HWA CHONG INSTITUTION (COLLEGE SECTION)
2023 JC2 9744 H2 BIOLOGY
PRELIMINARY EXAMINATIONS PAPER 4 MARK SCHEME

QUESTION 1

Part A

Observe and make brief notes of any differences between a leaf from plant **A** and a leaf from plant **B**.

leaf from plant A is green whereas leaf from plant B has patches of yellow

(a) State two differences between the chloroplasts from specimen **A** and specimen **B**. [2]

any two:

1 extract A has more chloroplasts

2 extract A has green chloroplasts but extract B has colourless / yellow chloroplasts

3 extract A has more developed chlorophyll than extract B

(b) Prepare the space below to record your results in an appropriate format so that you can compare extract **A** with extract **B**. Include the R_f value for each pigment calculated as instructed in step **21**. [4]

1 correct table headings without units

2 table layout that compares colour and R_f in the 2 extracts

3 correct observation of colour of pigments

4 location of pigments

(c) Label your chromatograms **A** and **B** and paste them in the space below using the sticky tapes provided. [1]

distance shown to solvent front and front of at least one pigment

(d)(i) Other than lack of replicates, suggest **one** source of error in this procedure and explain how it affects your results. [2]

one mark for each statement of the following pairs:

L1 location of the pigment position

E1 calculation of Rf value may be inaccurate

L2 extract may not have been concentrated enough

E2 not certain if all the pigments have been extracted

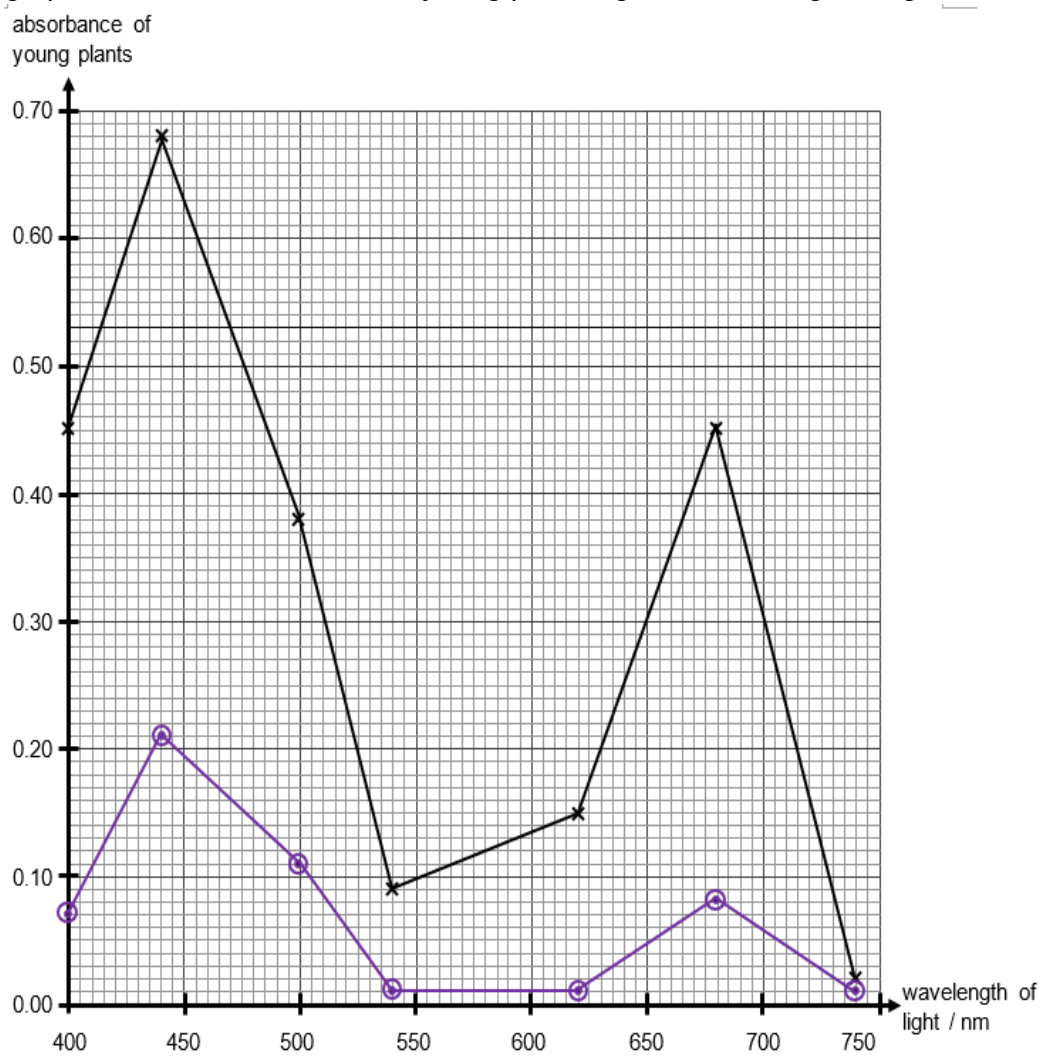
(d)(ii) Suggest an improvement that can be made to eliminate the error. [1]

any one:

1 use a longer piece of chromatography paper

2 use more leaves to make the extract

(e) Plot a graph of the absorbance for the young plants against wavelength of light. [3]



1 scale + correct axis orientation with appropriate labels & units
2 use of different symbols to represent each graph
3 all correct plots

(f) From the graph plotted, suggest what conclusions can be made about the number of pigments and about the concentration of pigments in the two sets of young plants. [2]

1 same number of pigments
2 leaf extract from plant A has a higher concentration of pigments

(g) Seedlings **A** and **B** were grown in different conditions.

(i) Based on all your observations and the experimental data available, suggest how the growing conditions were varied. [1]

seedling A is grown in light but seedling B is grown in the absence of light

(ii) Explain how the results from all your observations and the experimental data support this conclusion. [2]

1 leaf from plant A is green whereas leaf from plant B has patches of yellow
2 leaf extract A has more chloroplasts
3 leaf extract A has more pigments
4 leaf extract from plant A has a higher concentration of pigments

Part B

(h) Design an experiment to compare the **rates** of complete hydrolysis of **PT** by **EN** and **EX**. [9]

Variables: 1 mark

IV: type of enzyme

DV: rate of complete hydrolysis of protein determined by reciprocal of time taken for complete hydrolysis of protein

Scientific reasoning used to decide the method: 1 mark

any one:

S1 ref. to PT having six hydrolysis sites for EN versus two hydrolysis sites for EX, so EN and EX have different specific 3D conformation of active site, hence products of hydrolysis differ

S2 ref. to different products of hydrolysis have different solubility in solvent used in chromatography, resulting in different number of spots

Method: 4 marks

M1 CV control: contents of EN, EX and PT in the respective reaction mixtures

M2 CV control: equilibrate protein and enzyme solutions separately

M3 CV control: Mix EN / EX with protein + incubate in thermostatically controlled water bath + start stopwatch

M4 DV measurement: remove sample of reaction mixture using micropipette tips + at 5 min intervals + use chromatography paper and solvent

M5 DV measurement: locate products of hydrolysis on the chromatograms using a spray bottle containing a specific dye that stains proteins, peptides and amino acids

M6 DV measurement: obtain time taken when there is no more change in, results / chromatogram / spots

M7 Coherent description of a complete method (M1 to M5) that can be repeated by anyone reading it

Reliability and Control: 2 marks

any two:

R1 Reliability – Obtain replicates / repeats

R2 Reliability – Use a t-test to check if there is an significant difference in the data obtained

R3 Control – Describe a control by performing the same procedure but by replacing the enzymes with equal volume of distilled water

R4 Repeat the whole experiment using a narrower time intervals to more accurately determine the time taken for complete hydrolysis of the protein by each enzyme

Data Recording and Manipulation: 1 mark

any one

D1 Recording – Draw a table showing relationship between independent variable and raw data with appropriate column heading and units + calculate the rate of complete hydrolysis

D2 Data manipulation – plot bar graph showing type of protease (x-axis) and rate of protein hydrolysis (y-axis)

(i) State **and** explain whether each of these conclusions is supported **or** not supported by all of the information provided about these two enzymes, including the evidence in Fig. 1.2. [3]

conclusion 1: not supported, because different number of bonds are cut so cannot compare the enzymes

conclusion 2: not supported, because some products will be dipeptides

conclusion 3: supported, because the endoprotease gives the exoprotease more ‘ends’ to work on
OR
not supported, because there will be, more / different, dipeptides since endoprotease created new ‘ends’

[Total: 30]

QUESTION 2

(a)(i) State which objective lens you have decided to use and give a reason for your choice. [1]

1 low-power, more representative sample
2 high-power, more accurate count

(ii) Using the objective lens selected in **(a)(i)**, calculate the **mean** number of stomata per field of view for **L**. Show your working. [2]

1 at least 3 counts in whole numbers
2 correct calculation of mean

(iii) Focus the objective lens selected in **(a)(i)** on the stage micrometer provided. The stage micrometer is 10 mm long and has 100 divisions.

Calculate the area of the field of view and record this area in mm^2. Show your working. [3]

1 calculate length of one stage micrometer division
2 calculate radius of field of view in mm
3 correct calculation of area of field of view in mm^2

(iv) Using your results from **(a)(ii)** and **(a)(iii)**, calculate the mean stomatal density per mm^2 for **L**. [1]

correct calculation of mean stomatal density in mm^{-2}

(b)(i) Deduce a relationship between light intensity and stomatal density based on the results shown in Table 2.1. [1]

any valid relationship derived from results shown in Table 2.1

(ii) Using an appropriate pair of stomatal densities, justify your answer in **(b)(i)**. [2]

any valid pair of stomatal densities calculated from results shown in Table 2.1

(iii) Calculate the value of *t* for the mean stomatal density.

Show your working. [2]

$t_{calculated} = 6.57$

(iv) Using your result from **(b)(iii)** and Table 2.3, comment on what the scientists' results in Table 2.2 show and suggest an explanation for any pattern. [4]

1 ref to correct degree of freedom and critical *t* value
2 ref to comparison of calculated and critical *t* value, and correct corresponding conclusion
3 ref to difference caused by exposure to different light intensities
4 ref to any valid explanation for difference

(c)(i) Use the microscope to observe the different tissues in the root on **N1**.

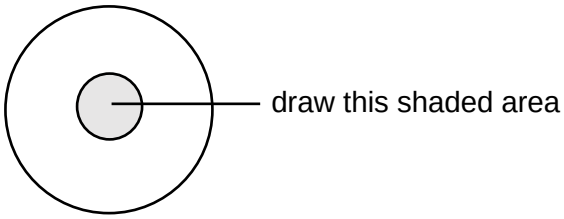
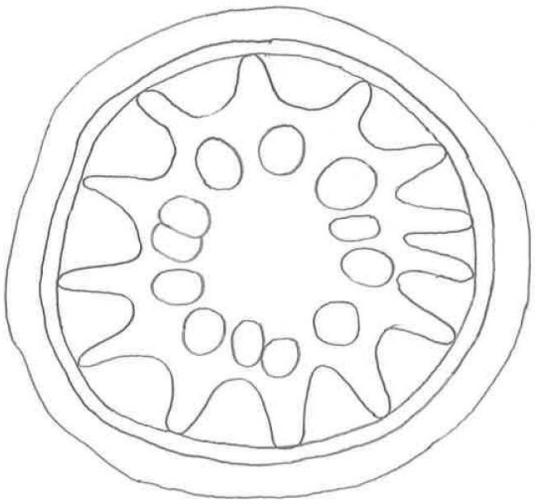


Fig. 2.2

Draw a large plan diagram of the shaded area of the root on **N1** shown in Fig. 2.2. This shaded area contains the vascular system.
A plan drawing shows the arrangement of different tissues. Your drawing should show the correct shapes and proportions of the different tissues.
No cells shown be drawn. [4]



MP1 correct section drawn with no cells

MP2 correct size of plan drawing

MP3 correct arrangement of tissues
MP4 correct shape and proportion

(ii) Observe the cells in the endodermis (outermost layer of the shaded area) of the root on **N1** shown in Fig. 2.3.

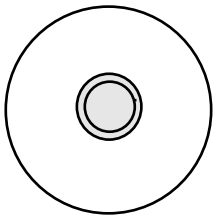


Fig. 2.3

Select **one** group of two adjacent endodermal cells and two other adjacent cells just outside the shaded area.
Each cell must touch at least two of the other cells.
Make a large drawing of this group of **four** cells. [3]

MP1 cells with cell wall drawn
MP2 correct arrangement of the four cells
MP3 correct shape and proportion

(iii) Fig. 2.4 is a photomicrograph of a stained transverse section through a different root.

Observe the photomicrograph in Fig. 2.4 and the section on **N1** to identify differences between them.

Complete Fig. 2.4 by:

- identifying **and** annotating **two** differences between the photomicrograph in Fig. 2.4 and the section on **N1**
- using a label line to identify the feature that is different. [2]

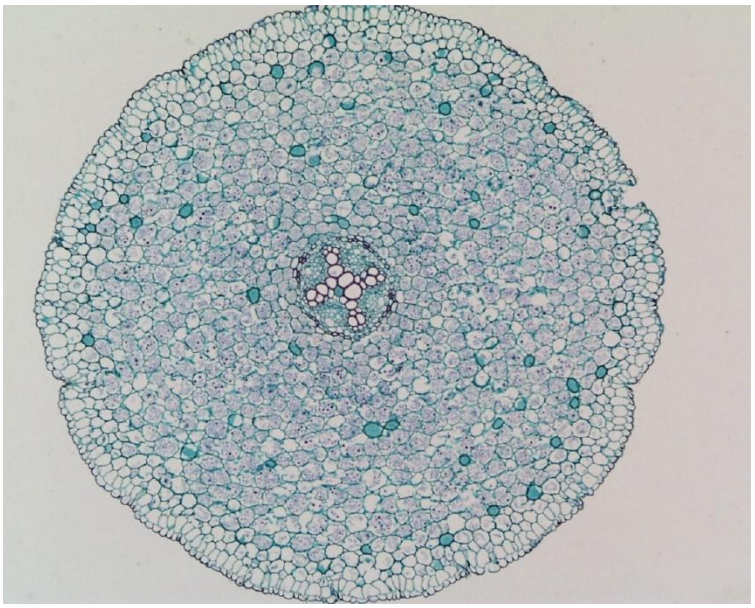


Fig. 2.4

1 ref to difference of endodermal layer
2 ref to difference in arrangement of vascular bundles

[Total: 25]