Classification & evolution

Model Answers 3

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Biodiversity, evolution and disease
Topic	Classification & evolution
Booklet	Model Answers 3

Time allowed: **58 minutes**

Score: **/43**

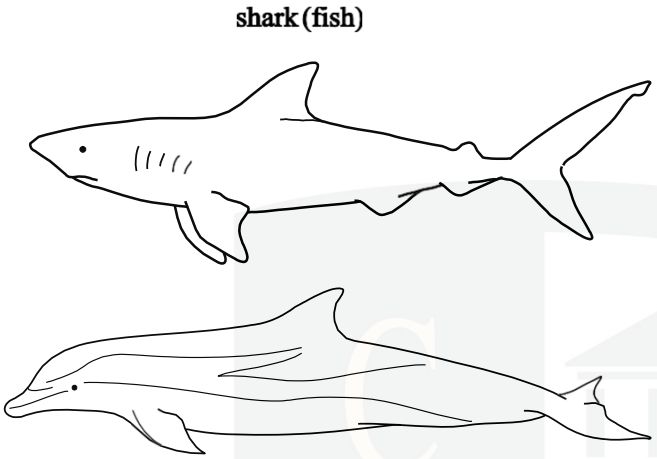
Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

Question 1

These two organisms show very similar anatomical adaptations but are classified in different taxonomic groups.



What is this an example of?

A convergent evolution

B divergent evolution

C disruptive selection

D stabilising selection

[1]

Although both are totally taxanomically different, they have evolved similar features that adapt them to the same function which, in this case, is swimming fast.

Question 2

A number of events occur for a new species to emerge in a population.

Which of the following statements correspond to events that are involved in the formation of a new species?

Statement 1: Gene mutation.

Statement 2: Selection pressure.

Statement 3: A change in the environment.

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

[1]

The change in the environment gives the organisms with the selective advantage chance to survive long enough to reproduce and pass the beneficial allele on to the next generation

Question 3

(a) Fig. 6.1 shows two species of trilobites, a group of arthropods that became extinct about 240 million years ago. Species **A** is 20 million years older than species **B**.

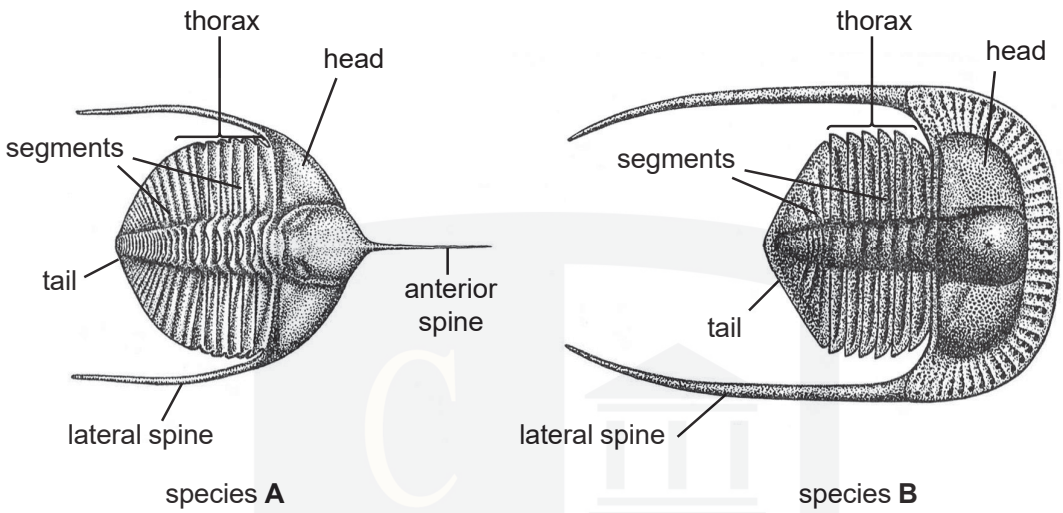


Fig. 6.1

(i) List **three** observable features from Fig. 6.1 that suggest the two species are related. **[3]**

Observable features include:

- They both have three parts to the body
- They both have a head, thorax and tail
- They are both segmented
- They both have spines from both sides of the head
- The thorax / tail both have a similar shape

Use the diagrams, but more importantly the labels, to help you answer this question

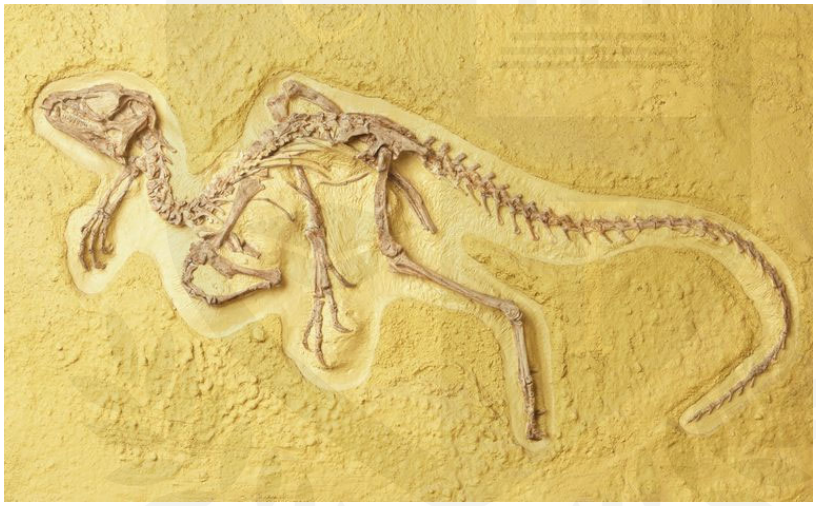
(i) List **two** observable features from Fig. 6.1, **other than size**, that could suggest they are **different** species. **[2]**

- Species A has an anterior spine
- The lateral spines on B are longer
- They head of species B is not as rounded
- Species A has more segments in its tail section than B

Make sure you refer to species A and B, don't leave it to the examiner to decide. Again use the labels on the diagram to help you

(b) Explain how fossils provide evidence for the theory of evolution. **[2]**

- Fossils show changes over time
- Fossils can be dated
- The simplest fossils are found in the oldest rocks
- Fossils show the relationships between different species
- Fossils give us information about organisms that no longer exist
- DNA can also be extracted from some fossils



Fossils that show intermediate characteristics are called transitional fossils — they have characteristics that are intermediate in nature to organisms that existed both prior to it and after it. Transitional fossils are strongly suggestive of evolution because they indicate the progression of from just as evolutionary theory predicts.

This fossil represents Heterodontosaurus.

[Total: 7]

Question 4

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

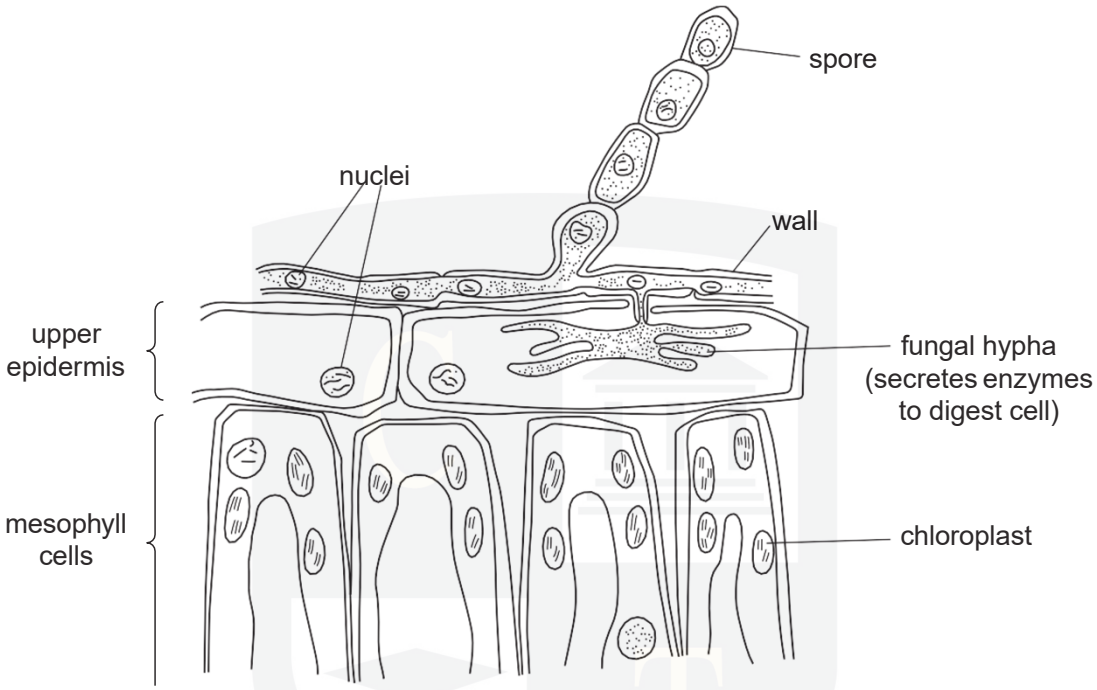


Fig. 5.1

(i) State **one** feature, **shown in Fig. 5.1**, that excludes **both** the pear tree and mildew from the kingdom Prokaryotae. **[1]**

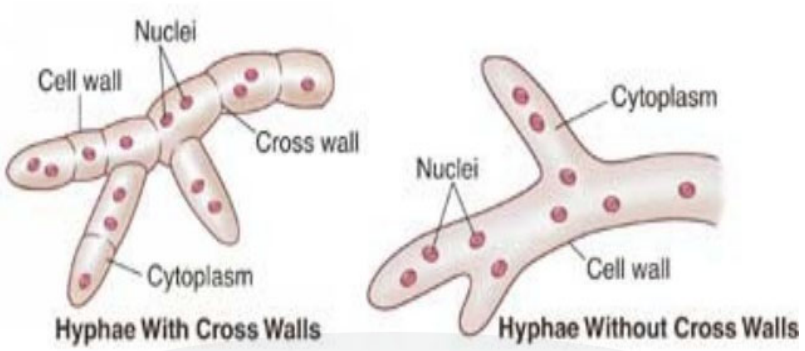
- Having a nucleus excludes Eukaryotes from Prokaryotes

(ii) State **two** reasons why mildew should be placed in the kingdom Fungi. **[2]**

- The kingdom fungi have a cell wall made of chitin
- They consist of thread-like hyphae
- The hyphae have many nuclei
- They reproduce by making spores
- Fungi secrete enzymes externally to digest their food

Don't be distracted by the reference to mildew and pear tree in this question.

They are just examples of fungi and plants which are both Eukaryotes



(iii) State **two** reasons why the pear tree should be placed in the kingdom Plantae. **[2]**

- Plants have cellulose cell walls
- Plants are multicellular
- They have chloroplasts / chlorophyll
- Perform photoautotrophic nutrition / photosynthesis

(iv) Name **two** kingdoms other than Prokaryotae, Fungi and Plantae. **[2]**

The remaining two kingdoms are:

- Animals
- Protoctists

Kingdom	Main characteristics
Animalia	multicellular; heterotrophic feeders so no chlorophyll; no cell walls; complex cell structure with nucleus
Plantae	multicellular; autotrophic feeders using chlorophyll; cell walls made of cellulose; complex cell structure with nucleus
Fungi	multicellular; cell walls not made of cellulose; saprophytic feeders so no chlorophyll; complex cell structure with nucleus
Protoctista	mostly unicellular (a few are multicellular); complex cell structure with nucleus
Prokaryotae	unicellular; simple cell structure with no nucleus

(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.

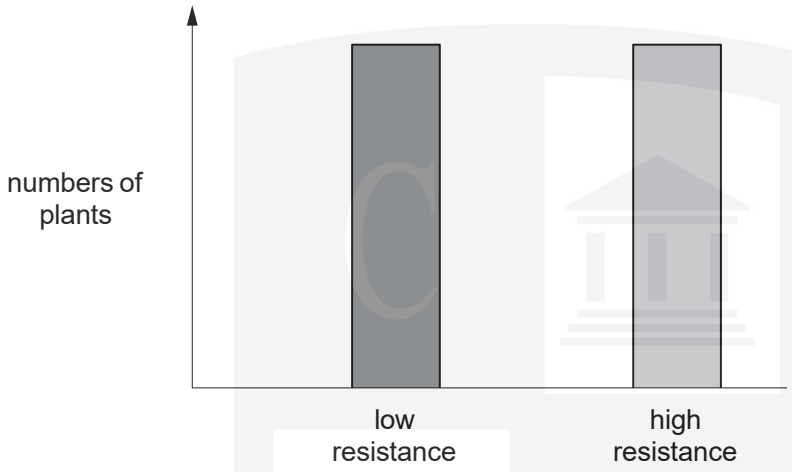


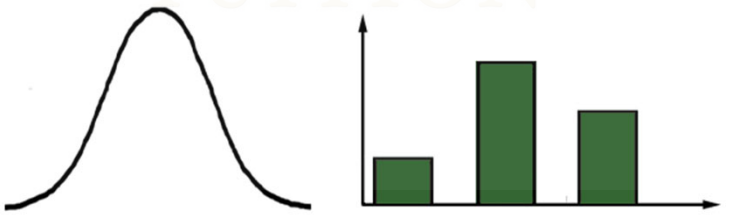
Fig. 5.2

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

type of variation ..... is discontinuous .....

characteristics of this type of variation **[3]**

- It is controlled by one or two genes
- The results are qualitative
- Values fall into discrete categories with no intermediates
- The environment has little effect



Continuous Variation
- No distinct catagories
- Tends to be quantitative
- Controlled by a lot of genes
- Strongly influenced by the environment

Discontinuous Variation
- Distinct catagories
- Tends to be qualitative
- Controlled by a few genes
- Unaffected by the environment

(ii) Outline how a breeding programme could be carried out to produce wheat plants which have both high yield **and** resistance to mildew. **[3]**

- A breeding programme will use artificial selection or selective breeding
- Breed wheat plants with high yield and disease resistance
- Remove the anthers of one plant to prevent self-pollination
- Choose the offspring with high yield and resistance to disease
- Cross these individuals with both characteristics
- Repeat this over many generations

Make sure you refer to the characteristics in the question and not just a general description of selective breeding

(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. **[4]**

- Natural selection arises as a result of genetic variation
- A mutation occurs
- Mutations are random or spontaneous
- Resistance to wheat is the selection pressure
- Individuals with resistance survive to reproduce
- They pass on the allele for resistance to the next generation
- Over many generations the frequency of this allele in the gene pool increases

Exam tip**: **Natural Selection: Questions can either be very direct and ask you to explain how a certain characteristic developed in a population, or how an allele became established or how resistance arises.

- *Start by stating what the selection pressure is, this will be given in the question*
- *A random mutation occurs*
- *The mutation gives the individual/organism a selective advantage*
- *The individual with the advantageous allele survives long enough to reproduce*
- *The allele is passed on to the next generation*
- *Over many generations*
- *The frequency of the mutant allele increases in the gene pool*

[Total: 17]

Question 5

In 1990, Carl Woese suggested a new top level taxon to the current system of classification of living organisms, which he termed a domain. He used his results from studying RNA to organise organisms into three distinct groups.

(a) (i) Name the cell component that appears in organisms of all three domains that Woese suggested. **[1]**

Ribosomes

(ii) One of the domains he suggested is called Eukarya.

Name the other **two** domains. **[2]**

Bacteria and Archaea

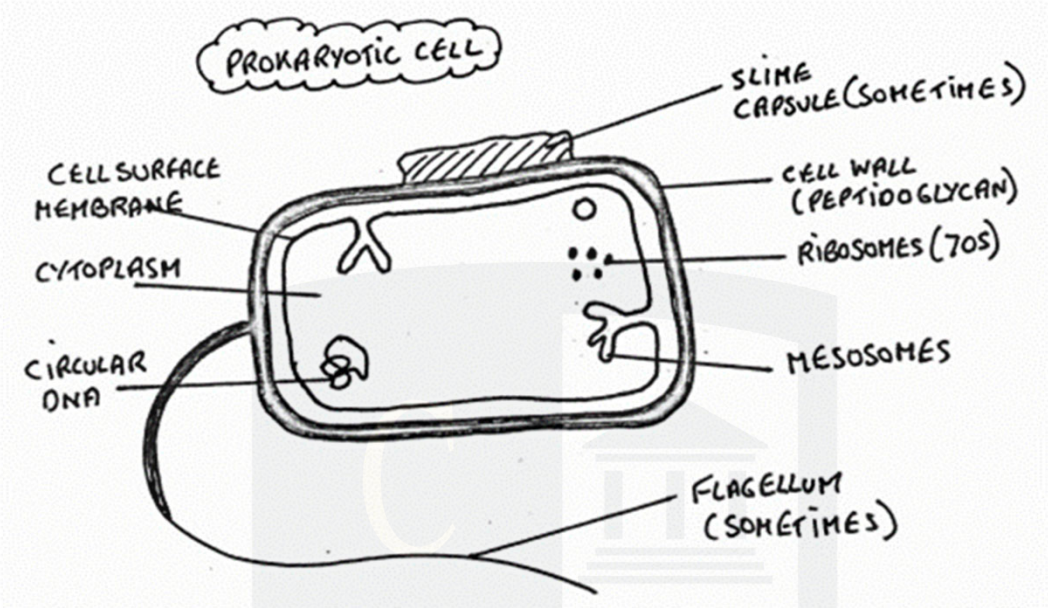
(iii) State **two** defining features of all members of the domain Eukarya. **[2]**

- They have a nucleus
- 80S ribosomes
- Linear DNA
- DNA is associated with histones
- They have membrane-bound organelles

Carl Woese has a lot to answer for, if you ask most Biology A level students!

His idea is not easy so here goes.

Carl was looking at the molecular similarities and differences between prokaryotic and eukaryotic cells, but the prokaryotes were causing a problem. There two major differences between them, one lot had no histones, their RNA polymerase had 4 sub units and they had a thick cell wall made of peptidoglycan. The other lot had histones, their RNA polymerase contained 14 sub units and they had a thin cell wall. The two groups still had 70S ribosomes and plasmids but the group with the histones had far more in common with eukaryotic cells, so he decided to create 3 domains, Eukaryotes, Bacteria and Archaea. The latter two both used to belong to the Prokaryotes. Phew!



(b) Woese carried out a detailed study of RNA molecules in order to draw his conclusions.

Suggest **two** ways in which the scientific community are likely to have validated Woese's research. **[2]**

- Scientific conferences
- Peer review
- The work is replicated by others to see if they get the same results

This question is a gift if it comes up, however answers can often be superficial and vague.

They are SCIENTIFIC conferences and journals, peer review is when experts in a similar field repeat the work TO SEE IF THEY GET THE SAME RESULTS.

[Total: 7]

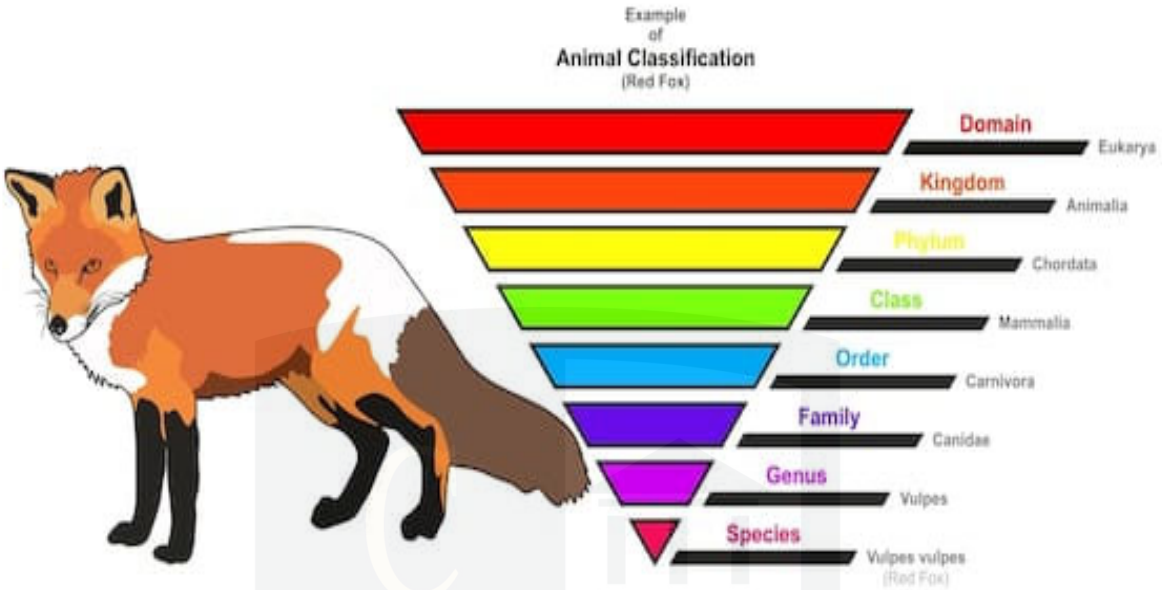
Question 6

Fig. 8.1

Fig. 8.1, shows an electron micrograph of an invertebrate known as a 'water bear'

(a) Complete the following passage about the classification of water bears using the most appropriate terms.

The water bear, *Echiniscus trisetosus* is a member of the genus Echiniscus and the family *Echiniscidae*. This family belongs to the Order *Echiniscoidea*, which forms part of the class *Heterotardigrada*. Water bears, also known as tardigrades, are classified into a Phylum of their own called the *Tardigrada*. Tardigrades form part of the kingdom Animalia within the domain Eukaryota. **[5]**

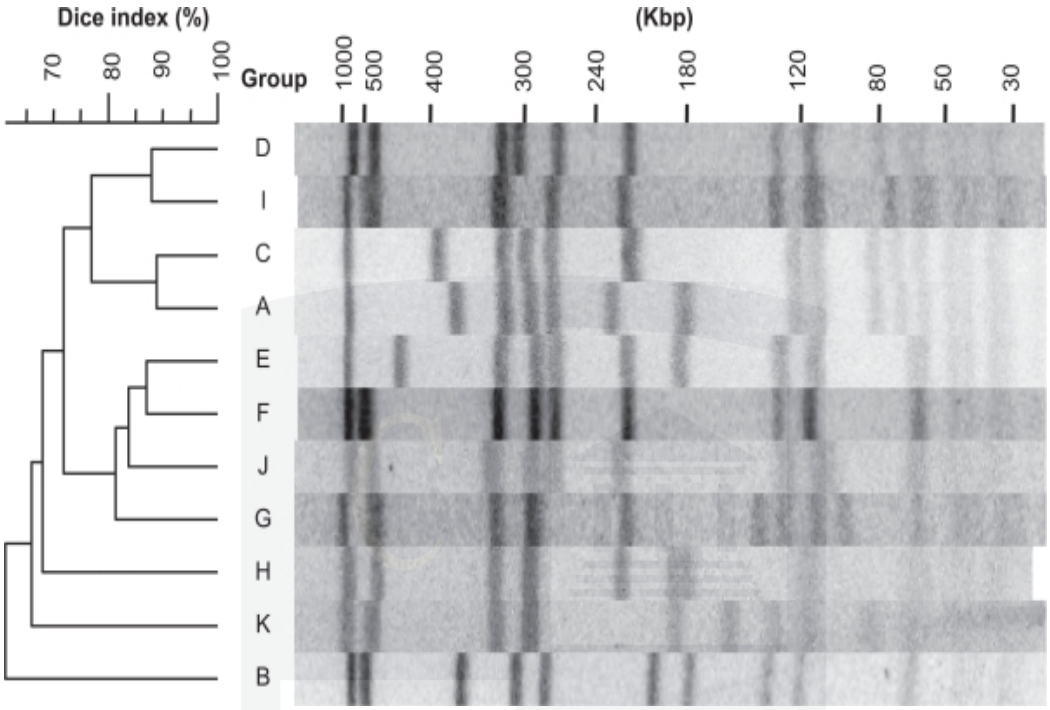


(b) State the meaning of the term *phylogeny* **and** explain how phylogeny is related to classification.

[3]

- Phylogeny is the study of the evolutionary relationships between organisms
- Phylogeny studies the closeness of relationships and when they shared a common ancestor
- Phylogeny is the modern classification of organisms we use today

Phylogeny uses modern scientific techniques such as DNA profiling and proteomics. DNA profiles can be compared by the number, width and distance the DNA fragments move during electrophoresis. The more closely related individuals are, the more similar will be their DNA profile, this means they shared a more recent common ancestor and have a closer evolutionary relationship.



(c) Water bears are extremely common in many habitats, including household gardens. However, they were not discovered until approximately 300 years ago.

Suggest reasons why they were not known before this time. **[2]**

- Waterbears were not known before this time because they were too small to be seen
- They could only be seen after microscopes were invented

[Total: 10]