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Other names

Pearson Edexcel
Level 3 GCE

Centre Number

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Biology A (Salters Nuffield)

Advanced

Paper 1: The Natural Environment and Species Survival

Thursday 7 June 2018 – Morning

Time: 2 hours

Paper Reference

9BN0/01

You must have:

Calculator, HB pencil, ruler

Total Marks

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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.
- Show your working in any calculation questions and include units in your answer where appropriate.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- You may use a scientific calculator.
- 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.

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

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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Answer ALL questions.

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 ☒.

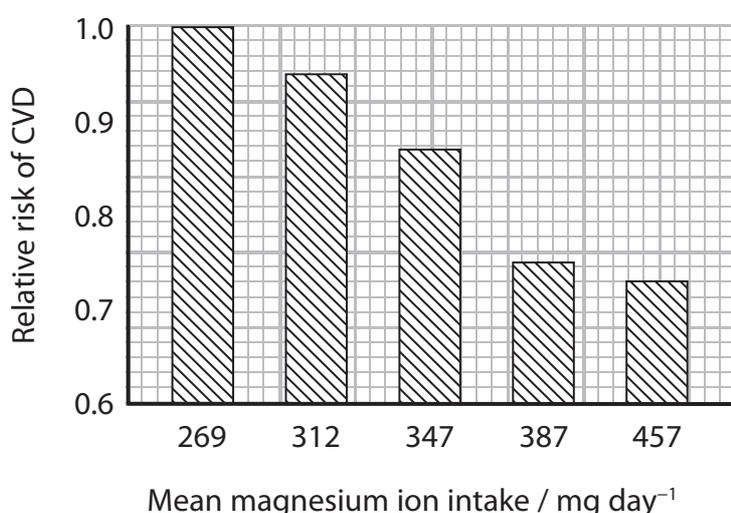
1 Cardiovascular disease (CVD) is a major cause of death and disability in the UK.

(a) The relationship between magnesium ions in the diet and CVD has been studied.

In one study, magnesium ions were added to the diets of a group of men.
The effect of this on the relative risk of CVD was recorded.

The mean normal dietary intake of magnesium ions is 269 mg day^{-1} .

The results of the study are shown in the graph.



(i) Which of the following statements can be made about the relationship between an increased magnesium ion intake and the risk of CVD in this study?

(1)

An increased magnesium ion intake

- A** causes an increase in CVD
- B** causes a reduction in CVD
- C** is correlated with an increase in CVD
- D** is correlated with a reduction in CVD

(ii) What is the daily increase in magnesium ion intake that reduces the relative risk of CVD by 0.13?

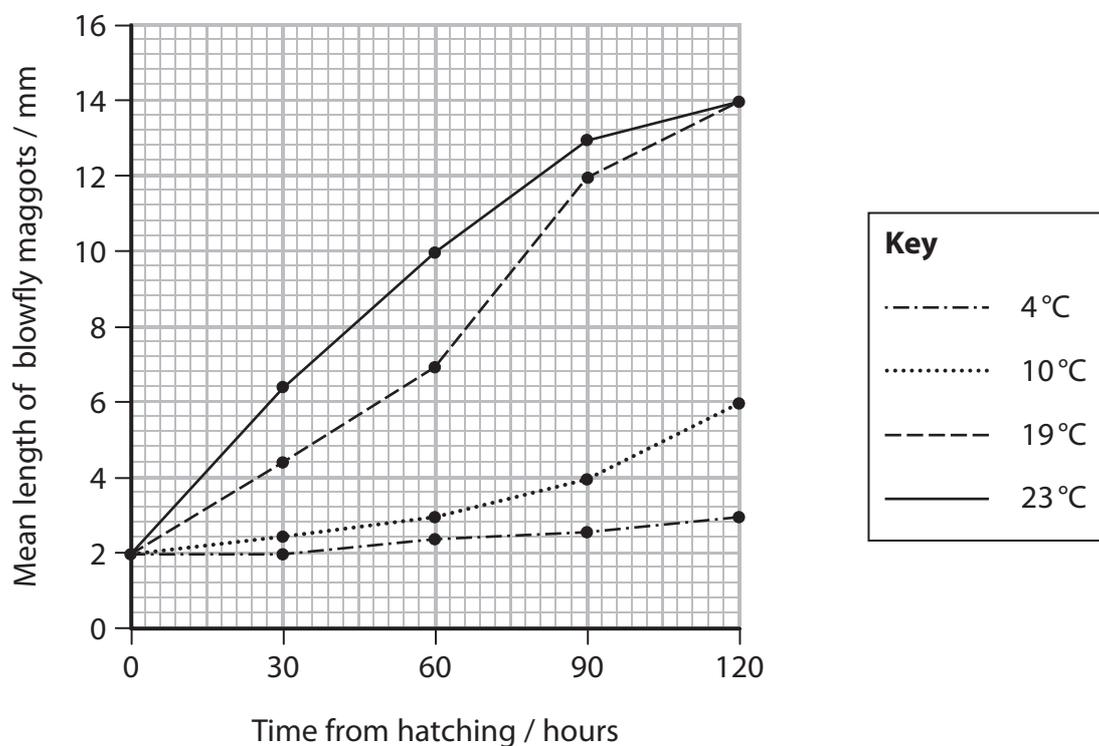
(1)

- A** 43 mg day^{-1}
- B** 78 mg day^{-1}
- C** 118 mg day^{-1}
- D** 347 mg day^{-1}



2 One method of estimating the time of death is to determine the age of blowfly maggots on a dead body.

(a) The effect of environmental temperature on the growth of blowfly maggots is shown in the graph.



(i) Blowfly maggots found on a dead body had lengths between 3 and 8 mm. The body had been at a constant environmental temperature of 19°C since death.

Determine the maximum time since these maggots hatched.

(1)

..... hours

(ii) Determine the fastest rate of growth of a blowfly maggot at a temperature of 19°C.

Give your answer to 2 significant figures.

(2)

..... mm hour⁻¹



(iii) Explain the effect of temperature on the rate of growth of blowfly maggots.

(3)

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(b) Microorganisms are also found on a dead body.

Describe the role of decomposers, such as microorganisms, in the carbon cycle.

(2)

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(Total for Question 2 = 8 marks)



3 A newborn baby can respond to infections.

(a) The mother of a baby will produce an immune response to any infections that she acquires.

Antibodies providing specific immunity to these infections are found in the milk produced by the mother.

(i) Which cell produces antibodies? (1)

- A macrophage
- B plasma cell
- C red blood cell
- D T cell

(ii) The type of immunity that the newborn baby obtains from the milk produced by its mother is (1)

- A artificial active immunity
- B artificial passive immunity
- C natural active immunity
- D natural passive immunity

(b) Inflammation is a non-specific response to an infection.

Explain how changes in the blood vessels result in the redness and swelling seen at the site of inflammation.

(4)

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(c) Interferon is involved in the response to viral infections.

(i) The influenza virus can be lethal to mice.

The effects of interferon on influenza infection in mice was investigated.

Mice were infected with influenza virus and then given interferon.

The results of the investigation are shown in the table.

Interferon dose / units per mouse	Median survival time / days
No dose	3.3
8×10^3	4.4
8×10^4	8.5
8×10^5	>42

Explain these results.

(3)

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(ii) Interferon can be used to treat people with viral hepatitis.

Interferon can be made by animal cells or by genetically modified bacteria.

The table shows information about interferon made by these animal cells and genetically modified bacteria.

Source of interferon	Type of molecule	Folding	Antiviral activity
Animal cells	Glycoprotein	Correctly folded	High
Genetically modified bacteria	Protein	Incorrectly folded and needs to be refolded before it can be used	Low

Explain why the interferon made by genetically modified bacteria is different from the interferon made by animal cells.

(2)

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(iii) Glycoproteins made in animal cells are released into the extracellular fluid by

(1)

- A endocytosis
- B exocytosis
- C facilitated diffusion
- D phagocytosis

(Total for Question 3 = 12 marks)



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4 Leptin is a protein hormone with a role in the control of appetite in humans.

(a) The leptin gene is located on chromosome 17.

(i) State what is meant by the term gene.

(2)

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(ii) Describe the role of tRNA in the production of leptin.

(3)

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(iii) Describe how the primary structure of leptin enables it to be soluble in water.

(3)

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5 Cigarette smoking is associated with several medical problems.

In an investigation, some female mice were exposed to cigarette smoke during pregnancy.

The ability of their male offspring to produce sperm and the activity of the sperm were investigated.

The results of this investigation are shown in the table.

Group	Percentage of sperm that are motile (%)	Ability of sperm to cross the zona pellucida of an egg cell	Percentage of stem cells producing sperm in the testes (%)
Offspring of control mice	68	Good	100
Offspring of mice exposed to cigarette smoke	45	Poor	40

- (a) Analyse the data to explain why exposing pregnant mice to cigarette smoke affects the fertility of their male offspring.

(3)

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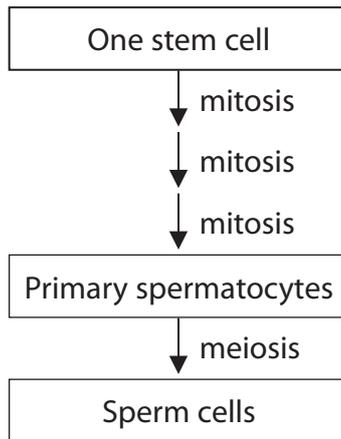
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(b) Sperm are produced from stem cells in a process that involves several cycles of mitosis and a single cycle of meiosis, as shown in the diagram.



(i) State what is meant by the term stem cell.

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6 Tuberculosis (TB) is an infectious disease caused by mycobacteria.

(a) Most cases of TB are caused by infection with *Mycobacterium tuberculosis* (*M. tuberculosis*).

The ribosomes of bacteria are

(1)

- A larger than the ribosomes in eukaryotes
- B smaller than ribosomes in eukaryotes
- C the same size as ribosomes in animal cells
- D the same size as ribosomes in plant cells

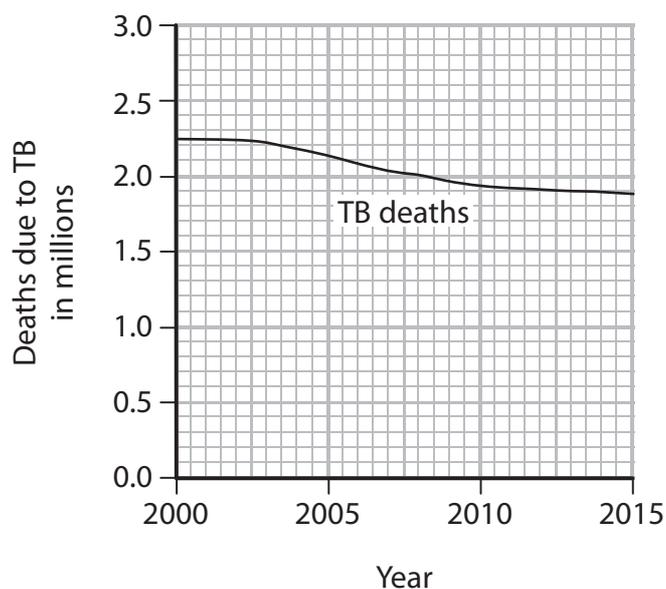
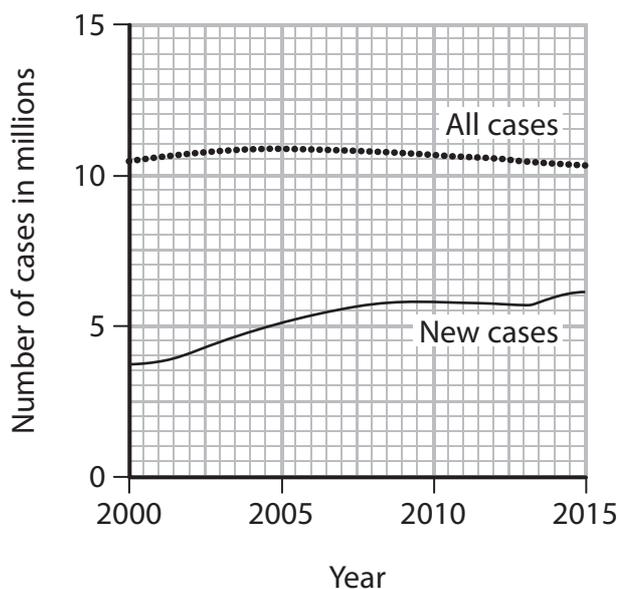


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(b) The graphs show the number of cases of TB and the number of deaths from TB worldwide from 2000 to 2015.



In 1993 the World Health Organisation (WHO) declared TB a global public health emergency. Since then, there has been a programme to reduce the impact of this disease.

Analyse the data to deduce the effectiveness of this programme.

(3)

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*(c) Individuals infected with *M. tuberculosis* can be treated with antibiotics.

Four of the antibiotics used to treat TB are shown in the table.

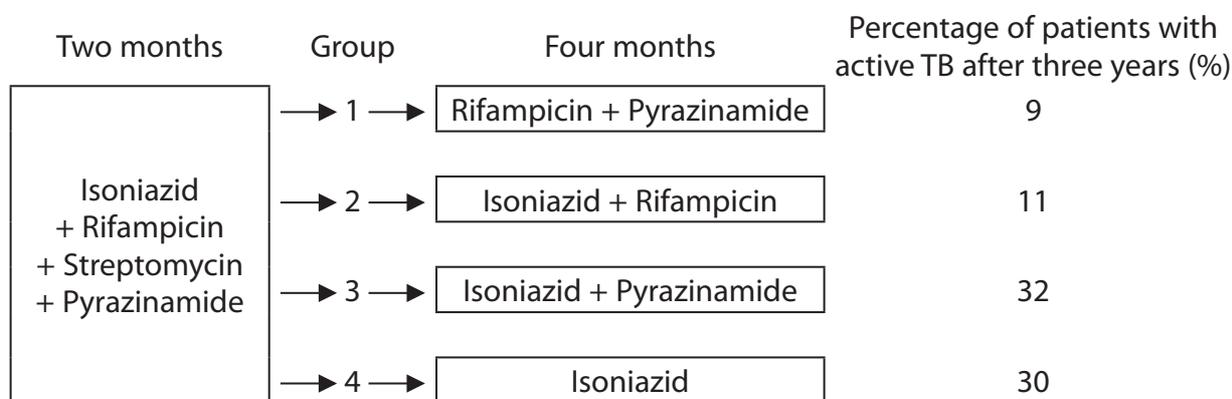
Antibiotic	Mechanism of action
Isoniazid	Inhibits the synthesis of a fatty acid needed to make bacterial cell walls
Rifampicin	Inhibits bacterial RNA polymerase
Streptomycin	Binds to bacterial ribosomes to prevent the binding of tRNA
Pyrazinamide	Not yet known, but not the same mechanisms as the other three antibiotics

In one clinical trial lasting six months, the effect of treating TB with these antibiotics was investigated.

All patients were treated with all four antibiotics for two months. Then they were treated with different pairs of antibiotics or isoniazid alone for a further four months.

All patients were free of any signs of active TB at the end of the clinical trial.

The design of the trial and the percentage of these patients with TB three years after the trial ended are shown in the diagram.



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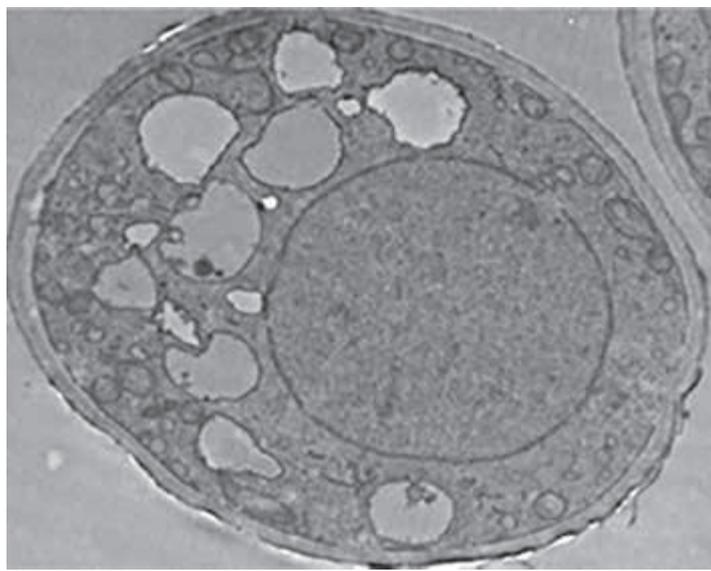
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7 *Hymenoscyphus fraxineus* (*H. fraxineus*) is the fungus that causes ash dieback. This disease usually kills all the ash trees that it infects.

(a) The electron micrograph shows a section through a fungal cell.



Magnification $\times 1000$

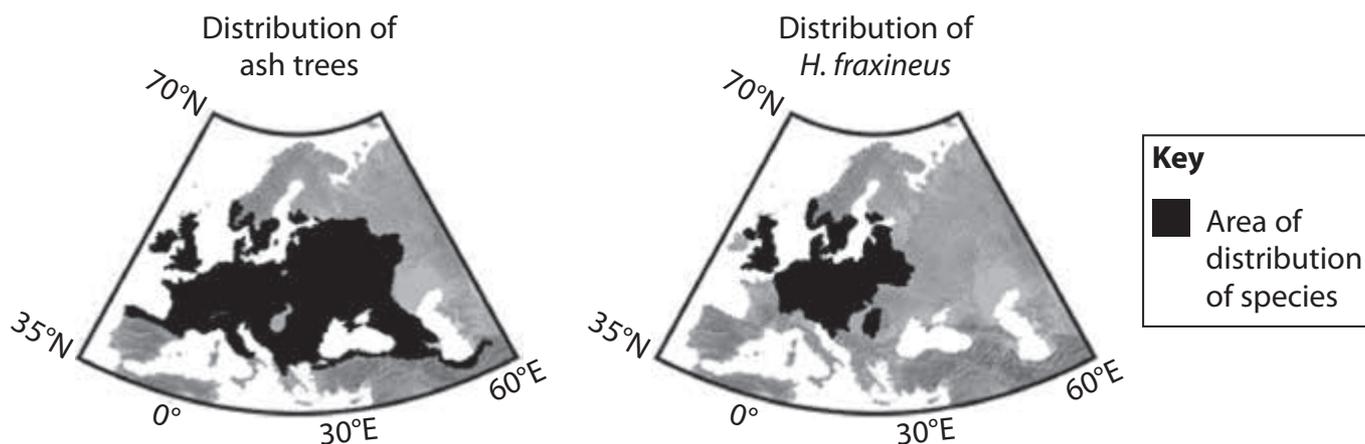
To which group do fungi belong?

(1)

- A Archaea
- B Eukaryota
- C Prokaryota
- D Viruses



(b) The diagrams show the distribution of ash trees and *H. fraxineus* in 2007.



In 2007 the mean atmospheric carbon dioxide concentration was 398 ppm.

Models have been used to predict the effect of increasing atmospheric carbon dioxide concentration on the distribution of ash trees and *H. fraxineus*.

The table shows these predictions.

Concentration CO ₂ / ppm	Predicted region suitable for ash trees	Predicted region suitable for <i>H. fraxineus</i>	Predicted distribution of ash trees
430			
1080			

(i) Which of the following is an abiotic factor that should be considered in the model?

(1)

- A ash tree resistance to *H. fraxineus*
- B *H. fraxineus* pathogens
- C humidity
- D ocean pH



8 Trypsin is an enzyme found in many groups of living organisms.

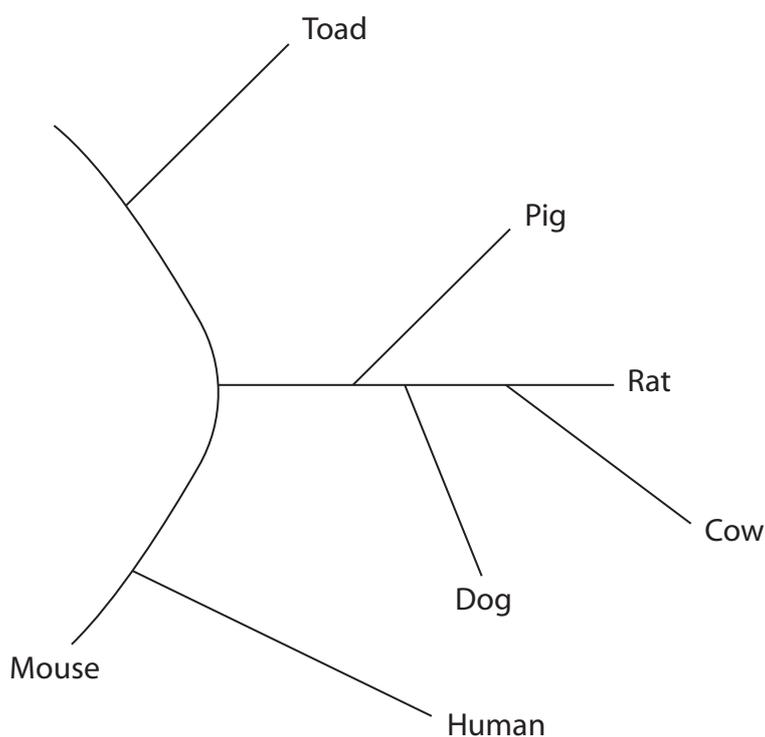
Trypsin specifically acts on a polypeptide to form amino acids.

(a) State the type of chemical reaction catalysed by trypsin.

(1)

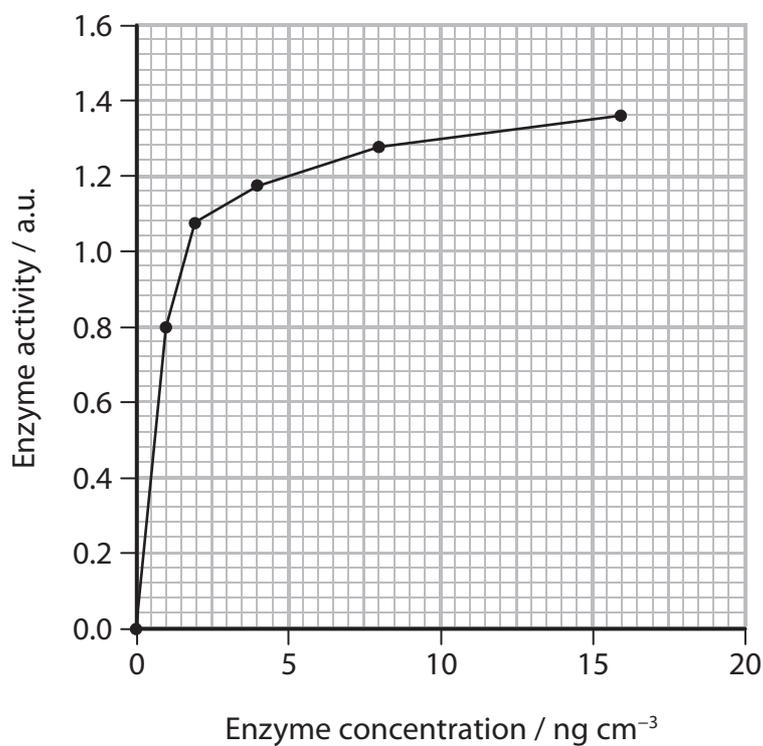
(b) The primary structures of trypsin molecules from different species have been used to produce a phylogenetic tree for trypsin.

Each branch of the following phylogenetic diagram represents trypsin from a different species.



(d) In an experiment, the effect of enzyme concentration on the activity of human trypsin was measured.

The results are shown in the graph.



Explain which range of enzyme concentrations should be used to compare the activity of trypsin from different species.

(2)

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(Total for Question 8 = 9 marks)



9 Tropical rainforests play a role in maintaining biodiversity and in storing carbon.

(a) In a mature tropical rainforest, there is no net increase in biomass.

(i) Which statement describes the role of photosynthesis in the carbon cycle? (1)

- A carbon dioxide is oxidised to form organic molecules
- B carbon dioxide is reduced to form organic molecules
- C organic molecules are combusted to produce carbon dioxide
- D organic molecules are decomposed to release carbon dioxide

(ii) The gross primary productivity (GPP) for one mature tropical rainforest was found to be 24 800 kJ m⁻² year⁻¹. It was estimated that 65% of GPP was used in respiration.

Calculate the energy transferred to the next trophic level. (2)

..... kJ m⁻² year⁻¹

(b) Explain how reforestation of tropical rainforests can be used to minimise climate change. (3)

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(c) Information on biodiversity has been collected from various rainforest habitats in Madagascar.

(i) Describe what needs to be measured in order to compare the biodiversity of two rainforests.

(2)

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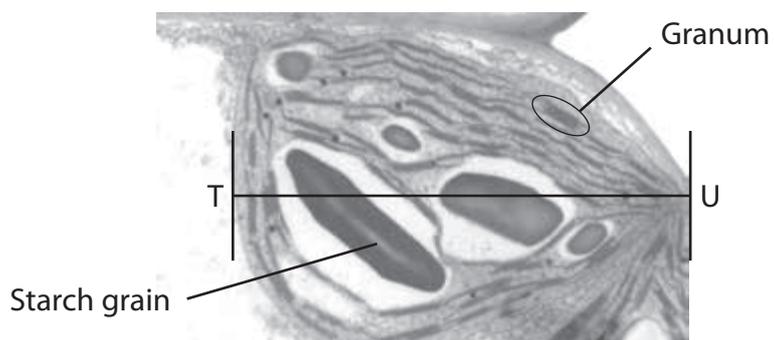
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10 Photosynthesis is a process that occurs in all green plants.

The electron micrograph shows part of a chloroplast in a plant cell.



(a) (i) The labelled starch grain in the chloroplast is $2.2 \mu\text{m}$ long.

Calculate the width of this chloroplast between T and U.

(2)

..... μm



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(Total for Question 10 = 15 marks)

TOTAL FOR PAPER = 100 MARKS



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