Question 1

(a) (i) State your observations of the sides of the test-tube. [1]

Ref. to white clumps / precipitate / solid (particles / substance) observed on the inner side of the test tube due to coagulation of milk ;

(a) (ii) State how your observations from addition of **E** differ from your answer in **(a)(i)**. [1]

Less / smaller white clumps formed in **E** compared to H

(a) (iii) Based on your observations in (ii), state whether H or E is more effective as a milk coagulant. [1]

H;

(a) (iv) Confidence in the results of this investigation may be limited by lack of replication and sources of error.

Describe **two** other significant sources of error in this procedure. [2]

- Ref. to subjectivity of determining first appearance of white precipitate ;
- Ref. to differences in rotating speed / number of rounds of rotation not standardised ;
- Ref. to not standardising the speed/ rate at which the plunger of the syringe is released to expel the solution into the test tube ;
- Temperature may not have been at the optimum temperature for rennin ;
- AVP;

(a) (v) Suggest how you could make **two** improvements to the procedure so that a more accurate estimate of the relative effectiveness on coagulation could be obtained. [2]

Any 2:

- Filter the coagulant and weigh the mass of coagulant after dying in oven overnight / decant to observe precipitate more clearly ;
- Use more milk so that there is more fat and protein to coagulate into a more visible clot ;
- Carry out experiment at optimum temperature of rennin using thermometer and thermostatically controlled water bath ;
- Use of mechanical rotator / mixer / magnetic stirrer ;
- Use of stopwatch to standardise duration of pressing syringe ;
- AVP ;

(b)(i) Use the information provided to plan a method that you can use to determine if **PE** coagulates milk by its acidity or by the presence of coagulating enzymes such as rennin. Do not plan to carry out repeats. You will carry out this method in step **9**. [5]

- Describes a method to manipulate independent variable (IV);
  e.g. prepare two samples of PE, each 2cm^3, but one has been boiled for 5 mins and allow to cool for 10 mins, i.e. with (unboiled) and without enzyme (boiled)

- Describes a method to determine dependent variable (DV);
  e.g. using a stopwatch, observe and record the time taken for coagulation to occur for up to 120 seconds

- Ref. to at least 2 suitable method used to control the control variables;
  e.g. use a 5cm^3 syringe to add 5 cm^3 of M into a clean test tube
  e.g. setting up a boiling water bath, and use of thermometer to ensure that it is boiling ;

- Determines whether coagulation is by enzyme and not acid;
  e.g. compare the time taken for first appearance of coagulation for the tube containing PE, and, boiled and cooled PE

- Ref to risk assessment and safety precaution ;
  e.g. Wear thermal gloves / safety goggles when taking test tubes in/out of boiling water bath to prevent scalding/burning of hands/ eyes by boiling water ;

(b)(ii) Use the space provided to record your results in a suitable format. [3]

coagulant / solution that was added to milk	time taken for coagulation to occur / s
(unboiled) **PE**	30
Boiled and cooled **PE**	90 (A: >120)

- Correct column headings with units;
  IV: coagulant / solution added to milk
  DV: time taken for coagulation / first appearance of white precipitate (in seconds)
- Time taken recorded to whole number of seconds ;
- Correct trend (increased time taken for boiled and cooled PE) ;

(b)(iii) Based on your results, state and explain whether the coagulative properties of pineapple is due to acidity, enzymes or both.

Give a reason for your answer. [4]

- Both acid and enzymes;
- In boiled and cooled PE, enzymes were denatured (ref. to loss of 3D conf of active site)
- However, coagulation still occurs due to acid present in PE ;
- Accurate quoting of student's data ;

OR

- Only enzymes (if no coagulation is observed >120s)
- In boiled and cooled PE, enzymes were denatured (ref. to loss of 3D conf of active site)
- Coagulation no longer occurs because no acid;
- Accurate quoting of student's data ;

(b)(iv) State an assumption that needs to be made in order for your conclusion to be valid. [1]

- The enzyme rennin must denature when boiled and cooled at 100 degrees celsius for 10 minutes ;

[Total: 20]

QUESTION 2

(a) (i) State **and** explain a hypothesis that could be used to predict the results of testing these two samples. [2]

- The test-tube with the type of sugar substrate, that is more easily broken down / hydrolysed by starter culture / yeast and bacteria ;
- will have darker pink colouration when TTC is added, and has a higher rate of respiration ;

(a) (ii) Record your results in the space below. [2]

Type of sugar	Intensity of colour
C1	3 / 4
C2	0

1. Correct column headings (no units);
   IV: type of sugar (**C1**, **C2**)
   DV: intensity of colour
2. Correct trend, **C1** > **C2** ;

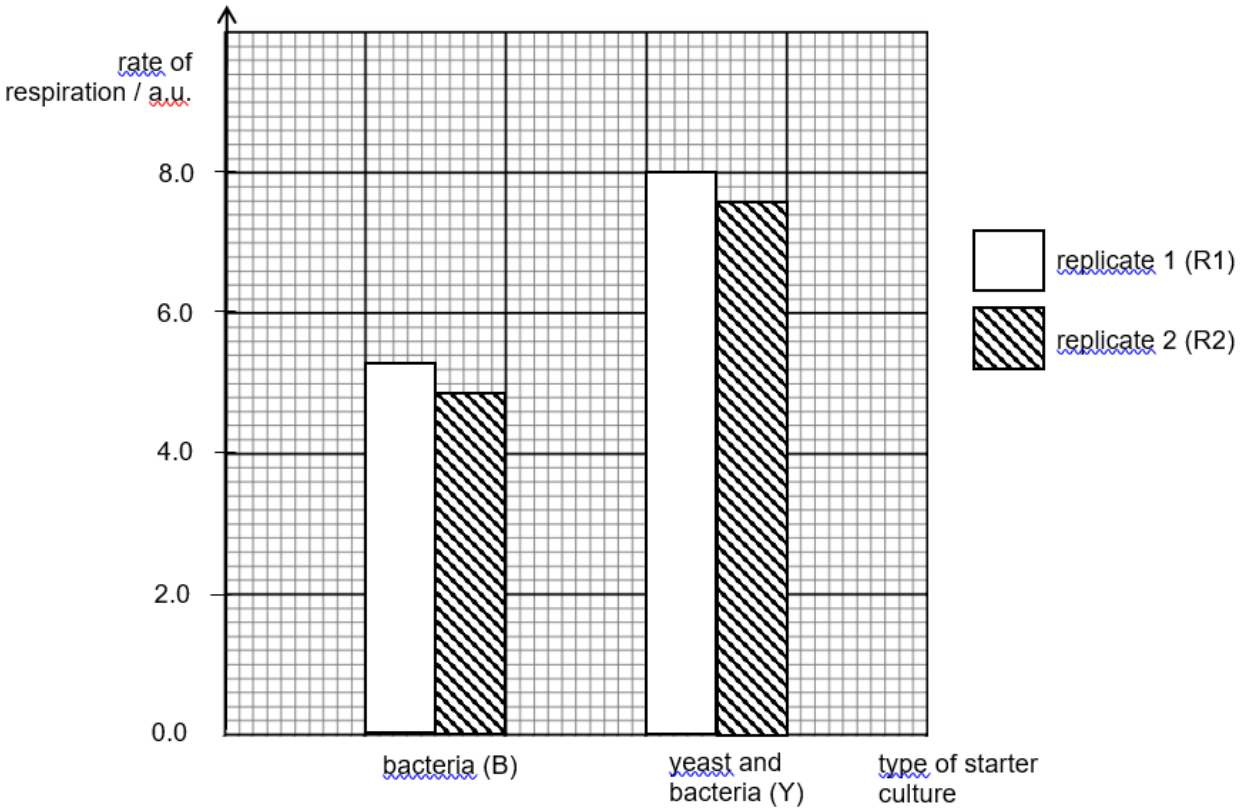
(a) (iii) Identify and explain whether **C1** or **C2** is more likely to be maltose. [2]

- **C1**;
- Higher intensity of colour observed as maltose is a disaccharide, and has two glucose per molecule / twice the amount of glucose ;

OR

- **C2**;
- Higher intensity of colour observed as yeast and bacteria contain enzymes for breaking down glucose but not maltose ;

(b) (i) Use the grid provided to display the results in Table 2.2. [4]



- Correct axis labels + correct units ;
  x-axis: type of sugar
  y-axis: rate of respiration / a.u.
- Graph occupying at 50% on the area of the total grid + no odd scales ;
- Bars are plotted accurately to half of a smallest square + bars of replicates for each culture side-by-side + gap present between two different starter cultures ;
- Appropriate legend to differentiate bars for **R1** and **R2** ;

(b) (ii) State what the standard deviation shows about the results of this investigation. [1]

s shows the spread of data about the mean, the smaller the *s* value implies that the sample mean is more likely a representative of the true mean / results are more reliable ;

(b) (iii) Calculate the value of *t* and the number of degrees of freedom, using these formulae. [2]

- t = 10.8 (3.s.f) + working shown ;
- v = 15 + 15 – 2 = 28 ;

(b) (iv) The critical value of *t* at the 5% level of significance is 2.05.

Explain whether the results of this t-test can help the student determine which starter culture is better for cheese making. [2]

- t calculated value of 10.8, is greater than the t critical value of 2.05 at a 5 % level of significance ;
- there is less than 5% possibility that the difference in the rates of respiration occurs due to chance, the starter culture **Y** is significantly more effective than starter culture **B** at cheese making **;**

[Total: 15]

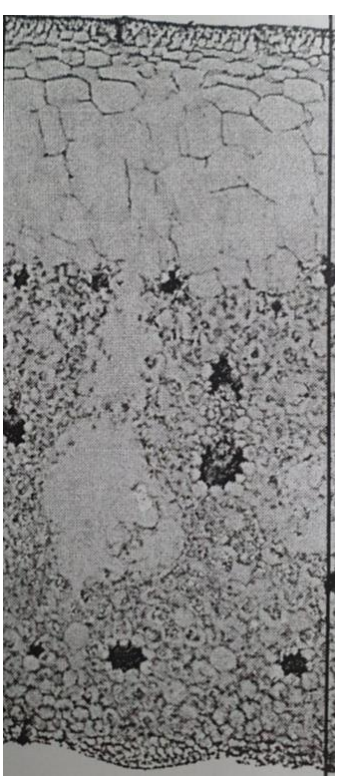
QUESTION 3

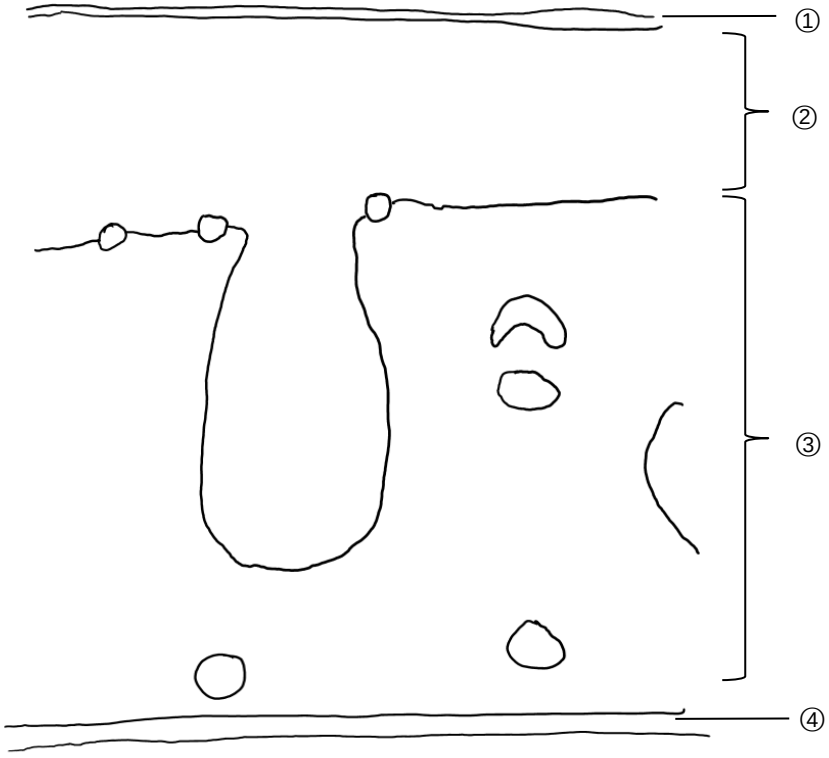
(a) (i) Draw a plan diagram of the region of the leaf indicated between the lines on Fig. 3.1.

A plan diagram shows the arrangement of different tissues. Your drawing should show the correct shapes and proportions of different tissues.

No cells should be drawn.

Labels are **not** required. [4]





PDO

- No cells + clear continuous lines ;
- Correct size of plan drawing + no labels ;

MMO

- Correct arrangement of tissues to include four layers (1- upper epidermis, 2- hypodermis, 3- mesophyll layer, 4- lower epidermis) + correct proportion of the layers of tissues (hypodermis thicker than epidermis + thinner than mesophyll layer) ;
- Correct shape of large air space and vascular bundles (at least 3 circles/ ovals representing vascular bundles) ;

(a) (ii) You can assume that the actual length of the bar in Fig. 3.1 is 200 μm.
Use this information to calculate the magnification of your drawing in **(a)(i)**.

Show all the steps in your calculation, including the appropriate units. [2]

- Determine actual length of sample;
- Correct conversion to same unit as length of scale bar (μm) + calculation of magnification in whole number;

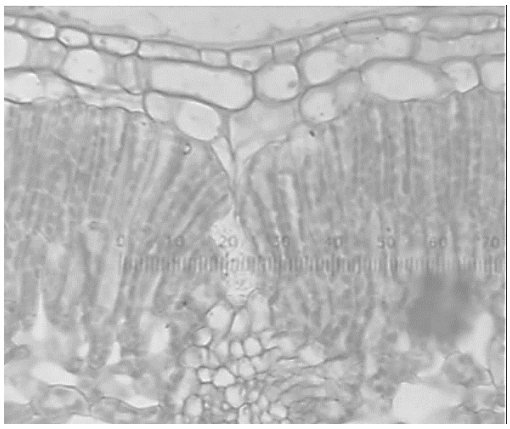
Worked example:

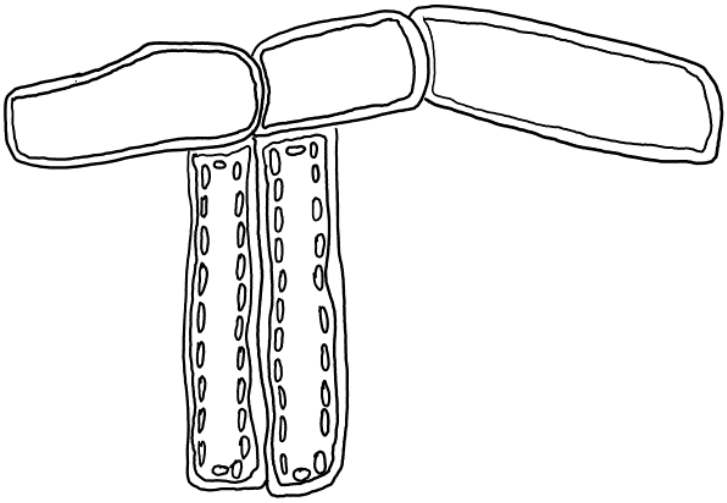
MP1:
Length scale bar in Fig 3.1 = 1.2 = 12mm
Thickness of section in Fig 3.1 = 8.4cm = 84mm
or Width of section in Fig 3.1 = 3.8cm= 38mm
Actual thickness of sample = 84mm/ 12mm x 200μm = 1400μm ;
OR Actual width of sample = 38mm/12mm x 200μm = 633μm ;

MP2:
Thickness of drawing = 100mm
Magnification = thickness of drawing /actual thickness of sample
= 100 x 10^3μm / 1400μm
= 100,000μm / 1400μm
= 71X ; (present answer as whole number)
Note: All working to be shown explicitly.

(b) (i) Select a group of two palisade mesophyll cells and three cells above it.
Each cell of the group must touch at least one of the other cells.

Make a large drawing of this group of **five** cells. [4]





PDO

- Clear continuous lines + no shading + cell walls shown as double lines (i.e. two lines around each cell and three lines where cells touch) ;
- Correct size of detailed drawing (at least 50% of space);

MMO

- Correct arrangement of five cells: two palisade mesophyll cells and 3 other cells in the layer above + each cell touching one other cell + no intercellular space between cells
- Correct proportion (palisade mesophyll length is at least twice that of hypodermal cell + length of palisade mesophyll cell is three times that of width) + shape of cells (nucleus/chloroplast in palisade mesophyll cells);

(b) (ii) There are numerous hair-like projections in region **X** of Fig. 3.2. Using the eyepiece graticule fitted in the eyepiece lens of your microscope, and the stage micrometer, find the actual length, in μm, of a single hair-like projection.

Show all the steps in your calculation, including the appropriate units. [2]

- Determine length of 1 eyepiece graticule division;
- Calculation of actual length of hair-like projection in μm;

Worked example
MP1:
At 400X magnification
100 eyepiece graticule divisions *= 25 stage micrometer divisions*
= 25 ×0.1 mm = 0.25 mm
= 250 μm
1 eyepiece graticule division *= 250 ÷100*
= 2.5μm ; (A: 10μm for 100X magnification)
MP2:
Length of hair-like projection *= 20 eyepiece graticule division (A: 5-50 at 400X)*
Actual length of hair-like projection *= 20 x 2.5μm*
= 50 μm;
Note: All workings to be shown explicitly.

(b) (iii) Suggest a possible function of these hair-like projections. [1]

- Protection against water loss by preventing excess transpiration ;
- Protection against pests ;
- AVP;

(b) (iv) Identify **two** observable differences between the leaf in Fig 3.1 and the leaf on **L1**. [2]

	Fig 3.1	**L1**
1	Absence of hair-like projections / trichomes	Presence of hair-like projections / trichomes;
2	Absence of distinct palisade mesophyll layer	Presence of distinct palisade mesophyll layer;
3	Absence of distinct spongy mesophyll layer	Presence of distinct spongy mesophyll layer;
AVP	Absence of (sunken) stomata Absence of cuticle	Presence of (sunken) stomata /AW; Presence of cuticle;

(c) (i) Explain the effect of ripening on the sugar-acid ratio of pineapples. [2]

- Quote sugar-acid ratio of Smooth Cayenne and MD2 increase as the plant ripens ;
  e.g Sugar-acid ratio of smooth cayenne increases from 19.8 to 27.8 while MD2 increased from 46.8 to 90.0

- Ref to ripening increasing amount of sugar/ decreasing amount of acid in acid in ripe pineapples as they ripen ;

(c) (ii) State one variable which would need to be controlled to obtain reliable results in this investigation. [1]

Any one:

- Equal mass of sample studied ; A: volume / number of pineapple
- Pineapples compared must be of same stage of ripening /AW ;
- Sample taken from same region of the fruit /AW;
- Ref to same developmental conditions (Temperature/ sunlight/ etc);
- AVP ;

Comment: This section was generally well answered.

(c)(iii) The researcher wishes to conclude that the mean sugar-acid ratio of MD2 appears to be higher than that of Smooth Cayenne at every stage of ripening.

Suggest why this conclusion may not be valid. [2]

- Ref to no standard deviation/ error bars / AW ;
- Hence, difference in sugar-acid ratios of Smooth Cayenne and MD2 may not be statistically significant / no significant difference ;
- Lack of replicates / repeats /small sample size;
- AVP ;

[Total: 20]