- ----- -----	----- ----- ----- -----

Table 2

(d) State the hypothesis for this experiment. [3 marks]

(e)(i) Construct a table and record all the data collected from this experiment. Your table should have the following titles: [3 marks]

- Name of the site
- Distance from the industrial area
- Number of moth in the first capture
- Number of moth in the second capture (recapture)
- Number of moth marked in second capture
- Estimated population of the moth

$$\text{Estimated population} = \frac{(\text{Number in the first captured}) \times (\text{number in second captured})}{\text{Number marked in the recapture}}$$

(e)(ii) Use the graph paper provided to answer this question. Using the data in 1(e)(i), draw the graph of the estimated population of the light winged moth against the distance from the Industrial Zone. [3 marks]

- (f) Based on the graph paper in 1(e)(ii), explain the relationship between the estimated population of the light winged moth and the distance from industrial area. [3 marks]

- (g) State the operational definition for estimated population of light winged moth. [3 marks]

- (h) Another group of students repeat the above experiment to investigate the effect of air pollution on the estimated population of dark winged moth. Results shows that at Site B, estimated population of dark winged moth is 68. Predict the estimated population of dark winged moth at Site A. Explain your prediction [3 marks]

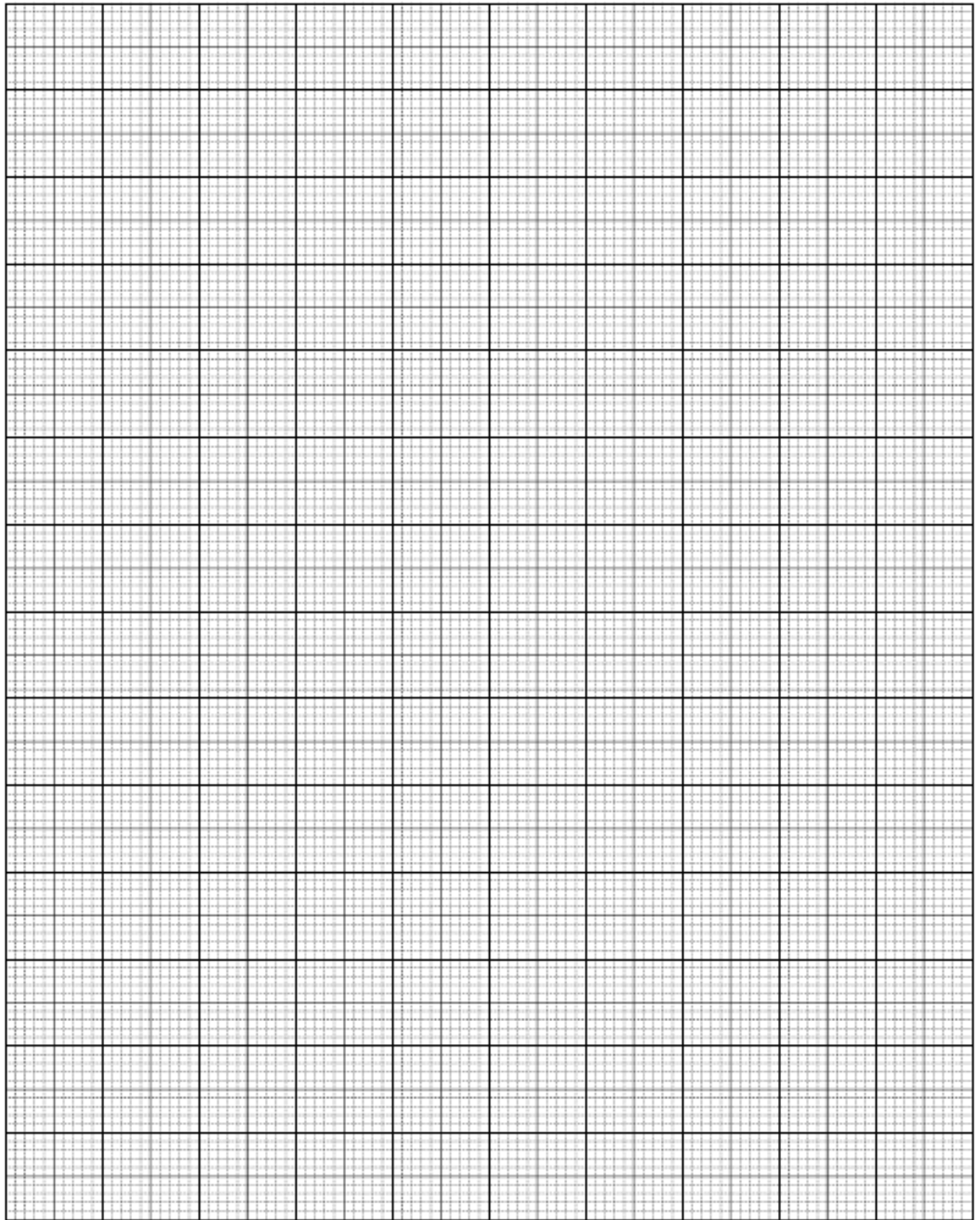
- (i) The following is a list of abiotic and biotic factors affecting the population of moths.

Smoke Bird Temperature Tree ant Light intensity

In Table 3, classify these factors. [3 marks]

Biotic factors	Abiotic factors

Table 3



QUESTION 4

The population size of an organism such as *Lemna sp* is influenced by the changes in the abiotic factors. Abiotic factors refer to the non-living components of an ecosystem which include pH, temperature, light intensity, humidity, topography and climate. *Lemna sp.* is small floating plants, which live in freshwater environments. These plants reproduce rapidly by vegetative propagation and spread to cover a large area of the water surface. As a student, you're required to plan an experiment to study the effect of light intensity on the population size of *Lemna sp.*

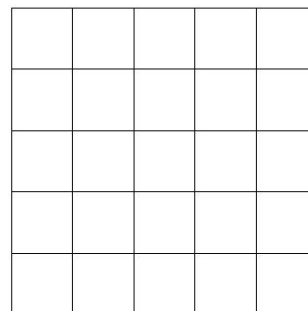
The planning of your experiment must include the following aspects:

- Problem statement
- Hypothesis
- Variables
- List of apparatus and materials
- Experimental procedure
- Presentation of data

[17 marks]

QUESTION 5

A group of students carried out a field work study to determine the population size of plants species by using the quadrat sampling technique. Figure below shows how the technique was used using a quadrat of 1m X 1m.



Based on the above diagram, design an experiment to study how the percentage coverage of certain plant species can be determined. The planning of your experiment must include the following aspects:

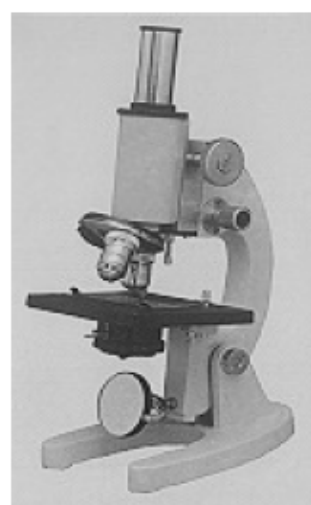
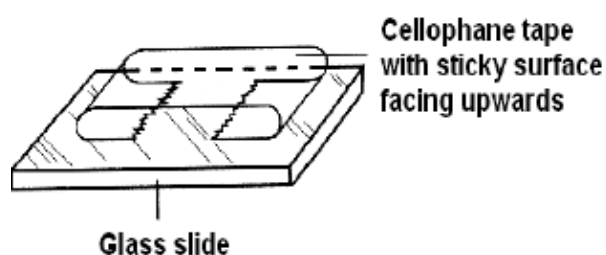
- Problem statement
- Hypothesis
- Variables
- List of apparatus and materials
- Experimental procedure
- Presentation of data

[17 marks]

CHAPTER 9

QUESTION 1

Air pollution occurs when there are increasing numbers of pollutants such as gases, smoke, dust and dirt in the atmosphere. This condition will affect the safety and health of living things. Based on the above information, a group of students had carried out an experiment to determine the number of solid pollutants in the air of different environments. The light microscope is used to help the students in their experiment.

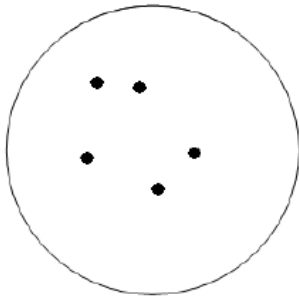


Light Microscope (10X10)

Diagram 1

Four sets of glass slides A, B, C and D prepared. Each of it is put in a place for two days as shown in Table 1.

Table 1 shows the result of the experiment.

Glass slide	Location of glass slide being placed	Solid particles as seen under light microscope (magnify: 10 x 10)	Number of solid particles as seen under light microscope (magnify: 10 x 10)
A	Air-conditioned room		

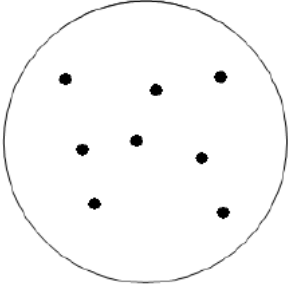
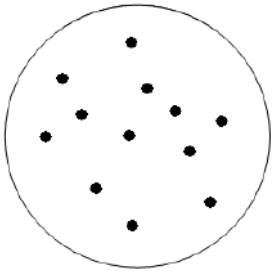
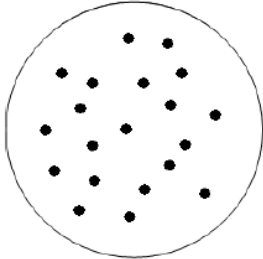
B	Class room		
C	School canteen		
D	School car park		

Table 1

- (a) Complete Table 1 by filling in the number of solid particles shown in the field view of the light microscope (magnify:10x10) [3 marks]
- (b)(i) Based on Table 1, state two different observations. [3 marks]

Observation 1:

Observation 2:

(ii) State the inferences which correspond to the observations in 1(b)(i). [3 marks]

Inference from observation 1:

Inference from observation 2:

(c) Complete Table 2 based on this experiment. [3 marks]

Variable	Method to handle the variable
Manipulated variable: ----- ----- -----	----- ----- ----- -----
Responding variable: ----- ----- -----	----- ----- ----- -----
Constant variable: ----- ----- -----	----- ----- ----- -----

Table 2

(d) State the hypothesis for this experiment. [3 marks]

(e)(i) Construct a table and record all the data collected from this experiment. Your table should have the following titles: [3 marks]

- Places where glass slide is located
- Number of solid particles as seen under the light microscope (magnify:10x10)

(e)(ii) Use the graph paper provided to answer this question. Using the data in 1(e)(i), draw a bar chart to show the relationship between the places where glass slide is located and the number of solid particles as seen under a light microscope (magnify:10x10). [3 marks]

(f) Based on the graph in 1(e)(ii), explain the relationship between the number of solid particles as seen under the light microscope (magnify: 10 x 10) and places where the glass slide is located. [3 marks]

(g) State the operational definition for air pollution. [3 marks]

(h) This experiment is repeated by placing the glass slide at a construction area. Predict the number of solid particles observed under the light microscope (magnify: 10x10). Explain your prediction. [3 marks]

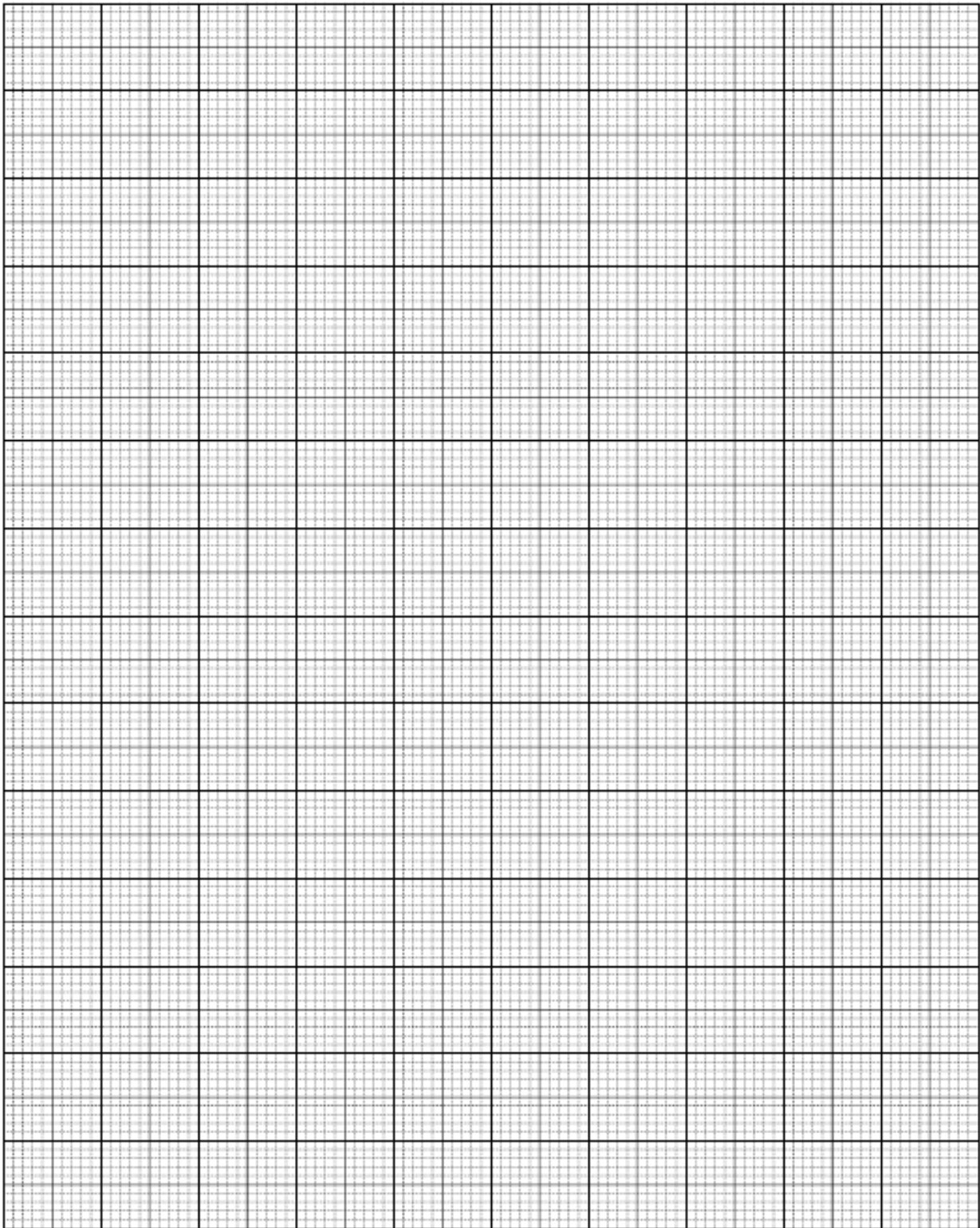
- (i) Another group of students carried out another experiment to determine the level of water pollution in given water samples. Below are the materials and apparatus used in the experiment. [3 marks]

Distilled water, Reagent bottle, syringe, 0.1% methylene blue solution, stopwatch, pond water, drain water
--

Complete Table 3 based on materials and apparatus used in the experiment.

Materials	Apparatus

Table 3



QUESTION 2

Diagram 1 shows an experiment carried out to determine the level of pollution in water samples from different sources in a village.

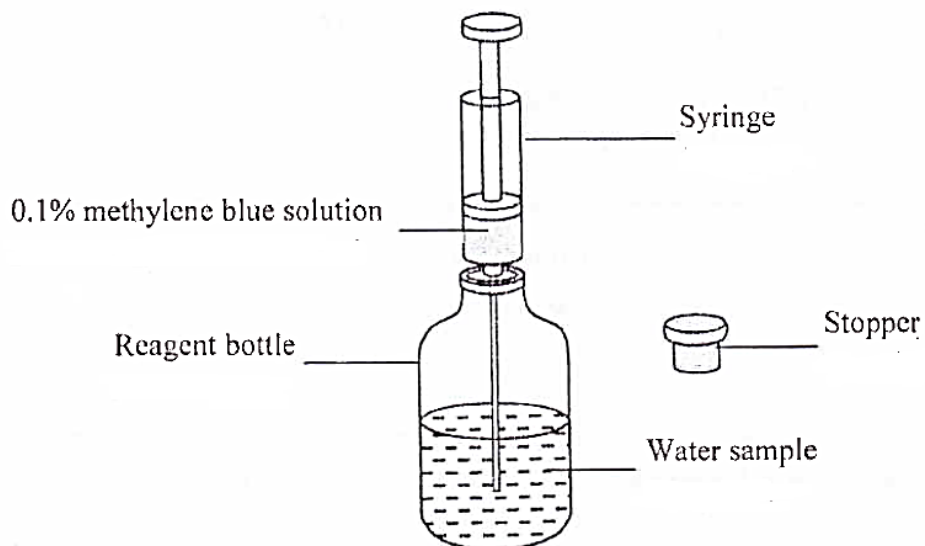


Diagram 1

The following steps were carried out:

Step 1: Water samples from five different sources were collected in five reagent bottles as follows;

Reagent bottle	Source of water sample
A	Well water
B	River water
C	Pond water
D	Drain water
E	Lake water

Step 2: 1 ml of 0.1% methylene blue solution was added to each water sample using a syringe

Step 3: The reagent bottles were closed and kept in a dark cupboard. The time taken for methylene blue solution to decolourise was recorded.

Diagram 2 shows the time at the beginning of the experiment.

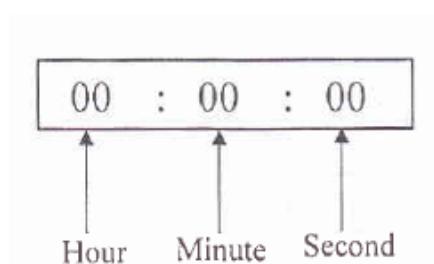


Table 1 shows the result of the experiment.

Reagent bottle	Stopwatch reading	Time taken for methylene blue solution to decolourise (hour)
A	04 : 00 : 00	
B	00 : 30 : 00	
C	03 : 00 : 00	
D	02 : 00 : 00	
E	01 : 00 : 00	

Table 1

(a) Record the time taken for methylene blue solution to decolourise in the spaces provided in Table 1. [3 marks]

(b)(i) State two different observation made from Table 1. [3 marks]

Observation 1:

Observation 2:

(ii) State the inferences which correspond to the observations in 1(b)(i). [3 marks]

Inference from observation 1:

Inference from observation 2:

(c) Complete Table 2 based on this experiment. [3 marks]

Variable	Method to handle the variable
Manipulated variable: ----- ----- -----	----- ----- ----- -----
Responding variable: ----- ----- -----	----- ----- ----- -----
Constant variable: ----- ----- -----	----- ----- ----- -----

Table 2

(d) State the hypothesis for this experiment. *[3 marks]*

(e)(i) Construct a table and record all the data collected from this experiment. Your table should have the following titles: *[3 marks]*

- Source of water sample
- Time taken for the methylene blue solution to decolourise
- Level of water pollution using the scale 1 (least polluted) to 5 (most polluted)

(e)(ii) Use the graph paper provided to answer this question. Using the data in 1(e)(i), draw a bar chart to show the relationship between the level of water pollution and the source of water samples. *[3 marks]*

(f) Explain the relationship between the time taken for decolourisation of methylene blue solution with the level of pollution of the water samples. *[3 marks]*

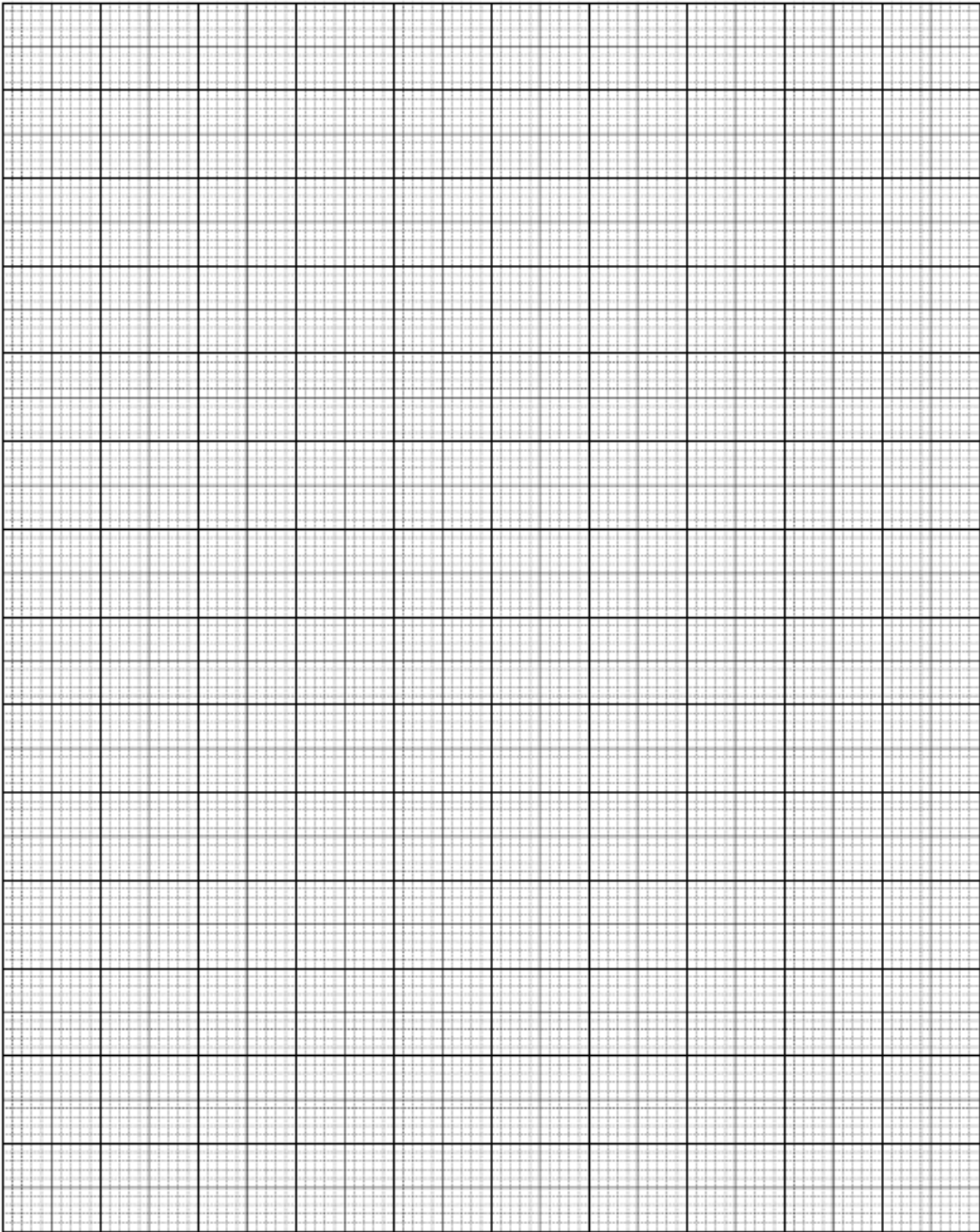
(g) State the operational definition for water pollution. *[3 marks]*

- (h) If the experiment is repeated on a water sample near an animal farm, predict the time taken for the decolourisation of methylene blue solution. Explain your prediction. [3 marks]

- (i) Complete Table 3 based on material and apparatus in Diagram 1 and Diagram 2. [3 marks]

Materials	Apparatus

Table 3



CHAPTER 1

QUESTION 1

An experiment was carried out to study the effect of different activities on heartbeat rates. The experiment is carried out by the same student.


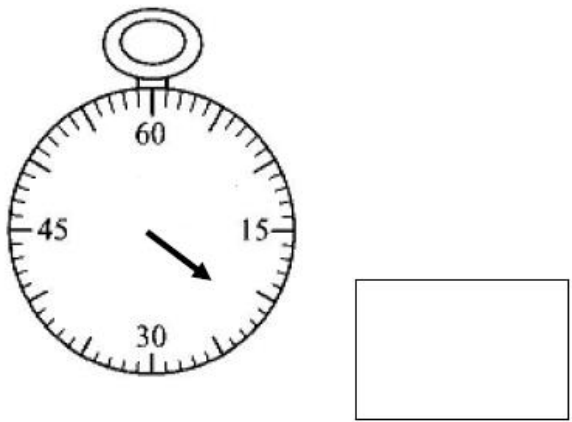
The following steps were carried out:

- Step 1 : The student is asked to jog on the spot for 5 minutes
- Step 2 : The time taken to obtain 35 heartbeats is measured by using heartbeat monitor watch immediately after the activity as shown in Diagram 1
- Step 3 : The experiment is repeated by the student who jogs on the spot form 10 minutes and 15 minutes



Diagram 1

Table 1 shows the result of the experiment.

Duration of activity (min)	Time taken for 35 heartbeat (second)
<div style="text-align: center;">  <p>Jogging on the spot for 5 minutes</p> </div>	<div style="text-align: center;">  </div>


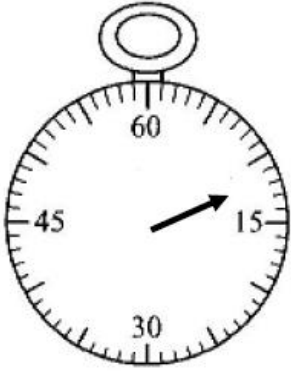

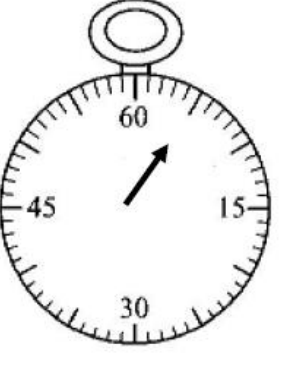
 <p>Jogging on the spot for 10 minutes</p>	 <div data-bbox="1114 555 1331 696" style="border: 1px solid black; width: 136px; height: 63px; margin-left: auto;"></div>
 <p>Jogging on the spot for 15 minutes</p>	 <div data-bbox="1094 1055 1299 1196" style="border: 1px solid black; width: 128px; height: 63px; margin-left: auto;"></div>

Table 1

- (a) Record the time taken to obtain 35 heartbeats in Table 1. [3 marks]
- (b)(i) Based on Table 1, state two different observations. [3 marks]

Observation 1:

Observation 2:

(ii) State the inferences which correspond to the observations in 1(b)(i). [3 marks]

Inference from observation 1:

Inference from observation 2:

(c) Complete Table 2 based on this experiment. [3 marks]

Variable	Method to handle the variable
Manipulated variable: ----- ----- ----- -----	----- ----- ----- -----
Responding variable: ----- ----- ----- -----	----- ----- ----- ----- -----
Constant variable: ----- ----- ----- -----	----- ----- ----- ----- -----

Table 2

(d) State the hypothesis for this experiment. [3 marks]

(e)(i) Construct a table and record all the data collected from this experiment. Your table should have the following titles: [3 marks]

- Duration of activity
- Time taken to obtain 35 heartbeats
- Rate of heartbeat

$$\text{Rate of heartbeat} = \frac{\text{Number of heartbeat}}{\text{time}}$$

(e)(ii) Use the graph paper provided to answer this question. Using the data i(e)(i), draw a graph of rate of heartbeat against the duration of activity. [3 marks]

(iii) Based on the graph, explain the relationship between the rate of heartbeat and the duration of activity. [3 marks]

- (f) Based on the result of the experiment, state the operational definition for heartbeat.
[3 marks]

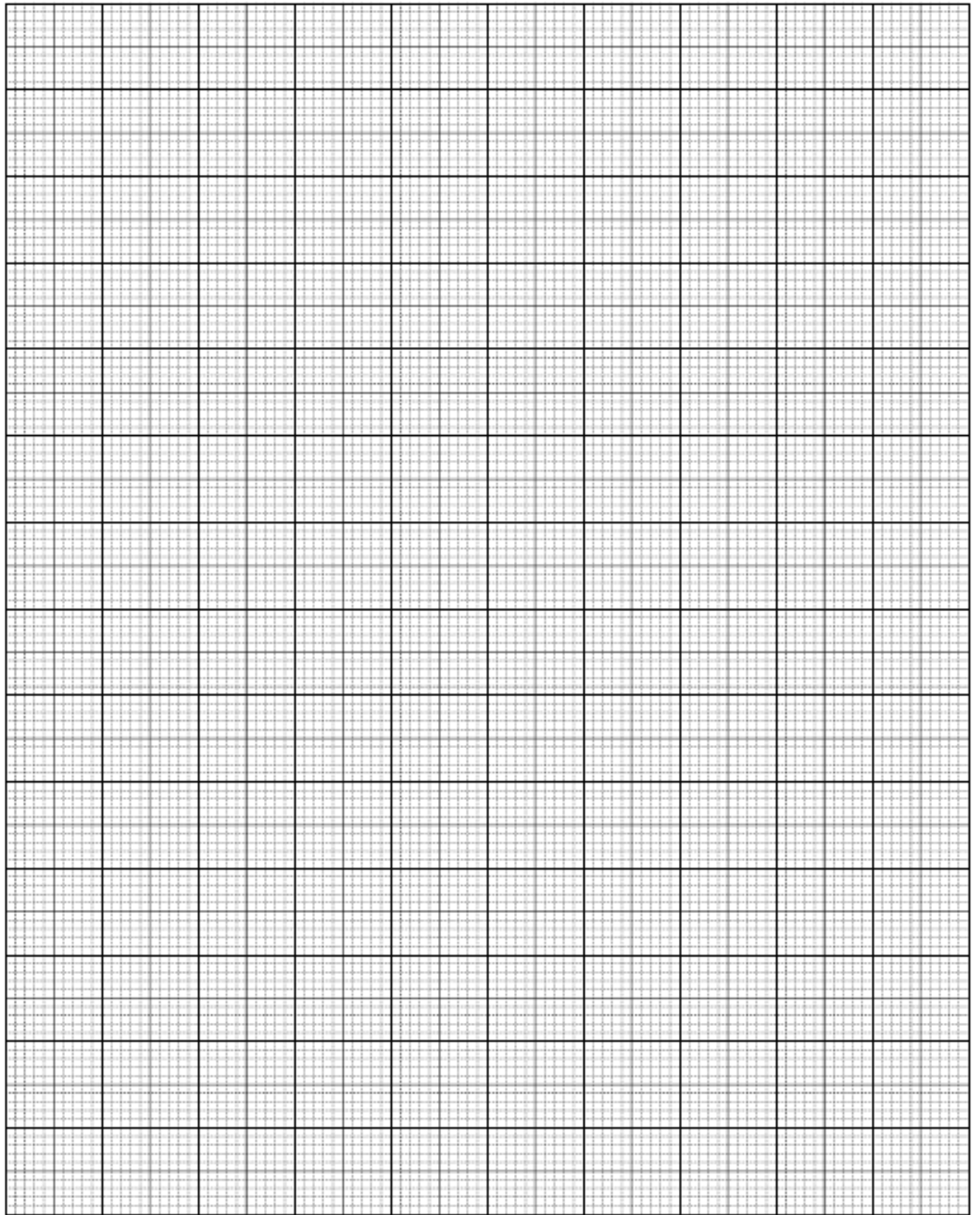
- (g) The student is tired after completing the activities. So, he takes a rest by sitting on a chair under a fan. Predict the time taken for him to obtain 35 heartbeats. Explain your answer.
[3 marks]

- (h) The average normal heart rate in adult is about 72 heartbeats per minute. Classify the following situations according to appropriate heartbeat rate in Table 3. [3 marks]

Swimming	Reading magazine	Sleeping	Gardening	Praying
	Cross contry running			

Heartbeat rate	Situation
Normal	
Increases	

Table 3



QUESTION 2

Transpiration is the process of water loss from the leaves surface. Humidity is one of the factor that affects transpiration in plant. When the air surrounding the leaves are dry, water loss from the leaves is higher. A group of students carried out an experiment to study the effect of humidity on the rate of transpiration in Hibiscus leafy shoot.

Diagram 1.1 shows the apparatus set-up used by this student. The pot was covered with polythene bag to prevent evaporation of water from the soil. The potted leafy shoot was weight before starting the experiment by using a balance. The mass was recorded as shown in Diagram 1.1.

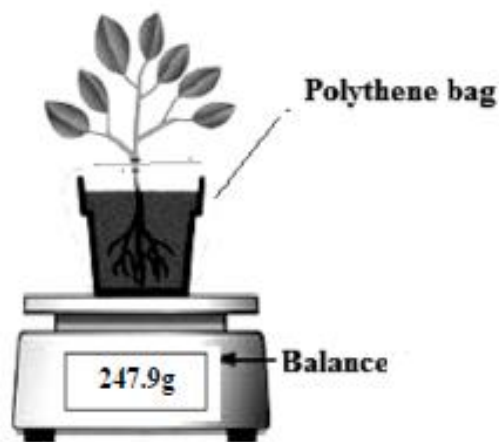


Diagram 1.1

Then the leafy shoots were covered with a transparent polythene bag containing anhydrous calcium chloride. This apparatus is placed under sunlight for nine hours as shown in Diagram 1.2. The mass of the potted leafy shoot is weight and recorded by using the balance without the polythene bag.



Diagram 1.2

The next day, this experiment is repeated by using the same potted leafy shoot with a transparent polythene bag without anhydrous calcium chloride. The apparatus is placed under sunlight for nine hours as shown in Diagram 1.3. The mass of the potted leafy shoot is weight and recorded by using the balance without the polythene bag.

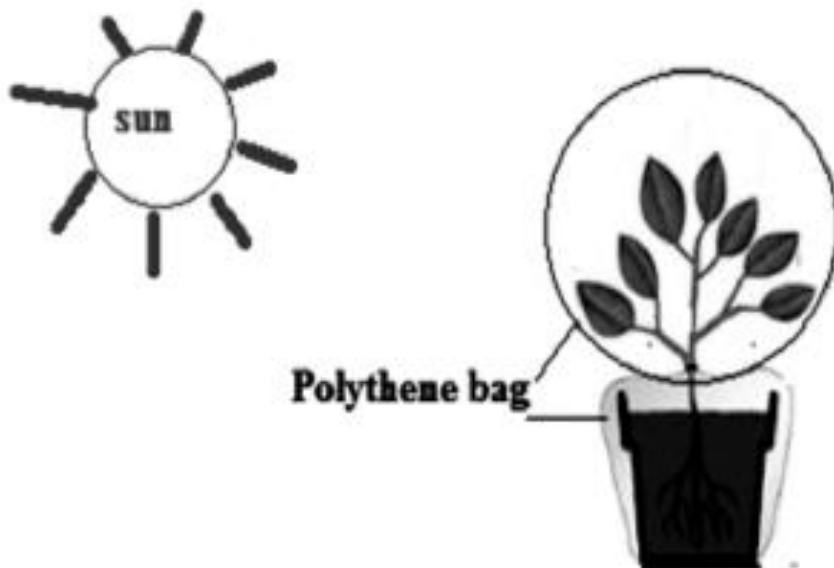
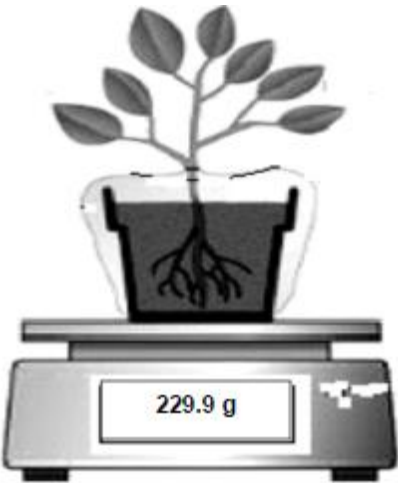


Diagram 1.3

All result is recorded in Table 1 below.

Condition	Mass of the potted leafy shoot after the experiment	Mass of water absorbs by Hibiscus leafy shoot.
Present of anhydrous calcium chloride		

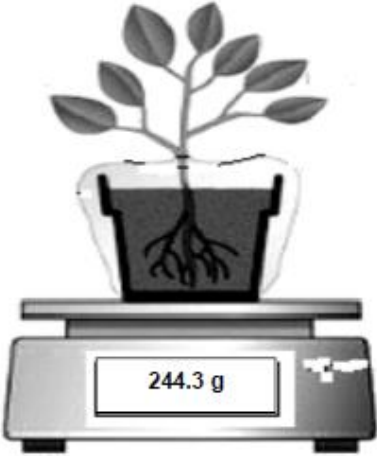
<p>Absent of anhydrous calcium chloride</p>		
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Table 1

(a) Record the mass of water absorbed by Hibiscus leafy shoot in Table 1. *[3 marks]*

(b)(i) Record two different observations made from Table 1. *[3 marks]*

Observation 1:

Observation 2:

(b)(ii) State the inference for each observation made in (b) (i). *[3 marks]*

Inference for observation 1:

Inference for observation 2:

(c) Complete Table 2 based on this experiment. [3 marks]

Variables	Operating the variables
Manipulated variable: ----- ----- -----	How to alter the manipulated variable: ----- ----- -----
Responding variable: ----- ----- -----	How to determine the responding variable: ----- ----- -----
Controlled variable: ----- ----- -----	How to maintain the controlled variable: ----- ----- ----- -----

Table 2

(d) State the hypothesis for this experiment. [3 marks]

(e)(i) Based Table 1, construct a table and record the results of the experiment which include the following aspects: [3 marks]

- Condition of experiment
- Mass of the potted leafy shoot after the experiment
- Mass of water absorbed by Hibiscus leafy shoot.
- Rate of transpiration

$$\text{Rate of transpiration} = \frac{\text{Mass of water absorbed}}{\text{Time taken}}$$

(e)(ii) Use the graph paper provided to answer this question. By using the data in 1(e)(i), draw a bar chart graph on the rate of transpiration of Hibiscus leafy shoot against the condition of the experiment. *[3 marks]*

(e)(iii) Based on the bar chart graph in 1(e)(ii), state the relationship between the condition of experiment and the rate of transpiration of leafy shoot. Explain your answer. *[3 marks]*

(f) This experiment is repeated on the same leafy shoot without the anhydrous calcium chloride and was placed 30 cm away from the same lighted bulb. Predict the outcome of the experiment. Explain your prediction. *[3 marks]*

(g) State the operational definition for transpiration. *[3 marks]*

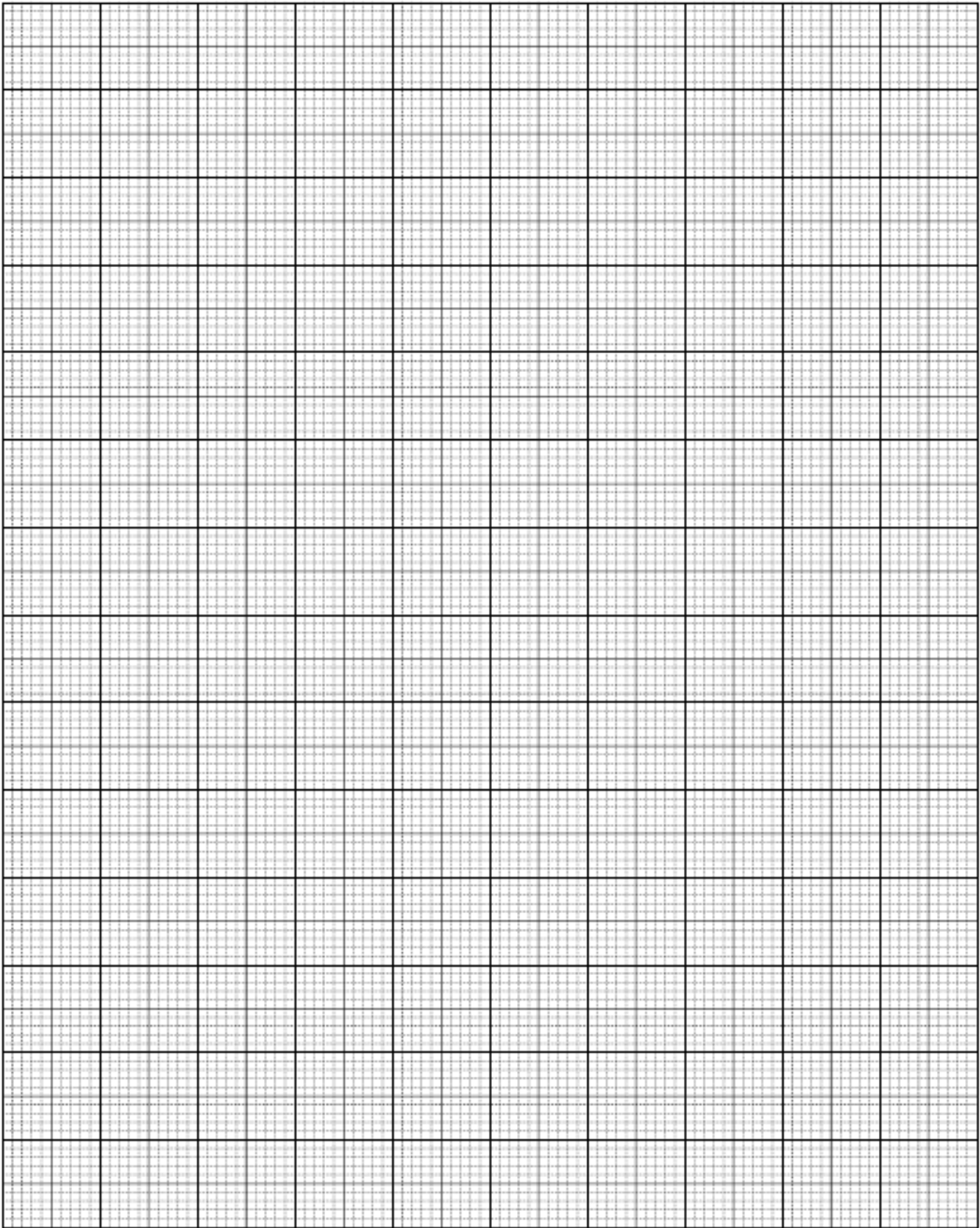
- (h) The following list is part of the conditions for which transpiration might occur. Classify into High transpiration and low Transpiration in Table 3. [3 marks]

Dry wind	Cool temperature	Sunny day
High humidity	Low speed of fan	More leaves

Classify each character to the correct category of factor.

High transpiration	Low transpiration

Table 3



CHAPTER 3

QUESTION 1

With frequent urination, the water level in blood are low causing blood solutes become more concentrated. This leads to higher blood osmotic pressure. Nerve message is sent to pituitary gland to release more ADH which are carried by bloodstream to the kidney. Kidney reabsorb more water and preventing water loss.

An experiment was carried out by two groups of students from the same age to investigate the function of the kidney. The aim of this experiment is to determine the effect of drinking different volumes of drinking water on the volume of urine released by kidney. Each group consists of two students.

Diagram 1 shows the apparatus set up for this experiment.

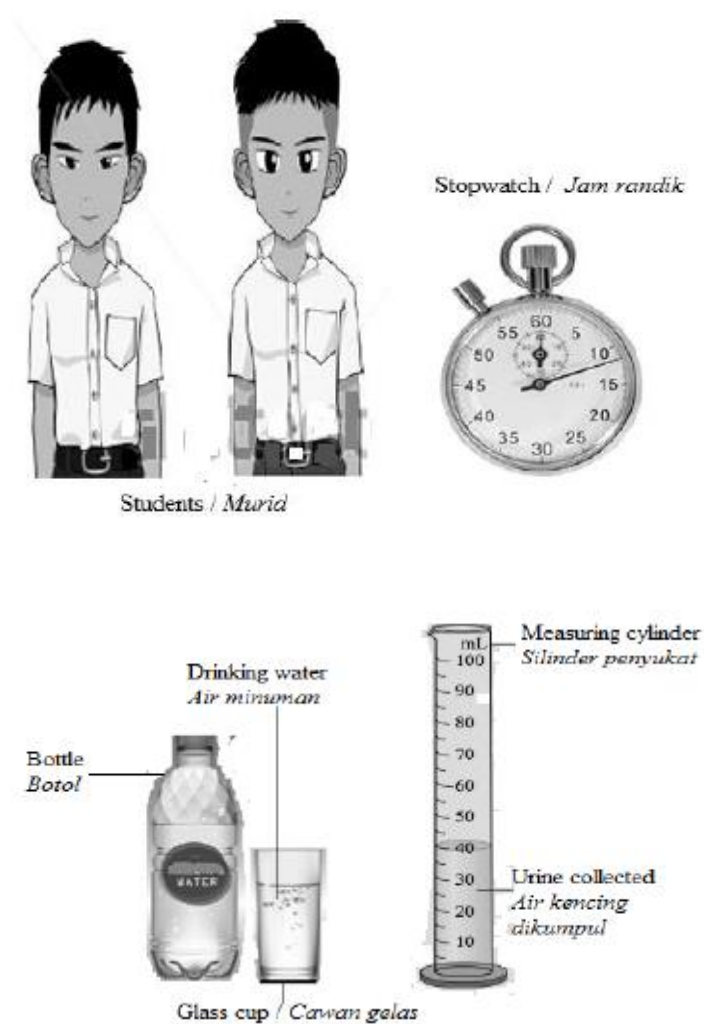
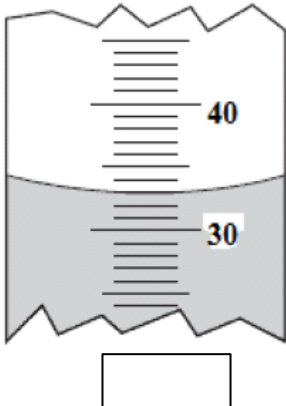
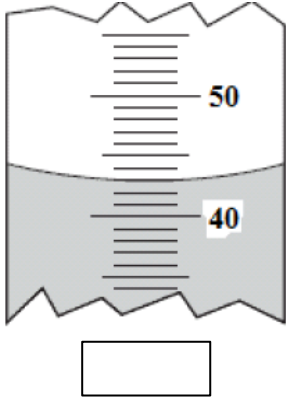
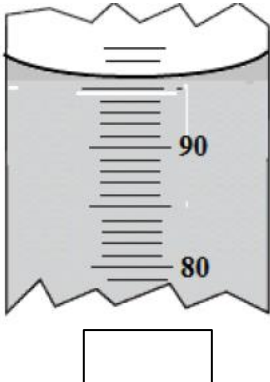
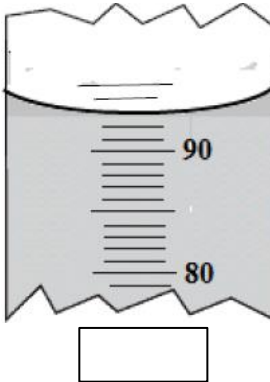


Diagram 1

The procedures for this experiment are as follows:

- Step 1: All the students are instructed to empty their bladder before starting the experiment.
- Step 2: Students from group A were given 200ml of drinking water to drink while students from group B were given 600 ml of drinking water to drink.
- Step 3: A stopwatch is started immediately after they drank the drinking water.
- Step 4: During the experiment, they are instructed not to eat and performed any vigorous activity in the air condition room
- Step 5: After 1 hour, the students are asked to empty their bladder and the stopwatch is stopped.
- Step 6: The volume of urine collected is measured and recorded by using a measuring cylinder.
- Step 7: Steps 2 until 6 are repeated for different amount of drinking water. Students from group A were given 400 ml of drinking water and students from group B were given 800 ml of drinking water.

The results of this experiment are shown in Table 1.

Student's group of the same age	Volume of drinking water drank (ml)	Volume of urine released by two different students after 1 hour (ml)	
		Student 1	Student 2
A	200		
	400		

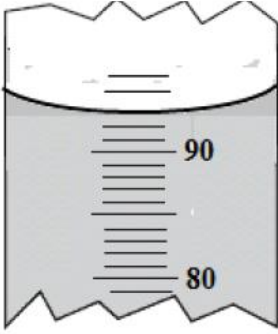
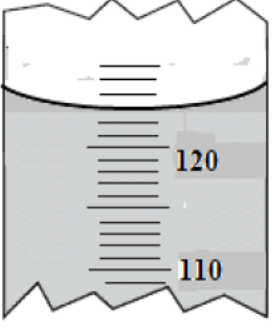
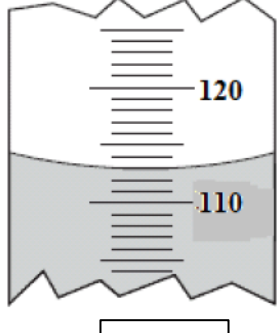
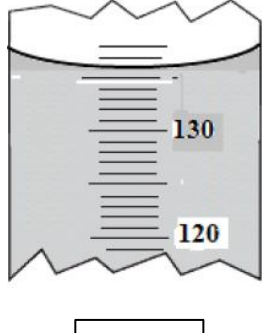
B	600	 <input type="text"/>	 <input type="text"/>
	800	 <input type="text"/>	 <input type="text"/>

Table 1

- (a) Based on Diagram 1, classify them under apparatus and materials using suitable variables in Table 2. [3 marks]

Variables	Apparatus	Material
Manipulated		
Responding		
Constant		

Table 2

- (b) Record the volume of urine collected by using measuring cylinder in Table 1. [3 marks]
- (c)(i) State two different observations which is one from Group A and one from Group B that can be made from Table 1. [3 marks]

Observation 1:

Observation 2:

(c)(ii) State two inferences from the observations in 1(c)(i). [3 marks]

Inference from Observation 1:

Inference from Observation 2:

(d) Complete Table 3 based on this experiment. [3 marks]

Variables	Method to handle the variables
Manipulated variable: ----- ----- -----	----- ----- -----
Responding variable: ----- ----- -----	----- ----- -----
Fixed variable: ----- ----- -----	----- ----- -----

Table 3

(e) State the hypothesis for this experiment. [3 marks]

(f)(I) Construct a table and record all your data collected in this experiment based on the following: [3 marks]

- Group
- Volume of water drank
- Volume of urine collected after 1 hour
- Average volume of urine collected
- Blood osmotic pressure

Blood osmotic pressure scale are measured as follows:
1 Lowest; 2 Low; 3 High ;4 Highest

(f)(ii) Use the graph paper provided to answer this question.
Using the data in 1(f)(i), draw a line graph to show the relationship between the average volume of urine collected against the volume of water intake. [3 marks]

(g) Based on the graph drawn in 1(f)(ii), state the relationship between the volume of water intake and the average volume of urine collected. Explain your answer. [3 marks]

(h) Based on the result of this experiment, state the operational definition of high blood osmotic pressure. [3 marks]

- (i) One student carried out another experiment as shown in Diagram 2.

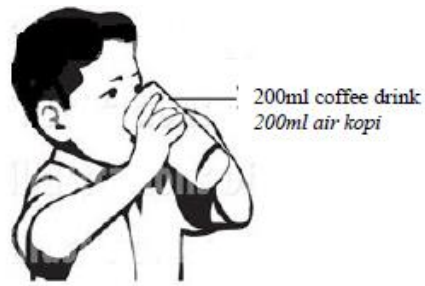
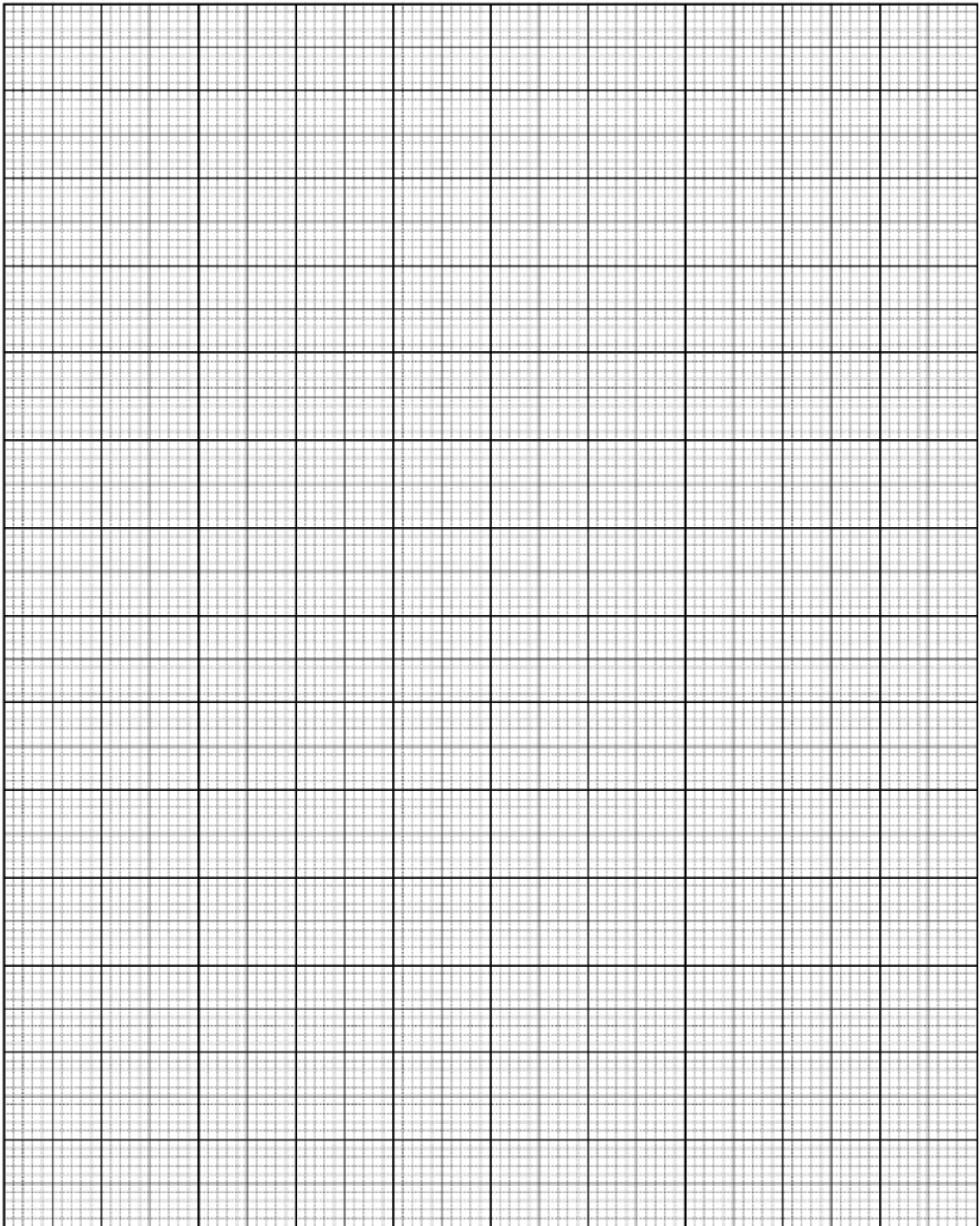


Diagram 2

Predict the volume of urine produced by this student. Explain your answer. [3 marks]



QUESTION 2

Using ripe fruits to induce the ripening of other fruits is a common method which is widely used by farmers in agriculture. A group of students carried out an experiment to investigate how the ripe mangoes able to induce the ripening process of a bunch of unripe bananas.

In the investigation, three set of experiment have been set up.

- Set A used a plastic container 30cm x 30cm x 20cm, placed a bunch of unripe bananas in it and closed the container with a cover.
- Set B used a plastic container 30cm x 30cm x 20cm, placed a bunch of unripe bananas and one ripe mango in it and closed the container with a cover.
- Set C used a plastic container 30cm x 30cm x 20cm, placed a bunch of unripe bananas and two ripe mangoes in it and closed the container with a cover.

All the three bunches of bananas were taken from the same three at the same day. All the plastic container of Set A, B and C are kept at room temperature in the laboratory.

The results of the experiment are shown in Table 1.

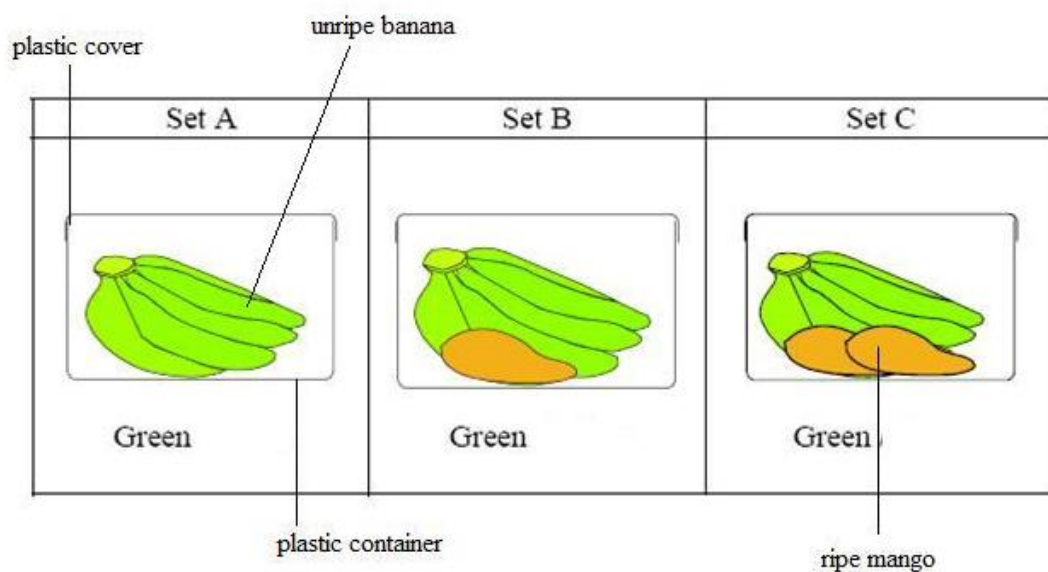






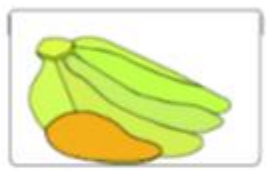
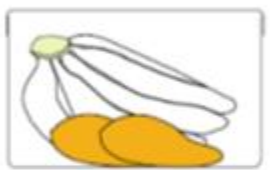


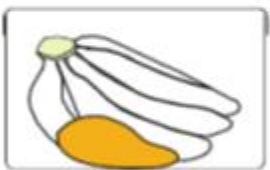
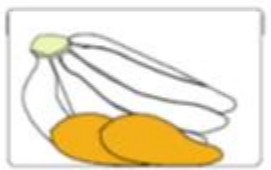

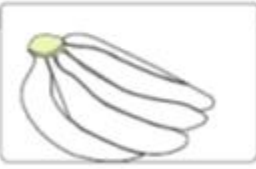
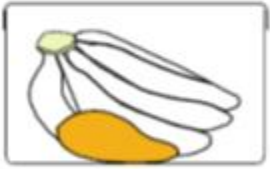
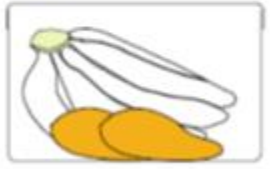


Diagram 1

Date	Set A	Set B	Set C
 Nov 15	 Green	 Green	 Green
 Nov 16	 Green	 Yellowish green	 Yellow
 Nov 17	 Yellowish Green	 Yellow	 Yellow
 Nov 18	 Yellow	 Yellow	 Yellow

	Time Taken for the bananas to turn yellow / day		

Table 1

(a) Record the time taken for the bananas to turn yellow in Table 1. [3 marks]

(b)(i) State two different observations on the relationship between the number of mangoes and the time taken for the unripe bananas to turn yellow from Table 1. [3 marks]

Observation 1:

Observation 2:

(b)(ii) State the inference from the observations in 1(b)(i). [3 marks]

Inference 1:

Inference 2:

(c) Complete Table 2 based on this experiment. [3 marks]

Variable	Method to handle the variable
Manipulated variable: ----- ----- -----	 ----- ----- ----- -----

Responding variable: ----- ----- -----	----- ----- ----- -----
Constant variable: ----- ----- -----	----- ----- ----- -----

Table 2

(d) State the hypothesis for this experiment. *[3 marks]*

(e)(i) Construct a table and record all the data collected in this experiment.

Your table should have the following aspects: *[3 marks]*

- Set of experiment
- Number of mangoes in the plastic container
- Time taken for the unripe bananas to turn yellow

(e)(ii) Use the data in 1(e)(i) and on a piece of graph paper, plot a graph to show the relationship between the number of mangoes in the plastic container and the time taken for the unripe bananas to turn yellow. [3 marks]

(f) Based on the graphs in 1(e)(ii), explain the relationship between the number of mangoes in the plastic container and the time taken for unripe bananas to turn yellow. [3 marks]

(g) Based on the results of this experiment, what can be deduced about the ripening process of the bananas? [3 marks]

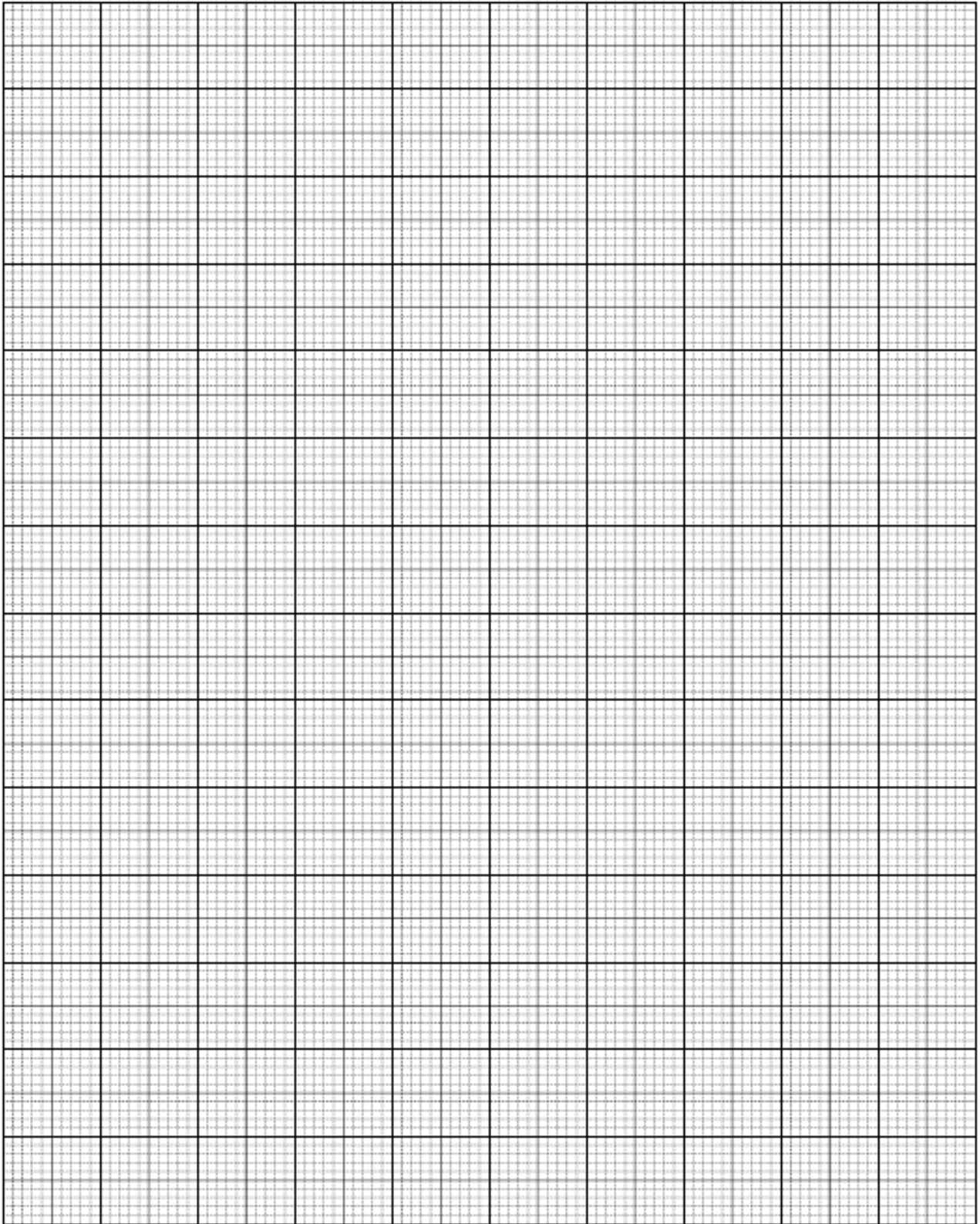
(h) A group of students repeat the above experiment by not closing the plastic container with the cover, based on the results of this experiment, predict the changes of the time taken for the unripe bananas to turn yellow in Set C
 Explain your prediction. [3 marks]

(i) Plant hormones are widely used in agriculture. Classify the following plant hormones in how they were used in agriculture. [3 marks]

Cytokinin, Auxin , Gibberellins

Plant hormones	Used for
	Used to produce seedless fruits
	Used to promote the growth of main stem
	Used in storage of green vegetable

Table 3



CHAPTER 4

QUESTION 1

The colour of the soil determines the level of soil fertility

Table 1.1 shows the different types of soil and its colour.

Type of soil	Yellowish
Clay	Brownish
Silty	Dark grey
Loamy	Black

Table 1.1

Based on the information given, a group of students carried out an experiment to investigate the growth rate of a plant in different types of soil.

The following steps were carried out:

- Step 1 : Four beakers are each filled with 300g of sandy soil, clay soil, silty soil and loamy soil respectively
- Step 2 : One red bean is put in each beaker.
- Step 3 : Each beaker is watered with 30 ml of water daily.
- Step 4 : After 3 days the root's length is measured as in Diagram 1 .1.

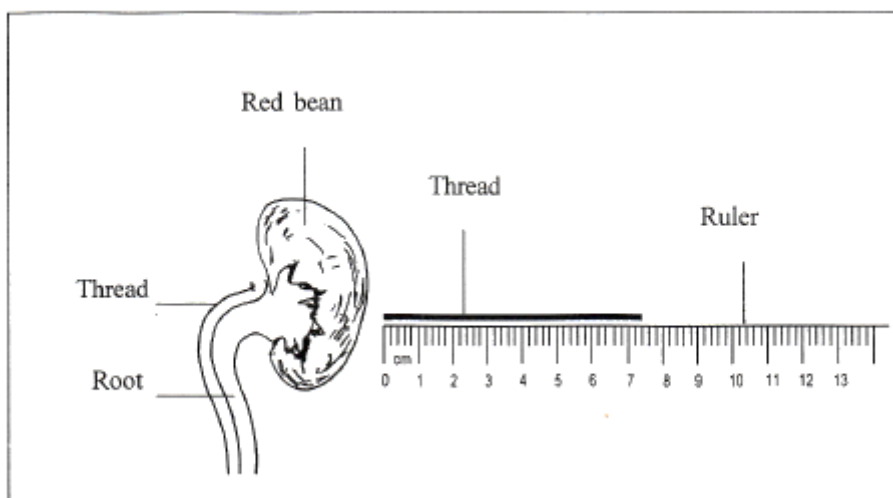


Diagram 1.1

Table 1.2 shows the length of the root from different type of soil.

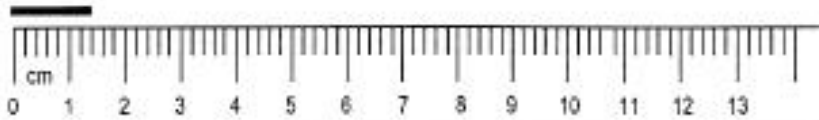

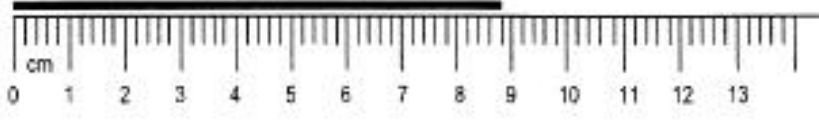

Soil	Measurement	Length /cm
Sandy		<input data-bbox="1297 432 1463 539" type="text"/>
Clay		<input data-bbox="1297 607 1463 714" type="text"/>
Silty		<input data-bbox="1297 781 1463 889" type="text"/>
Loamy		<input data-bbox="1297 956 1463 1064" type="text"/>

Table 1.2

(a) Record the length of the root of the red bean in the spaces provided in Table 1.2 [3 marks]

(b)(i) State two different observations made from the Table 1.2. [3 marks]

Observation 1:

Observation 2:

(ii) State the inferences which correspond to the observations in 1(b)(i). [3 marks]

Inference from observation 1:

Inference from observation 2:

(c) Complete Table 1.3 based on this experiment. [3 marks]

Variable	Method to handle the variable
Manipulated variable: ----- ----- -----	----- ----- ----- -----
Responding variable: ----- ----- -----	----- ----- ----- ----- -----
Constant variable: ----- ----- -----	----- ----- ----- ----- -----

Table 1.3

(d) State the hypothesis for this experiment. [3 marks]

(e)(i) Construct a table and record all the data collected from this experiment. Your table should have the following titles: [3 marks]

- Type of soil
- Length of the root
- Growth rate of the root

$$\text{Growth rate} = \frac{\text{length of the root}}{\text{time}}$$

(e)(ii) Use the graph paper provided to answer this question. Using the data i(e)(i), draw a bar chart to show the relationship between the colour of the soil and the length of the red bean's root. [3 marks]

(f) Based on the bar chart, explain the relationship between the length of the root and the colour of the soil. [3 marks]

(g) Based on the result of the experiment, state the operational definition of the growth. [3 marks]

(h) If the experiment is carried out by using loamy soil mixed with cow dung, predict the length of the root after 3 days. Explain your prediction. [3 marks]

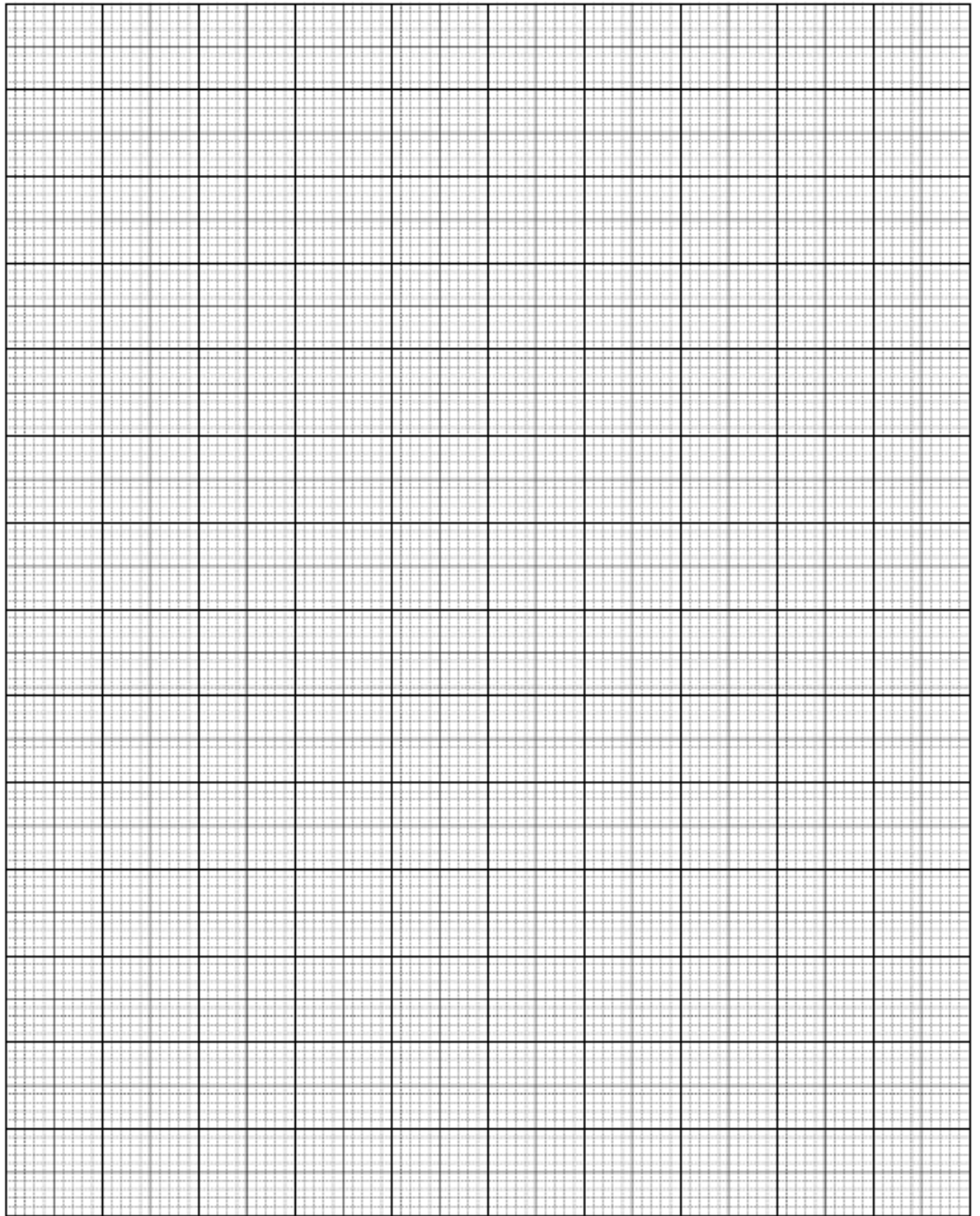
(i) Another group of students carried out this experiment to investigate the growth pattern of organisms below [3 marks]

- Grasshopper
- Cockroach
- Fish
- Maize plant
- Paddy plant

Classify the above organisms into their growth pattern in Table 1.4.

Sigmoid curve	Series of steps curve

Table 1.4



QUESTION 2

Growth in a multicellular organism can be estimated by measuring certain parameters such as length, height, volume, fresh mass and dry mass of the organism over a certain duration of time

Design an experiment to determine the growth curve of maize plant using height as the parameter of growth.

The planning of your experiment must include the following aspects:

- Problem statement
- Hypothesis
- Variables
- List of apparatus and materials
- Experimental procedure
- Presentation of data

[17 marks]

CHAPTER 5

QUESTION 1

A zygote is formed when an ovum is fertilised by sperm. The ovum and sperm carry one set of chromosomes each. Thus, after random fertilisation, the zygote has two sets of chromosomes, the homologous chromosomes, that are maternal and paternal chromosomes. The homologous chromosomes carry pairs of alleles that determine each trait inherited by an organism.

A group of students carried out an experiment to determine the phenotypes of offspring when two parents of the same genotype are crossed.

The investigation is on the inheritance of the fur colour in rabbits. Two black rabbits are crossed. The fur colour is a characteristic of rabbits, black and white are the traits inherited by the rabbits. B represents the dominant allele and b represents the recessive allele. The pair of alleles, BB, Bb, and bb are the genotypes that determine the phenotype, black fur and white fur.

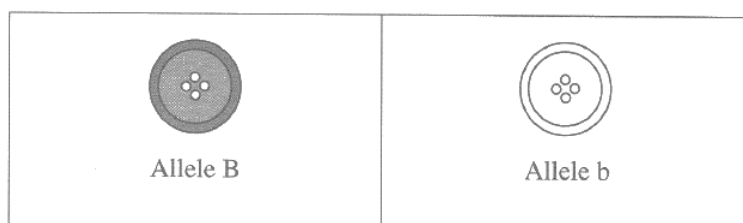


Diagram 1.1

Diagram 1.1 shows the buttons used to represent the alleles. Black buttons as allele B and white button as allele b.





























- If two black buttons are picked, the genotypes are BB and phenotype is black
- If one black button and one white button are picked, the genotype is Bb and the phenotype is also black
- If two white buttons are picked, the phenotypes are bb and the phenotypes is white

Two rabbits black parents, both with genotype Bb are crossed.

Parents phenotype: Black Black

Parents genotype: Bb X Bb

Table 1.2 shows the alleles inherited by offspring from both parents and the offspring phenotype

Offspring	Maternal allele	Paternal allele	Genotype	Phenotype
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				




















15				
16				
17				
18				
19				
20				
21				
22				
23				
24				

Table 1.2

- (a) Complete Table 1.2 by stating the genotype as BB, Bb, or bb, and stating the phenotype as Black or white, for each random pairing of alleles in the offspring [3 marks]
- (b)(i) Based on Table 1.2, state two different observations. [3 marks]

Observation 1:

Observation 2:

(b)(ii) State the inference which correspond to the observations made in 1(b)(i) [3 marks]

Inference from observation 1:

Inference from observation 2:

(c) Complete Table 1.3 based on the experiment. [3 marks]

Variables	Method to handle the variable
Manipulated variable: ----- ----- -----	----- ----- -----
Responding variable: ----- ----- -----	----- ----- -----
Controlled variable: ----- ----- -----	----- ----- -----

Table 1.3

(d) State the hypothesis for this experiment. [3 marks]

(e)(i) Based Table 1.2, construct one or two tables and record the results of the experiment which include the following aspects: [3 marks]

- Genotype and phenotype of parents
- Genotype and phenotype of offspring (number)
- Genotype and phenotype of offspring (percentage)

(e)(ii) Draw a bar chart of the percentage of offspring against the phenotype of fur colour in rabbits on the graph paper provided [3 marks]

(e)(iii) Based on the bar chart drawn in (e)(ii), state the phenotypic ratio of fur colour among the rabbit offspring. Explain the inheritance of fur colour based on the phenotypic ratio. [3 marks]

(f) Based on the experiment, describe the term phenotype [3 marks]

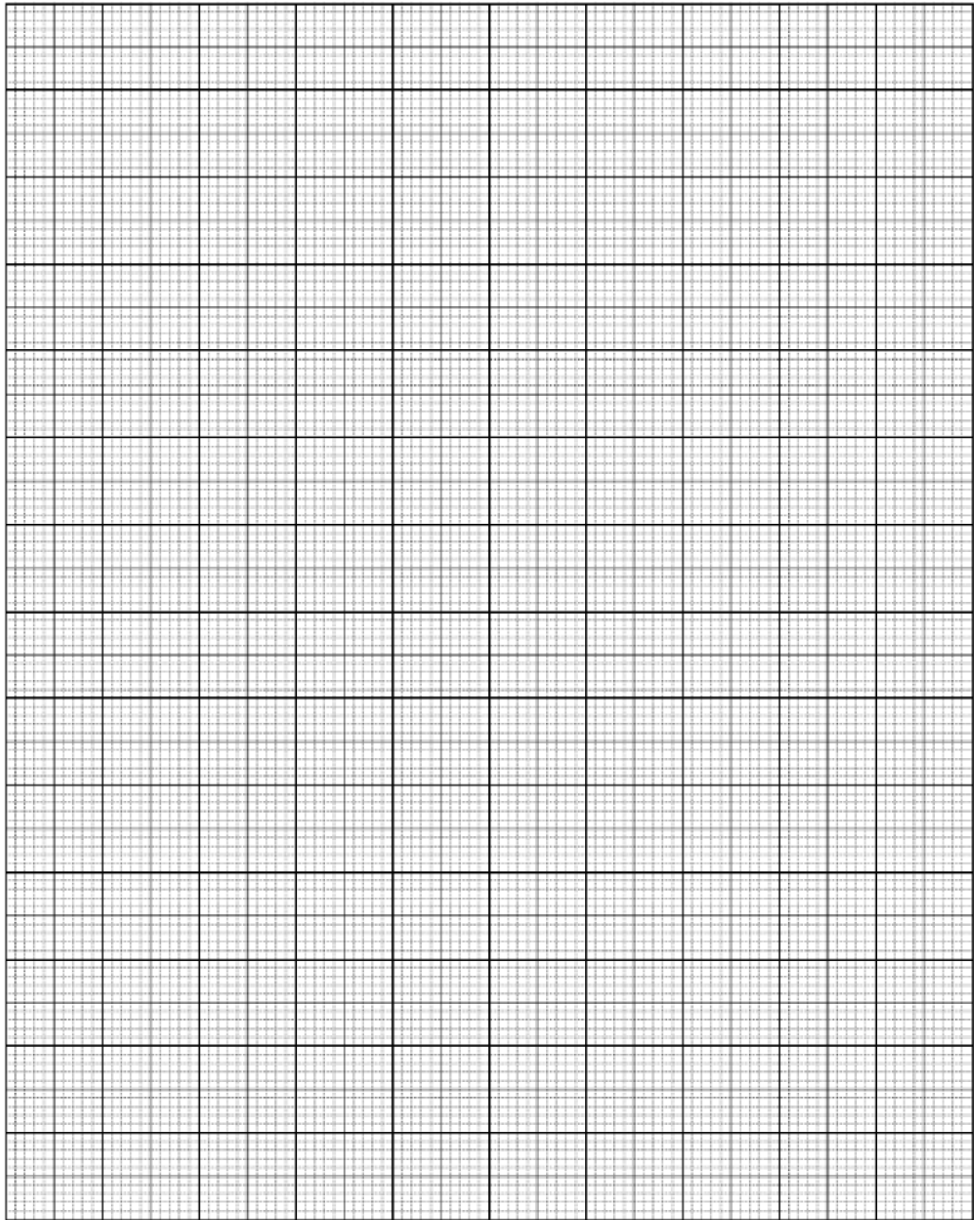
- (g) The experiment is repeated by crossing the same parents in a surrounding with more food supply. Predict the number and the phenotypic ratio of the offspring. Explain your answer. [3 marks]

- (h) The following list are some characteristics and traits in human.

Blood group A	Tall	Short	Height
Blood group O	Blue iris	Curly hair	Type of hair
Blood group	Brown iris	Eye iris colour	Straight hair

Classify the characteristics and traits according to the categories in the following table. [3 marks]

Characteristics	Dominant trait	Recessive trait



CHAPTER 6

QUESTION 1

There are 2 types of variation which is continuous and discontinuous variation. Discontinuous variation is affected by genetic factor while continuous variation affected by both genetic and environmental factors. The pattern of thumbprint with the highest number of students is dominant to the pattern of thumbprint with the least number of students.

A group of students carried out an experiment to study the percentage of students with the types of variation for the patterns of thumbprints among a group of students in a class.

Table 1 shows the different types of pattern of thumbprint.

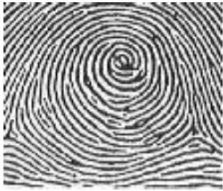
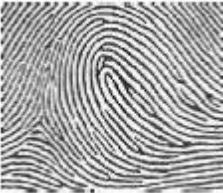

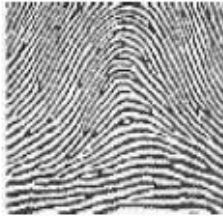
Variation in thumbprint	Types of thumbprint
	Whorl
	Loop
	Composite
	Arch

Table 1

Diagram 1 shows the patterns of thumbprint of 35 students in a class.

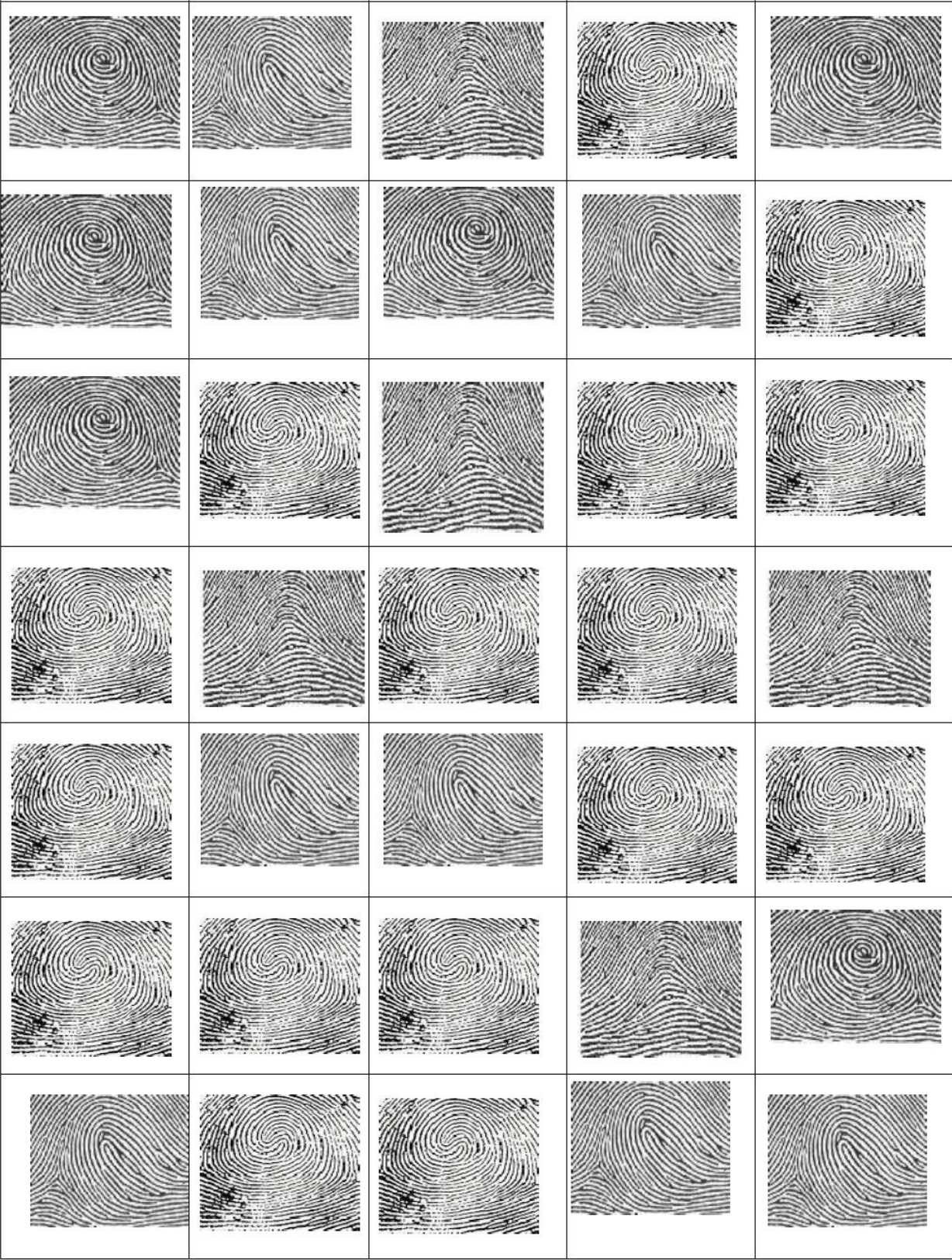


Diagram 1

- (a) Record the number of students with the same pattern of thumbprint in the boxes provided in Table 2. [3 marks]




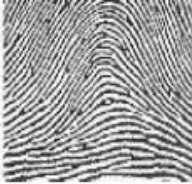
Variation in thumbprint	Number of students with the same pattern of thumbprint
 <p data-bbox="483 607 553 636">Whorl</p>	
 <p data-bbox="483 846 553 875">Loop</p>	
 <p data-bbox="456 1099 584 1128">Composite</p>	
 <p data-bbox="491 1361 549 1391">Arch</p>	

Table 2

- (b)(i) State two different observations based on Table 2. [3 marks]

Observation 1:

Observation 2:

(ii) State the inferences from the observations in 1(b)(i) [3 marks]

Inference from observation 1:

Inference from observation 2:

(c) Complete Table 1.2 based on this experiment. [3 marks]

Variable	Method to handle the variable
Manipulated variable: ----- ----- -----	 ----- ----- -----
Responding variable: ----- ----- -----	 ----- ----- -----
Constant variable: ----- ----- -----	 ----- ----- -----

Table 1.2

(d) State the hypothesis for this experiment. [3 marks]

(e)(i) Construct a table and record all the data collected from Table 2
Your table should have the following titles: [3 marks]

- Pattern of thumbprint
- Number of students
- Percentage students with same pattern of thumbprint

(ii) Use the graph paper provided, draw a bar graph on the percentage of students against the patterns of thumbprint. [3 marks]

(f) Based on graph in 1(e)(ii), determine the type of variation found in pattern of thumbprint. Explain. [3 marks]

(g) Based on the result of this experiment, state the operational definition for discontinuous variation. [3 marks]

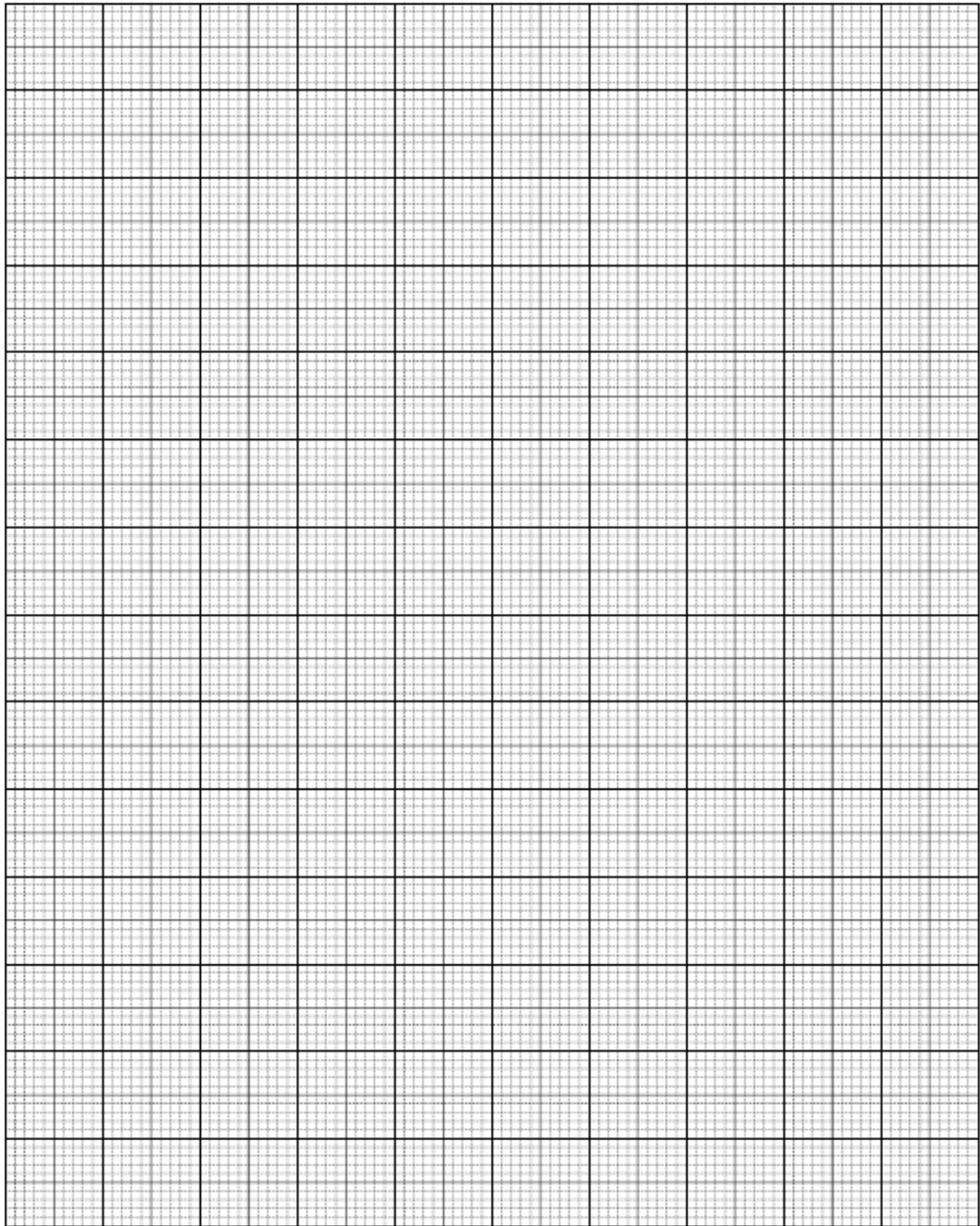
(h) The experiment was repeated by measuring the height of the students.

Predict the shape of the graph obtained. Explain your prediction. [3 marks]

(i) The following lists are factors that cause variation.

Nutrition	Experience	Benzene
X-Ray	Standard of living	Radioactive ray

Continuous Variation	Discontinuous variation



QUESTION 2

Variation is differences between organism of the same species. Variation in plant can be shown by the different size/mass of fruits, length of leaves or colour of flower. These variations can be affected by light intensity, amount of water, amount of minerals or pH of soil. One experiment was carried out to investigate the effect of light intensity onto growth of tomato plants which contain the same genetic. The tomato plants were planted in two glass houses with same other basic needs. The following steps were carried out.

- Step 1 : 10 tomato plants were planted in glass house A.
 Step 2 : While the other 10 tomato plants were planted in glass house B.
 Step 3 : Basic needs such as water and minerals were fixed for both glass house A and B.
 Step 4 : For the factor of light intensity, tomato plants in glass house A were exposed to light about 12 hours daily while in glass house B, tomato plants were exposed to the light about 6 hours.
 Step 5 : After 4 months, the tomato fruits which were planted in both glass houses shown differences in size and mass.

Table 1 shows the result of the experiment.

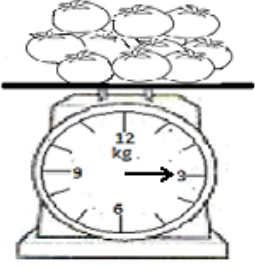
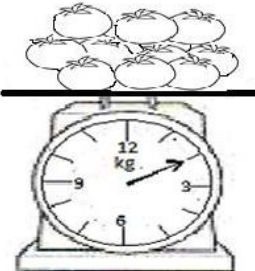
Glass house	Duration of tomato plant exposed to the light intensity daily (hour)	Mass of 10 tomatoes	Average mass of each tomato
A	12		<input type="text"/>
B	6		<input type="text"/>

Table 1

(a) Record the mass of 10 tomatoes and calculate the average reading in Table 1. [3 marks]

(b)(i) Based on Table 1, state two different observations. [3 marks]

Observation 1:

Observation 2:

(ii) State the inferences which correspond to the observations in 1(b)(i). [3 marks]

Inference from observation 1:

Inference from observation 2:

(c) Complete Table 2 based on this experiment. [3 marks]

Variable	Method to handle the variable
Manipulated variable: ----- ----- -----	----- ----- -----
Responding variable: ----- ----- -----	----- ----- -----

	----- -----
Constant variable: ----- ----- -----	----- ----- ----- -----

Table 2

(d) State the hypothesis for this experiment. [3 marks]

(e)(i) Construct a table and record all the data collected from this experiment. Your table should have the following titles: [3 marks]

- Glass house
- Duration of tomato plant exposed to the light intensity daily
- Mass of 10 tomatoes
- Growth rate of tomato

Use the formulae:

$$\text{Growth rate of tomato} = \frac{\text{Mass of 10 tomatoes}}{\text{Time taken for planting}}$$

(e)(ii) Use the graph paper provided to answer this question. By using the data in 1(e)(i), draw a bar chart on the growth rate of tomato against duration of tomato plant exposed to the light intensity daily. [3 marks]

- (iii) Based on the bar chart in 1(e)(ii), explain the relationship between the growth rate of tomato against duration of tomato plant exposed to the light intensity daily. [3 marks]

- (f) This experiment is repeated by exposing the tomato plant to the light intensity for 4 hours daily. Predict the mass of 10 tomatoes that will be provided. Explain your prediction. [3 marks]

- (g) Based on the result of this experiment, state the operational definition for continuous variation. [3 marks]

- (h) The following list is part of the apparatus and material used in this experiment.

Light bulb Calendar Tomatoes fertiliser Compression balance tomato plant

Complete Table 3 by matching each variable with the apparatus and material used in this experiment

Variable	Apparatus	Material
Manipulated		
Responding		
Controlled		

[3 marks]

