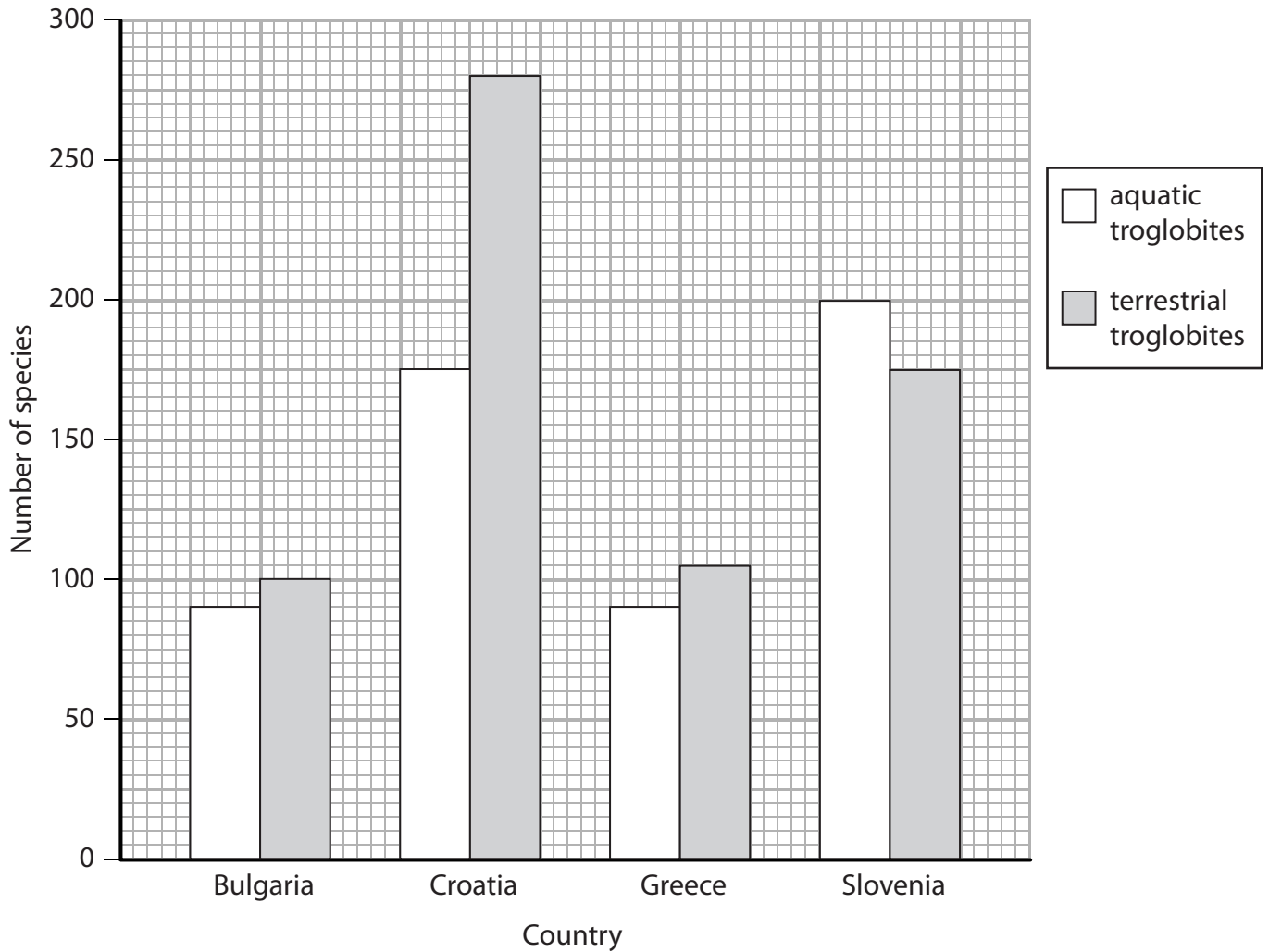


1 Animals that live only in underground caves are called troglobites.

Aquatic troglobites live in water in caves. Terrestrial troglobites live on the floors and walls of caves.

(a) The graph below shows the numbers of species of aquatic troglobites and terrestrial troglobites in four European countries.



(i) Using information in the graph, identify which country has the lowest biodiversity of troglobites.

(1)

(ii) Place a cross  in the box that corresponds to the correct ratio of aquatic troglobites to terrestrial troglobites in Croatia.

(1)

A 5:8

B 6:7

C 8:7

D 9:10

(iii) Using the information from the graph, compare the biodiversity of troglobites in Greece and Slovenia.

(2)

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(b) Troglobites occupy different niches.

Explain what is meant by the term **niche**.

(2)

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- (c) An example of a troglobite is the olm, *Proteus anguinus*, as shown in the photograph below. This species is an amphibian endemic to the caves of Slovenia and Croatia.

Olms have a number of special adaptations: external gills as adults, undeveloped eyes, lack of skin pigmentation and a slow metabolic rate.



Magnification  $\times 0.1$

- (i) Explain what is meant by the phrase 'endemic to the caves of Slovenia and Croatia'. (1)

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- (ii) Suggest which of the following is a physiological adaptation of olms to their habitat.

Place a cross  in the box corresponding to the correct answer.

(1)

- A** external gills as adults
- B** slow metabolic rate
- C** streamlined shape
- D** undeveloped eyes



2 The biodiversity of species in Costa Rica is one of the highest in the world.

Costa Rica represents 0.3% of the Earth's total land area. It has 4% of all identified species of living organisms. Many of these species live in the rainforests of this country.

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

(2)

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(ii) Describe how the species richness of the rainforests in Costa Rica could be measured.

(1)

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(b) A study was carried out to investigate the antimicrobial properties of plants found in Costa Rica. The species tested are all used in traditional medicine.

Nine of the species tested showed antimicrobial properties and six of these species are found only in the rainforest.

(i) Suggest why the results of this investigation support the need to maintain biodiversity.

(2)

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(iii) Some of the plants tested could be used to develop new drugs to treat diseases caused by bacteria.

Before these drugs could be approved for use, they would have to be tested on animals and healthy volunteers.

Suggest why these drugs would have to be tested on animals and healthy volunteers.

(2)

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**(Total for Question 2 = 12 marks)**

- 3 A pathologist was called to examine the body of a young man found partly-buried in a shallow grave. The initial examination of the body provided evidence that could be used to estimate the time of death of the young man.

One source of evidence used for an estimation of the time of death was the remains of insects found on the body.

The table below describes some of the types of insect remains found and the pathologist's notes.

Type of insect	Life cycle stage	Pathologist's notes
<i>Chrysomya rufifacies</i> (blowflies)	Pupa cases	Pupa cases empty
<i>Dermestes maculatus</i> (beetles)	Third stage larval skins	Good condition
<i>Necrobia rufipes</i> (beetles)	Adult	Active

- (a) Place a cross ☒ in the box next to the term that describes the use of evidence provided by insect remains on a dead body.

(1)

- A forensic bryology
- B forensic entomology
- C forensic mycology
- D forensic neurology



(b) The flow diagram below shows the main stages in the life cycle of blowflies and beetles.

EGG → LARVA → PUPA → ADULT

(i) Place a cross ☒ in the box next to the factor that would have the most effect on the rate of development of each stage of the life cycle of insects on this dead body.

(1)

**A** interspecific competition

**B** light

**C** predation by birds

**D** temperature

(ii) Suggest how the pathologist might use the information in the table and the flow diagram to estimate the time of death of the young man.

(3)

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(c) Suggest how useful each of the following additional sources of evidence would be for the pathologist in determining the time of death of this young man. Give an explanation for each of your answers.

(i) Body temperature

(2)

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(ii) State of decomposition

(2)

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**(Total for Question 3 = 9 marks)**

4 The process of photosynthesis has two main stages. The first of these involves the light-dependent reactions.

(a) The statements below describe important parts of the light-dependent reactions of photosynthesis. Place a cross  in the box next to the term that completes each statement correctly.

(i) When light is absorbed by chlorophyll, it excites

(1)

**A** electrons

**B** neutrons

**C** photons

**D** protons

(ii) Oxygen is produced when water molecules are split in the process of

(1)

**A** analysis

**B** autolysis

**C** hydrolysis

**D** photolysis

(iii) The products of the light-dependent reactions that are used in the light-independent reactions are reduced NADP and

(1)

**A** ATP

**B** GALP

**C** DNA

**D** RuBP

(b) Describe the structures in a chloroplast that are involved in the light-dependent reactions of photosynthesis.

(3)

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(c) In an investigation, wheat plants were grown using artificial lighting. Three different types of lighting were used. When the wheat plants were mature, the total biomass of the plants and the mass of the grain (seeds) they produced were measured for each type of lighting.

The table below shows the results of this investigation.

Type of lighting	Total biomass / kg	Mass of grain / kg	Grain yield as a percentage of total biomass (%)
Low pressure sodium lamps	171	61.7	36.1
High pressure sodium lamps	159	58.8	37.0
Metal halide lamps	162	62.4	

(i) Calculate the grain yield, as a percentage of total biomass, for the wheat grown under metal halide lamps. Show your working.

(2)

Answer..... %

(ii) With reference to the data in the table, suggest the conclusions the investigators may have made about the effect of using different types of lighting on grain yield.

(3)

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(iii) Suggest **two** advantages of growing crops of wheat in glasshouses with artificial lighting rather than growing them in open fields.

(2)

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**(Total for Question 4 = 13 marks)**