Module 3: Biodiversity and Evolution
2.3.2 Classification
June 2009-January 2013
Questions

(a) define the terms *classification, phylogeny* and *taxonomy*;
(b) explain the relationship between classification and phylogeny;
(c) describe the classification of species into the taxonomic hierarchy of domain, kingdom, phylum, class, order, family, genus and species;
(d) outline the characteristic features of the following five kingdoms: Prokaryotae (Monera), Protoctista, Fungi, Plantae, Animalia;
(e) outline the binomial system of nomenclature and the use of scientific(Latin) names for species;
(f) use a dichotomous key to identify a group of at least six plants, animals or microorganisms;
(g) discuss the fact that classification systems were based originally on observable features but more recent approaches draw on a wider range of evidence to clarify relationships between organisms, including molecular evidence (HSW1, 7a);
(h) compare and contrast the five kingdom and three domain classification systems

Answer **all** the questions.

1 Many insects live in freshwater habitats such as rivers and ponds for part of their life cycle.

Fig. 1.1 shows a labelled diagram of a generalised insect along with six common insects found in freshwater in the UK.

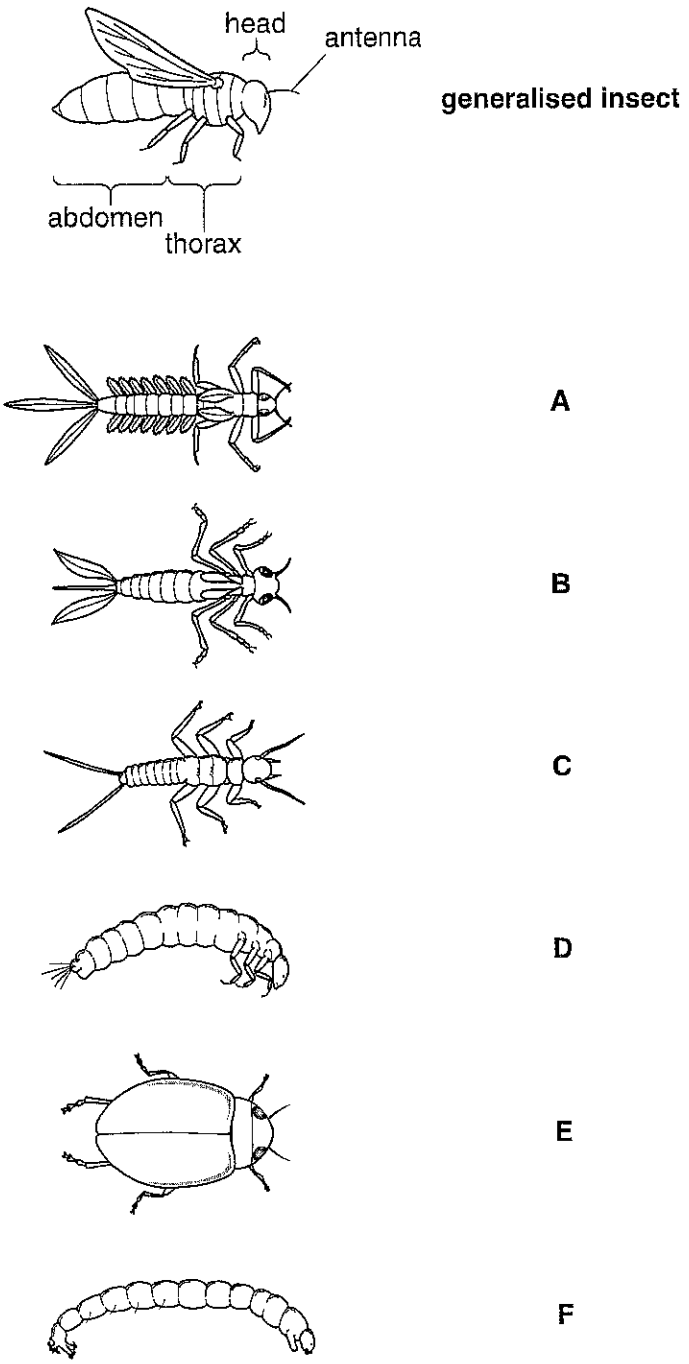

Fig. 1.1

Table 1.1 below shows a dichotomous key used for the classification of insects.

Key:			
Question 1	Does it have jointed limbs?	yes no	go to question 2 **bloodworm**
Question 2	Does it have an oval body shape?	yes no	**diving beetle** go to question 3
Question 3	Is the length of the tail greater than the length of three abdominal segments?	yes no	go to question 4 **caddis fly larva**
Question 4	Are gills attached to the abdominal segments?	yes no	**mayfly larva** go to question 5
Question 5	Does it have two narrow tails?	yes no	**stonefly larva** **damsel fly larva**

Table 1.1

(a) **(i)** Use Table 1.1 to identify the insects labelled **A** to **F** shown in Fig. 1.1.

A .....

B .....

C .....

D .....

E .....

F .....

[2]

(ii) Why is the key in Table 1.1 described as a *dichotomous* key?

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

(b) Suggest an adaptation shown by at least one of the insects in Fig. 1.1 that allows them to survive in an aquatic habitat.

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

(c) Insects belong to the animal kingdom within the domain *Eukaryota*.

(i) Suggest **one** feature of the cells of insects that would identify insects as belonging to the domain *Eukaryota*.

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

(ii) State **two** features that are present in the eukaryotic cells of plants that are **absent** from the cells of insects.

1 .....

2 .....

[2]

[Total: 7]

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]

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]

QUESTION 4 CONTINUES ON PAGE 14

(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]

5 DNA and RNA are nucleic acids.

(a) The table below contains a number of statements relating to nucleic acids.

Complete the table, using a letter **D**, **R** or **B**, to show whether each statement applies to:

- DNA only (**D**)
- RNA only (**R**)
- both DNA and RNA (**B**).

The first one has been done for you.

statement	DNA only (**D**) or RNA only (**R**) or both DNA and RNA (**B**)
contains thymine	D
contains ribose	
consists of two chains connected to each other with hydrogen bonds	
has a sugar-phosphate backbone	
has four different nitrogenous bases	
contains a pentose sugar	
is found in the nucleus and cytoplasm	

[6]

(b) It has been found that 98.4% of chimpanzee DNA is identical to that of a human.

(i) Suggest how the information obtained by DNA analysis can be useful to taxonomists.

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

(ii) State **two** types of evidence, other than biochemical evidence, that are used by taxonomists when classifying organisms.

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

(c) Cytochrome C is a protein found in living organisms. The structure of cytochrome C varies between different organisms. However, closely related organisms have similar cytochrome C.

Fig. 5.1 shows a possible evolutionary tree for vertebrates.
Common ancestors are indicated by the number 1 and various letters.

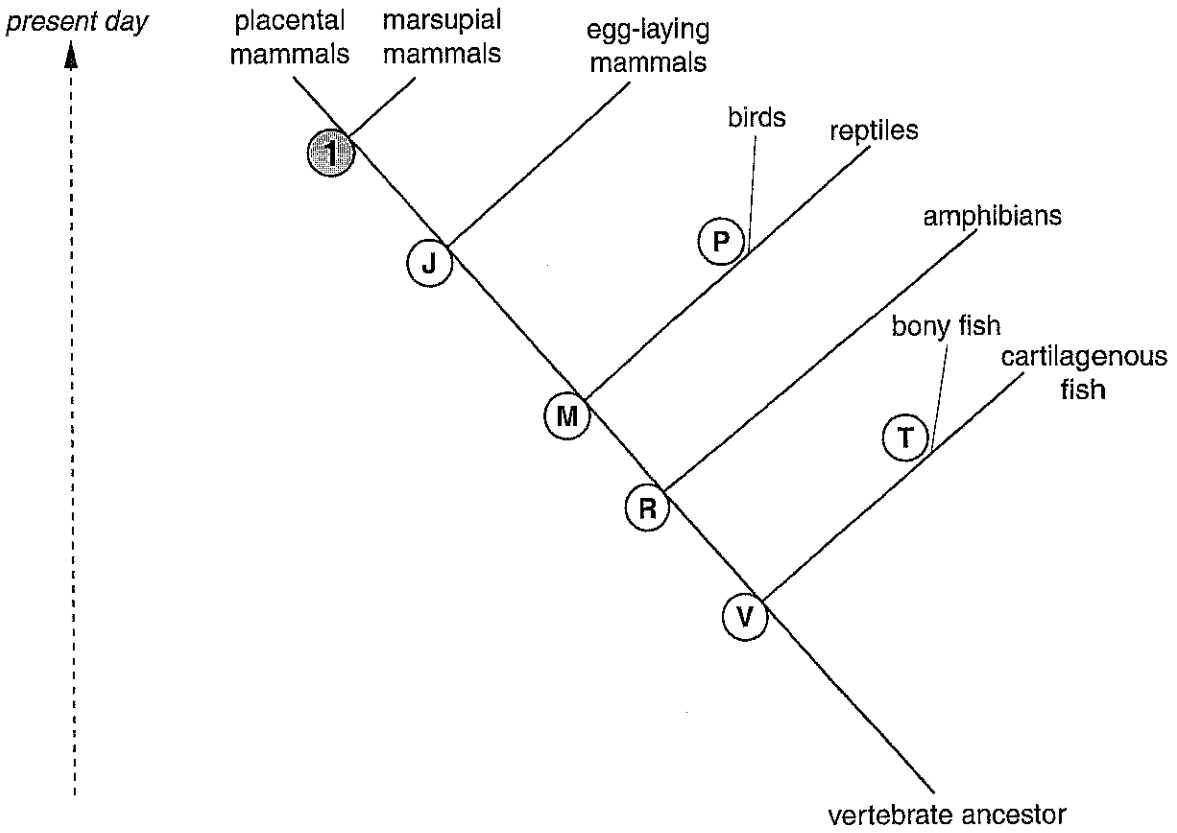

Fig. 5.1

State the **letter** of the common ancestor that has cytochrome C which will be:

most similar in structure to common ancestor 1 .....

least similar in structure to common ancestor 1 ..... **[2]**

(d) The pine marten is a small mammal that is rare in the United Kingdom. Its numbers are particularly low in Wales and there have been few confirmed sightings of this animal in the past 50 years. There have been plans to introduce pine martens from other areas of the United Kingdom into Wales to increase the size of the population.

The DNA of museum specimens of Welsh pine martens in the National Museum of Wales was tested, the most recent specimens dating from 1948. The DNA analysis suggests that Welsh pine martens are genetically distinct from those found elsewhere in the United Kingdom.

(i) The relevance of this analysis has been questioned by some scientists.

Suggest why the findings from the museum specimens may not relate closely to the current pine marten population of the United Kingdom.

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

(ii) Suggest why some people are concerned about the plan to introduce pine martens from other areas into Wales.

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

[Total: 14]

2 When a new species is discovered, it needs to be classified.

(a) Define the term *classification*.

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

(b) **(i)** Suggest what criteria a taxonomist may take into account when classifying a new species.

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

(ii) Table 2.1 shows the main taxonomic groups. The groups are **not** in the correct order.

Table 2.1

	Q	R	S	T	U	V	W
taxonomic group	species	order	class	phylum	genus	kingdom	family

Place the **letters** representing the taxonomic groups into the correct order.

The first one has been done for you.

V

.... **[3]**

(c) The classification of organisms into domains is relatively new.

Describe the differences between a classification system based on domains and one based on kingdoms.

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

[Total: 12]

5 **(a)** Fig. 5.1 shows a section of a leaf from a pear tree that is infected by the mildew fungus.

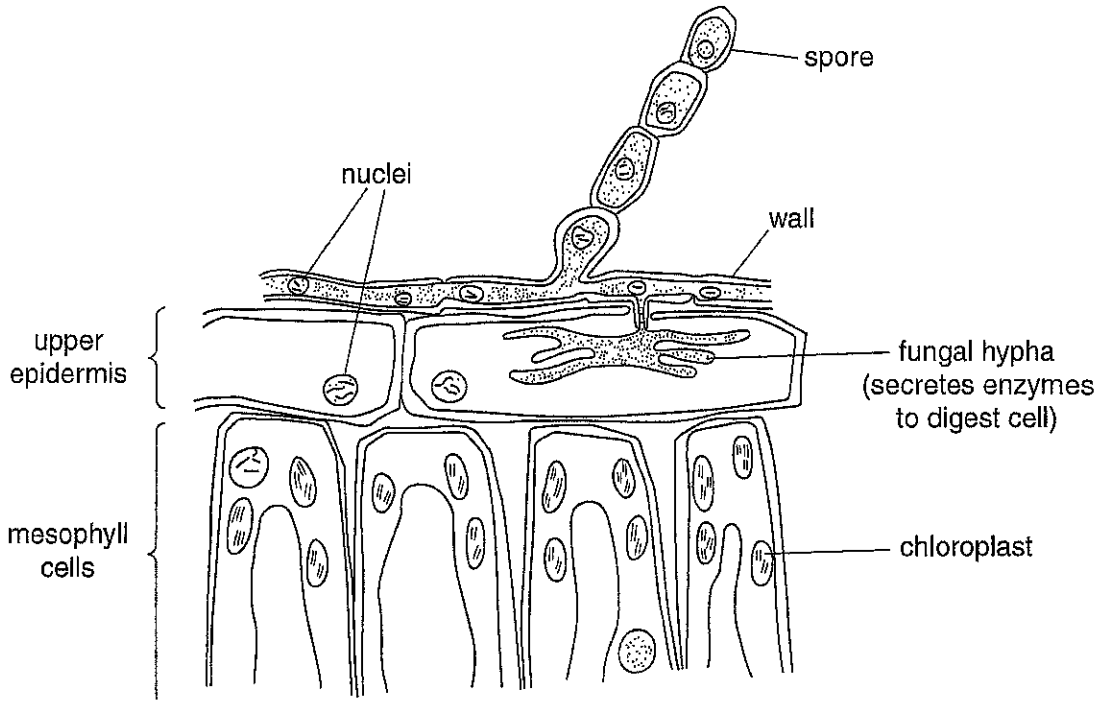

Fig. 5.1

(i) State **one** feature, **shown in Fig. 5.1**, that excludes **both** the pear tree and mildew from the kingdom Prokaryotae.

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

(ii) State **two** reasons why mildew should be placed in the kingdom Fungi.

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

(iii) State **two** reasons why the pear tree should be placed in the kingdom Plantae.

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

(iv) Name **two** kingdoms other than Prokaryotae, Fungi and Plantae.

1 .....

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

(b) The mildew fungus also infects wheat plants, causing disease.

- Most wheat plants in the UK show little resistance to this disease.
- Some Iranian wheat plants are resistant.
- The yield from these resistant wheat plants is very low.

(i) An investigation into the resistance of the Iranian wheat plants to mildew produced the results shown in Fig. 5.2.

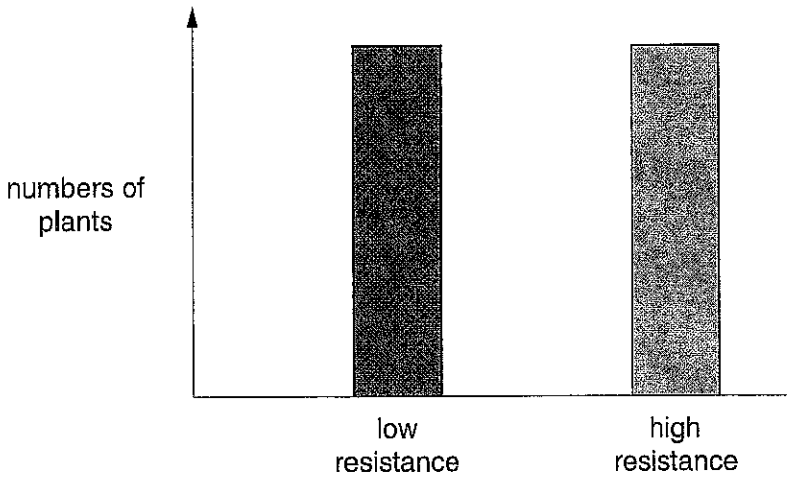

Fig. 5.2

State the type of variation that is shown in Fig. 5.2 **and** describe its characteristics.

type of variation .....

characteristic of this type of variation

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

(ii) Outline how a breeding programme could be carried out to produce wheat plants which have both high yield **and** resistance to mildew.

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

(c) Over a period of time, mildew can overcome the resistance bred into the wheat.

Use the theory of natural selection to explain how the mildew fungus adapts to overcome this resistance.

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

[Total: 17]