1 **(a)** Many species of insects have evolved resistance to chemical insecticides.

Three different patterns of resistance in insect species **R**, **S** and **T** are shown in Fig. 6.1.

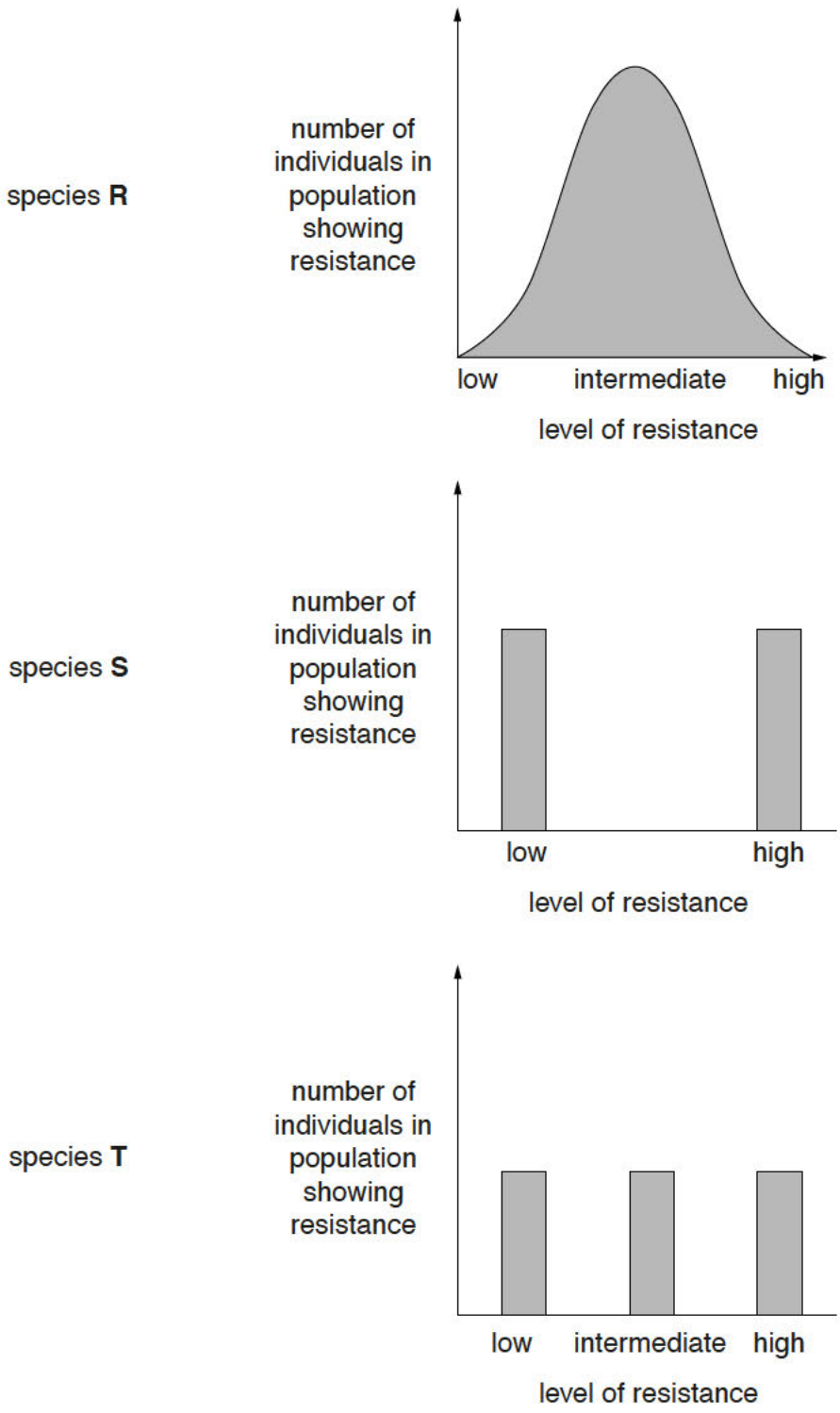


Fig. 6.1

(i) Complete the table below with the letter(s), **R**, **S** and **T**, to indicate which species show a continuous pattern of variation and which species show a discontinuous pattern.

	Discontinuous	**Continuous**
Species identified by letter		

[2]

(ii) A student noted a number of statements on his revision card that referred to the patterns of resistance shown in species **R**, **S** and **T** in Fig. 6.1.

Revision card – patterns of resistance

1. It's controlled by a single gene
2. There is an additive effect
3. May involve multiple alleles
4. Heterozygote shows a distinct phenotype
5. It's controlled by many genes (polygenic)
6. Involves a dominant and a recessive allele
7. Shows co-dominance or incomplete dominance
8. Involves just two alleles

Complete Table 6.1 below, by selecting the correct numbered statement(s) that explain the genetic basis of each pattern of resistance for each species.

You may select a number more than once.

Species	**Statement number(s)**
R	
S	
T	

Table 6.1

[6]

(b) Dog fleas are small parasitic insects that live in the fur of dogs and feed on their blood. Dogs are routinely treated with sprays or powders to kill fleas.

A vet believes that dog fleas may have become resistant to a popular flea-killer product.

He asks an A-level work experience student to plan an experiment to test this hypothesis.

The student needs to sample fleas from dogs visiting the surgery and also fleas from long grass in fields visited by dog-walkers. The fleas then need to be tested for resistance to the flea-killer.

Describe the methods the student could use to:

- collect both samples of fleas
- find out the proportion of fleas that are resistant
- process the data.



In your answer you should describe the methods for collection, testing and data processing in a logical series of steps.

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..... **[7]**

[Total: 15]

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2 Living organisms can be classified into five kingdoms, based on certain key characteristics.

(a) Table 2.1 shows some of the characteristics of the five kingdoms.

Complete the table.

Table 2.1

kingdom	membrane-bound organelles	cell wall	type(s) of nutrition
prokaryote	absent	present – made of peptidoglycan	
	present	sometimes present – composition varies	heterotrophic and autotrophic
fungi		present – made of chitin	heterotrophic
	present		autotrophic
animal		absent	heterotrophic

[6]

(b) An unknown species is discovered. Its cells contain many nuclei scattered throughout the cytoplasm of thread-like structures.

Suggest the kingdom to which this species belongs.

..... **[1]**

(c) Living organisms can also be classified into three groups called **domains**.

Outline the features of this system of classification compared with the five kingdom system.

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..... **[3]**

[Total: 10]

3 Bats are the only mammals that can truly fly. Many species of bat hunt flying insects at night. Bats are able to use sound waves (echolocation) in order to help them find their prey in the dark.

(a) Suggest how the ability to use echolocation may have evolved from an ancestor that did not have that ability.

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..... **[4]**

The pipistrelle is the most common species of bat in Europe. It was originally thought that all pipistrelles belonged to the same species, *Pipistrellus pipistrellus*. However, in the 1990s, it was decided that there were two species: the common pipistrelle, *Pipistrellus pipistrellus* and the soprano pipistrelle, *Pipistrellus pygmaeus*.

Data for both species are provided in Table 3.1.

Table 3.1

species	mean body mass (g)	mean wingspan (m)	range of echolocation call (kHz)	colour
common pipistrelle	5.5	0.22	42–47	medium to dark brown
soprano pipistrelle	5.5	0.21	52–60	medium to dark brown

(b) (i) Name the genus to which the soprano pipistrelle belongs.

..... **[1]**

(ii) Using the data in Table 3.1, suggest why pipistrelles were originally classified as one species.

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..... **[1]**

(iii) State **two** pieces of **molecular** evidence that can be used to identify organisms as belonging to different species.

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..... **[2]**

(iv) Describe how it is possible to confirm, over a longer period of time, whether two organisms belong to different species or the same species.

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..... **[2]**

(c) The soprano pipistrelle has an echolocation call that is 'high pitched' (between 52 and 60 kHz). The common pipistrelle has an echolocation call that is 'low pitched' (between 42 and 47 kHz).

Variation within and between species can be as a result of genetic or environmental factors. Whatever the causes of variation, the type of variation displayed can occur in two different **forms**.

Using the pipistrelle as an example, describe the key features of both **forms** of variation.

In your answer you should make it clear how genes and environment relate to each form of variation.

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[Total: 17]

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4 The system used by scientists for classifying living things has developed from the original classification system proposed by Carl Linnaeus around 250 years ago.

(a) Complete the following paragraph by using the most appropriate term(s).

The system of classifying organisms according to their observable features or genetic characteristics is called ..... . Organisms are classified into large groups which are then subdivided into increasingly smaller groups. A system such as this is called a ..... . The term that describes the evolutionary relationship between organisms is ..... .

[3]

(b) New Zealand is made up of two large and many smaller islands and is situated a long distance from any other land mass.

In New Zealand there is a large variety of birds not found elsewhere in the world.

Among its many species of the parrot family, Psittacidae, are:

- kaka (*Nestor meridionalis*)
- kea (*Nestor notabilis*)
- kakapo (*Strigops habroptila*)

These birds are shown in Fig. 4.1 **on the insert**.

(i) State **two** characteristics that birds, such as parrots, share with other members of the animal kingdom.

1 .....

2 ..... **[2]**

(ii) Name the **domain** to which the parrot belongs.

..... **[1]**

(iii) Species that are more closely related in evolutionary terms have more genes in common than species that are less closely related.

Using the information provided, suggest the likely genetic relationship between the three parrot species.

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..... **[4]**

(c) The kakapo is one of the world's largest and rarest parrot species. The variation in mass of adult birds in the kakapo population has been reported to be between 950 g and 4000 g.

(i) Define the term *variation*.

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..... **[2]**

(ii) Suggest **two** reasons why the kakapo varies in size.

1 .....

2 ..... **[2]**

(iii) Suggest **two** reasons why the reported mass range for the adult kakapo may not be accurate.

1 .....

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2 .....

..... **[2]**

(d) At some point in the past, distinct species of New Zealand parrot are likely to have arisen from an original ancestral population.

State the name of the process by which new species arise **and** suggest the mechanisms necessary for this process to occur.

name of process .....

mechanisms necessary for this process to occur .....

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..... **[3]**

[Total: 19]