EUNOIA JUNIOR COLLEGE
JC2 Preliminary Examination 2019
General Certificate of Education Advanced Level
Higher 2

CANDIDATE NAME							
CIVICS GROUP	1	8	-			REGISTRATION NUMBER	

H2 Biology

9744/04

Paper 4 Practical

30 August 2019

2 hours 30 minutes

Candidates answer on the Question Paper.
Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

Write your name, civics group and registration number on all the work you hand in.
Give details of the practical shift and laboratory, where appropriate, in the boxes provided.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use paper clips, highlighters, glue or correction fluid.

Answer **all** questions in the spaces provided on the Question Paper.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Shift
Laboratory

For Examiner's Use	
Section A	
1	
2	
3	
Total	**55**

This document consists of **14** printed pages and **2** blank page.

Important info for students based on teachers' observations:

1. It is very important to check that you have all the necessary apparatus and materials before the start of the examination.

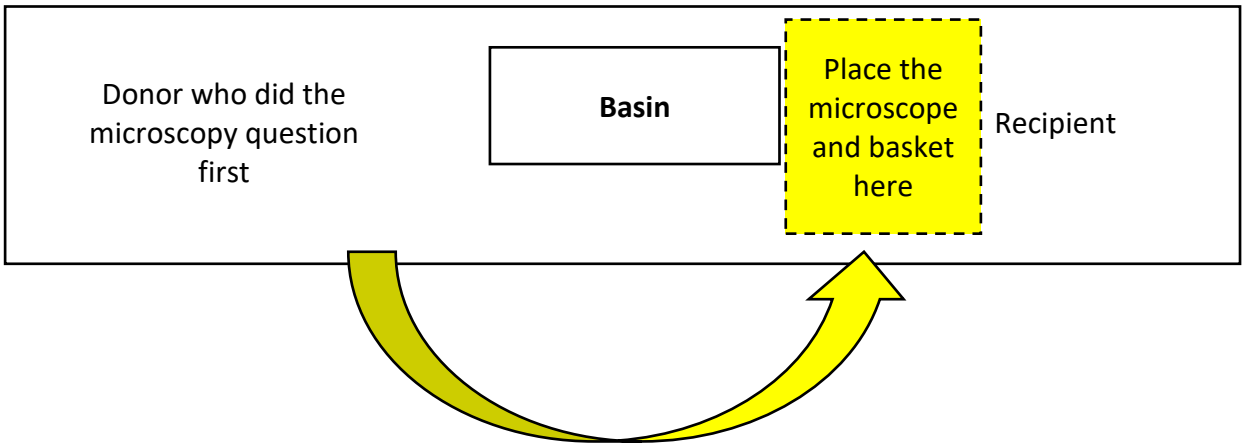
2. It is OK to seek help from your Subject Supervisor (SS; your bio teachers) if you are unsure whether there is a flaw in the apparatus (e.g. microscope), OR, if you are unable to carry out a particular step (e.g. focusing).

   Recording of your conversation with the SS by the invigilator does NOT mean you will definitely be penalised! Hence, feel free to seek assistance!

For standardisation by all students regarding placement of microscope and the basket containing the specimen slide and related apparatus.

At the mid-point of the exam, the invigilator will announce a pause in the exam for the transfer of the microscope and its related basket. You are to stop all work immediately (Note: *Do not disregard the instruction!*)

To do:
The student (*"the donor"*) who did the microscopy question first will place the microscope AND the basket at the side of the basin nearer to the student (*"the recipient"*) on the other side of your bench.



Answer **all** the questions.

Living organisms require a daily supply in their diet of the biological chemicals - protein, starch and reducing sugars.

Using the solutions provided, you are required to obtain a **mixture** of **two** of the solutions which would supply a high concentration of starch, a high concentration of protein and low concentration of reducing sugar.

Using only the reagents provided, carry out the appropriate tests to identify the contents of each of the solutions **S1**, **S2**, **S3**, **S4** and **S5**.

The solutions contain one or more of starch, reducing sugar and protein in varying concentrations.

To compare the concentrations in each solution, you will need to consider carefully how you will control the tests.

1 Complete **Table 1.1** below to show how you will carry out the tests on each solution.

Table 1.1

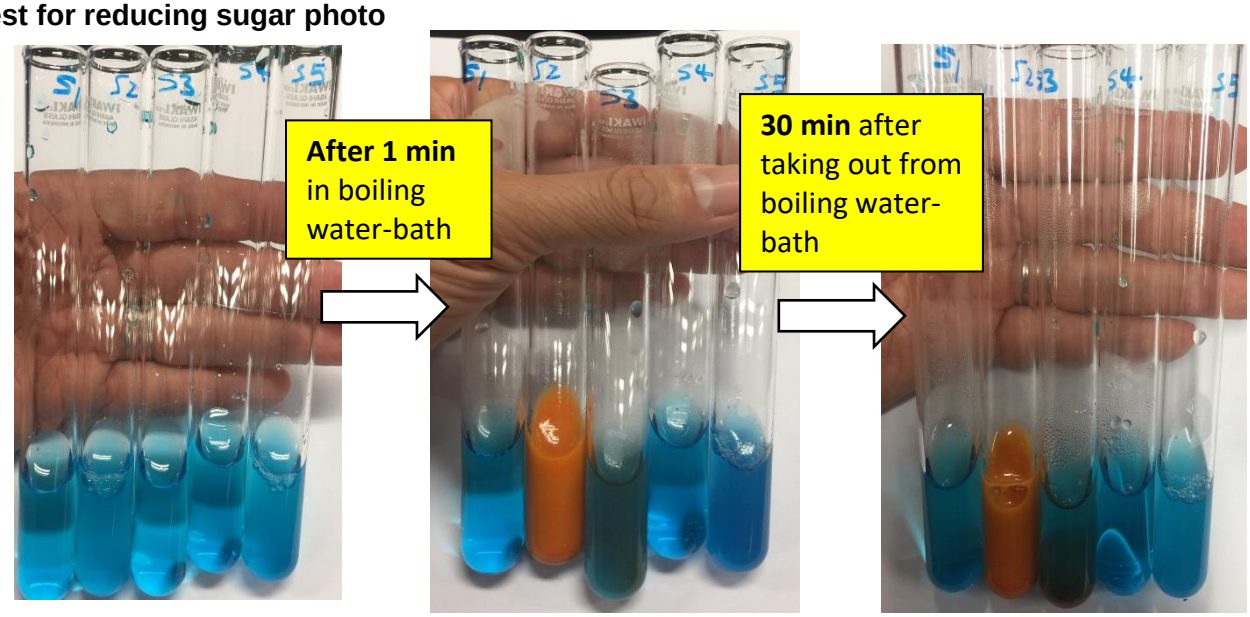
Test for	Description of test	Expected result for the **presence** of biological chemical
Starch Note: The *"iodine solution" is actually "iodine in potassium iodide solution (or I_2/KI)"*	**Iodine/Potassium Iodide test** **1. Add 1 cm^3 of the solution to a test-tube.** **2. Add a few drops of iodine solution.**	**Yellow brown iodine solution turns blue-black**
Reducing sugar Note: When performing this test, the tubes should only be added **after** *the water starts to boil* (not before).	**(Benedict's test)** **1. Add 1 cm^3 of the solution to a test-tube.** **2. Add an equal volume of Benedict's solution. (Mix contents of the test-tube well.)** **3. Place the test-tube in a boiling water bath for 1 minute.**	Note: Qualitative test, no need to quantify the amount of products **Clear blue mixture turns green / yellow / orange / orange-red.** R: brick red
	(Biuret test) **1. To 1 cm^3 of test solution in a test tube.** **2. Add Biuret reagent dropwise and mix well.**	**The blue solution turns violet / purple.**

[6]

2 Carry out the tests on all the solutions – **S1**, **S2**, **S3**, **S4** and **S5**.

Read the important comments on page 4!

Test for reducing sugar photo



All tubes: Starting observation:
"Clear blue mixture"

Refer to above answer
For Tube S3: *"Dark blue green mixture formed"*

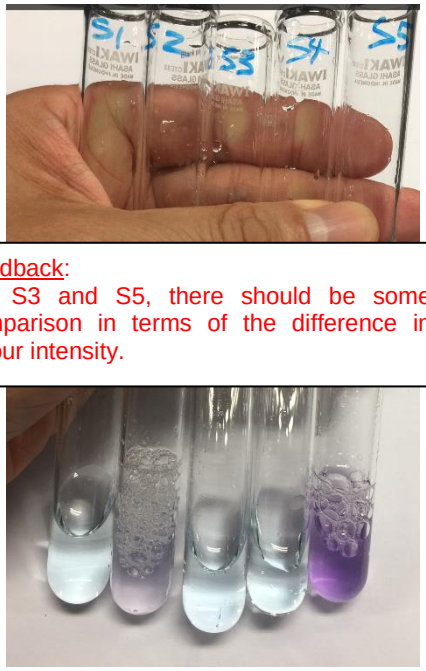
Tube S3 differs from above answer because ppt suspension will settle to the bottom of tube over time *"Blue-green mixture with some red-brown precipitate at the bottom of the tube"*

Feedback:
- For observation of colour change, the initial and final colour of the mixture should be stated
  E.g. For S1, the (clear) blue mixture remained blue.
- Terms such as "brick red or dirty green" are not accepted. Terms such as "dark red or dark green" are acceptable.
- There is no such thing as a *green or yellow precipitate* although you may put down as dark green mixture (see S3) as an answer. Dark blue with some red-brown precipitate at the bottom of the test tube is also acceptable.

Test for starch photo

Refer to answer below

Test for protein photo



Feedback:
For S3 and S5, there should be some comparison in terms of the difference in colour intensity.

Refer to answer below

3 In the space below, record your observations of the tests on all the solution in a table.

Tube	Test for starch	Test for reducing sugar	Test for protein
S1	Light yellow / yellow-brown / brown iodine solution turned blue-black	Blue mixture remained	Light blue mixture remained
S2	Light yellow / yellow-brown / brown iodine solution remained.	Blue mixture turned orange/red/orange red R: Brick red	Light blue mixture turned light purple / violet
S3	Light yellow / yellow-brown / brown iodine solution turned blue-black	Blue mixture turned dark blue green R: Dirty green, dirty blue	Light blue mixture remained
S4	Light yellow / yellow-brown / brown iodine solution remained.	Blue mixture remained	Light blue mixture remained
S5	Light yellow / yellow-brown / brown iodine solution turned blue-black / dark blue	Blue mixture remained	Light blue mixture turned dark purple / violet

Mark scheme
S: Correct observation for test for starch in all tubes;
RS: Correct observation for test for reducing sugar in all tubes;
P: Correct observation for test for protein in all tubes;
C: Correct comparison S2 (lighter) vs S5 (darker purple colour) [some idea of comparison]

If no mention of initial colour, minus 1 mark but only once in either step 1 or 3.
If "***No observable change / negative result***" was given as an answer, minus 1 mark

Reminder to self:

1. I must remember to state the **initial** colour and **final** colour of the mixture. Including the **clarity** (e.g. clear, cloudy, etc) of the mixture would be good too.
2. The ~~presence~~ amount of reducing sugar is determined by the amount of **red-brown** precipitate
3. I may need to compare the colour intensity between tubes in order to determine the relative amount of sugar between samples.
4. If there is absence (or non-detectable amount) of reducing sugar, I should be specific in describing the initial colour of the mixture and not give a vague answer such as "*no observable change*".

4 The **mixture** needed should combine equal volumes of **two** of the solutions to make a **high concentration of starch**, **high concentration of protein** and **low reducing sugar**.

Using your results from **3**, decide which solutions you would use and explain your decision. [2]

S3 and S5 only.
Correct explanation by using observations from the results in Table 1.1;
For example: Mention that
S3 tube - has low reducing sugar concentration
S5 tube - has high protein concentration
Either/both S3 and S5: has/have high starch concentration

Tube	Concentration		
	Starch	Protein	Reducing sugar
S3	**High**	Absence	**Low**
S5	**High**	**High**	Absence

5 State **two** variables that need to be kept constant when performing the test for reducing sugar in S1 to S5. [2]

Volume of test solution;
Duration of water-bath;

R: Temperature of water-bath since it is supposed to be boiling water-bath
R: Volume of Benedict's solution since equal volume of Benedict's solution to the test solution was mentioned in Table 1.1.

6 Identify one significant source of error in your tests and state one way to overcome the error.

Source of error	Improvement
Estimating colours is not accurate due to subjectivity in interpretation.	**Use a colorimeter / spectrophotometer to provide quantitative readings for colour intensity.**
Use of a dropper or Pasteur pipette to add I_2 in KI solution or Biuret reagent is inaccurate / Drop size may vary in volume.	**Use 1 mL syringe or micropipette to add the solution.**
AVP	**AVP**

[4]

Another essential biological chemical for living organisms is ascorbic acid (vitamin C). The concentration of ascorbic acid can be found by using iodine. When iodine is added, the ascorbic acid is oxidised to dehydroascorbic acid and the iodine is reduced to iodide ions.

Once all the ascorbic acid has been oxidised, the excess iodine is free to react with starch, used as an indicator, forming the blue-black starch-iodine complex. This change in colour shows the end-point.

The volume of iodine added increases as the concentration of ascorbic acid increases.

Table 1.2 provides the data for the different concentrations of ascorbic acid.

Table 1.2

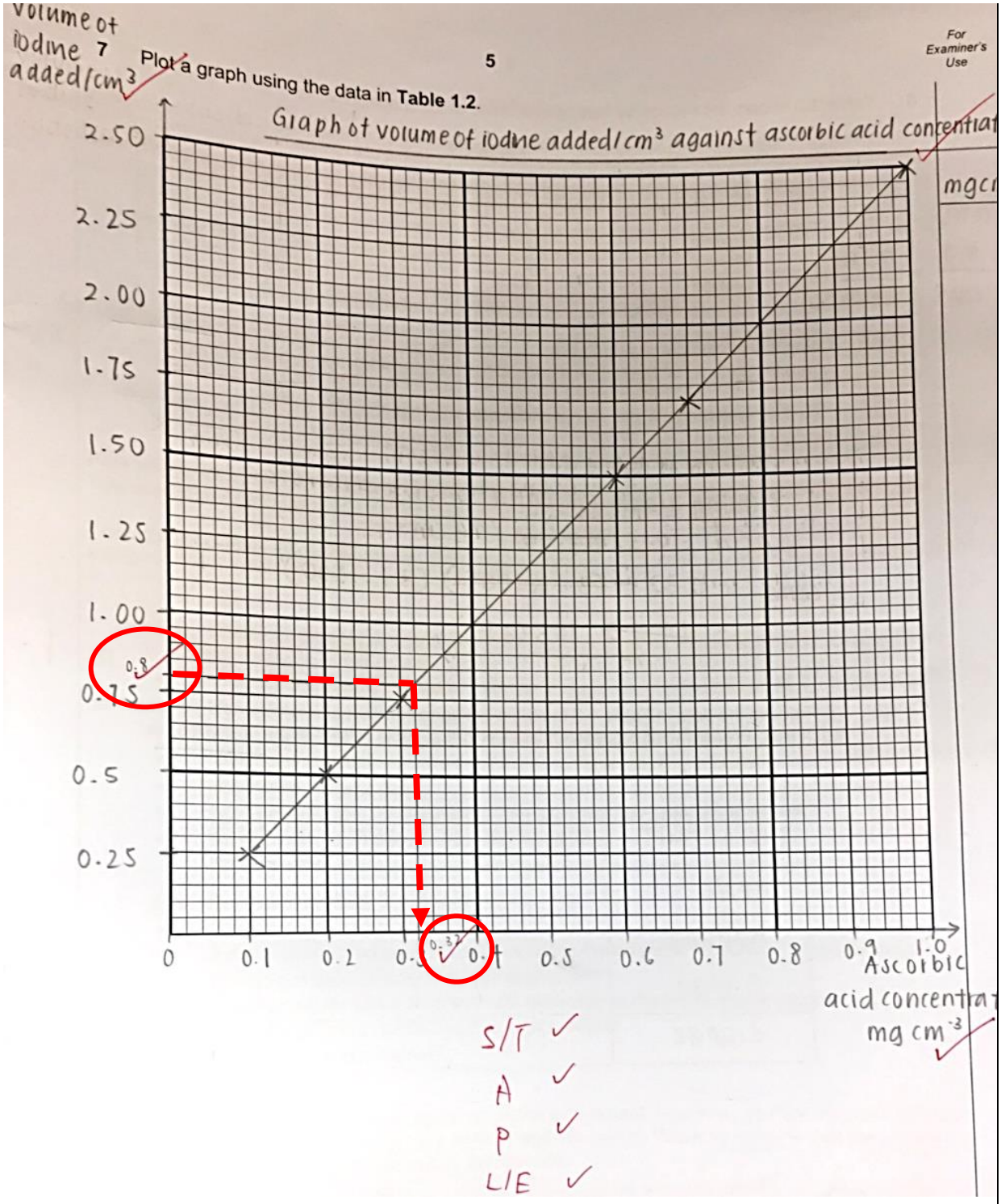
Ascorbic acid concentration / mg cm^{-3}	Volume of iodine added / cm^3
1.0	2.50
0.7	1.75
0.6	1.50
0.3	0.75
0.2	0.50
0.1	0.25

Note the following before you plot your graph:

1. **Ascorbic acid concentration = indep variable ; Volume of iodine added = dep variable**
2. **The column heading and units will be used for the axes labels**
3. **The no. of dp / SF will be used as well**

7 Plot a graph using the data in **Table 1.2**.

For Examiner's Use



Refer to the mark scheme below. [4]

Mark scheme

- **S/T: Sensible scale + Title;**
- **A: Axes – correct X and Y axes with appropriate units;**
- **P: Points – correctly plotted points;**
- **L/E: Line that cuts through all points + no extrapolation beyond plotted points;**

8 **Table 1.3** shows the results for testing four types of fruits using iodine.

Table 1.3

Type of fruit	Mass used in test / g	Volume of iodine added / cm^3
Apple	3.1	0.80
Banana	7.2	5.40
Mango	2.2	4.20
Orange	3.4	4.30

(a) Using the plotted graph and **Table 1.3,** obtain the concentration of ascorbic acid per gram of apple. Show your working and indicate on the graph how you obtained the value.

Indicate this clearly on your drawn graph: X-axis (**0.32** $mgcm^{-3}$) and Y-axis (**0.8** cm^3 iodine added) lines clearly drawn that intersected graph;

You may lose mark if you do not show your working.

Working:
Based on 0.8cm^3 iodine added, the concentration of ascorbic acid in apple (indicated from graph) = 0.32 $mgcm^{-3}$

Concentration of ascorbic acid per gram of apple = 0.32 $mgcm^{-3}$ / 3.1g = 0.103 $mgcm^{-3}g^{-1}$

Remember to include the units and 3SF in your final answer! [2]

(b) **(i)** Process the data in **Table 1.3** to obtain the concentration of ascorbic acid per gram for each fruit. Present your processed data using a **suitable format** in the space below.
(This refers to a table!)

Type of fruit	**Concentration of ascorbic acid per gram / $mgcm^{-3}g^{-1}$**
Apple	**0.103**
Banana	**0.300**
Mango	**0.764**
Orange	**0.506**

Mark scheme
- **Correct column heading with units;**
- **Correct calculation for all values;**
- **Answers in 3SF;**

Example: Calculation for banana

Volume of iodine added = 5.4 cm^3
Concentration of ascorbic acid = (0.32$mgcm^{-3}$/0.8 cm^3) x 5.4 cm^3 = 2.16 $mgcm^{-3}$
Concentration of ascorbic acid per gram = 2.16 $mgcm^{-3}$ / 7.2 g = 0.300 $mgcm^{-3}g^{-1}$

[3]

(ii) State the assumption you made as you processed the data.

…….. [1]
The concentration of ascorbic acid is directly proportionate to the volume of iodine added

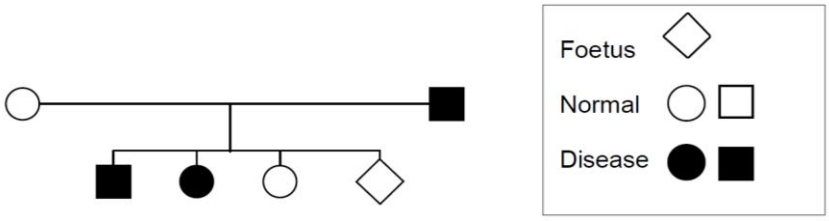
[Total 28]

For Examiner's Use

2 (a) **Sickle cell anaemia** is caused by a **single nucleotide substitution** in the β-globin gene. This substitution eliminates a **restriction site for the enzyme *Dde*I in the sickle cell allele.** The mutation in the β-globin gene results in haemoglobin molecules **crystallising out under low oxygen concentration, resulting in sickled shaped cells.** *(you should know)*

Note to student:
You are expected to know this named **autosomal recessive** disease for the A level exam. Hence, it should be used as an example for ESQ 4a or 5a in H2 Bio Prelim Paper 3. However, you are not required to know that Huntington's disease (Prelim Paper 2, STQ 9) is caused by an autosomal dominant mutation.

The following family, which has a history of sickle cell anaemia, took part in the study.



Plan an experiment to investigate if the male foetus in this family is affected by sickle cell anaemia through restriction fragment length polymorphism (RFLP) analysis.

Your planning must be based on the assumption that you have been provided with the following equipment and materials.

- Small sample of aminotic fluid containing cells from the foetus and blood samples from the mother and father of the fetus
- DNA extraction buffer solution
- Micropipettes and tips
- Microfuge tubes
- Centrifuge machine
- Restriction enzyme *Dde*I
- Agarose gel plate, electrophoretic chamber and electrophoresis buffer
- Suitable source of electrical current

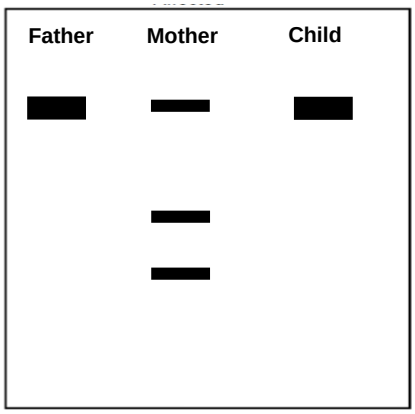
Note: Choice of using PCR approach or Southern blotting approach
Your plan should include:

- An explanation of the theory to support your practical procedure
- A description of the method used, including the scientific reasoning behind the method
- The type of data generated by the experiment
- How the results will be analysed with reference to the family tree to determine if the child is normal, affected by the disease, or is a carrier
- Appropriate safety measure

You are not required to draw the setup of the experiment. However, you are required to draw the expected band patterns of the parents and the foetus. You may assume that the mother is a carrier and the child is affected by the disease.

[Total 13]

A. Aim: (no mark)
To investigate if the male foetus in this family is affected by sickle cell anaemia.



Note:
As it was not specified that the amount of DNA extracted from each individual was equal, we will only focus on the relative positions of the bands, and not include the relative thickness of the bands.

However, the answer provided reflects the relative difference in the amount of DNA. Since both affected father and child have 2 copies of the mutant allele, then the thickness is about twice that to the single copy of the mutant allele in the mother.

Correct drawing of the band patterns [1 mark]

B. Theory [2 marks]
Sickle cell anaemia is an autosomal recessive disease affecting the gene coding for β-globin. [1]

The mutation results in a deletion of the *Dde* I restriction site within the gene locus. This generates different number and length of the restriction fragments upon the restriction enzyme digest of the normal and recessive alleles (also accept: generates different band patterns) Largest band corresponds to the sickle cell / mutant allele while two smaller bands corresponds to the normal allele [1]

Marking points:
- Sickle cell anaemia = (autosomal) recessive condition [1]
- Relate position of the band to normal and mutant allele on the gel / x-ray film and how it identifies the state of disease for the different individuals [1]

Feedback:
Since the apparatus and material list did not indicate whether PCR or Southern blot approach, you are free to use either one. Hence, the sequence of you planned experiment could either be:

DNA extraction → PCR → Restriction digestion → Agarose gel electrophoresis → DNA staining
Or
DNA extraction → Restriction digestion → Agarose gel electrophoresis (without DNA staining) Southern blot → Autoradiography

Additional information: If you are required to answer a question in the theory paper [*something like 2019 Prelim Paper 2 STQ 9a (i) and (ii)*]

Since the mother is assumed to be a **carrier**, she must be a **heterozygote**. Her DNA band pattern will consists of **3 bands**. The affected father (as shown in the pedigree tree) is **homozygous recessive** and will only have **1 (thicker) band (2 copies of the recessive mutant alleles).** The affected child is also **homozygous recessive**, and will also have a **single band** since he inherited **1 recessive allele from each parent**.

C. Pilot test (no mark)
Conduct a pilot experiment to determine suitability of apparatus, optimum conditions, and amount of materials to be used.

PROCEDURE

1) Extracting DNA from individuals

1. Centrifuge the cells from the amniotic fluid and blood samples of the fetus and parents, respectively. Discard the supernatant.

2. Add DNA extraction buffer to lyse the cells in the microfuge tubes. [1 mark]

3. Centrifuge the microfuge and transfer the supernatant containing DNA is transferred to new microfuge tubes. [1 mark]

Approach A using PCR method –

4. The purified DNA are subjected to polymerase chain reaction (PCR) to amplify a particular region of the DNA/gene [1 mark] using *Taq* polymerase, appropriate forward and reverse DNA primers, and free DNA nucleotides [1 mark]

PCR step / cycle (30 cycles)	Temperature / °C	Duration / s
Denaturation	95	60
Annealing	50	60
Extension	72	60

[1 mark]

5. 1µl DdeI is used to digest the 10µl *amplified* DNA (PCR product) from the different individuals at 37°C for 1h. [1 mark]

6. Prepare 1% agarose gel. Add 1µl of loading dye/buffer to the 10µl of the digested DNA / restriction fragments and load into the different wells of the gel. [1 mark]

7. Carry out gel electrophoresis to separate the DNA fragments.
Negatively charged DNA fragments will migrate toward the positive electrode under an electric field. Smaller sized fragments migrate faster than larger fragments. [1 mark]

8. At the end of electrophoresis, stain the agarose gel with a DNA staining agent / ethidium bromide and view under UV light. [1 mark]

Approach B using Southern blot method –

4. 1µl DdeI is used to digest 10µl of *extracted* DNA from the different individuals at 37°C for 1h. [1 mark]

5. Prepare 1% agarose gel. Add 1µl of loading dye to the 10µl of the digested DNA / restriction fragments and load into the different wells of the gel. [1 mark]

6. Carry out gel electrophoresis to separate the DNA fragments.
Negatively charged DNA fragments will migrate toward the positive electrode under an electric field. Smaller sized fragments migrate faster than larger fragments. [1 mark]

7. At the end of electrophoresis, place a nitrocellulose membrane over the agarose gel to transfer the (separated) DNA fragments from the gel to the membrane. [1 mark]

8. Place the above set-up to a new container containing alkaline solution / NaOH. Use a wick or paper towels to transfer the NaOH solution from the container to the agarose gel. NaOH will help to transfer the DNA fragments from the agarose gel to the nitrocellulose membrane and to denature the DNA to make them single-stranded. [1 mark]

9. After immobilizing the (single-stranded) DNA fragments in the nitrocellulose membrane in a 80°C oven, place the nitrocellulose membrane in another container containing radioactive DNA probe to detect the DNA fragments of interest. [1 mark]

10. After washing excess unbound probes, carry out autoradiography / expose the nitrocellulose membrane to an x-ray film The DNA band pattern of different individuals should be shown on the x-ray film. [1 mark]

Risks and Precautions [1 mark]

Any one

Point 1-2: Only for PCR approach

1. **Ethidium bromide is carcinogenic. Wear gloves when you handle the chemical.**
2. **UV light is harmful. Wear appropriate safety glasses or stand behind an appropriate transparent shield when viewing the agarose gel.**

Point 3: Only for S blotting approach

3. **Direct exposure to radioactive probes are harmful to the body. Handle the chemical behind a protective screen.**

Point 4: Either approach

4. **One may be electrocuted when handing the electric points (e.g. turning on the electric switch or connecting the electrical cables). Ensure that your hands and the areas around the electric points are not wet.**

3 **S1** is a slide of a stained transverse section through a plant root.

You are not expected to be familiar with this specimen.

You are required to use a sharp pencil for drawings.

(a) **(i)** Using a **40X** objective lens, draw a large plan diagram of the central region of the root **S1**. Your plan drawing should include the different tissues found in **S1**.

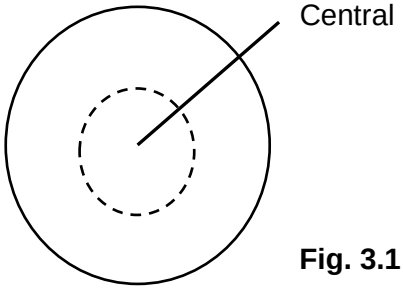
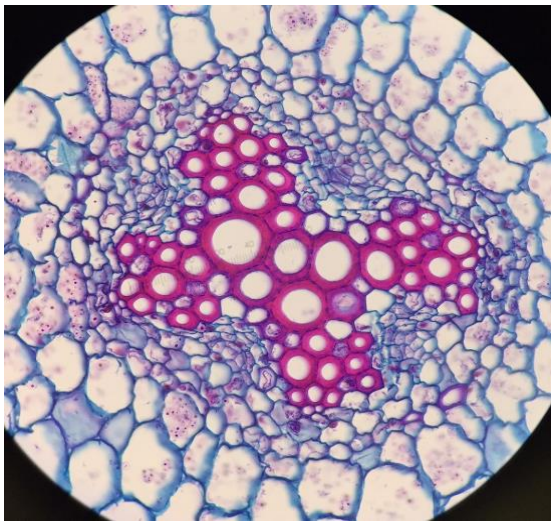
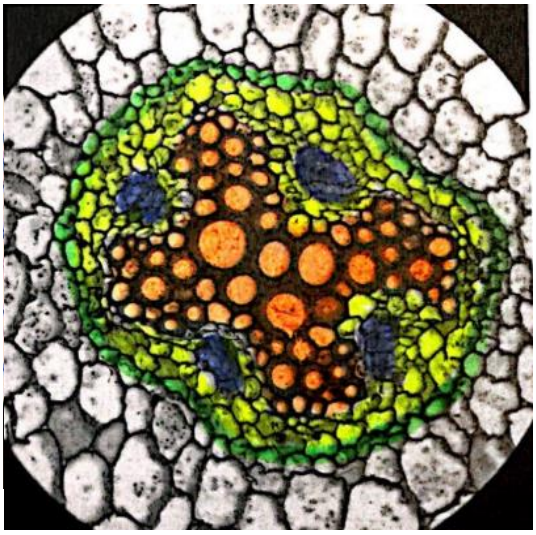
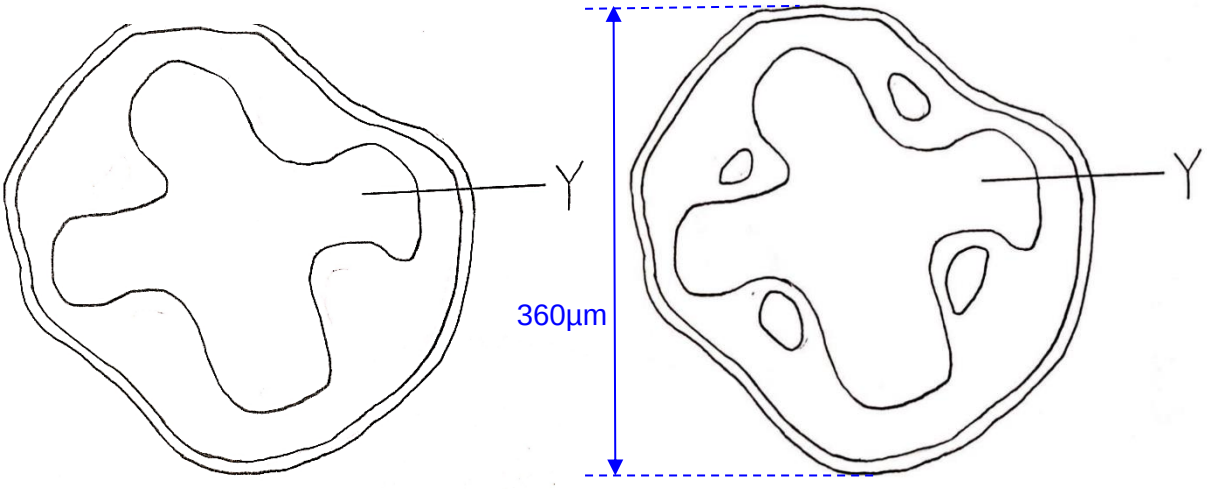


Fig. 3.1

You are expected to draw the correct shape and proportions of the different tissue. On your drawing, label with the letter **Y**, the region containing structures that transport water. Your drawing should also include an appropriate title.







Plan drawing of the central region of the root S1 viewed under 40X objective lens

[5]

1. **D: Clear plan drawing with sharp, clear and unbroken lines;**
   Do not award marks if the following observed:
   - Shading
   - Ruled lines
   - Overlapping lines
   - 'Feathery' lines
   - Less than 7 cm across length of drawing

2. **TS: 3 to 4 types of tissues drawn in correct proportion (central region – xylem, phloem, endodermis; see examples)**
   - No cells drawn
   - Guideline: (i) endodermis represented by double line (thickness about 2-3% of the total diameter of drawing) (ii) xylem tissue represented by X-shaped (occupy > 50% of total area drawn, range ~ 60-80%)

3. **L: Correct label (Y) pointing to X shaped structure (xylem vessels)**
4. **S: Size of the drawing > 7cm across diameter**
5. **T: Title including mention of the use of or viewed under *"40X objective lens or 400X magnification"***

(ii) Using the **S1** given and your drawing in **(i)**, calculate the magnification of your drawing.

You may lose marks if you do not show clear working.

Example:

Length of line on drawing = 7.3 cm = 73 mm = 73 000 µm
Actual length of line = 360 µm

Magnification of drawing = Actual length / drawing length = **73 000 µm / 360 µm** = 45.7 or 202.777 = 203X (rounded up to nearest whole number)

Magnification = ……**203 X**…

Reminder to self:

1. I should invest in a good mechanical pencil and a good **eraser**
2. I must remember to indicate the **actual** dimension (in **µm**) of the specimen against the corresponding part of my biological drawing because my assessor has no access to the exact specimen slide I used when he/she needs to check my calculation in deriving the magnification of my drawing.
3. It will be easier to convert both actual and drawing lengths to **µm** instead of cm^{-4} during my calculation.
4. When I go through this prelim paper, I should also go through the recent **Mock 2** practical answer.

[2]

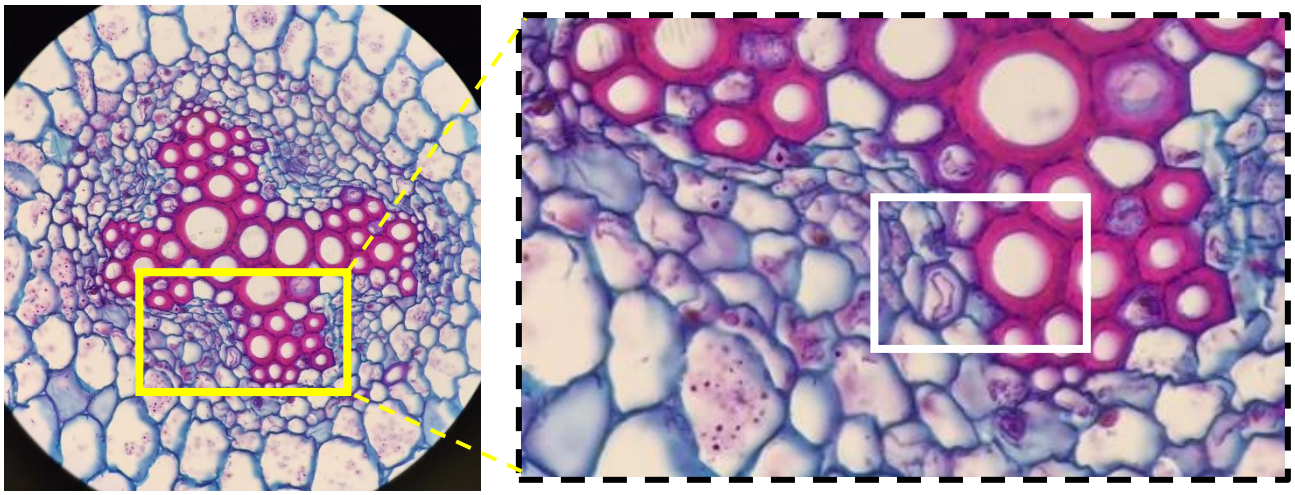
1. **Line in plan drawing + actual dimension in µm**
2. **Division of drawing size by actual size and magnification given;**

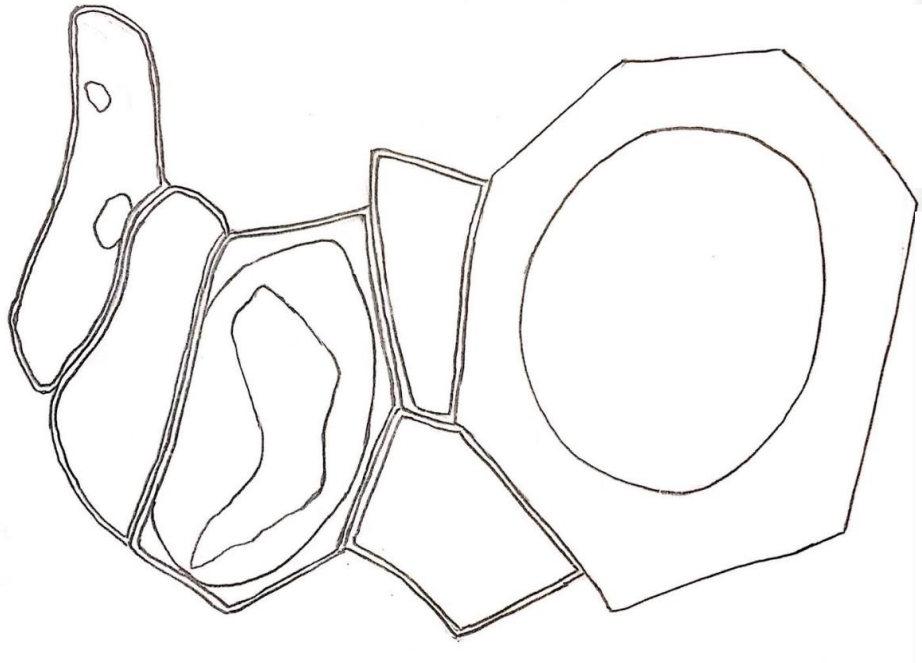
(b) Observe the central tissue in the root of **S1**. The cells in the central tissue are not identical.

Select one group of adjacent cells that belong to different tissues.

Make a large drawing of this group of cells using the **40X** objective lens to show the differences between these cells.

Use **one** ruled label line and label to identify the cell wall of **one** cell. Other labels are **not** required. Your drawing should also include an appropriate title.





Drawing of 6 adjacent cells from different tissues under 40X objective lens

1. D: Clear drawing with sharp, clear and unbroken lines;

Do not award marks if the following observed:

- Shading
- Ruled lines
- Overlapping lines / 'breaks' in cells
- 'Feathery' lines
- If cell walls are drawn as 2 lines, the 2 lines must not be fused to each other

2. **AC: At least 3 adjacent cells from 2 different tissues are drawn**
   - Walls must touch each other; do not award marks if there is a gap / space between any 2 adjacent cells

3. **XY: Accuracy of drawing – e.g. xylem vessel cell with (i) thick walls with corners (ii) empty lumen (not more than 5 times the thickness of the wall)**
   - Must be at least 4 cm for the largest cell

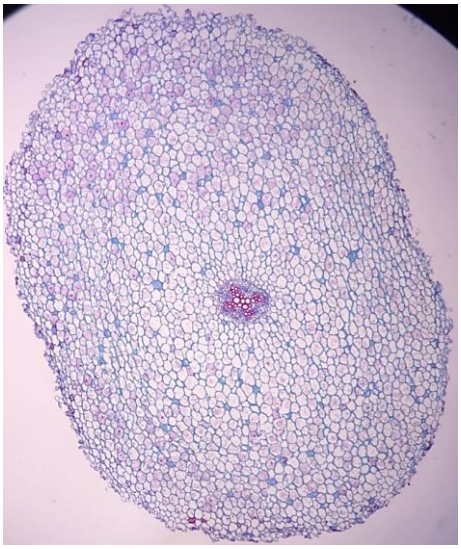
4. **L: Cell wall labelled correctly**

5. **T: Title – description includes objective lens (40X) or magnification (400X)**

[5]

(c) **Fig. 3.2** is a photomicrograph of a stained transverse section through the root of a different type of plant.

You are not expected to be familiar with this specimen.



S1

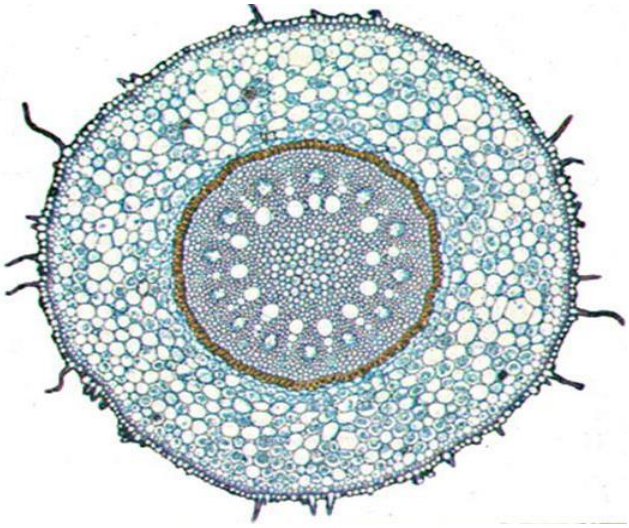


Fig. 3.2

There are observable differences between the root shown in **Fig. 3.2** and the root shown in **S1**. Identify **two** differences between the roots.

For each difference, draw one label line to a feature in **Fig. 3.2** that shows this difference. Label as two features **A** and **B**.

Complete **Table 3.1** to describe the differences between the roots of the two types of plants.

Table 3.1 Any 2:

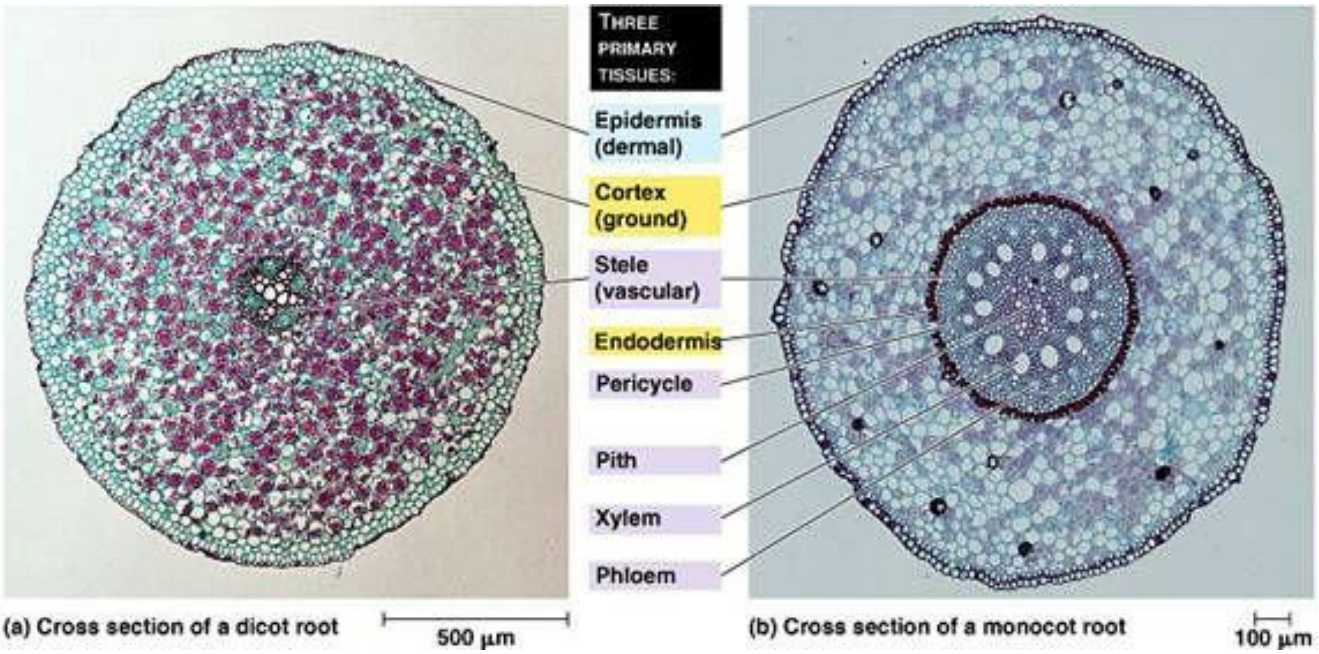
Feature	S1	Fig. 3.2
A	**1. Central region relative to root cross section is smaller** (R: "root is larger" as the photos are not shown to scale)	**Central region relative to root cross section is larger**
B	**2. Fewer xylem vessels**	**More xylem vessels**
	3. Xylem vessels arranged in an X-shape pattern	**Xylem vessels arranged in a ring**
	4. Root hair absent	**Root hair present**

[2]

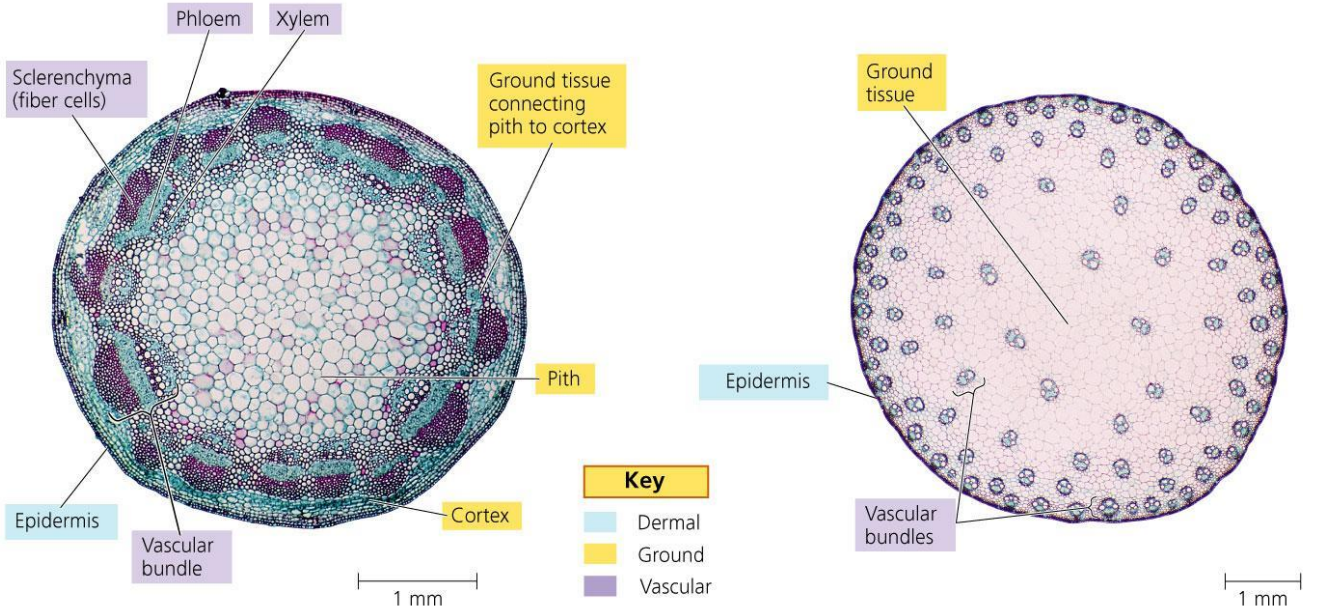
End of Paper

Additional info:

Dicot root vs Monocot root



Dicot vs Monocot stem (Bio Mock 2 exam)



(a) A eudicot (sunflower) stem. Vascular bundles form a ring. Ground tissue toward the inside is called pith, and ground tissue toward the outside is called cortex. (LM of transverse section)

(b) A monocot (maize) stem. Vascular bundles are scattered throughout the ground tissue. In such an arrangement, ground tissue is not partitioned into pith and cortex. (LM of transverse section)

To practice: Bar Chart

In addition to the usual guidelines to graph plotting and drawing, please note the following for bar chart -

- Relevant labels for the axes and bars
- Bars separated by a suitable gap

Source: 2017 Paper 4 Q1 (step 7b)

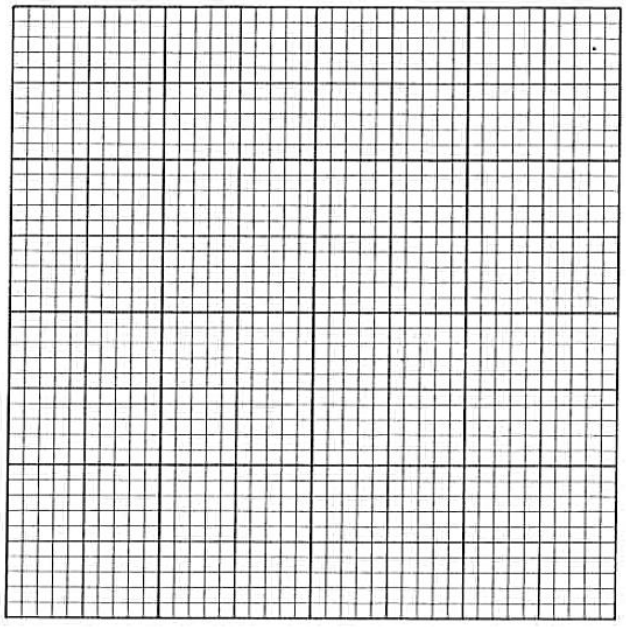
(b) Some students studied the effect of sucrose and other carbohydrates on the rate of respiration of yeast cells, using a different method. All conditions in the experiments, other than the type of carbohydrate, were kept the same, including the starting concentration of the different carbohydrates.

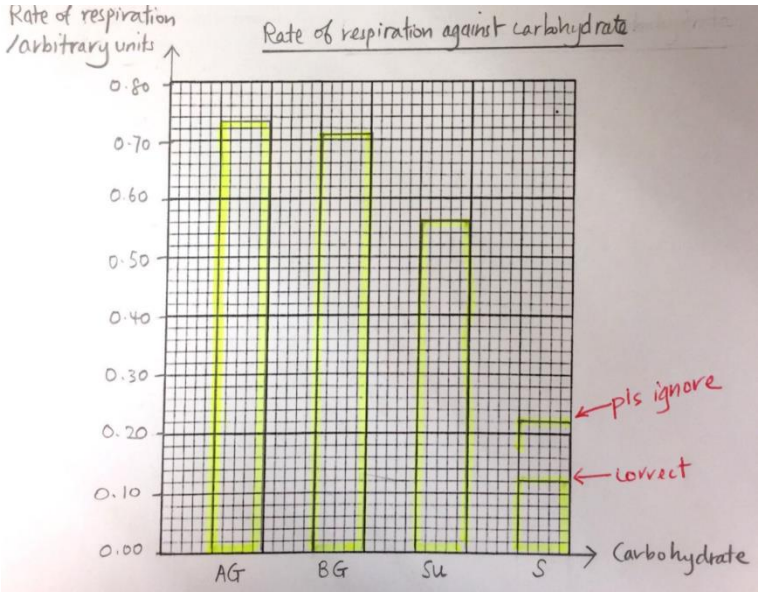
The students' results are shown in Table 1.1.

Table 1.1

carbohydrate	rate of respiration /arbitrary units
α-glucose (AG)	0.73
β-glucose (BG)	0.71
sucrose (Su)	0.56
starch (S)	0.12

(i) Use the grid to display the results shown in Table 1.1 in an appropriate form.





(b) Some students studied the effect of sucrose and other carbohydrates on the rate of respiration of yeast cells, using a different method. All conditions in the experiments, other than the type of carbohydrate, were kept the same, including the starting concentration of the different carbohydrates.

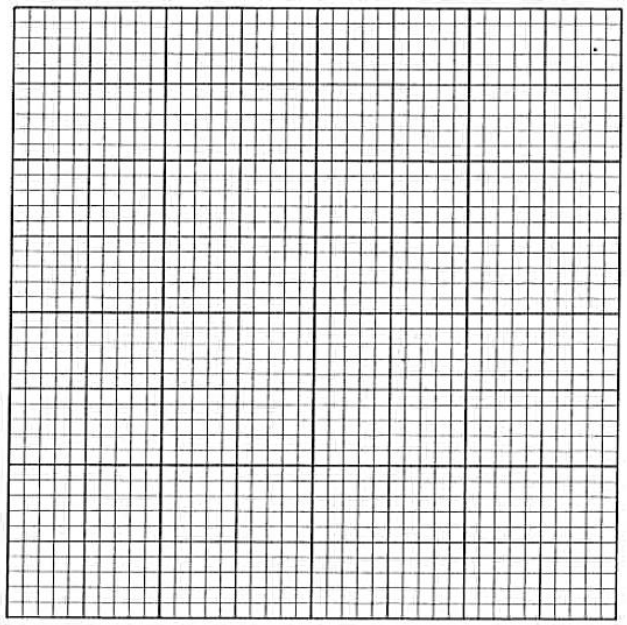
The students' results are shown in Table 1.1.

Extension: Let's assume that another yeast cells suspension was removed and heat-treated before the various carbohydrates were added to each sample.

Table 1.1

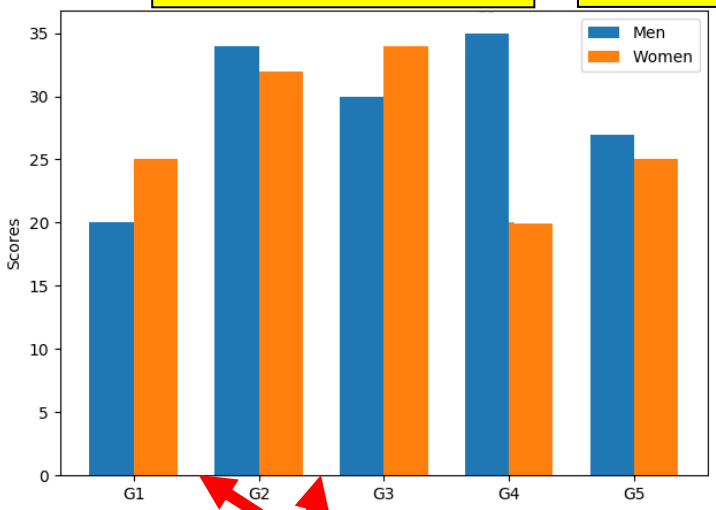
carbohydrate	rate of respiration /arbitrary units	
α-glucose (AG)	0.73	**0.08**
β-glucose (BG)	0.71	**0.11**
sucrose (Su)	0.56	**0.09**
starch (S)	0.12	**0.10**

(i) Use the grid to display the results shown in Table 1.1 in an appropriate form.



Example

Include a legend



2 adjacent bars (of a set) are of equal width

The width between adjacent bar sets need not be the same as the bar itself, but should be the same between them