Rewarding Learning

ADVANCED
General Certificate of Education
2025

Centre Number

Candidate Number

Biology

Assessment Unit A2 3
assessing
Practical Skills in Biology

[ABY31]

ABY31

WEDNESDAY 18 JUNE, MORNING

TIME

1 hour 15 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete questions in black ink and use a dark HB pencil for drawings and graphs.
Do not write with a gel pen.
Answer **all eight** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 60.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You may use a scientific calculator.
You are reminded of the need for good English and clear presentation in your answers.
Use accurate scientific terminology in all answers.
Statistics Sheets are provided for use with this paper.

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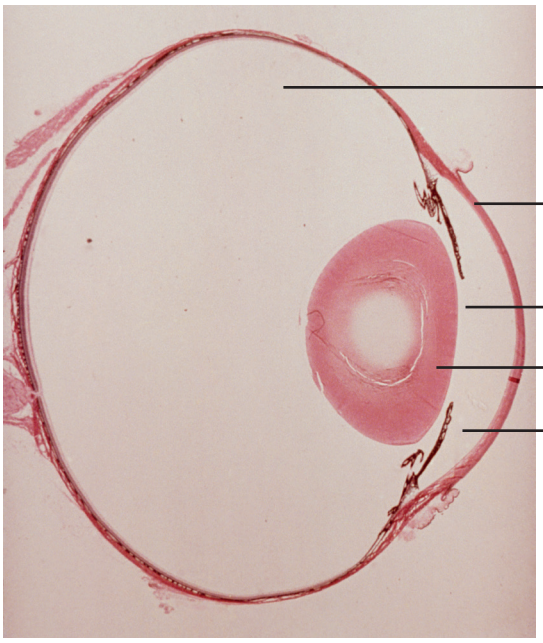
1 The photomicrograph below shows a section through a mammalian eye.



Source: © Gene Cox / Science Photo Library

(a) Identify structures **X** and **Y**.

X _____

Y _____ [2]

(b) Name the structures which hold the lens in place.

_____ [1]

Both the vitreous and aqueous humour are transparent.

(c) Explain fully the significance of this property in producing an image.

_____

_____ [1]

2 DNA can be extracted from strawberry cells by following the method below.

Step 1 Add a pinch of salt and a small amount of cold water to a strawberry in a mortar.

Step 2 Homogenise the strawberry using a pestle.

Step 3 Filter the larger pieces of strawberry and retain the filtrate.

Step 4 Mix the filtrate with detergent and leave for 10 minutes.

Step 5 Add protease to the mixture.

Step 6 Gently add a layer of ice-cold ethanol.

(a) Identify the **step number** in which:

- phospholipids in cell membranes are broken down.

  _____

- DNA is separated from proteins in the chromosome.

  _____

- surface area of exposed cells is increased.

  _____ [3]

Strawberry cells are octoploid. This means that they have eight sets of chromosomes rather than two sets which are found in diploid cells.

(b) Suggest how octoploidy makes strawberries particularly suitable for the procedure described by this method.

_____

_____

_____ [1]

[Turn over

3 Biological pest control can involve the use of a natural predator to manage pests.

(a) State an important characteristic of an effective biological control organism.

_____

_____

_____ [1]

(b) An investigation was carried out to compare chemical pest control (pesticide) with biological control by ladybirds.

Three shrub plants of the same species were used in the investigation. The leaves of one shrub were left untreated. The leaves of the second shrub were treated with pesticide and those of the third shrub had ladybirds added. All three shrubs were infested by a common aphid pest (greenfly) and the mean number of aphids per cm^2 of leaf was calculated and recorded over a period of 5 weeks.

The results are shown in the table below.

	Mean number of aphids per cm^2 of leaf		
Number of weeks after beginning of treatment	**Untreated**	**With chemical control (pesticide)**	**With biological control (ladybirds)**
0	1.0	1.7	1.9
1	1.8	0.4	0.6
2	4.2	0.2	0.2
3	7.9	0	0
4	15.6	0	0
5	32.5	0	0

(i) Give the term used to describe the population growth rate for the untreated shrub, where the density of aphids approximately doubles each week.

_____ [1]

(ii) Comment on the effectiveness of:

- chemical control compared to untreated.

_____

_____

- biological control compared to chemical control.

_____

_____ [2]

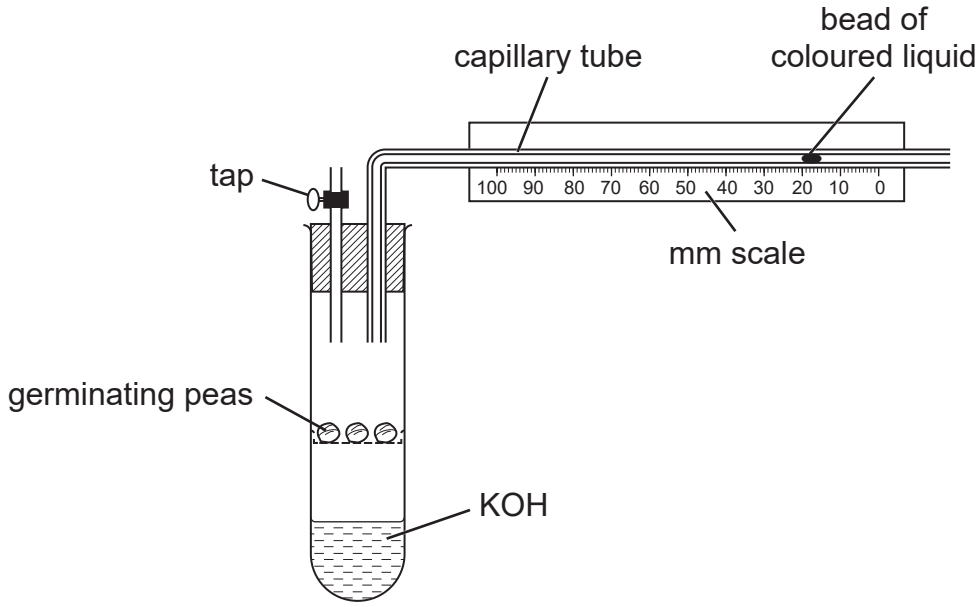
(iii) Suggest why the mean number of aphids per cm^2 of leaf was recorded rather than the mean number of aphids per leaf.

_____

_____

_____ [1]

4 A simple respirometer is shown below. Potassium hydroxide (KOH) absorbs carbon dioxide (CO_2).



(a) **(i)** Describe how the apparatus could be used to determine the respiratory quotient (RQ) of the peas.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ [5]

(ii) State **two** variables that should be controlled in this experiment.

1. _____

2. _____ [2]

To improve the reliability of the results in respirometer investigations, repeat measurements are taken.

Between repeats, the tap on the apparatus is opened to allow ‘fresh’ air to enter the test tube.

(b) Suggest and explain what would happen to the rate of respiration over time if this step was **not** taken.

_____

_____

_____

_____

_____ [2]

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(Questions continue overleaf)

5 Estimation of population size for most animal species is typically more difficult than it is for plant species.

(a) Suggest **one** reason for this.

_____

_____

_____ [1]

(b) Scientists investigated the population size of a species of woodland bird in a large wood.

Initially, 66 birds were trapped and a small ring was placed on one of the legs of each of the trapped birds. The birds were released back into the wood and, two weeks later, a second trapping exercise was carried out.

110 birds were trapped in this recapture exercise and 30% of them had leg rings.

(i) Estimate the size of the population of these woodland birds.

Show your working out.

_____ [2]

(ii) Suggest and explain the effect on the estimation of population size if the second trapping exercise was carried out two days later, rather than two weeks later.

_____

_____

_____

_____

_____ [2]

Modern rings used in bird population estimates can have an electronic chip inserted. These are similar to the chips that may be inserted into domestic pets. These chips are unique to individual birds and can be monitored remotely without requiring further re-trapping.

(c) Suggest **one** piece of additional information that chips unique to individual birds could provide.

_____

_____

_____ [1]

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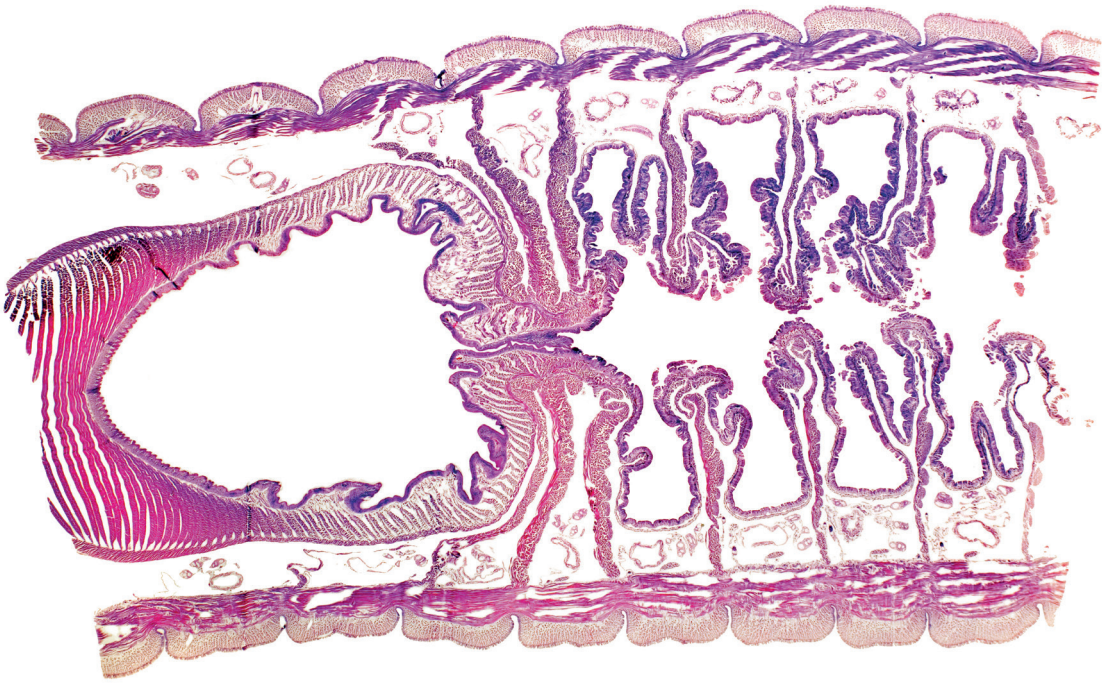
6 The photomicrograph below shows part of a longitudinal section of an earthworm (*Lumbricus terrestris*).



Source: © Dr Keith Wheeler / Science Photo Library

(a) State the phylum to which the earthworm belongs.

_____ [1]

(b) **(i)** Identify **two** features, visible in the photomicrograph, that are typical of this phylum.

1. _____

2. _____ [2]

The photomicrograph shows part of a longitudinal section.

(ii) Describe the shape of an earthworm in transverse section.

_____

_____ [1]

[Turn over

(c) In an investigation into the effect of earthworms in the soil on plant growth, two plant species were investigated, Annual Meadow-grass (*Poa annua*) and Lesser Trefoil (*Trifolium dubium*). Plant growth in both nutrient-rich and nutrient-poor soil was measured.

These results are shown in the graph overleaf along with 95% confidence limits (CL). One set of CL is not included.

$\bar{x}$	t	$\hat{\sigma}_{\bar{x}}$	Upper CL	Lower CL
13.40	2.262	0.440		

(i) Complete the table above by calculating the missing upper and lower 95% confidence limits.

Show your working out.

[2]

(ii) Complete the graph overleaf by adding the upper and lower 95% confidence limits for this mean. [1]

(iii) Briefly describe the information provided by 95% confidence limits.

_____

_____

_____ [1]

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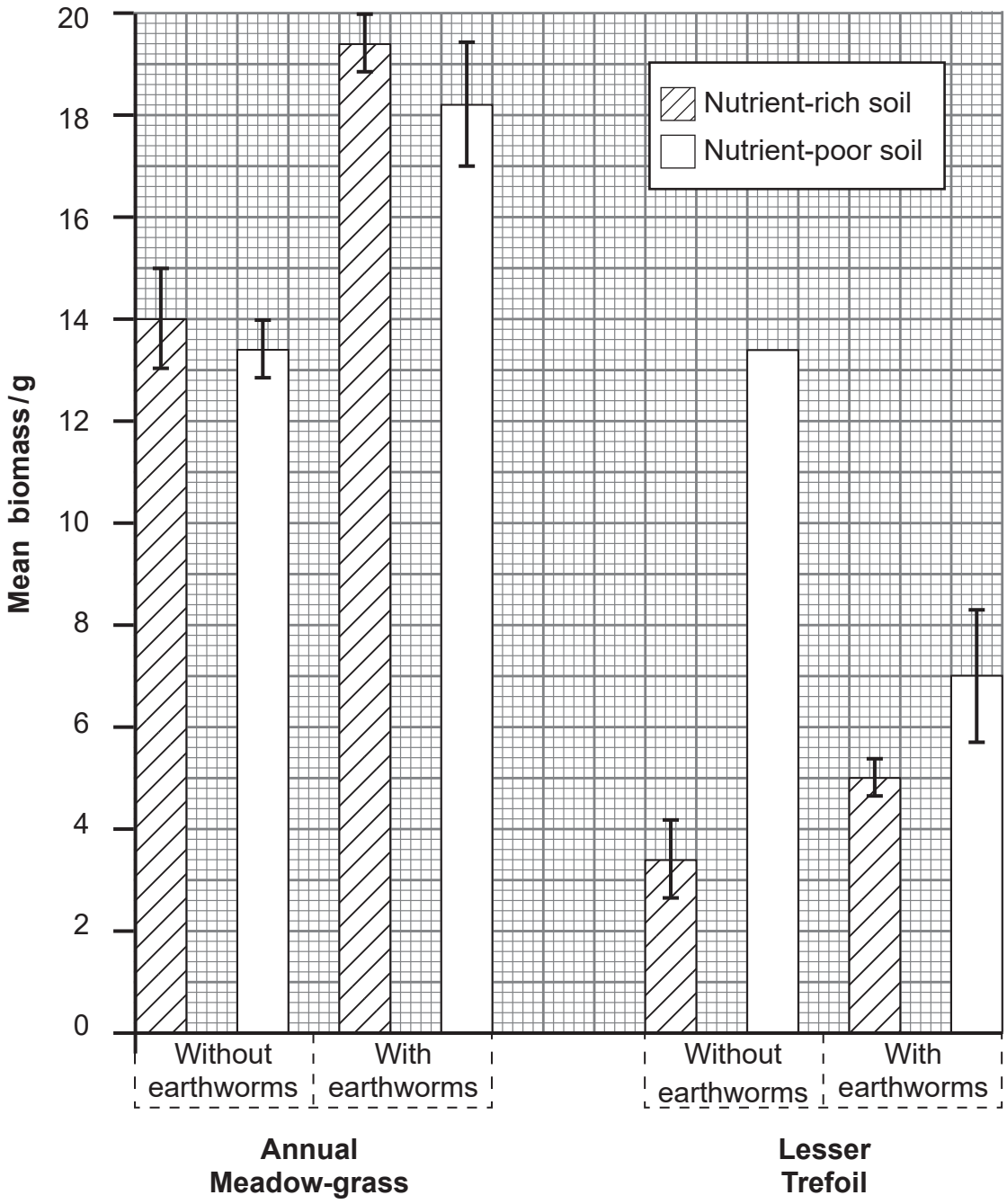
(Questions continue overleaf)

Mean biomass of Annual Meadow-grass and Lesser Trefoil grown in nutrient-rich and nutrient-poor soil, with and without earthworms



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(iv) The table below states some conclusions which can be made from the data shown in the graph.

Indicate the soil type (or types) in which each conclusion is supported by placing a tick (✔) in **one** appropriate box in each row.

	Conclusion supported in…		
Conclusion	**…nutrient-rich soil only.**	**…nutrient-poor soil only.**	**…both nutrient-rich and nutrient-poor soil.**
Mean biomass of Annual Meadow-grass is greater with earthworms than without.			
Mean biomass of Lesser Trefoil is greater with earthworms than without.			
Mean biomass of Annual Meadow-grass is greater than the mean biomass of Lesser Trefoil when earthworms are not present.			

[3]

7 **(a)** Describe how a dissection of a small animal, animal organ, or part of a plant could be carried out.

[4]

(b) The bacteria normally present in mammalian intestines are called the 'microbiome'. Antibiotic use can adversely affect diversity within the microbiome with negative consequences for health.

(i) If provided with a sample of microbiome bacteria (stock culture) and a Petri dish with nutrient agar jelly, briefly describe how a streak plate culture of these bacteria could be obtained.

_____

_____

_____

_____

_____

_____ [2]

It is important that the stock culture is not contaminated during the transfer of bacteria to the agar.

(ii) State **two** aseptic techniques which would prevent such contamination.

1. _____

_____

2. _____

_____ [2]

(c) A study was carried out by a group of researchers led by Maier *et al*. to determine the effect of antibiotics on gut bacteria. The work they carried out was published in a scientific journal as detailed below.

Maier, L., Goemans, C.V., Wirbel, J. *et al*. 'Unravelling the collateral damage of antibiotics on gut bacteria.' *Nature* 599, pp.120–124.

(i) Using the information above, state the name of the journal in which this study was published.

_____ [1]

(ii) State **one** other piece of information, normally included in a reference, which is missing from the information given.

_____ [1]

8 Paper chromatography can be used to identify the main photosynthetic pigments present in leaves. When setting up a chromatogram for this purpose, a horizontal baseline (origin) is drawn in pencil on chromatography paper and a concentrated spot of plant pigment is added to it.

(a) (i) Explain the importance of:

- having a baseline. _____

_____

- drawing the baseline in pencil. _____

_____ [2]

(ii) Following the addition of the pigment extract to the baseline, describe the steps taken to produce a paper chromatogram of plant pigments and to calculate R_f values.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ [5]

[Turn over

One solvent which can be used in plant pigment chromatography is a mixture of petroleum ether and acetone in the ratio 9:1.

(iii) Calculate the volume of each substance which would be required to make 250 cm^3 of this mixture.

Show your working out.

Petroleum ether _____ cm^3

Acetone _____ cm^3 [1]

(b) The colours and R_f values of the common pigments found in most plant species will be similar to the values in the table below.

Name of pigment	**Colour**	**R_f value**
Carotene	yellow	0.95
Xanthophyll	yellow-brown	0.71
Chlorophyll a	blue-green	0.65
Chlorophyll b	green	0.45

(i) Identify the pigment which is most soluble.

_____ [1]

Plants which are adapted to grow in shaded habitats tend to absorb more blue-green light and have greater concentrations of accessory pigments than a non-shade-adapted plant.

(ii) With reference to the pigments named in the table opposite, describe how a chromatogram of pigment extract from a shade-adapted plant would differ from a non-shade-adapted plant.

_____

_____

_____

_____

_____

_____ [2]

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For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
Total Marks	

Examiner Number

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