Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Time 1 hour 45 minutes

Paper reference **WBI14/01**

Biology

International Advanced Level
UNIT 4: Energy, Environment, Microbiology and Immunity

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- **Show all your working out** in calculations and **include units** where appropriate.

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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B:1/1/1/1/1/

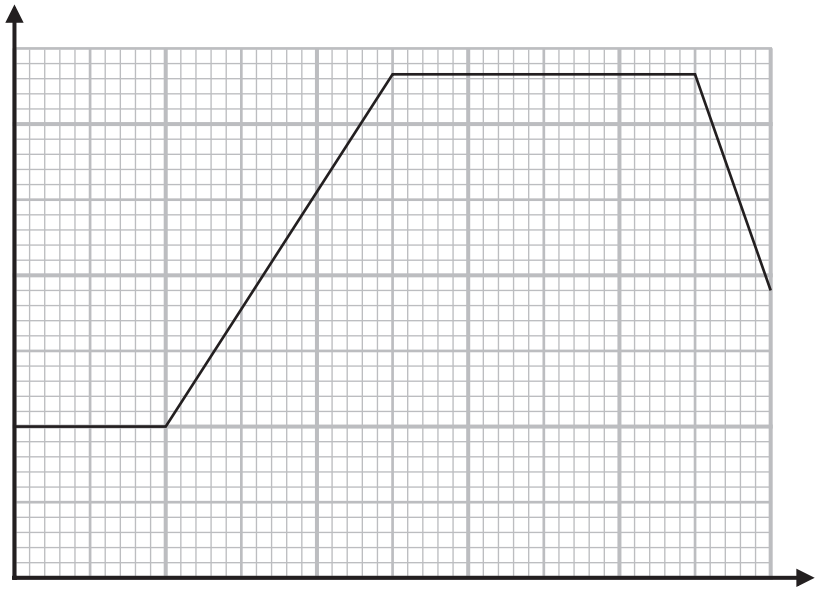
P 7 1 8 4 8 A 0 1 3 2

Pearson

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 The graph shows a bacterial growth curve, produced by counting the number of bacterial colonies using the dilution plating technique.



Time / hours

(a) Which label should be used for the y-axis of this graph?

(1)

☒ **A** $\log_{10}$ number of living bacterial cells

☒ **B** $\log_{10}$ total number of bacterial cells

☒ **C** number of living bacterial cells

☒ **D** total number of bacterial cells

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(b) When culturing microorganisms, it is important that an aseptic technique is used.

(i) Explain the importance of using an aseptic technique.

(2)

(ii) Explain **two** aseptic techniques that should be used in dilution plating.

(2)

(Total for Question 1 = 5 marks)

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2 The following features of viruses can be used to classify them:

- the type of nucleic acid they contain
- the arrangement of the proteins in their capsid
- the presence or absence of an envelope
- the enzymes they contain.

(a) For each structure, put one cross ☒ in the appropriate box, in each row, to show which viruses have that structure.

(3)

Structure	Virus			
	Ebola only	**HIV only**	**both Ebola and HIV**	**neither Ebola nor HIV**
DNA	☒	☒	☒	☒
helical capsid	☒	☒	☒	☒
envelope	☒	☒	☒	☒

(b) Human cells contain several types of DNA polymerase.

One type of DNA polymerase, found in some cancer cells, has been shown to synthesise DNA from an RNA template.

(i) Name the enzyme, found in some types of virus, that can synthesise DNA from an RNA template.

(1)

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(ii) Suggest why this DNA polymerase may be a target for drugs used to treat cancer.

(1)

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(Total for Question 2 = 5 marks)

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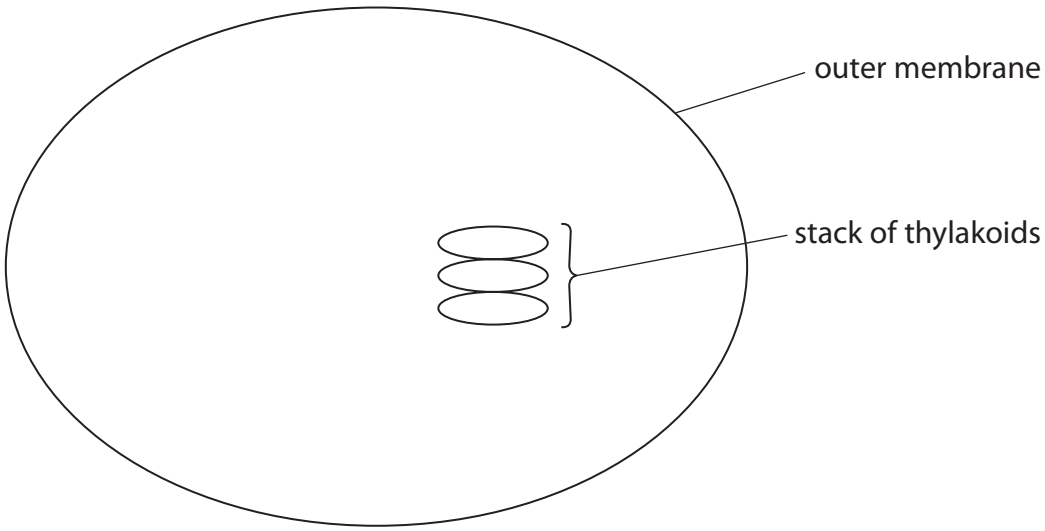
3 Chloroplasts are involved in both the light-dependent reactions and the light-independent reactions of photosynthesis.

(a) Which row of the table is correct for these two reactions?

(1)

	Light-dependent reactions	Light-independent reactions
☒ **A**	ADP is phosphorylated, releasing energy	ATP is hydrolysed, requiring energy
☒ **B**	ADP is phosphorylated, requiring energy	ATP is hydrolysed, releasing energy
☒ **C**	ATP is hydrolysed, releasing energy	ADP is phosphorylated, requiring energy
☒ **D**	ATP is hydrolysed, requiring energy	ADP is phosphorylated, releasing energy

(b) The diagram shows part of a chloroplast.



(i) Complete this diagram to show **three** other labelled structures found in a chloroplast.

(3)

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(ii) Compare and contrast the structure of the outer membrane of a chloroplast with that of a thylakoid membrane.

(4)

(Total for Question 3 = 8 marks)

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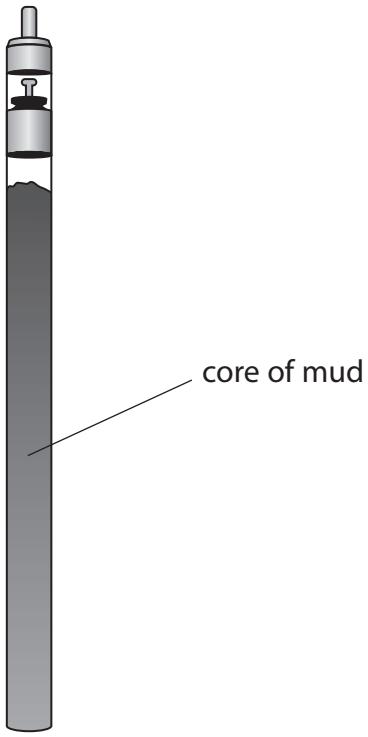
4 Scientists have used specialised apparatus to remove cores of mud from a tropical rainforest in the Republic of the Congo.

The diagram shows the apparatus containing a core of mud.



(a) The core of mud removed has a diameter of 80 mm and a length of 900 mm.

Which is the volume of this core of mud?

Use the formula: $V = \pi r^2 l$

Use $\pi = 3.142$

(1)

☒ **A** 4524 cm^3

☒ **B** 4525 cm^3

☒ **C** 18 097 cm^3

☒ **D** 18 098 cm^3

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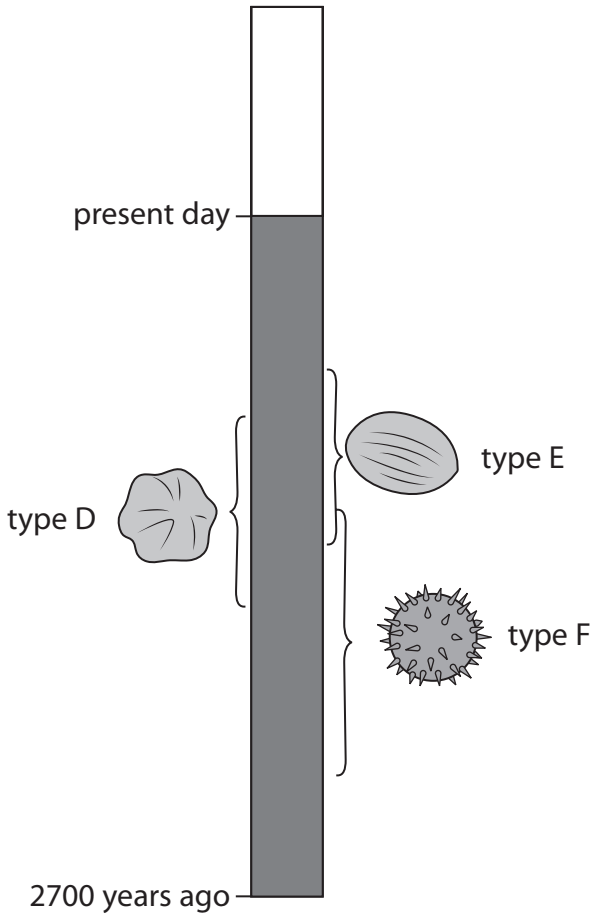
(b) The scale diagram shows where three types of pollen grain were found in a core of mud.

The depth of the mud is proportional to how long ago the mud was deposited.



(i) Calculate how many years the plants producing type D pollen grains were present in this rainforest.

(2)

Answer ..... years

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(ii) Explain the distribution of these three types of pollen grain in this mud column.

Use the information in this diagram to support your answer.

(4)

(Total for Question 4 = 7 marks)

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5 Human serum albumin is a globular protein found in blood plasma.

Albumin has a molecular mass of 66 300 daltons.

It consists of 585 amino acids.

At pH 7.4 albumin has over 200 negative charges on the surface of each molecule.

(a) (i) Calculate the mean molecular mass of an amino acid in albumin.

Give your answer to an appropriate number of significant figures.

(1)

Answer ..... daltons

(ii) Explain why albumin is soluble in blood plasma.

(2)

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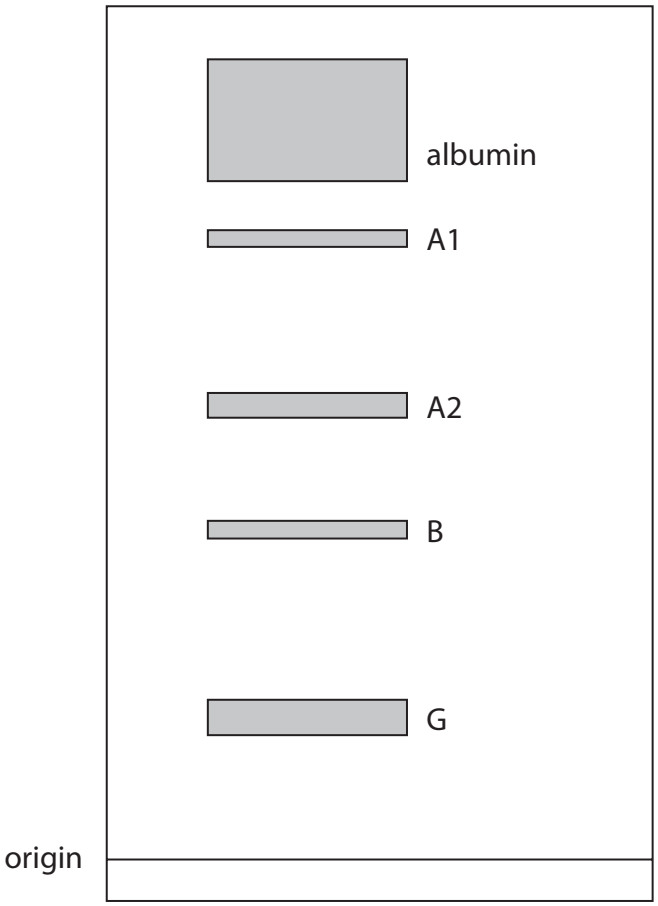
(b) Albumin can be separated from other proteins in blood plasma, A1, A2, B and G, by gel electrophoresis.

The diagram shows the banding pattern produced on separation of these proteins by gel electrophoresis.



(i) Protein G has a concentration in blood plasma in the range 0.700 g dm^{-3} to 1.700 g dm^{-3}.

Albumin has a concentration in blood plasma in the range 0.525 g dm^{-3} to 1.275 g dm^{-3}.

Calculate the maximum difference in the concentration of these two proteins.

(1)

Answer ..... g dm^{-3}

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(ii) Describe the conclusions that can be made about albumin, compared with the other four proteins present in blood plasma.

Use the information in the diagram to support your answer.

(3)

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(c) Albumin binds to and activates a proton channel, hHv1.

This proton channel is present in the membranes of sperm cells. When the channel is activated, sperm cells have the ability to penetrate and fertilise egg cells.

Sperm cells are released in a liquid called seminal fluid. Seminal fluid has an albumin concentration of 15 μmol dm^{-3}.

The fluid inside the uterus of the female has an albumin concentration of 500 μmol dm^{-3}.

Explain the role of albumin concentration in controlling fertilisation.

(4)

(Total for Question 5 = 11 marks)

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6 Alzheimer's disease is a cause of dementia in older people.

The neurones in the brain are damaged and eventually destroyed.

Abnormal plaques are seen in the brains of people with Alzheimer's disease. These plaques are made of a protein called ß-amyloid.

Drug ATD is a new drug used to treat people with Alzheimer's disease.

This drug is an antibody that is specific for ß-amyloid.

(a) Drug ATD was recently approved for the treatment of Alzheimer's disease.

Describe the information that had to be collected by scientists before this drug could be approved.

(3)

(b) (i) Explain the phrase: 'an antibody that is specific for ß-amyloid'.

(2)

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(ii) Drug ATD reduces the build-up of ß-amyloid in the brains of people with Alzheimer's disease.

Suggest how drug ATD could result in the reduction of the build-up of ß-amyloid.

(3)

(c) Drug ATD was derived from a B memory cell taken from an elderly person who showed no signs of Alzheimer's disease.

(i) Suggest why this person did not have Alzheimer's disease.

(2)

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(ii) Explain why this drug could be produced only from B memory cells taken from a person who did not have Alzheimer's disease.

(2)

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(Total for Question 6 = 12 marks)

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7 Methicillin-resistant Staphylococcus aureus (MRSA) is a disease causing worldwide concerns.

Methicillin is one of the antibiotics to which this pathogen has developed resistance.

Castaneroxy A is a molecule extracted from the European chestnut tree, endemic to Southern Europe and Turkey.

The effects of Castaneroxy A have been investigated.

The investigations have found that Castaneroxy A:

- does not affect the natural skin flora
- prevents MRSA from producing toxins
- weakens the MRSA bacteria
- reduces the size of skin infections caused by MRSA.

(a) Explain why the development of this drug is an example of an 'evolutionary race' between humans and this pathogen.

(2)

(b) Explain why it is important that Castaneroxy A does not affect skin flora.

(2)

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(c) Suggest how weakening the MRSA bacteria could help the recovery of a patient infected with this bacteria.

(2)

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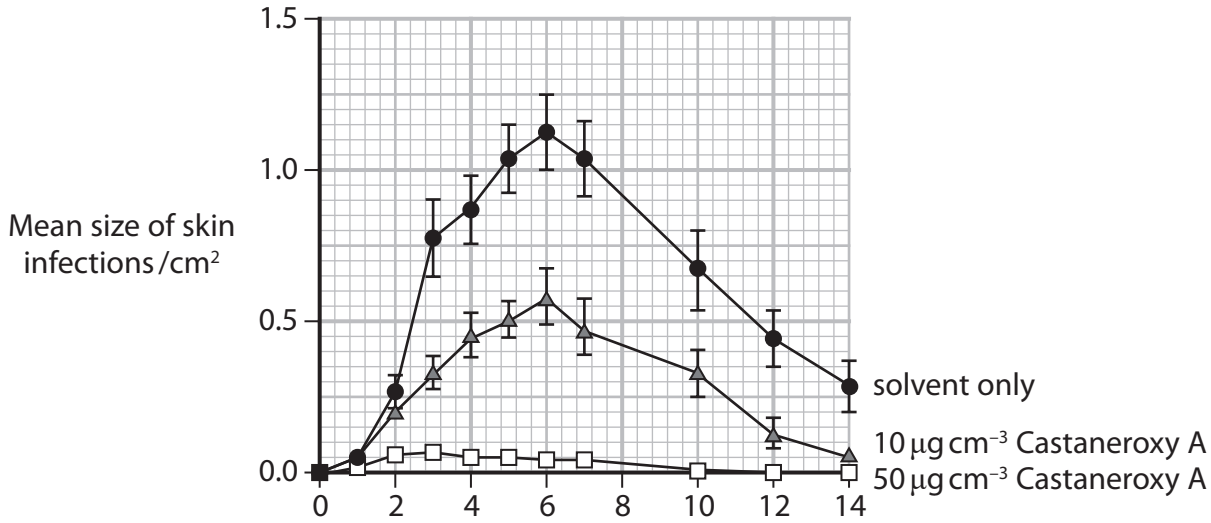
(d) In an investigation, patients who had developed skin infections were divided into three groups.

Two groups were each treated with a different concentration of Castaneroxy A. The other group was treated with only the solvent that was used in the treatment.

The graph shows the results of these treatments on the mean size of the skin infections.



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(i) Explain why this investigation included treatment with the solvent only.

(2)

(ii) Determine the effect that Castaneroxy A has on the mean size of skin infections.

(3)

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(iii) The leaves of the chestnut tree contain 0.0019 %, by mass, of Castaneroxy A.

Calculate the mass of leaves, in kilograms, that would be needed to produce 1 dm^3 of Castaneroxy A at a concentration of 50 $\mu g\, cm^{-3}$.

Give your answer to the nearest kilogram.

(3)

Answer ..... kg

(Total for Question 7 = 14 marks)

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8 There has been an increase in the number of forest fires in many areas of the world.

Climate change caused by humans is claimed to be responsible for this.

The photograph shows the devastation caused by a forest fire in Myanmar.



(Source: © robertharding/Alamy Stock Photo)

(a) (i) State the term used to describe climate change caused by human activity.

(1)

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(ii) Explain why some people consider this claim to be controversial.

(2)

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*(b) Discuss the effects that forest fires have on the local atmosphere and local biodiversity, in the short term and the long term.

(6)

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(c) Reforestation is one way to repair the damage caused to forests by climate change.

Explain why the changes to the environment caused by climate change need to be considered when selecting the species of trees to use in reforestation.

(4)

(Total for Question 8 = 13 marks)

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9 Plants store biomass both above and below ground.

(a) Scientists have found that on average, 24 % of plant biomass is underground in the roots.

The total plant biomass underground contains 113 gigatonnes of carbon. This is equivalent to the mass of carbon dioxide emissions produced by humans in 10 years.

One gigatonne is 1×10^{12} kg.

Calculate the mass of carbon dioxide, in kilograms, produced by humans in one year.

Give your answer in standard form.

(2)

Answer ..... kg

(b) Describe how GALP, produced in the leaves, becomes incorporated into biomass in the roots.

(4)

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(c) Inorganic ions are used by plants to make molecules.

The table shows some molecules made by plants.

For each molecule, put one cross ☒ in the appropriate box, in each row, to show which inorganic ion provides an atom found in the molecule.

(3)

Molecule	Inorganic ion			
	nitrate only	phosphate only	both nitrate and phosphate	neither nitrate nor phosphate
cellulose	☒	☒	☒	☒
nucleic acid	☒	☒	☒	☒
triglyceride	☒	☒	☒	☒

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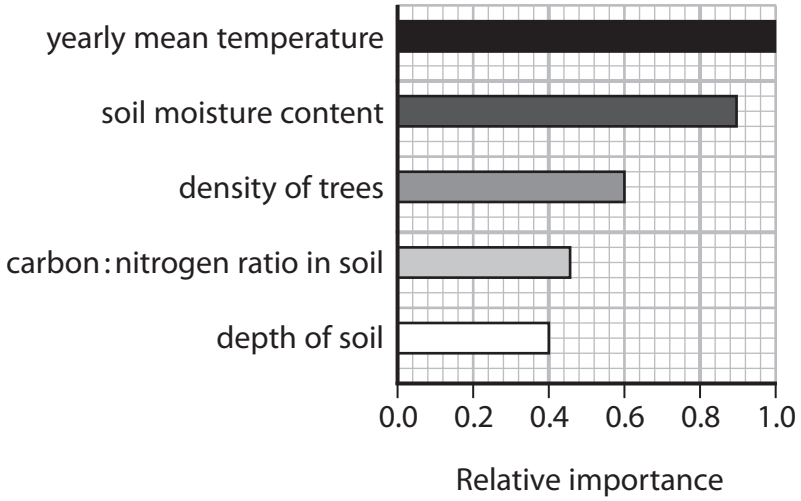
*(d) Forests, shrublands and grasslands are three types of ecosystem.

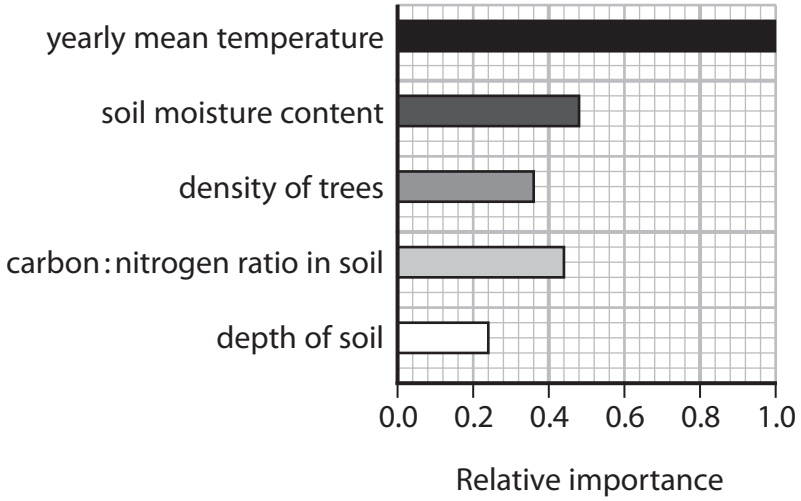
Biotic and abiotic factors affect how much biomass is stored in the roots of plants.

The graphs show the importance of some abiotic factors in determining how much biomass is stored in the roots in these ecosystems.

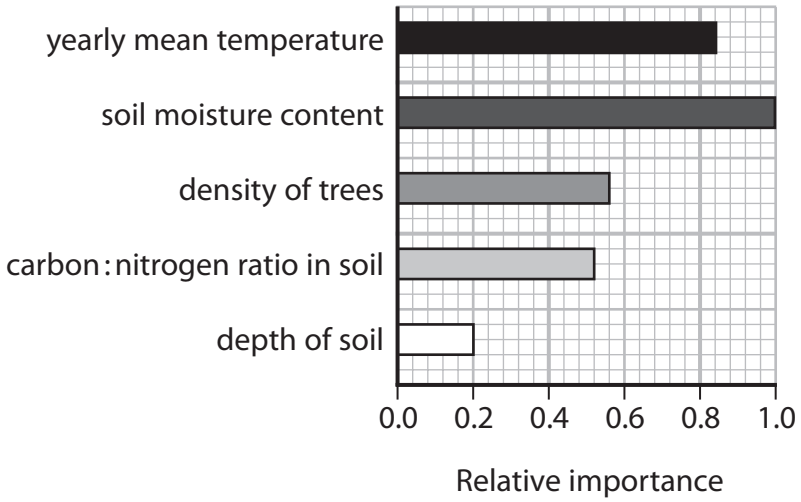
Forests



Shrublands



Grasslands



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Discuss how these factors could affect the proportion of biomass stored in the roots of plants growing in these three ecosystems.

(6)

(Total for Question 9 = 15 marks)

TOTAL FOR PAPER = 90 MARKS

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