OXFORD

INTERNATIONAL
AQA EXAMINATIONS

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

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I declare this is my own work.

INTERNATIONAL A-LEVEL

BIOLOGY (9610)

Unit 3 Populations and Genes

Tuesday 14 January 2020 07:00 GMT Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

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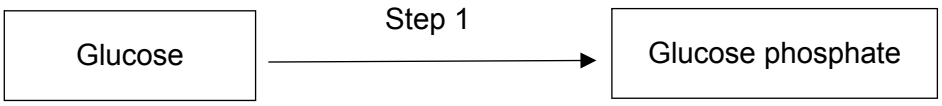
Answer **all** questions in the spaces provided.

0 1 Glycolysis occurs in the cytoplasm of cells.

Figure 1 shows the first step in glycolysis.

Figure 1



0 1 . 1 Name the type of reaction that converts glucose to glucose phosphate in Step 1 of glycolysis.

[1 mark]

0 1 . 2 Name the source of the phosphate used in Step 1 of glycolysis.

[1 mark]

0 1 . 3 Some people have a diet high in fat and low in carbohydrate.

Fatty acids from fats are converted into acetyl groups in mitochondria.

The low carbohydrate intake causes reduced glucose levels in cells.

Explain how aerobic respiration continues with low glucose levels.

Use the information given and your knowledge of aerobic respiration.

[2 marks]

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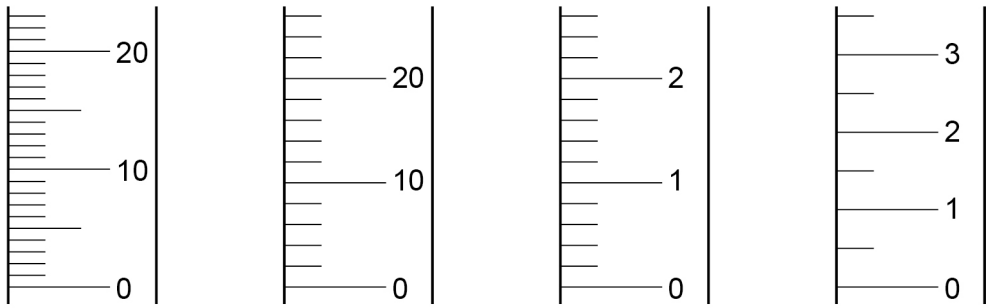
A student measures the rate of respiration in cells using a respirometer.

The student uses the respirometer to measure oxygen uptake.

The respirometer has a capillary tube to measure the volume of oxygen.

Figure 2 shows four different scales the student could have on the capillary tube.
All of the scales show volume in cm^3

Figure 2



0 1 . 4 Which letter, **A**, **B**, **C** or **D**, shows the most suitable scale for the respirometer?

Give **one** reason for your choice.

[1 mark]

Letter ☐

Reason _____

_____

_____

Question 1 continues on the next page

Turn over ►

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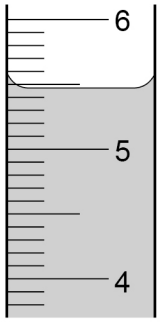
Figure 3 shows the position of the liquid at the end of another student's investigation.

Figure 3



0 1 . 5 Give the volume of liquid in the capillary tube.

[1 mark]

Volume = _____ cm^3

Table 1 shows data about the oxygen uptake rate and carbon dioxide production rate of cells.

Table 1

Oxygen uptake rate / micromoles $cell^{-1}$ day^{-1}	Carbon dioxide production rate / nanomoles $cell^{-1}$ day^{-1}
1.77×10^{-7}	1.64×10^{-4}

0 1 . 6 Calculate the respiratory quotient (RQ) using data from **Table 1**.

[2 marks]

Respiratory quotient = _____

8

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ANSWER IN THE SPACES PROVIDED

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0 2 *Paramecium aurelia* and *Paramecium caudatum* are single-celled aquatic organisms. A scientist investigates the interaction between these two species of organism in the laboratory.

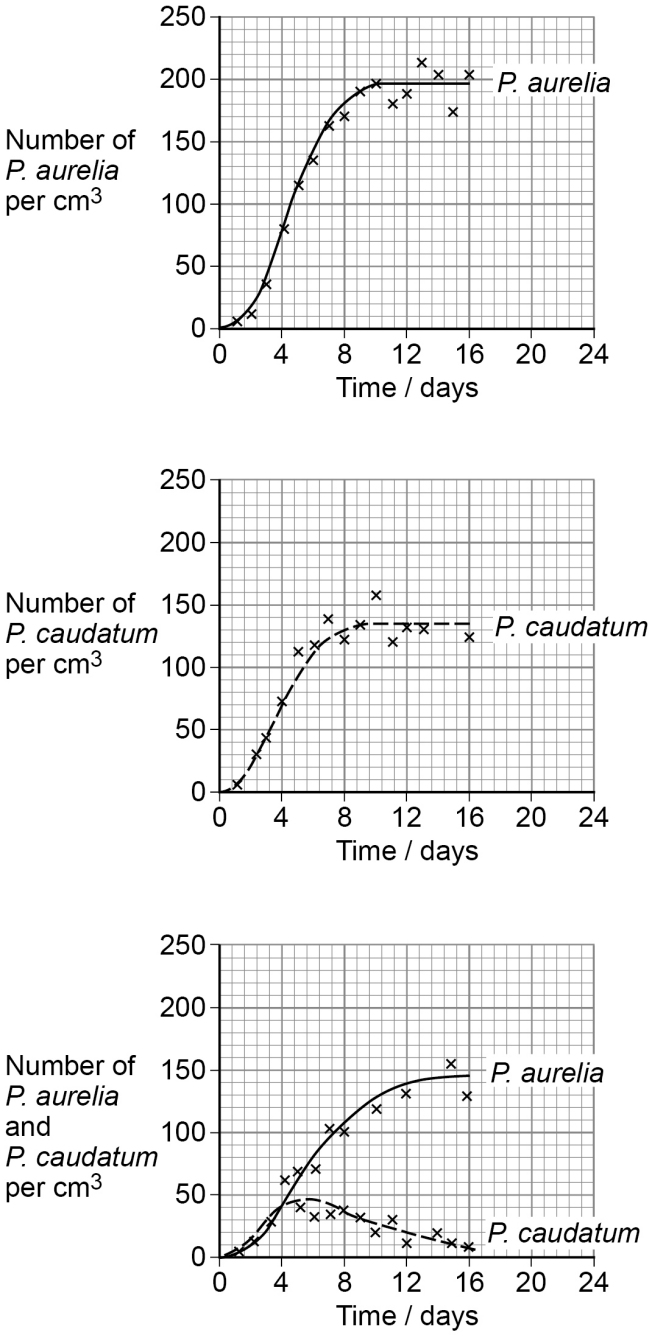
The scientist:

- grows *P. aurelia* on its own
- grows *P. caudatum* on its own
- grows *P. aurelia* and *P. caudatum* together.

The scientist records the size of each population every day for 16 days.

Figure 4 shows the scientist's results.

Figure 4



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0 2 . 1 *P. aurelia* and *P. caudatum* compete with each other for resources.

Name the type of competition between *P. aurelia* and *P. caudatum*.

[1 mark]

0 2 . 2 Describe the effects of growing *P. aurelia* and *P. caudatum* together.

Use information from **Figure 4**.

[3 marks]

0 2 . 3 The scientist concludes that *P. aurelia* and *P. caudatum* occupy the same niche. Another scientist concludes that *P. aurelia* produces a toxic waste product that kills *P. caudatum*.

Evaluate these **two** conclusions.

Use your own knowledge and the information given.

[4 marks]

P. aurelia and *P. caudatum* occupy the same niche

The answer space for Question 02.3 continues on the next page

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P. aurelia produces a toxic waste product that kills P. caudatum _____

8

0 3 A scientist investigates energy transfers through the trophic levels in a food chain. **Figure 5** shows the food chain.

Figure 5

Phytoplankton → Zooplankton → Herring

The scientist measures:

- net productivity
- respiratory loss
- stored energy in ingested food.

Table 2 shows the scientist's results.

Table 2

Organism	Energy kJ m^{-2} $year^{-1}$		
	Net productivity	**Respiratory loss**	**Ingested food**
Phytoplankton	3600	1200	0
Zooplankton	1400	400	1800
Herring	20	180	200

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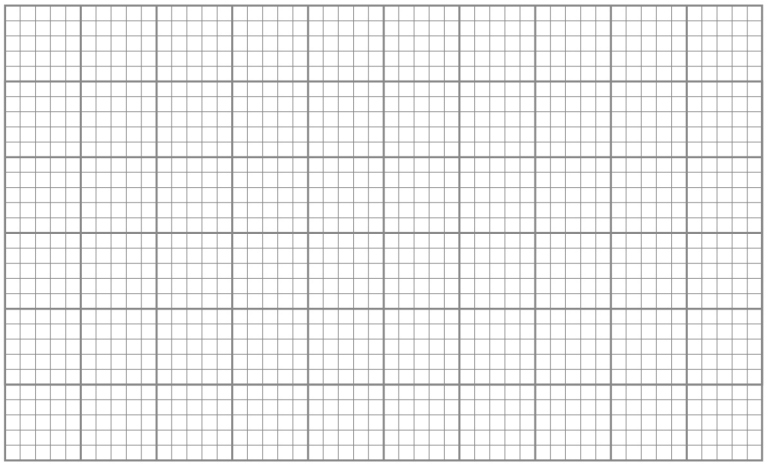
0 3 . 1 Draw a pyramid of energy to show the net productivity for the food chain.

Use data from **Table 2**.

Use a suitable scale.

[2 marks]



0 3 . 2 Give the reason why phytoplankton have a value of 0 kJ m^{-2} $year^{-1}$ for ingested food.

[1 mark]

0 3 . 3 The scientist calculated the net productivity of the herring by subtracting the energy lost in respiration from the energy in ingested food.

Explain why this would give a value that was too high for net productivity.

[2 marks]

5

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ANSWER IN THE SPACES PROVIDED

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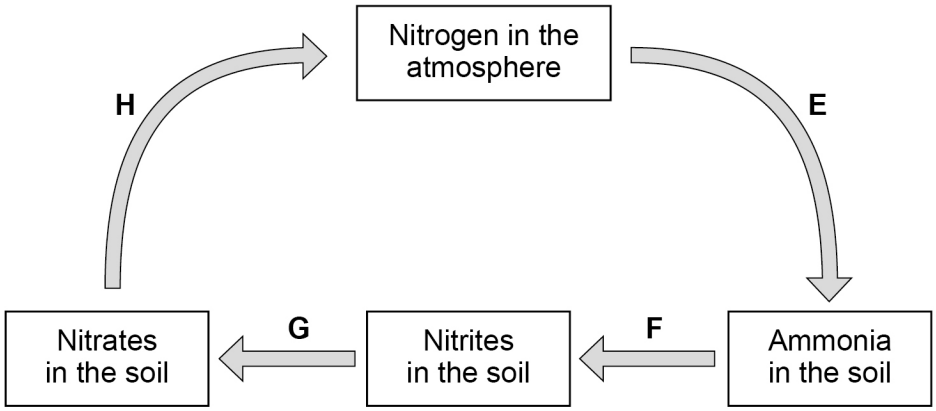
0 4 **Figure 6** shows part of the nitrogen cycle.

Figure 6



0 4 . 1 Name the process represented by arrow **E** on **Figure 6**.

[1 mark]

Tick (✓) **one** box.

Ammonification ☐

Denitrification ☐

Nitrification ☐

Nitrogen fixation ☐

Question 4 continues on the next page

Some fields are ploughed before crops are planted.

A scientist investigates the effect of ploughing on the concentration of nitrate in soil.

Table 3 shows the scientist's results**.**

Table 3

Time after planting crop / days	**Concentration of nitrate in soil / mg dm^{-3}**	
	Ploughed	**Not ploughed**
12	39.50	56.49
21	138.83	82.52
34	226.20	111.87
40	165.18	56.30
185	46.88	37.15
205	37.68	27.40
223	64.95	23.38
241	26.24	21.51

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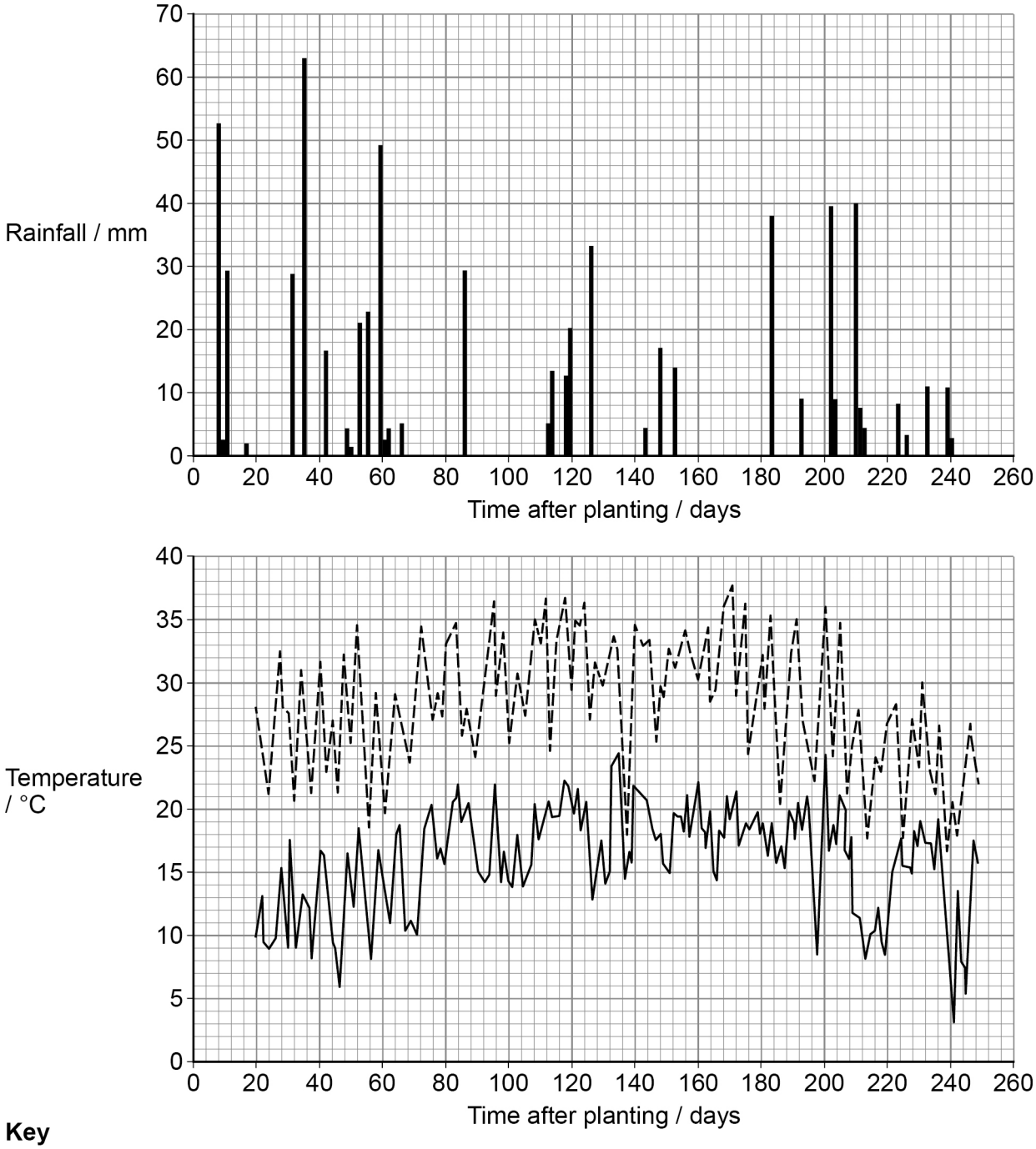
The scientist measures the temperature and rainfall during the investigation.

Figure 7 shows the scientist's results.

Figure 7



Question 4 continues on the next page

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0 4 . 2 Suggest an explanation for the change in nitrate concentration between days 34 and 40.

Use information from **Table 3** and **Figure 7** (on pages 12 and 13).

[2 marks]

0 4 . 3 The scientist concludes that ploughing increases nitrate concentration.

Evaluate this conclusion.

Use evidence from **Table 3** and **Figure 7** (on pages 12 and 13).

[3 marks]

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0 4 . 4 Farmers plough some fields before planting crops.

Nitrifying bacteria in the soil are aerobic, but denitrifying bacteria are anaerobic.

Ploughing increases the amount of air in the soil and reduces the growth of anaerobic denitrifying bacteria.

Suggest reasons why ploughing can increase crop yield.

[3 marks]

9

Turn over for the next question

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0 5 Elephants are large mammals with long teeth called tusks.

Figure 8 shows an elephant.

Figure 8

0 5 . 1 An elephant's tusk has a length of 2 m and a mean diameter of 18 cm

Calculate the mass of one tusk in kilograms.

Assume that the tusk is a cylinder and that 1 cm^3 is equal to 1 g

Use the formula:

Volume = $\pi r^2 l$

where:

π = 3.14
r = radius
l = length

Give your answer to the nearest whole kilogram.

[3 marks]

Mass of one tusk = _____ kg

Do not write outside the box

Having no tusks is an inherited trait. The allele for no tusks is dominant.

0 5 . 2 In a population of elephants, 2% have no tusks.

Calculate the frequency of the recessive allele.

Use the Hardy–Weinberg equation.

Give your answer to 2 significant figures.

[2 marks]

Frequency of recessive allele = _____

Some elephants are hunted and killed for their tusks.

A population of elephants was hunted to very low numbers.
This hunting stopped 100 years ago.
The number of elephants in this population that never grow tusks is now 50%

0 5 . 3 Explain how hunting can cause a **rapid increase** in the number of elephants that never grow tusks.

Use your knowledge of natural selection and the information given.

[5 marks]

_____

_____

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10

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0 6 A scientist investigates the effect of competition with grass on seedling growth in two plant species, common mullein and lesser burdock.

The scientist:

1. prepares four plastic trays
   - tray 1: soil + 100 common mullein seeds
   - tray 2: soil + 100 common mullein seeds + grass
   - tray 3: soil + 25 lesser burdock seeds
   - tray 4: soil + 25 lesser burdock seeds + grass

2. counts the number of seedlings in each tray every 7 days for 77 days

3. calculates the mean dry mass of seedlings in each tray at the end of the investigation.

0 6 . 1 Give **two** variables that the scientist should control in this investigation.

[2 marks]

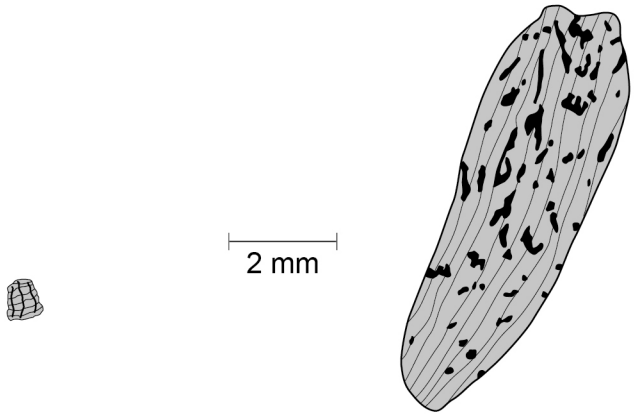
1 _____

2 _____

0 6 . 2 Seeds can be different sizes.

Figure 9 shows a common mullein seed and a lesser burdock seed drawn to the same scale.

Figure 9



Common mullein seed Lesser burdock seed

Suggest why the scientist adds different numbers of common mullein seeds and lesser burdock seeds to the trays.

[1 mark]

_____

_____

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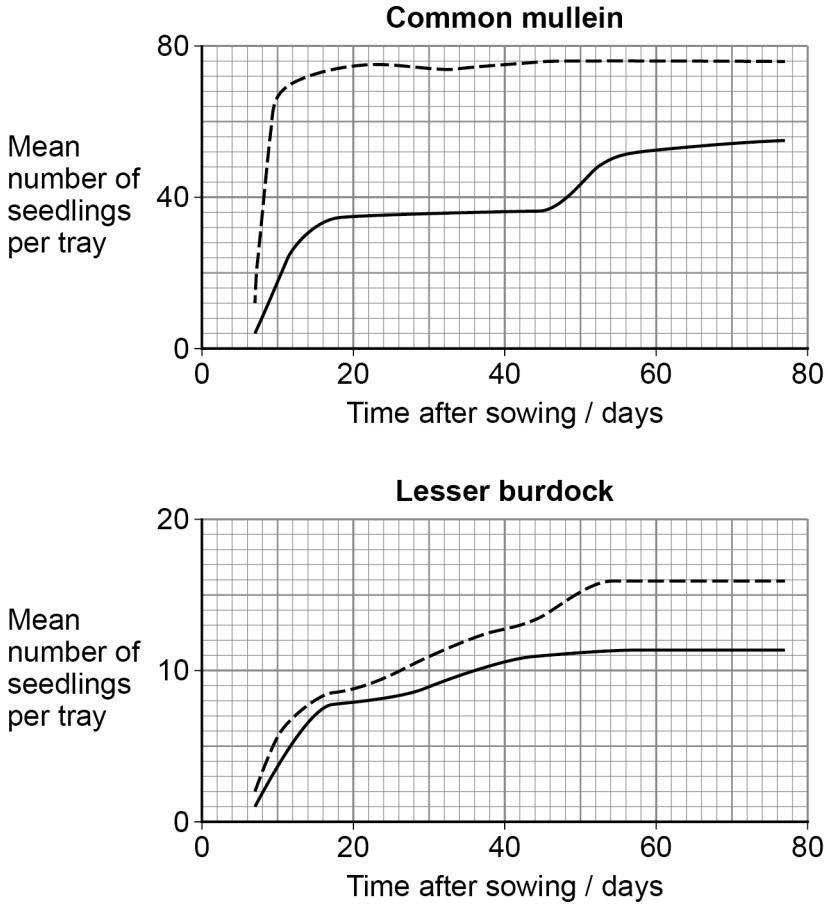
Figure 10 shows the scientist's results.

Figure 10



0 6 . 3 Suggest why the effect of competition with grass plants is different for common mullein and lesser burdock.

Use your own knowledge and information from **Figure 10**.

[4 marks]

The answer space for Question 06.3 continues on the next page

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0 6 . 4 The scientist calculates the mean initial dry mass of seedlings using 10 seedlings that have germinated on filter paper.

Suggest **two** reasons why the scientist uses this method to determine dry mass.

[2 marks]

1 _____

2 _____

0 6 . 5 Lesser burdock seedlings grown without grass have an initial mean dry mass of 4.8 mg and a final mean dry mass of 484 mg at the end of the investigation.

Calculate the mean growth rate during the investigation.

Give your answer to 2 significant figures.

[2 marks]

Mean growth rate = _____ mg day^{-1}

11

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0 7 Pondweed is an aquatic plant.

A student investigates the effect of light intensity on the rate of photosynthesis in pondweed.

The student:

- cuts two pieces of pondweed, each 10 cm long
- puts each piece of pondweed in a separate test tube
- adds 0.1% sodium hydrogen carbonate solution to each tube
- adds buffer solution to each tube
- measures the oxygen concentration of the solutions in each tube
- seals each tube with a bung
- puts each tube in a different location:
  tube **1** – 20 cm away from a lamp
  tube **2** – 10 cm away from a lamp
- measures the oxygen concentration of the solutions in each tube every 5 minutes.

0 7 . 1 Give **one** reason why the student adds sodium hydrogen carbonate solution to each tube.

[1 mark]

0 7 . 2 The student added buffer solution to each tube to keep the pH constant.

Suggest why the pH would increase during photosynthesis without this buffer solution.

[1 mark]

Question 7 continues on the next page

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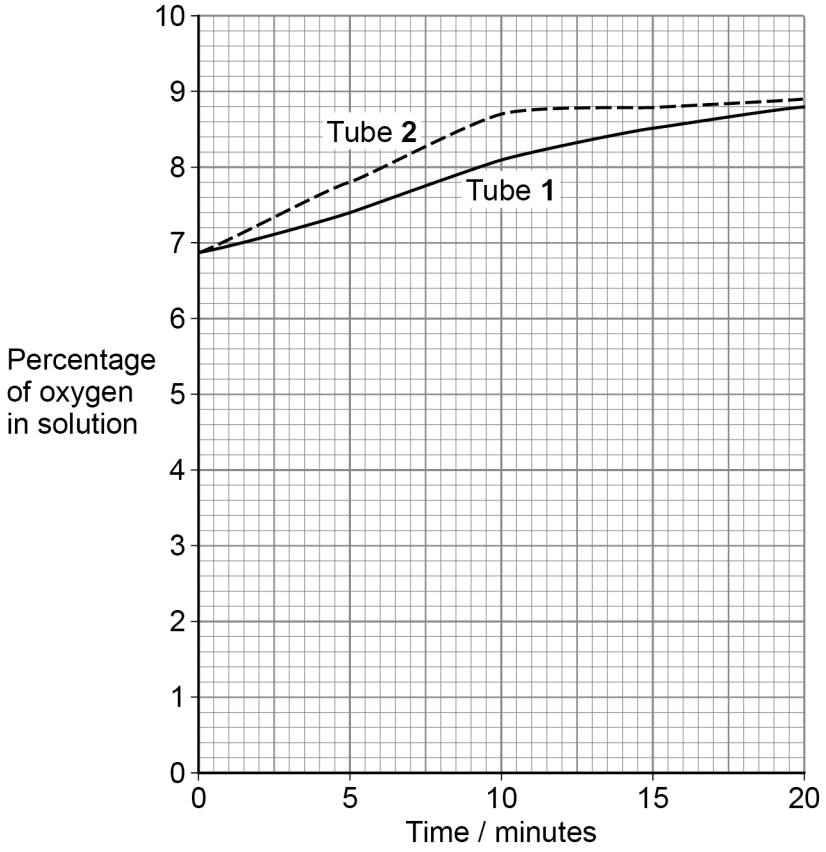
Figure 11 shows the student's results.

Figure 11



0 7 . 3 Calculate the difference in the rates of oxygen production for tubes **1** and **2** between times 0 and 5 minutes.

Give the unit for your answer.

[2 marks]

Difference in rate = _____

Unit = _____

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0 7 . 4 Tube **1** is 20 cm away from the lamp and tube **2** is 10 cm away from the lamp.

Explain the difference in oxygen production between tube **1** and tube **2**.

Include reference to the light-dependent reaction of photosynthesis in your answer.

[2 marks]

0 7 . 5 The percentage of oxygen in the solution in tube **1** would level off after 40 minutes. Suggest a biological explanation for this.

[1 mark]

0 7 . 6 The student repeats the investigation to find the effect of no light on oxygen concentration.

The student puts a piece of pondweed in a third test tube (tube **3**) and puts tube **3** in the dark.

The student measures the oxygen concentration of the solution in tube **3** every 5 minutes.

Explain what would happen to the percentage of oxygen in the solution in tube **3** from 0 to 20 minutes.

[2 marks]

9

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0 8 . 1 Describe how the products of the light-dependent reaction of photosynthesis are made.

[6 marks]

0 8 . 2 Describe how useful organic substances are made during the light-independent reaction of photosynthesis.

[6 marks]

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0 8 . 3 Explain why a decrease in temperature affects the rate of the **light-independent** reaction.

[3 marks]

15

END OF QUESTIONS

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