UCLSE

New Curriculum

Biology

Practical Workbook

BY

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Contents

Introduction to New Curriculum Biology Practical

Practical skills form the backbone of any Biology course. It is hoped that by using this book, you will gain confidence in this exciting and essential area of study. This book has been written to prepare Uganda Certificate of Lower Secondary Education (UCLSE) Biology students for the practical paper.

For this practical paper, you need to be able to demonstrate a wide range of practical skills. Through the various investigations and accompanying questions you can build and refine your abilities so that you gain enthusiasm in tackling laboratory work. Aside from the necessary exam preparation, these interesting and enjoyable investigations are intended to kindle a passion for practical Biology.

Great care has been taken to ensure that this book contains work that is safe and accessible for you to complete. Before attempting any of these activities, though make sure that you have read the safety section and are following the safety regulations of the place where you study.

Skills

Assessment Objective 3 (AO3) 'Experimental and Investigative skills' of the UCLSE is about your ability to work as a scientist. Each aspect of the AO3 has been broken and listed for you below.

- Demonstrate knowledge of how to safely use techniques.
- Demonstrate knowledge of how to use apparatus and materials.
- Demonstrate knowledge of how to follow a sequence of instructions where appropriate.
- Plan experiments and investigations.
- Make and record estimates.
- Interpret experimental observations and data.
- Evaluate methods.
- Suggest possible improvements to methods.
- Constructing own table.
- Drawing / analysing a graph.
- Planning safety of an investigation.
- Mathematical calculations.

Exam style questions

Worked example

Item: John's friend expressed doubts about the health benefits of Sample **B**, (an onion bulb Extract), in John's diet.

Task: Conduct experiments to analyze the nutrient content and potential health benefits of Sample **B**. Evaluate its nutritional composition, focusing on vitamins, minerals, and antioxidants present in the sample. Based on your findings, provide recommendations to John regarding the suitability of including Sample **B** in his diet.

Solution

Aim: To investigate the nutrients present in the food sample B.

Hypothesis: "If Sample B contains significant levels of vitamins, minerals, and antioxidants, then it may offer potential health benefits when included in John's diet."

List of Apparatus, reagents, solutions and Materials used:

- Extract B.
- Iodine solution.
- Benedict's solution.
- Dilute hydrochloric acid.
- Dilute Sodium hydroxide.
- DCPIP.
- Copper(II) sulphate solution.
- Heat source.
- Test tubes and droppers.

Procedure, Observations/ data presentation

	Tests	**Observations**	**Deductions**
(i)	To $2cm^3$ of **B** in a test tube, add 2 drops of iodine solution	Turbid solution**;** turns to brown solution **;**and remains brown	Starch absent in solution
(ii)	To $2cm^3$ of **B** in a test tube, add $2cm^3$ of Benedict's solution and boil	Turbid solutions**;** turns to blue solution green solution; yellow ppt and	Much reducing sugars present.

		finally brown precipitate**;**	
(iii)	To 2cm^3 of **B** in a test tube, add 2cm^3 of dilute sodium hydroxide solution followed by equal amount of copper(ii) sulphate solution	Turbid solution**;** turns to pale green/ accept colourless on addition of sodium hydroxide/ blue precipitate/	Proteins absent
(iv)	To 2cm^3 of DCIP in a test tube, add drop by drop of **B** and also establish the number of drops. …… ……	The dark blue colour of DCPIP**;** turns to colourless on addition of 6/7/8 drops.	Vitamin C/ as cubic present in acid solution
(v)	Boil 2cm^3 of **B** for 3 minutes, cool it and repeat test (iv) above …… ……	The dark blue colour of DCPIP**;** turns to colourless on addition of 8/9/10 drops.	Little vitamin C/ Ascorbic acid present**;**
(vi)	To 1cm^{3}of solution add 1 cm^3 of ethanol shake, then add 5 drops of water and shake.	Turbid solution remains turbid	Lipids absent.
(vii)	To 2cm^3 of Hydrogen peroxide in a test tube, add 2 drops of **B**	Moderate bubbles of colourless gas given off	Moderate break down of H_2 0_2 by active substance in solution.

Conclusion:

After conducting various experiments to analyze the nutrient content and potential health benefits of Sample **B**, the onion bulb extract, several observations were made. Sample **B** demonstrated the absence of starch and proteins, indicating its potential as a low-carbohydrate and protein-free dietary component. However, it exhibited a significant presence of reducing sugars, suggesting a source of readily available energy. Furthermore, the tests for vitamin **C** revealed its presence in moderate amounts, which could contribute to the antioxidant properties of Sample **B**.

Recommendations:

Inclusion in Diet: Despite the absence of starch and proteins, Sample B, the onion bulb extract, can still be included in John's diet due to its notable presence of reducing sugars and vitamin C. These components offer potential health benefits, especially in terms of providing energy and antioxidant support.

Moderation: While Sample B may offer health benefits, it's essential for John to consume it in moderation, considering its concentrated form and potential impact on flavor when added to dishes.

Dietary Diversity: John should continue to maintain a balanced diet rich in a variety of nutrients from different food sources. Sample B can complement other food items to enhance overall nutritional intake.

Advice:

Consultation: John should consult with a healthcare professional or nutritionist to assess how Sample B fits into his overall dietary plan and health goals.

Observation: John should observe any personal reactions or changes in health upon incorporating Sample B into his diet and adjust accordingly.

Variety: While Sample B may offer specific health benefits, it's crucial for John to continue consuming a diverse range of foods to ensure adequate intake of all essential nutrients.

In conclusion, while Sample B, the onion bulb extract, may not be a significant source of certain nutrients like starch and proteins, its presence of reducing sugars and vitamin C suggests potential health benefits. However, John should consume it in moderation and alongside a varied diet to optimize his overall nutritional intake and well-being.

Experiment 3

Item

A chef in a certain restaurant wants to understand how soaking potato slices in solutions of sugar affects their size.

Task:

(a) Help the chef by performing an experiment to analyze how various concentrations of sucrose solution affect the movement of water in and out of potato cells via osmosis. Observe changes in potato stick length over time when immersed in solutions with varying sucrose concentrations and deduce the direction of water movement.

(b) Another investigation was carried out into the effect of different concentrations of sucrose solution on potato sticks.

In this investigation students decided to measure the change in mass rather than the change in length.

The students followed a similar method to the one in your investigation but they left the potato sticks to soak for three hours instead of 30 minutes.

(i) Suggest why the students left the potato sticks in the solutions for three hours instead of 30 minutes.

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(ii) The students dried the potato sticks on paper towels before measuring the mass of each potato stick.

Suggest why this step was **not** important in your investigation, where length was measured.

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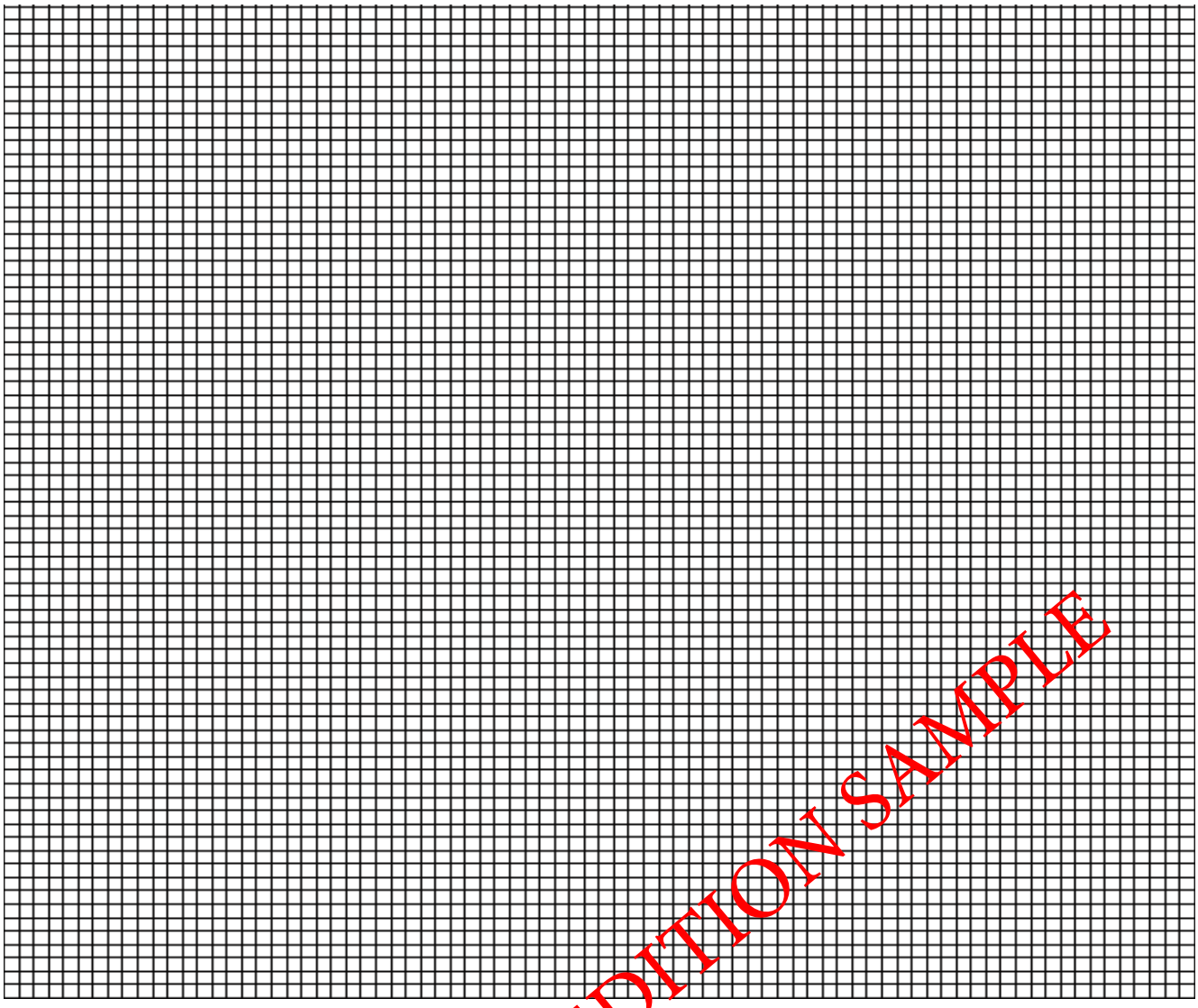
Table **3.1** shows their results

Table 3.1

concentration of sucrose solution (g per dm^3)	percentage change in mass
0	29.5
70	12.0
140	-3.0
210	-15.0
280	-26.0
350	-29.5

(iii) Using Table **3.1**, plot a graph on the grid to show the effect of the concentration of sucrose solution on the percentage change in mass.



(iv) Use your graph to find the concentration of sucrose solution that would cause **no change** in mass of the potato stick.
Mark this concentration on your graph with a + and record the concentration.
Include the unit

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(v) Students tested other potatoes and found different values for the concentration of sucrose solution that would cause no change in mass.

Suggest **one** reason for this.

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Experiment 4

Item:

A farmer in Namayingo district wanted to understand how temperature variations affect water movement in celery stalks.

Task:

(a) Help the farmer conduct an experiment to investigate how different temperatures influence the movement of red stain into the xylem tissue of celery stalks. Analyze the rate of stain movement to determine the effect of temperature on water transport in the celery stalks.

(b) Some farmers wanted to investigate the effect of humidity on the rate of transpiration in celery plants.

Fig. **4.1** shows a celery plant being harvested.

Fig. 4.1

One method of measuring the rate of transpiration is to record how long it takes a red stain to travel up the xylem tissue in a celery stalk that still has its leaves attached.

Plan an investigation to determine the effect of humidity on the rate of movement of water through leafy celery stalks.

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Experiment 9

Fig. **9.1** shows a bird's egg. Part of the shell has been removed.

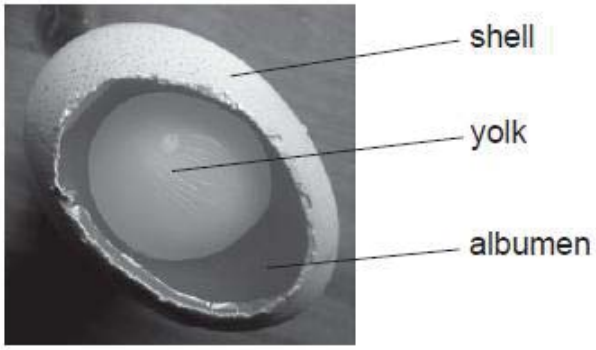

Fig. 9.1

Approximately 90 % of albumen is water. The remaining 10 % is made up of other substances such as reducing sugar.

Item:

A biscuit company seeks to analyze the composition of various components of a bird's egg to enhance their biscuit recipes and requires assistance in conducting the experiment.

Task:

Assist the biscuit company in analyzing the composition of different components of a bird's egg. Conduct tests to detect the presence of reducing sugar and protein in the albumen, observe the effect of acid on albumen, and perform the emulsion test to identify the presence of fat in the yolk. This information will aid the company in improving their biscuit recipes.

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Experiment 10

Starch is broken down into reducing sugars in the alimentary canal. The digested products are absorbed into the blood.

A biology experiment aims to investigate the action of enzymes on the digestion of starch.

Task:

(a) Help in conducting an experiment to explore how enzymes affect the digestion of starch. By participating in this experiment, you will assist in observing and analyzing the process of starch digestion in the presence of enzymes, contributing to a better understanding of enzymatic activity in biological processes.

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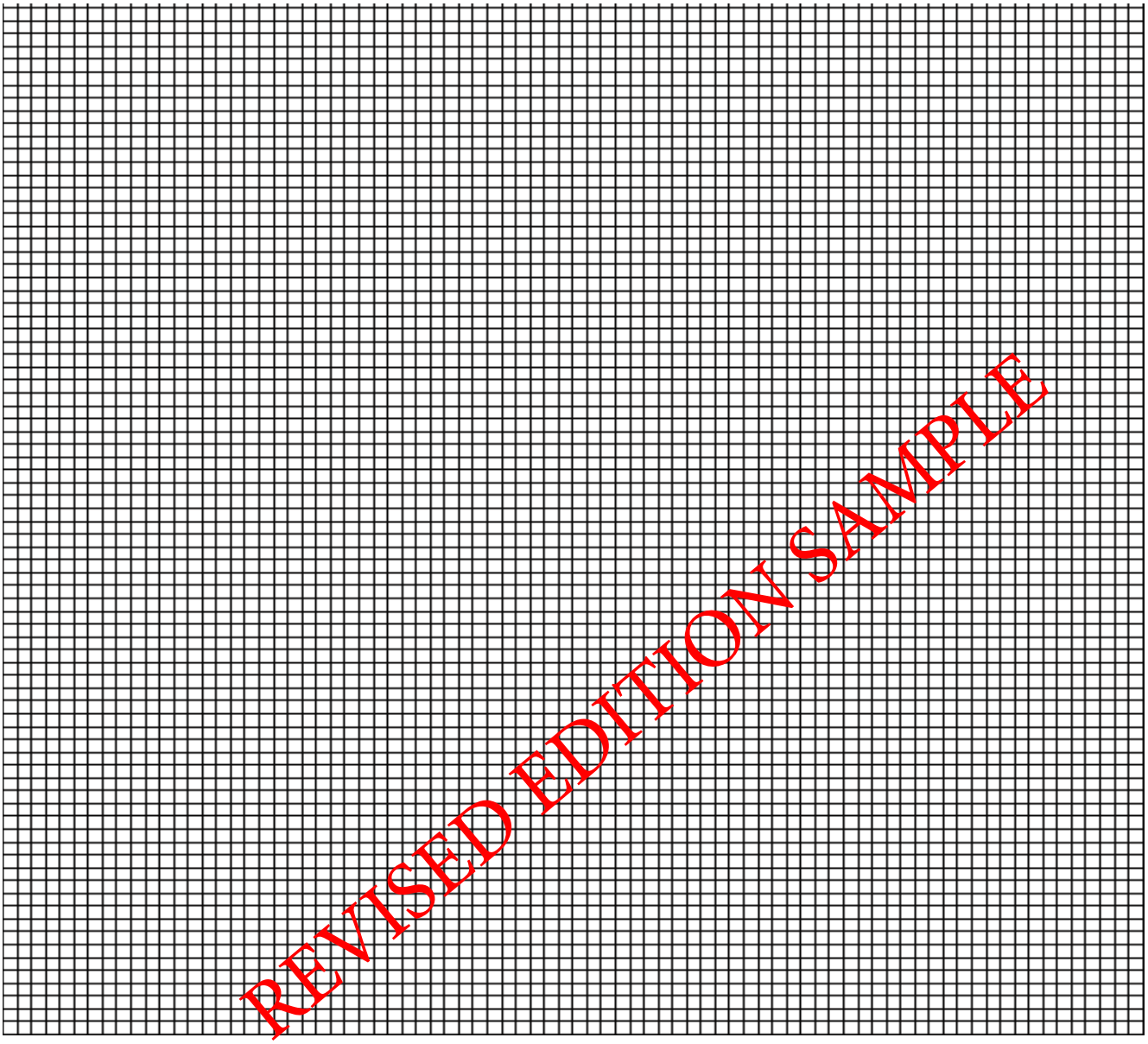
(b) Some students investigated the effect of pH on the activity of this enzyme. Their results are shown in Table **10.1**.

Table 10.1

pH	time for starch to be broken down (min)
3.5	9.0
4.0	7.0
5.2	4.0
6.6	1.5
7.0	1.0
8.0	4.5
8.5	10.0

(i) Plot a graph to show the results in Table **10.1**.



(ii) Use the graph to suggest the optimum (best) pH for this enzyme.

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(iii) Describe the effect of pH on the activity of this enzyme.

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Experiment 32

Students at a certain Secondary School were intrigued when they found specimen D5 in their classroom. They wondered how the seed reached their classroom and decided to investigate its structure and dispersal mechanism.

Task:

(a) Suggest how the structure of D5 enables the seed to be more efficiently dispersed. Consider factors such as wind dispersal and the design of the pappus. Provide detailed explanations to help the students understand the seed's dispersal mechanism.

(b) (i) Using the hand lens provided, make a large, detailed drawing to illustrate the structure of specimen D5. Labels are not required.

(ii) Calculate the magnification of your drawing in (a)(i). Draw a line across your drawing to indicate where you measured. Clearly show your working.

Experiment Requirements (Practical Instructions)

Each candidate will require the following materials and apparatus.

Experiment 1

(i) two large test-tubes, label one **A** and the other **B**, supported in a beaker
(ii) one syringe to measure 10 cm^3 [without a needle]
(iii) 50 cm^3 of active yeast culture to be presented in a container, labelled **yeast culture**

This should be freshly prepared in bulk, no more than one hour before the examination is due to start, by adding 50 g of new, fast acting, dried yeast to 500 cm^3 cooled, boiled distilled water, containing 50 g of glucose. Keep in a warm environment of about 40 °C. This is sufficient to supply 10 candidates.

(iv) implement for stirring the yeast culture e.g. wooden spill or plastic spoon
(v) two sets of apparatus as shown in Fig. 1, bungs must make an air-tight seal with large

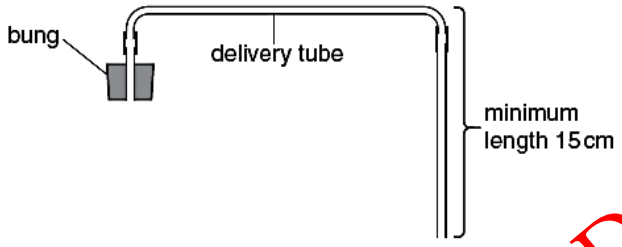

Fig. 1.

(vi) approximately 5 cm^3 vegetable oil, labelled **oil**
(vii) one dropping pipette
(viii) two test-tubes, in a beaker, each containing 10 cm^3 hydrogencarbonate indicator solution covered by plastic film, labelled **hydrogencarbonate indicator solution**

The hydrogencarbonate indicator solution needs to be freshly prepared on the day of the examination and to be presented in the red state.

Prepare the hydrogencarbonate indicator solution by dissolving 0.84 g sodium hydrogencarbonate in 500 cm^3 distilled water, and then make up to the final volume (1 dm^3) with distilled water. Add this to a solution of 0.1 g cresol-red and 0.2 g thymol-blue, dissolved in 2 cm^3 ethanol.

Add just enough dilute sodium hydrogencarbonate solution to make the solution red rather than orange.

(ix) two beakers to support the test-tubes containing hydrogencarbonate indicator solution
(x) one beaker of warm water approximately 45 °C at the start of the examination
(xi) paper towels (in case of spillages)
(xii) view of a clock or timer
(xiii) eye protection

Experiment 2

(i) two test-tubes
(ii) test-tube rack
(iii) a marker pen to mark the glassware and spotting tile
(iv) view of a clock or timer that allows the candidate to time minutes accurately
(v) approximately 150 cm^3 warm water (40 °C), in a 250 cm^3 beaker, labelled **warm water**
(vi) approximately 150 cm^3 iced water, in a 250 cm^3 beaker, labelled **cold water**
(vii) means of measuring 2 cm^3, e.g. 5 cm^3 syringe (without needle)
(viii) three dropping pipettes
(ix) white spotting tile (with at least 12 depressions/wells)
(x) iodine in potassium iodide solution (as normally used for food testing), presented in a dropping bottle, labelled **iodine solution**
(xi) 10 cm^3 1% starch solution, in a small beaker, labelled **starch solution**
(xii) 5 cm^3 1% amylase solution, in a small beaker, labelled **amylase**
(xiii) eye protection
(xiv) protective gloves
(xv) access to paper towels (in case of spillages)
(xvi) glass rod for stirring

Preparation of solutions and trialling

1% amylase solution

This is prepared by dissolving 1 g of amylase (or 1 cm^3 of stock amylase solution) in 90 cm^3 of distilled (or deionised) water and making up to 100 cm^3. This will provide sufficient solution for 20 candidates.
The activity of amylase from different sources, and of different ages, may vary. 1 cm^3 of the 1% amylase solution should break down all of the starch in 3 cm^3 of the 1% starch solution at 40 °C within 4 minutes.

It is important that this is trialled **before** the examination. If the time taken is greater, the concentration of the amylase solution should be increased accordingly.

1% starch solution
This is prepared by heating 1 g of **soluble** starch in 90 cm^3 of distilled (or deionised) water until the liquid

Experiment 38

(i) **Specimen W3** – two flowers, as large as possible, from the family *Bignoniaceae*, labelled **W3**. (e.g. *Catalpa, Jacaranda, Tabebuia, Campsis, Tecoma, Eccremocarpus* or similar)
(or one each, with some spares available)
If it is impossible to supply a flower from the family *Bignoniaceae* then an alternative tubular, zygomorphic flower could be supplied.
(ii) **Specimen W4** – a panicle of any grass with some florets open, if possible, labelled **W4**.
(could be shared if necessary)
(iii) Ruler (mm).
(iv) Cleaned white tile

Experiment 39

- Male pawpaw flower labelled **F**
- Solanum flower labelled **G**

Experiment 40

- Ginger / spear grass stem / Couch grass stem with scale leaves labeled **C**
- Baugainvillea stem with thorns, and some leaves labeled **D**

Experiment 41

- Fresh bean pod labelled **P**
- Raw tomato/ripe tomato labelled ***Q***
- Ripe orange labelled **T**

Experiment 42

Mature fruit of:
Bidens pilosa, labelled **H**.
Tridax procumbens, labeled **I**
Desmodium, labeled **J**
Bean, labeled **K**
(*For specimens* **H** *and* **I** *provide atleast 5fruits)*

Experiment 43

(i) Specimen labelled **W1**, a leaf, ovate in shape, between 6 and 10 cm long, with a toothed or wavy margin, preferably fairly stout rather than delicately thin.
(ii) Specimen labelled **W2**, a short piece of stem of an upright grass with a node bearing one leaf.
(iii) Hand lens.

Experiment 44

No items are required for this experiment

Experiment 45

(i) A mosquito (adult), in a watch glass or other small container, in 40% ethanol (IMS), labelled **X**.
(ii) Hand lens (×10 or ×8, preferably).
(iii) Microscope slide.
(iv) Cover glass.
(v) Ruler, mm
(vi) Teat pipette.
(vii) Forceps .

Experiment 46

- A fleshly killed Soldier termite labelled **A**
- A fleshly killed worker termite labelled **B**
- A fleshly killed housefly labelled **C**
- Hand lens

END