BIOLOGY MIND

Edexcel

A-Level

BIOLOGY

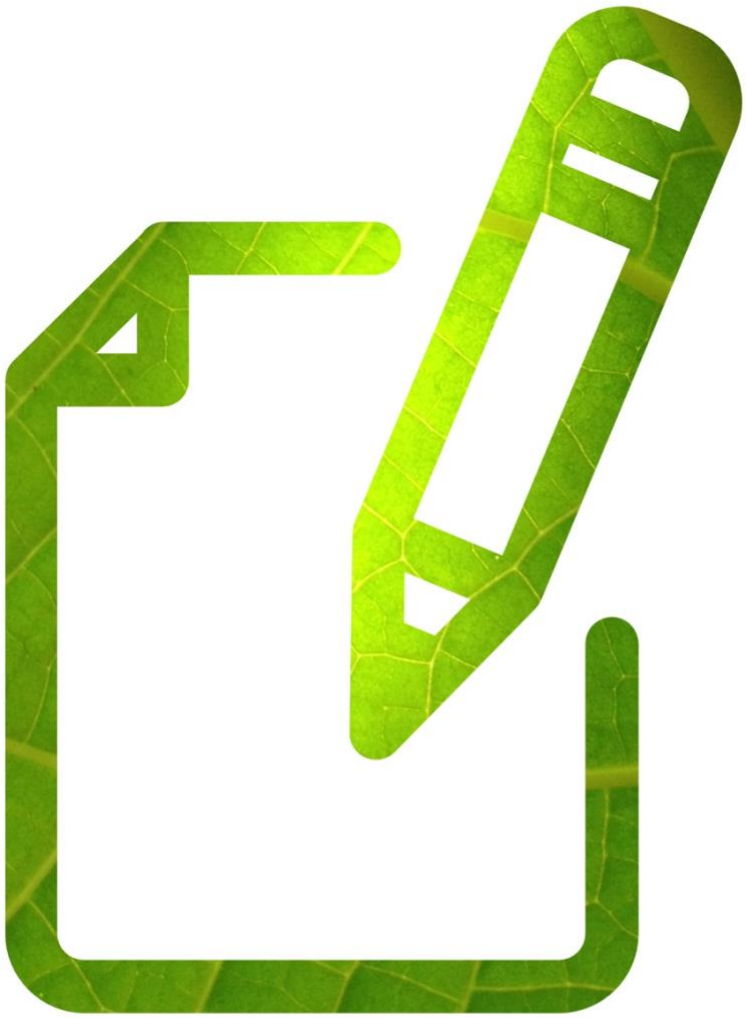
Biological Molecules

Inorganic Ions 2

Time allowed

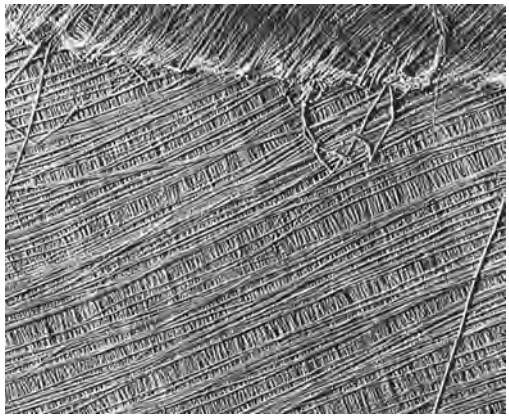
54 minutes

QUESTION PAPER



Score	Percentage
/45	%

1 The photograph below shows part of a cellulose cell wall, as seen using an electron microscope.



© Biophoto Associates/Science Photo Library

Magnification ×70 000

(a) Using the information in the photograph and your own knowledge, describe the structure of a cellulose cell wall.

(3)

(b) Cellulose can be used to produce biofuel. The xylem tissue in wood is a good source of cellulose. The cell walls of this tissue are heavily lignified.

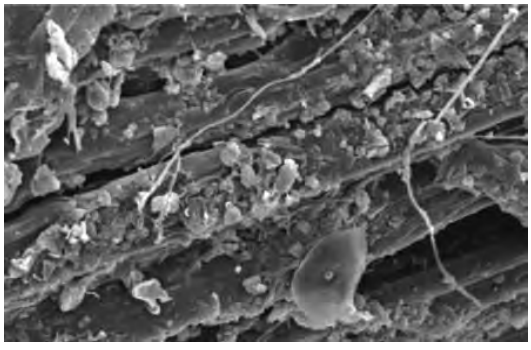
(i) Explain what is meant by the term **tissue**.

(2)

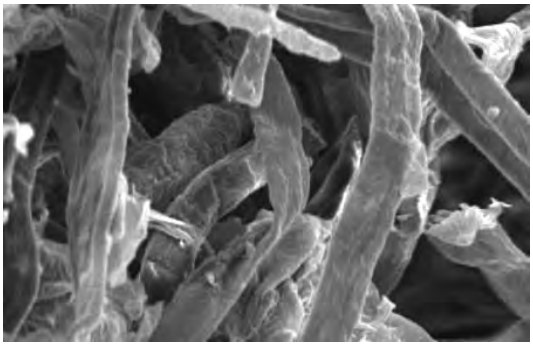
(ii) The cellulose in the xylem tissue of wood has to be broken down by enzymes before it can be used to produce biofuels.

The lignin has to be removed before the enzymes can be used to break down the cellulose.

The photographs below show fibres containing cellulose before and after the removal of lignin.



Before removal of lignin



After removal of lignin

Source: SciELO

Magnification ×500

Using the information from the photographs, suggest how lignin adds strength to xylem tissue.

(2)

(c) Mineral ions such as calcium, nitrate and magnesium are transported in the xylem vessels. These mineral ions are dissolved in water.

(i) Describe how the structure of xylem vessels allows them to transport water.

(2)

(ii) Explain how calcium, nitrate and magnesium ions are used by plants.

(3)

(Total for Question 1 = 12 marks)

2 The photograph below shows seed pods of a Canola plant (*Brassica napus*). Canola is a plant grown as a crop because the seeds are rich in oil. The extracted oil is used in cooking and as a sustainable fuel.

Magnification ×0.1

(a) Suggest why the production of oil from Canola seeds can be described as **sustainable**.

(2)

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(b) Farmers provide the plants with fertiliser containing nitrate ions.

Explain the importance of nitrate ions for the growth of plants.

(2)

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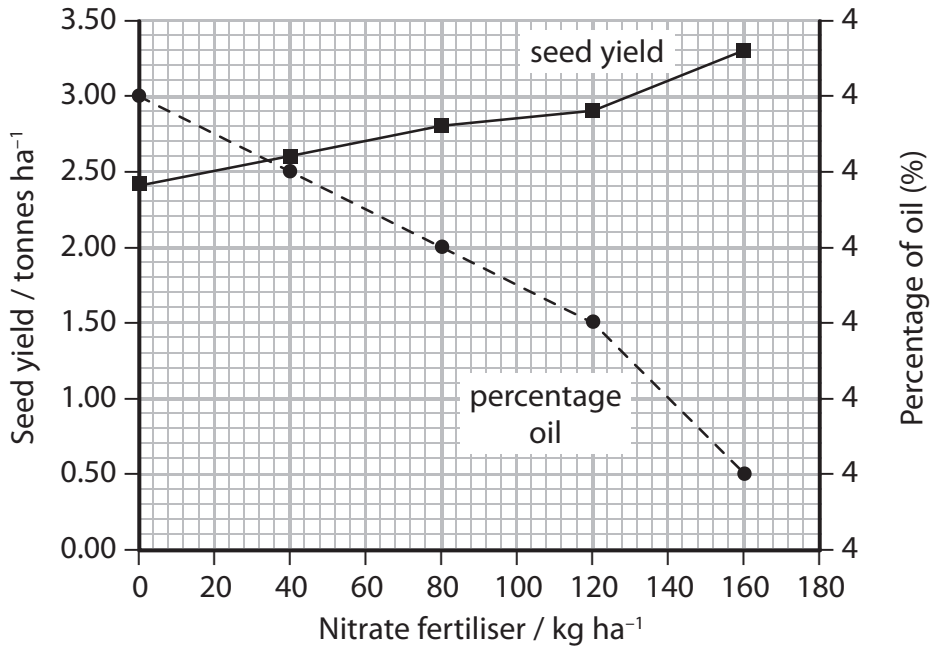
(c) Scientists carried out an investigation into the effect of nitrate fertiliser on the yield.

The graph below shows the results of this investigation.



(i) Place a cross ☒ in the box next to the correct word or words to complete the following statement.

The mass of nitrate fertiliser added and the percentage of oil produced show

(1)

☐ **A** a negative correlation

☐ **B** no relationship

☐ **C** a positive correlation

☐ **D** a proportional relationship

(ii) Using information in the graph, calculate the percentage change in seed yield when the level of nitrate fertiliser is increased from 0 to 160 kg ha^{-1}.

Show your working.

(3)

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(iii) Suggest how the scientist could have ensured that this investigation was valid.

(4)

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(Total for Question 2 = 12 marks)

3 Biofuels are being developed to reduce the effect of greenhouse gases on global warming.

(a) The list below shows some of the gases found in the atmosphere:

- carbon dioxide
- helium
- methane
- nitrogen
- oxygen

Place a cross ☒ in the box next to the number of greenhouse gases in this list.

(1)

☐ **A** 1

☐ **B** 2

☐ **C** 3

☐ **D** 4

(b) Biofuels are produced from crop plants.

Bioethanols are produced from carbohydrates, such as corn starch and sugar.

Biodiesels are produced from lipids, such as soybean oil and rapeseed oil.

(i) Describe the structure of lipids.

(2)

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(ii) The table below gives some information about the **production** of biofuels from four different crop plants.

Crop plant	Carbon dioxide emissions from the production of biofuels / kg per MJ of energy produced	Level of resources used in production of biofuels		
		water	fertilisers	pesticides
Corn	81 to 85	High	High	High
Sugar cane	4 to 12	Medium to low	High	Medium
Soy	49	High	Low to medium	Medium
Rape	37	High	Medium	Medium

Using the information in the table, discuss the advantages of producing biodiesels instead of bioethanols.

(3)

(iii) Fertilisers contain inorganic ions. Name **three** inorganic ions that could be contained in the fertilisers and explain how these would improve the yield of the crop plants.

(4)

(Total for Question 3 = 10 marks)

4 Following the extraction of coal from the ground in the United Kingdom, the unwanted material was usually deposited in large heaps known as bings. Most of the material in a bing is shale fragments composed of minerals and clay.

There have been a number of studies of the colonisation and the development of plant communities on bings. In these studies, the approximate age of the bing can be estimated by reference to the type of plant community growing on the bing. This is shown in the table below.

Type of plant community	Approximate age of bing / years
Lichens and mosses	3 – 15
Grasses and small herbs	15 – 40
Grasses, small herbs and large herbs	40 – 70
Small trees and shrubs	60 – 80
Large trees, small trees and shrubs	80 – more than 100

(a) Place a cross ☒ in the box next to the mineral ion that would need to be present if plants, such as grasses and herbs, are to grow successfully on a bing.

(1)

☒ **A** Copper

☒ **B** Nitrates

☒ **C** Sodium

☒ **D** Sulphites

(b) Place a cross ☒ in the box that describes the gradual change in the type of plant community growing on a bing.

(1)

☒ **A** Endemism

☒ **B** Evolution

☒ **C** Phylogeny

☒ **D** Succession

*(c) With reference to the information in the table, suggest why the type of plant community growing on a bing changes over time.

(5)

(d) After 100 years, the community on a bing becomes stable.
State the term used to describe this type of community and explain why it is stable.

(4)

(Total for Question 4 = 11 marks)