OXFORD AQA INTERNATIONAL A-LEVEL
BIOLOGY

(9610)

PAPER 3

Specimen 2018   Morning   Time allowed: 1 hour 30 minutes

Materials
For this paper you must have:
* a pencil
* a ruler with millimetre measurements
* a calculator

Instructions
* use black ink or ball-point pen
* answer **all** questions
* show all your working.

Information
* The marks for questions are shown in brackets
* The maximum mark for this paper is 75 marks

Please write clearly, in block capitals, to allow character computer recognition.

Centre number ☐☐☐☐☐   Candidate number ☐☐☐☐

Surname ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

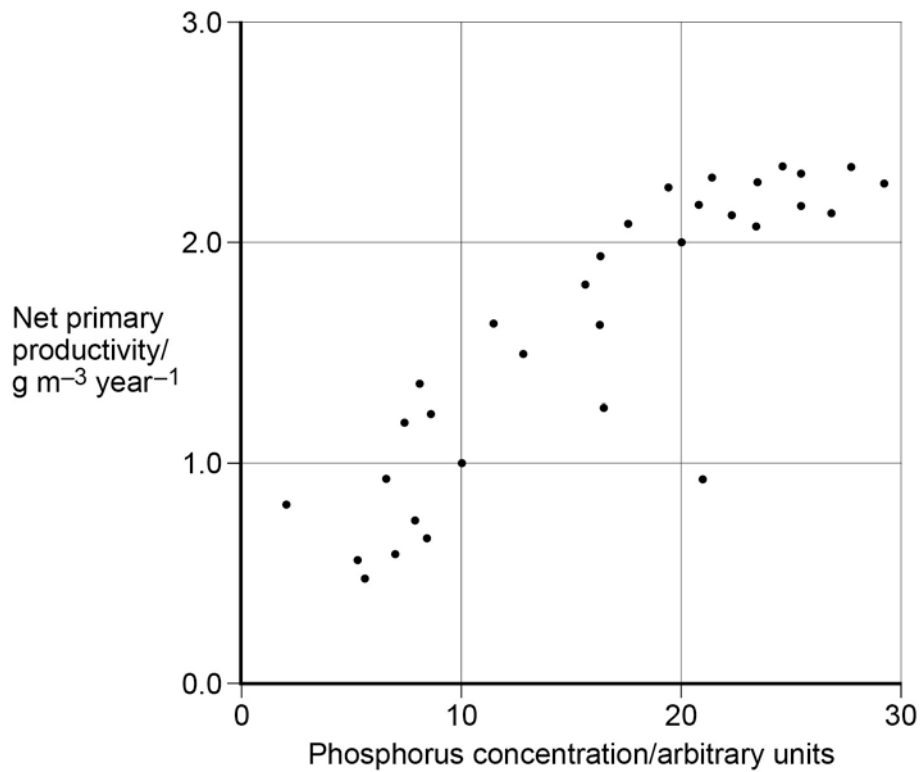Forename(s) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Candidate signature _____

Answer **all** questions in the spaces provided

1 Phytoplankton are small photosynthetic organisms that float in the surface layers of open water.

Figure 1 shows the relationship between the concentration of phosphorus and the net productivity of phytoplankton in a number of different lakes.

Figure 1

0 1 . 1 The samples of plankton were all collected from the same depth below the surface. Explain why.

[2 marks]

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0 1 . 2   A log scale has been used on the y-axis to plot the data on **Figure 1**.
Give **one** advantage of using a log scale to plot these data.

[1 mark]

0 1 . 3   By how many times greater is the net primary productivity at a phosphorus
concentration of 20 than at a phosphorus concentration of 10 arbitrary units?

[1 mark]

0 1 . 4   Name **two** substances found in phytoplankton that contain the element phosphorus.

[2 marks]

0 1 . 5 Use your knowledge of limiting factors to explain **Figure 1**.

[3 marks]

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0 2 . 1 What does the Hardy-Weinberg principle predict?

[3 marks]

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Table 1 shows the frequencies of some alleles in the populations of cats in three cities.

Table 1

City	Frequency of allele			
	White	Non-agouti	Blotched	Long-haired
Athens	0.001	0.72	0.25	0.50
Paris	0.011	0.71	0.78	0.24
London	0.004	0.76	0.81	0.33

0 2 . 2 White cats are deaf. Would the Hardy-Weinberg principle hold true for white cats? Explain your answer.

[2 marks]

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0 2 . 3 Give the evidence from **Table 1** that non-agouti and blotched are alleles of different genes

[1 mark]

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0 2 . 4 Hair length in cats is determined by a single gene with two alleles. The allele for long hair is recessive. The allele for short hair is dominant.

Use the information in **Table 1** and the Hardy-Weinberg equation to estimate the percentage of cats in London that are heterozygous for hair length. Show your working.

[2 marks]

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0 3 . 1 In fruit flies, the genes for body colour and wing length are linked. Explain what this means.

[1 mark]

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A scientist investigated linkage between the genes for body colour and wing length. He carried out crosses between fruit flies with grey bodies and long wings and fruit flies with black bodies and short wings.

Figure 2 shows his crosses and the results.

- **G** represents the dominant allele for grey body and **g** represents the recessive allele for black body.
- **N** represents the dominant allele for long wings and **n** represents the recessive allele for short wings.

Figure 2

| Phenotype of parents | grey body, long wings | × | black body, short wings |

| Genotype of parents | **GGNN** | | **ggnn** |

| Genotype of offspring | | **GgNn** | |

| Phenotype of offspring | | all grey body, long wings | |

These offspring were crossed with flies homozygous for black body and short wings. The scientist's results are shown in **Table 2.**

Table 2

	Grey body, long wings	Black body, short wings	Grey body, short wings	Black body, long wings
Number of offspring	975	963	186	194

0 3 . 2 In fruit flies, the genes for body colour and wing length are linked. Explain what this means.

[4 marks]

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0 3 . 3 If these genes were not linked, what ratio of phenotypes would the scientist have expected to obtain in the offspring?

[1 mark]

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0 3 . 4 Which statistical test could the scientist use to determine whether his observed results were significantly different from the expected results? Give the reason for your choice of statistical test.

[2 marks]

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Turn over for next question

4 Wheat is an annual crop. A wheat crop was grown in the same field on a farm for three consecutive years. When the wheat was harvested, all parts of the crop growing above ground were removed. **Figure 3** shows the nitrogen cycle for this field. The figures are in kg of nitrogen per hectare for the second year that the crop was grown.

Figure 3
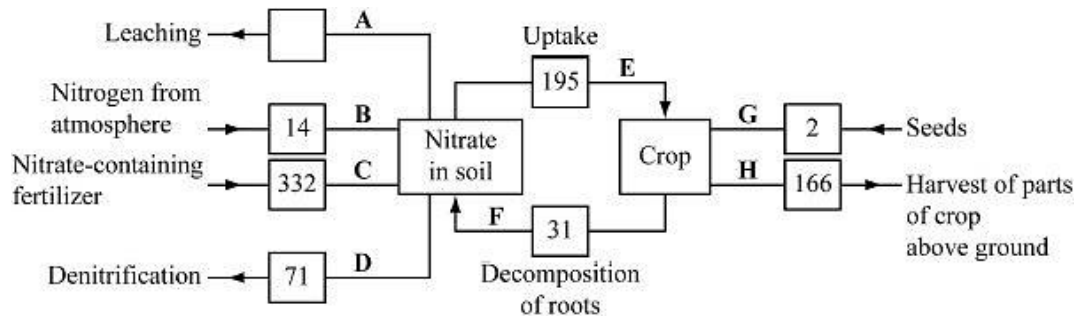
0 4 . 1 Give the letter of **one** pathway involving nitrogen-fixing bacteria. Write your answer in the box

[1 mark]

0 4 . 2 Give the letter of **one** pathway involving nitrogen-fixing bacteria. Write your answer in the box

[1 mark]

0 4 . 3 Describe the part played by bacteria in pathway **D**

[2 marks]

0 4 . 4 This wheat crop was growing on soil that is easily waterlogged. The figure for pathway **D** would be lower on a farm with sandy soil that does not become waterlogged. Explain why.

[2 marks]

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0 4 . 5 Calculate the maximum percentage of nitrogen that could be leached from the soil where this crop was growing in a year. Show your working.

[2 marks]

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0 4 . 6 A log scale has been used on the y-axis to plot the data on this graph.
Give **one** advantage of using a log scale to plot these data.

[1 mark]

5   Scientists investigated the uptake of radioactively labelled carbon dioxide in chloroplasts. They used three tubes, each containing different components of chloroplasts. They measured the uptake of carbon dioxide in each of these tubes. Their results are shown in **Table 3** below.

Table 3

Tube	Contents of tube	Uptake of radioactively labelled CO_2 / counts per minute
A	Stroma and grana	96 000
B	Stroma, ATP and reduced NADP	97 000
C	Stroma	4 000

0 5 . 1   Name the substance that combines with carbon dioxide in a chloroplast.

[1 mark]

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0 5 . 2   The results in tube **B** are similar to those in tube **A**. Explain why.

[1 mark]

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0 5 . 3 Use the information in **Table 3** to predict the uptake of radioactively labelled carbon dioxide if tube **A** were placed in the dark. Explain your answer.

[2 marks]

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0 5 . 4 Use your knowledge of the light-independent reaction to explain why the uptake of carbon dioxide in tube **C** was less than the uptake in tube **B**.

[2 marks]

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0 5 . 5 DCMU is used as a weed killer. It inhibits electron transfer during photosynthesis. The addition of DCMU to tube **A** decreased the uptake of carbon dioxide. Explain why.

[2 marks]

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6   *Caranga microphylla* is a pioneer shrub that grows in desert areas. Scientists compared sand underneath these plants with bare sand nearby. Some of their results are shown in **Table 4**. The figures are mean values (± standard deviation).

Table 4

Property	Sand underneath *C. microphylla*	Bare sand	Enrichment ratio
Density of soil / g cm^{-3}	1.56 ± 0.01	1.64 ± 0.02	Not applicable
Percentage soil moisture	4.01 ± 0.17	3.62 ± 0.60	Not applicable
Percentage organic matter	0.23 ± 0.05	1.16 ± 0.04	1.44
Total nitrogen / g kg^{-1}	0.14 ± 0.03	0.10 ± 0.22	1.40
Nitrogen available to plants / mg kg^{-1}	25.52 ± 5.26	26.82 ± 7.62	

0 6 . 1 Calculate the enrichment ratio for the nitrogen available to plants. Show your working.

[1 mark]

0 6 . 2 Explain why the figures for the amount of nitrogen available to plants are lower than those for total nitrogen.

[2 marks]

0 6 . 3 The soil moisture content underneath *C. microphylla* varies less than that in the bare sand. Explain how the data in **Table 4** support this statement.

[1 mark]

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0 6 . 4 Suggest **one** explanation for the lower variation in soil moisture content underneath *C. microphylla*;

[1 mark]

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0 6 . 5 The scientists who carried out this research wrote a paper. In this paper, they described the sand beneath *C. microphylla* as "islands of fertility". Use the data in **Table 4** to evaluate this description.

[3 marks]

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7 A group of students investigated the effect of temperature on the growth of the roots of germinating mung beans.

Figure 4 is a photograph which shows mung bean seeds that were incubated at 21°C for 48 hours.

Figure 4
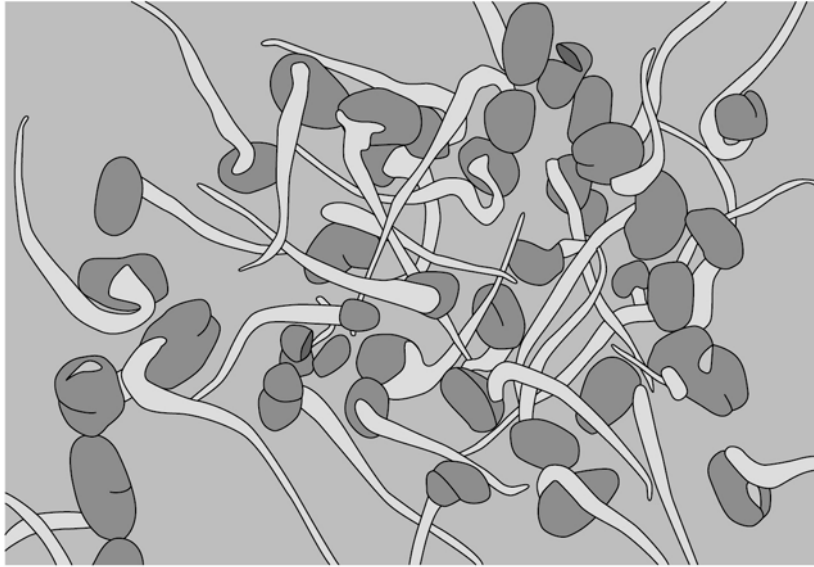
The students devised a technique for measuring the mung bean roots.
- They selected a sample of germinating seeds.
- Each seed was pressed on to an ink pad.
- The seeds were the transferred to and pressed on to a sheet of graph paper.
- The roots were measured using the graph paper.

0 7 . 1 Describe how you would have selected the sample of germinating seeds.

[2 marks]

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0 7 . 2 Describe how you could use this technique to measure the growth rate of mung bean roots.

[2 marks]

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0 7 . 3 Describe **one** significant source of error with this technique.

[1 mark]

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The students then used the apparatus shown in **Figure 5**.

Figure 5

Glass rod
May be slid up or down
through hole in the bung

Pin
Acts as reference
point

Bung

Bean
Attached to bung with pin and
arranged so that its tip just
touched the surface of the
water.

Water in specimen tube
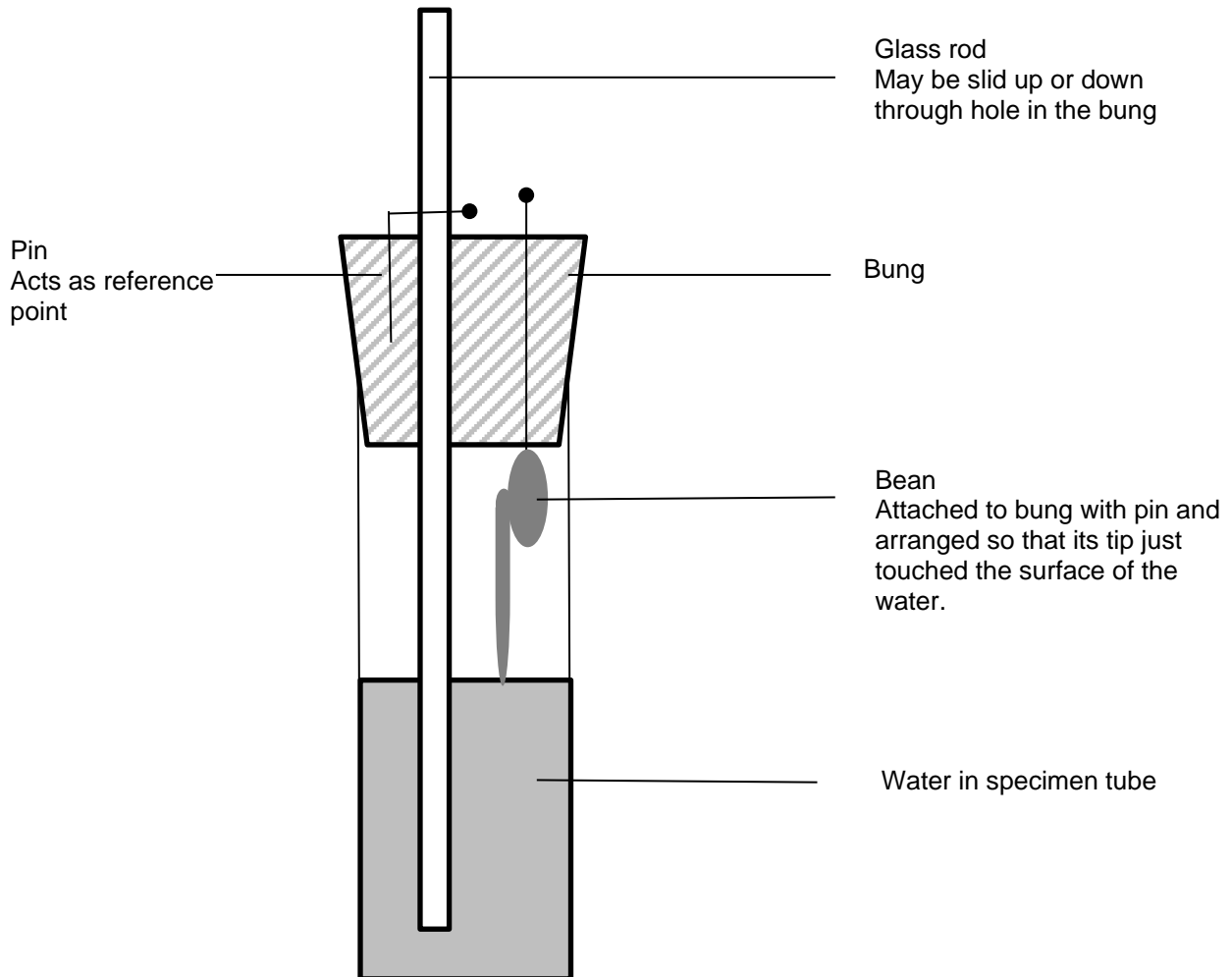
- They measured the diameter of the glass rod and the diameter of the specimen tube.
- They set up the apparatus as shown in Figure 2 and incubated it in a water bath at 21 ^{O}C.
- After 15 minutes, they removed the apparatus from the water bath and pulled the glass rod upwards. The level of water in the tube fell.
- They stopped pulling the glass rod upwards when the root again just touched the surface of the water in the tube.
- They noted how far the glass tube had been pulled

0 7 . 4 The specimen tube had a flat base. Suggest **one** advantage of using a specimen tube rather than a boiling tube.

[1 mark]

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The students' results are shown in **Table 5**.

Table 5

Feature	Measurement / mm
Diameter of glass rod	6.0
Diameter of specimen tube	30.0
Distance glass rod pulled upwards	15.0

0 7 . 5 Use the information in **Table 5 t**o calculate the growth rate of the mung bean root

[4 marks]

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0 8 . 1 ATP is useful in many biological processes. Explain why.

[4 marks]

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0 8 . 2 Describe how ATP is made in mitochondria.

[6 marks]

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0 8 . 3 Plants produce ATP in their chloroplasts during photosynthesis. They also produce ATP during respiration. Explain why it is important for plants to produce ATP during respiration in addition to during photosynthesis.

[5 marks]

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END OF QUESTIONS