Pearson Edexcel

Additional Assessment Materials
Summer 2021

Pearson Edexcel GCE in AS/A Level Biology

Maths Skills – Paper 3

(Public release version)

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Additional Assessment Materials, Summer 2021

General guidance to Additional Assessment Materials for use in 2021

Context

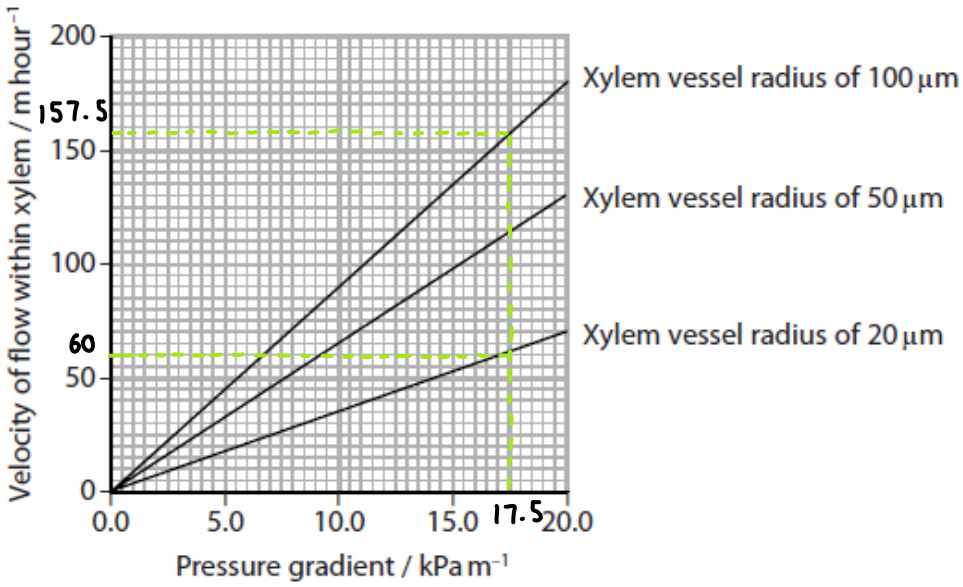
- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

1

The graph shows the effect of pressure gradient on the velocity of flow within three xylem vessels.



(ii) Calculate the percentage increase in the velocity of water flowing through a xylem vessel of radius 20 µm and a xylem vessel of radius 100 µm, at a pressure gradient of 17.5 kPa m^{-1}.

(2)

$\frac{157.5 - 60}{60} \times 100 = 162.5\%$

Answer 162.5 %

2

A scientist studied the growth of *Salmonella*.

(ii) The scientist made a broth culture of *Salmonella* at a concentration of 5×10^3 cells per cm^3.

Ten hours later the concentration of *Salmonella* was 4×10^6 per cm^3.

Calculate the exponential growth rate constant (k) for this culture of *Salmonella* using the formula

(3)

$$k = \frac{\log_{10}N_t - \log_{10}N_0}{0.301 \times t}$$

$$\frac{6.602\ldots - 3.698\ldots}{0.301 \times 10} = 0.9644\ldots$$

Answer 0.96 (2.s.f)

(iii) In this calculation, the scientist did not allow for the time that the *Salmonella* spent in the lag phase.

Explain the effect that this will have on the calculated value for the growth rate constant.

(3)

The value for t used in the calculated value is greater than the actual value. Therefore, the calculated value for k will be smaller. The Salmonella will not be replicating in the lag phase.

3

Soya beans are an important crop for the production of food and oil.

(a) In the 2012 to 2013 growing season, production of soya beans was highest in the United States and second highest in Brazil.

The United States produced 93 million tonnes of soya beans from 31 million hectares.

This was 9.4% more than Brazil produced from 28 million hectares.

Calculate the difference in the yield per hectare of soya beans from these two countries.

(3)

$\frac{93\text{m} \times 100}{109.4} = 85.009\ldots\text{m}$

$\frac{93}{31} = 3$ tonnes per hectare

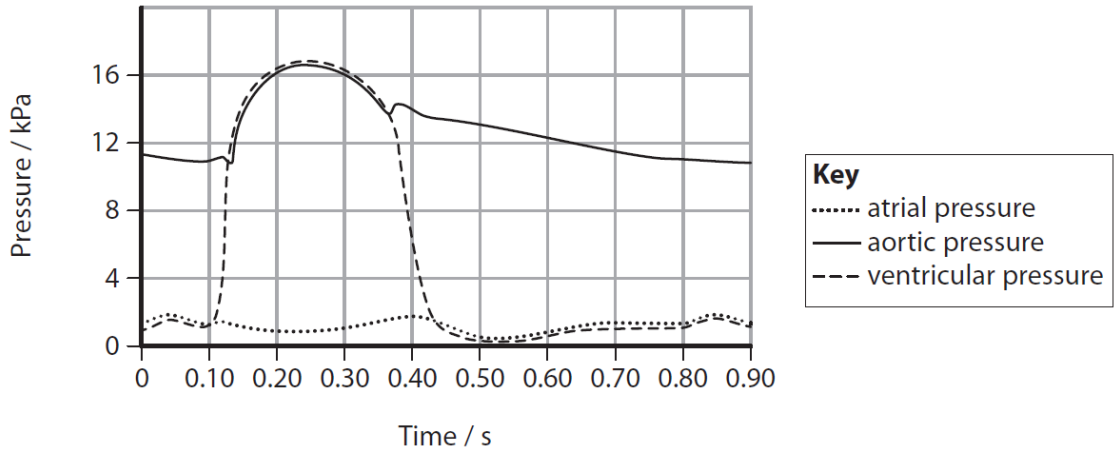
$\frac{85.009\ldots}{28} = 3.03\ldots$ tonnes per hectare

$3.03\ldots - 3 = 0.04$ (2.dp)

Answer 0.04 tonnes

4

The graph shows the pressure changes in the left side of the heart during one cardiac cycle.



(a) (i) Calculate the heart rate.

(1)

$\frac{60}{0.8} = 75$ beats per minute

Answer 75

5

Down's syndrome in humans is caused by non-disjunction.

The chance of having a baby with Down's syndrome increases as the age of the mother increases.

At age 40, the probability of having a baby with Down's syndrome is 0.018.

In 2016 the number of women aged 40 in the UK was estimated to be 500 000.

The pregnancy rate for women in the UK aged 40 is 14 pregnancies per 1000 women per year.

Calculate the number of babies with Down's syndrome that were expected in 2016 in the UK.

(2)

$14 \times 500 = 7000$

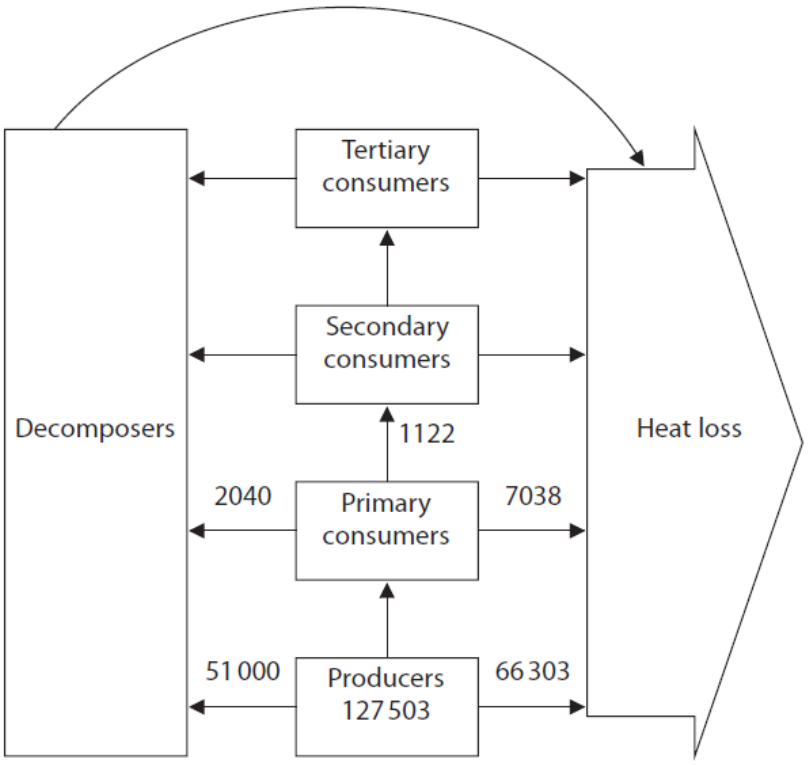
$7000 \times 0.018 = 126$

Answer 126

6

(b) The diagram shows some of the energy transfers through a food chain from this area.

The figures show the energy transfer in kJ m^{-2} yr^{-1}.



(i) Calculate the percentage efficiency of energy transfer from the producers to the primary consumers.

127503 - 51000 - 66303 = 10200

(2)

$$\frac{10200}{127503} \times 100 = 8$$

Answer 8

7

(b) The Benedict's test can be made quantitative and used to determine the concentration of a glucose solution.

The red precipitate formed is removed by filtration. The precipitate is dried and the mass recorded.

The table shows the mass of precipitate formed from a range of glucose concentrations heated with 5 cm^3 of Benedict's reagent.

Glucose concentration / mg cm^{-3}	Mass of precipitate formed / g
0	0.00
2	0.28
4	0.57
6	0.92
8	1.33
10	1.63
12	1.92
14	1.98
16	2.00
18	2.00
20	2.00

(ii) When the investigation was repeated, the mean error for each measurement was calculated.

The mean error for each measurement was 0.05 g.

Calculate the percentage error for the mass of precipitate measured at the glucose concentration of 2 mg cm^{-3}.

(1)

$\frac{0.05}{0.28} \times 100$

Answer 17.9 %

8

Chymosin is an enzyme used to clot milk for the production of cheese.

A farmer investigated the effect of chymosin concentration on the rate of milk clotting.

1 cm^3 of a 0.2% chymosin solution was added to 9 cm^3 milk and the time taken for the milk to clot was recorded. This was repeated using five other concentrations of chymosin.

The results are shown in the table.

Chymosin concentration (%)	Time for milk to clot / min		Mean rate of milk clotting / min^{-1}
	Trial 1	Trial 2	
0.2	7.0	7.5	0.14
0.5	3.5	3.0	
1.0	1.5	1.5	0.67
1.5	1.0	1.5	0.80
2.0	0.8	0.7	1.33
3.0	0.5	0.3	2.50

(a) (i) Calculate the mean rate of milk clotting at a chymosin concentration of 0.5%.

(3)

$\text{mean} = \frac{3.5 + 3.0}{2}$

$= 3.25 \text{ min}$

$\text{mean rate} = \frac{1}{3.25}$

$= 0.30769$

$\approx 0.31 \text{ min}^{-1}$

Answer 0.31 min^{-1}

(b) The chymosin used for the investigation costs 3.6p to treat 100 cm^3 of milk.

Calculate how much it would cost to treat 200 dm^3 milk.

(2)

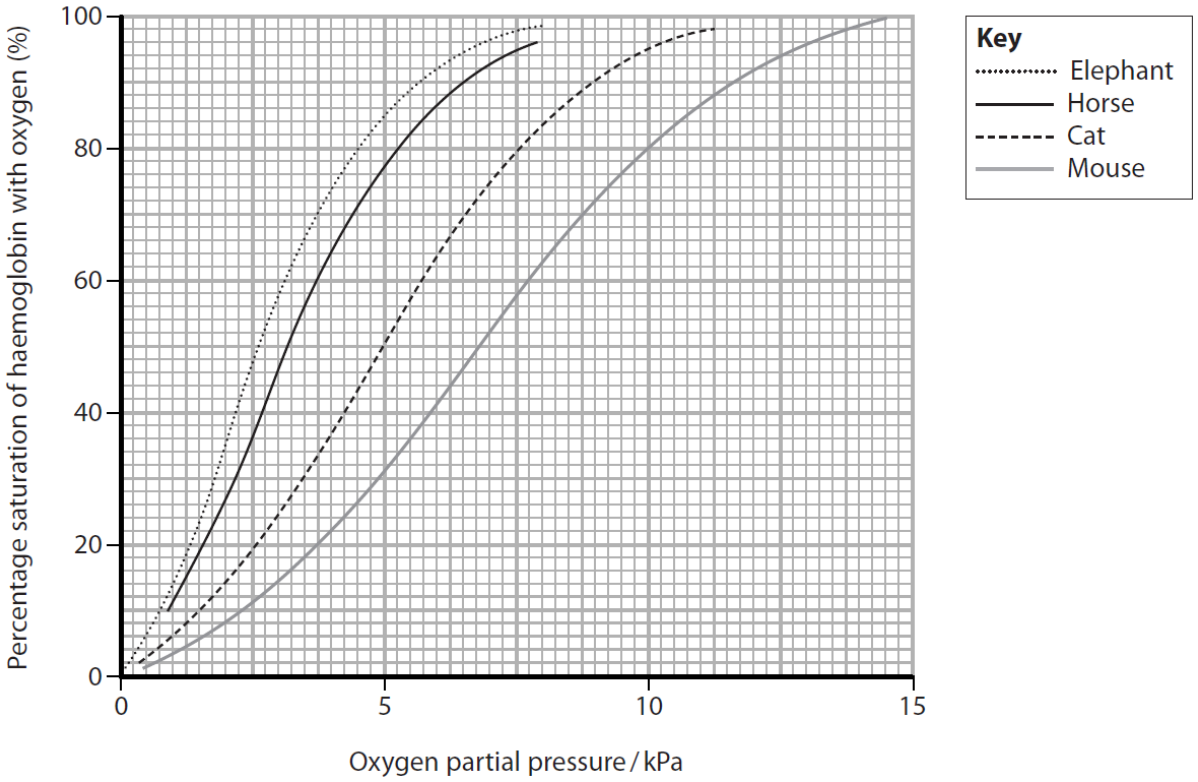
$200 \text{ dm}^3 = 200000$

$3.6 \times 2000 = £72$

Answer £ 72

9

The graph shows the oxygen dissociation curves of haemoglobin from four species of mammal.



(b) Calculate how much more oxygen is released as the partial pressure falls from 10 kPa to 5 kPa in the mouse than in the cat.

(3)

Cat : 45%

mouse : 49%

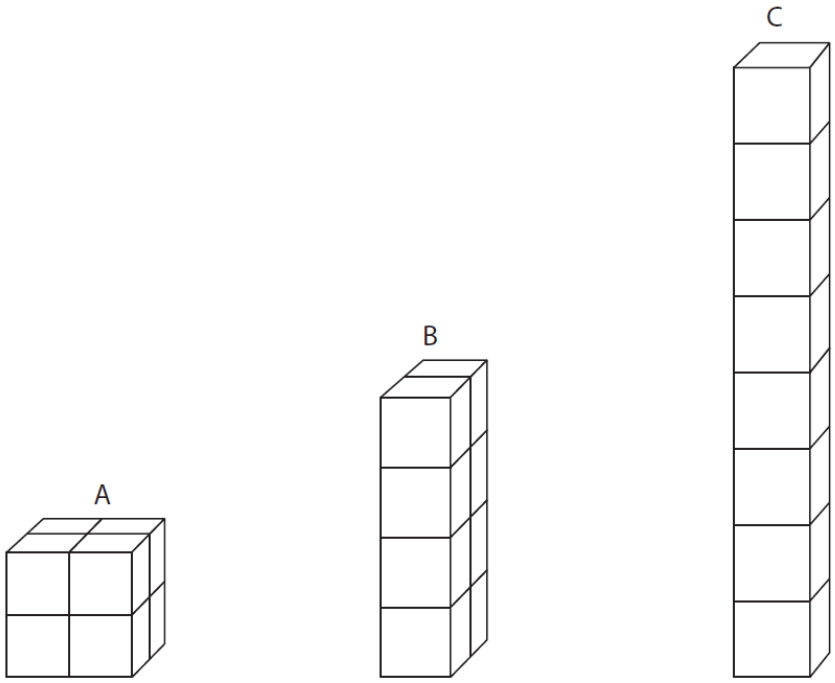
49 − 45 = 4

Answer 4 %

10

A student investigated the effect of the shape of a potato chip on the rate of absorption of water.

Different shaped chips, A, B and C, were used.



(a) Calculate the surface area to volume ratio of potato chip B.

(3)

SA = 28

V = 8

28 : 8 → 3.5 : 1

Answer 3.5 : 1

(b) These three chips will absorb water at different rates.

Predict the order in which the chips will absorb water, from the lowest rate to the highest rate.

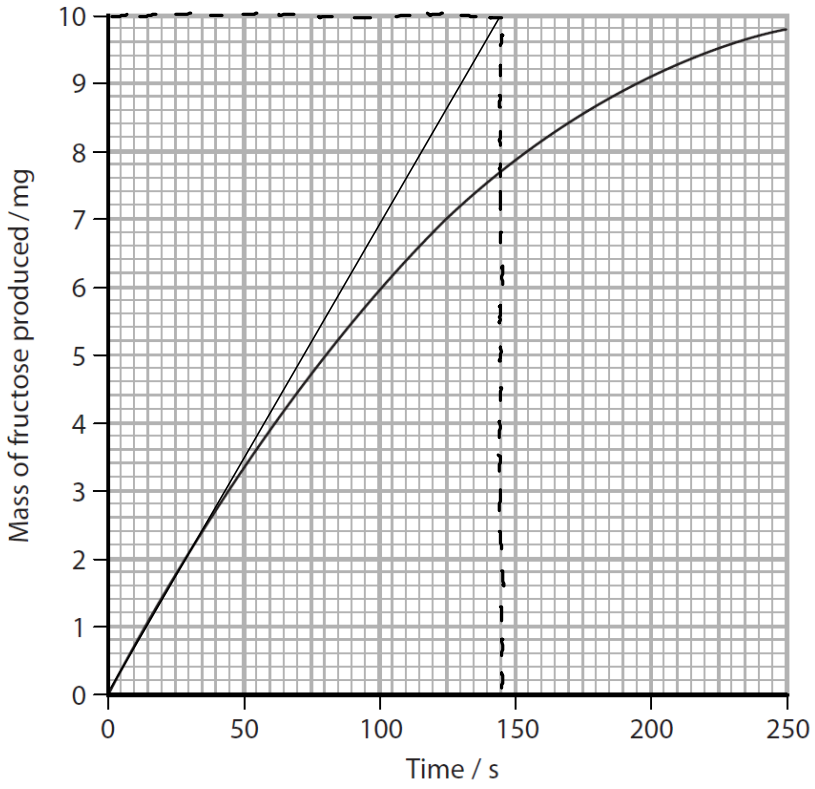
(1)

A , B , C

11

(ii) A student investigated the activity of glucose isomerase.

The graph shows the results of this investigation.



Determine the initial rate of the reaction.

(1)

$\frac{10\ mg}{145\ s} = 0.0689...$

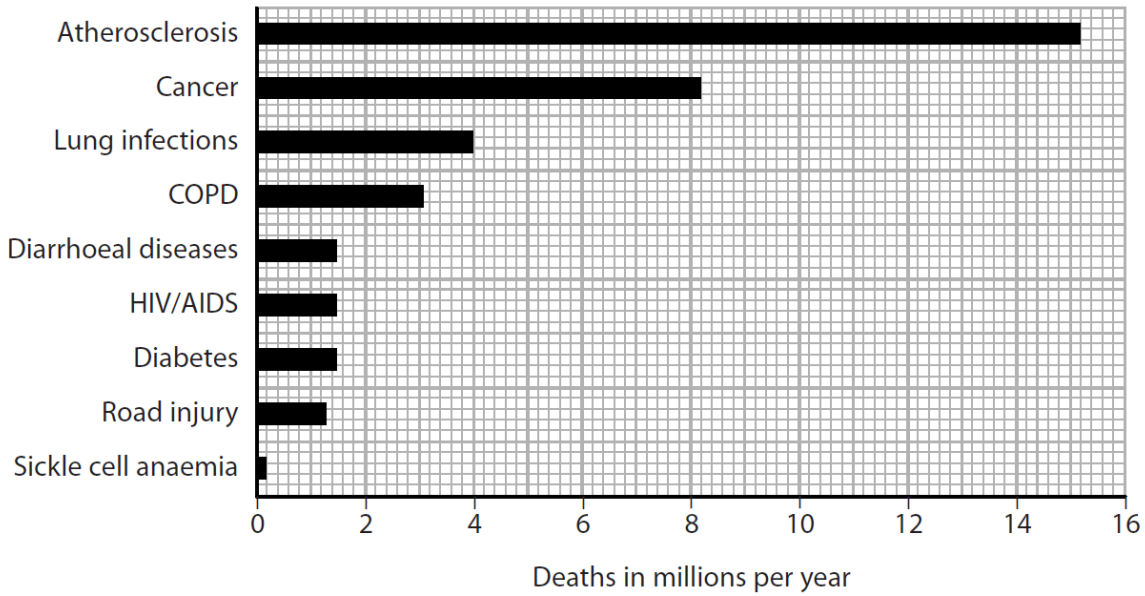
$\simeq 0.069\ mg\ s^{-1}$

Answer 0.069 mg s^{-1}

12

There are many disorders that affect the health of people.

The graph shows the number of people in the world who die each year from different health disorders.



(a) The graph shows that atherosclerosis kills more people than any of the other disorders.

This is mainly due to its development in the coronary arteries.

(i) State the number of deaths caused by atherosclerosis.

Give your answer in standard form.

(1)

Answer 1.52×10^7

13

Last year, eight million Christmas trees were bought in the UK.

There are many Christmas tree farms that supply these trees.

The photograph shows young Christmas trees growing on a farm.

Christmas tree farmers remove the other plants (weeds) in order to increase tree growth.

A farmer investigated two methods of removing weeds:

- removing weeds by hand
- spraying herbicides that inhibit weed growth.

The table shows the mean height of Christmas trees using each method, over a five-year period.

Year	Mean height of trees / cm	
	Removing by hand	Using herbicide
0	20	20
1	50	60
2	70	100
3	90	130
4	110	160
5	130	200

(a) (i) Calculate the difference between the mean rate of growth of these trees over the five years.

(2)

$36 - 22 = 14$ cm / year

Answer 14 cm / year

14

The table shows some information about two types of lipoprotein, high density lipoprotein (HDL) and low density lipoprotein (LDL).

Information about lipoproteins	HDL	LDL
density range / g cm^{-3}	1.063 to 1.210	1.019 to 1.063
typical diameter / nm	8	22
typical volume / nm^3	268	
percentage of protein (%)	50	20

(i) Complete the table to show the volume of a typical LDL using the formula:

$\frac{4}{3}\pi r^3$ where $\pi = 3.14$

(2)

15

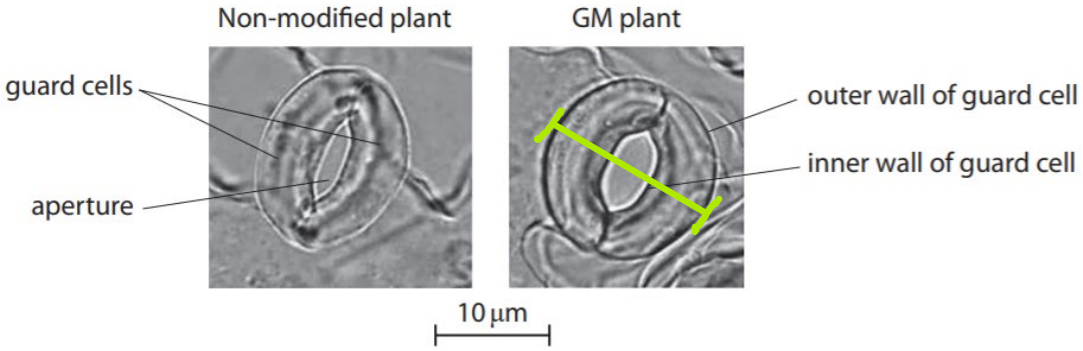
$\frac{4}{3}\pi\left(\frac{22}{2}\right)^3 = 5572.45$

$\simeq 5572$ nm^3

Genetically modified (GM) crop plants have been produced that have stomata with a wider aperture than non-modified crop plants.

This difference in the width of the aperture is only evident in daylight.

The photographs show the appearance of each type of stoma in daylight.



Sourced from: http://www.aip.nagoya-u.ac.jp/en/public/nu_research/images/Wang_f1.jpg

(a) (i) Calculate the magnification of the GM plant photograph using the scale bar.

Give the answer in standard form.

(2)

$\frac{2\text{ cm}}{1.3\text{ cm}} \times 10\,\mu\text{m} = 15.3846$

$\simeq 15.4\,\mu\text{m}$

Answer 15.4 µm

TOTAL FOR TEST = 37 marks