

Classification & evolution

Model Answers 2

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Biodiversity, evolution and disease
Topic	Classification & evolution
Booklet	Model Answers 2

Time allowed: 53 minutes

Score: /39

Percentage: /100

Grade Boundaries:

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

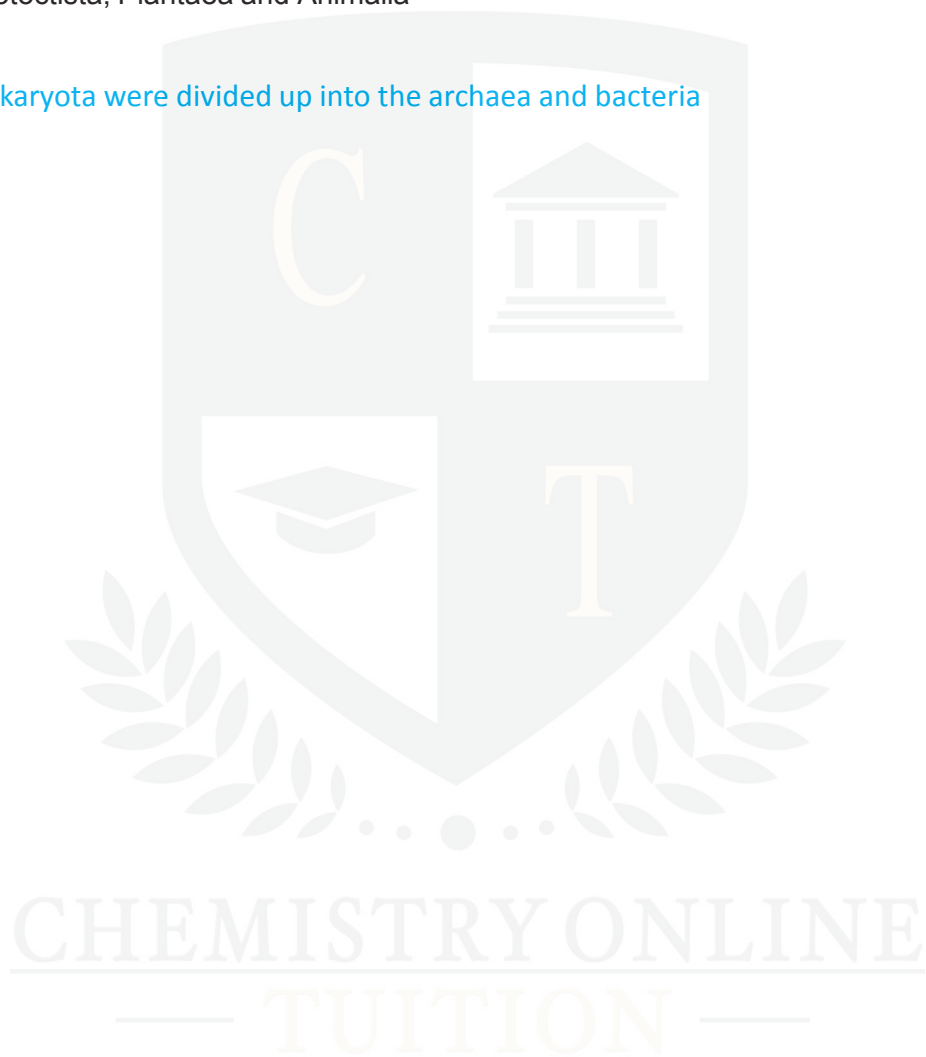
Question 1

Which of the following options, **A** to **D**, lists the three domains of life?

- A. Archaea, Bacteria and Eukaryota
- B. Bacteria, Prokaryota and Eukaryota
- C. Prokaryotae, Protoctista and Eukaryota
- D. Protoctista, Plantaea and Animalia

[1]

The prokaryota were divided up into the archaea and bacteria



Question 2

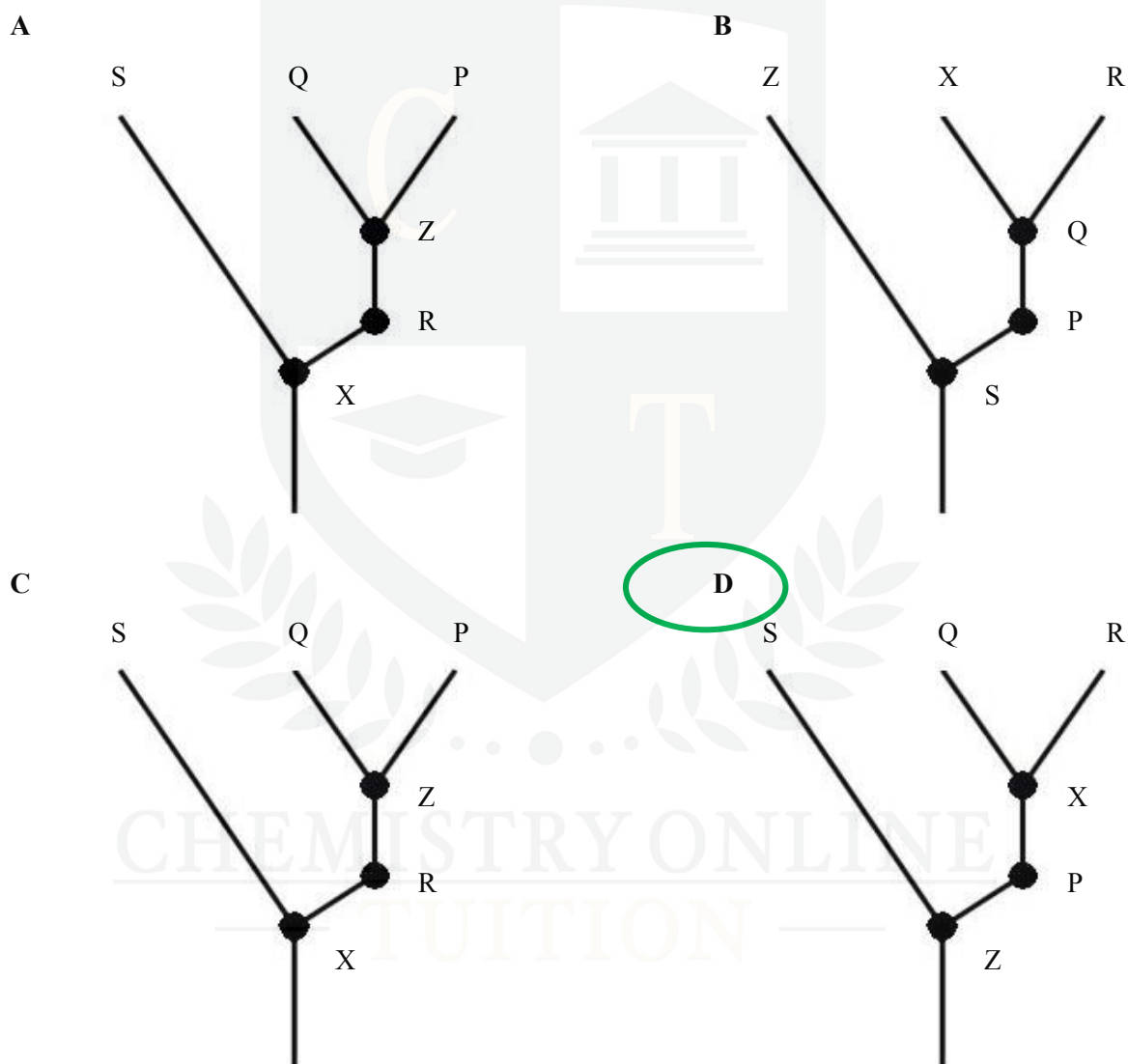
Q, P, R and S are related species of organisms.

Species X is an extinct recent common ancestor of species Q and R. X,

Q and R all evolved from species P.

Species S is the least related to the others, with extinct species Z being its most recent phylogenetic link to the other species.

Which of the following phylogenetic trees correctly represents the relationships described above?



[1]

Where the tree branches is the common ancestor. In this case X is a common ancestor of Q and R and all three are common ancestors of P

Question 3

In 2006, the scientific journal, *Nature*, reported the discovery of a fossil from around 380 million years ago. It was given the name *Tiktaalik roseae*.

This fossil has some features in common with fish and some features in common with amphibians.

A photograph of the fossil is shown in Fig. 1.1.



Fig. 1.1

A diagram of the fossil viewed from above is shown in Fig. 1.2.

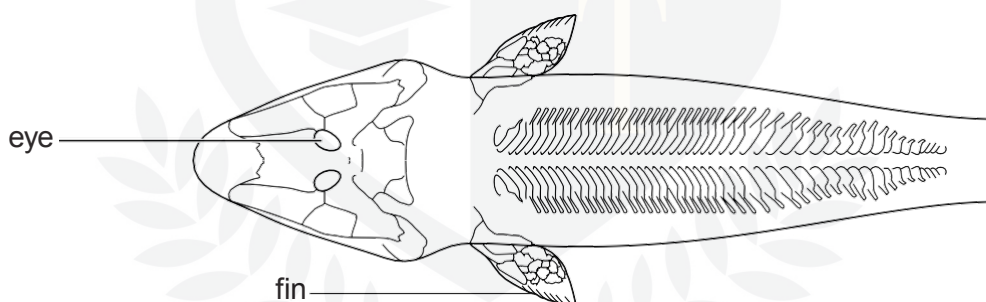


Fig. 1.2

- (a) (i) Suggest **one** adaptation, **visible in Fig. 1.1 and Fig. 1.2**, which would be an advantage for life under water. [1]

An adaptation for life underwater would be (any one of):

- Fins
- Streamlined shape

Exam tip: make sure you use adaptations that you can see in the picture.

- (ii) Suggest **one** adaptation, **visible in Fig. 1.1 and Fig. 1.2**, which would be useful for an animal that lives on the sea bed. [1]

A useful adaptation for living on the sea bed would be:

- Eyes on top of the head

- (b) *Tiktaalik roseae* is a member of the kingdom Animalia. The structure of its individual cells has not been preserved by fossilisation.

State **two** features of cells of an organism from the kingdom **Plantae** that would **not** have been present in the cells of *T. roseae*. [2]

Features from the kingdom Plantae, that would not be found are (any two of):

- Chloroplasts
- Cellulose cell wall
- Large permanent vacuole
- Starch grains

These are the key features of the kingdom Plantae, which are not shared by any members of the kingdom Animalia.

- (c) Fossils provide strong evidence that organisms have evolved over time.

Describe **other** types of evidence that support the theory of evolution.



In your answer you should describe some different types of evidence.

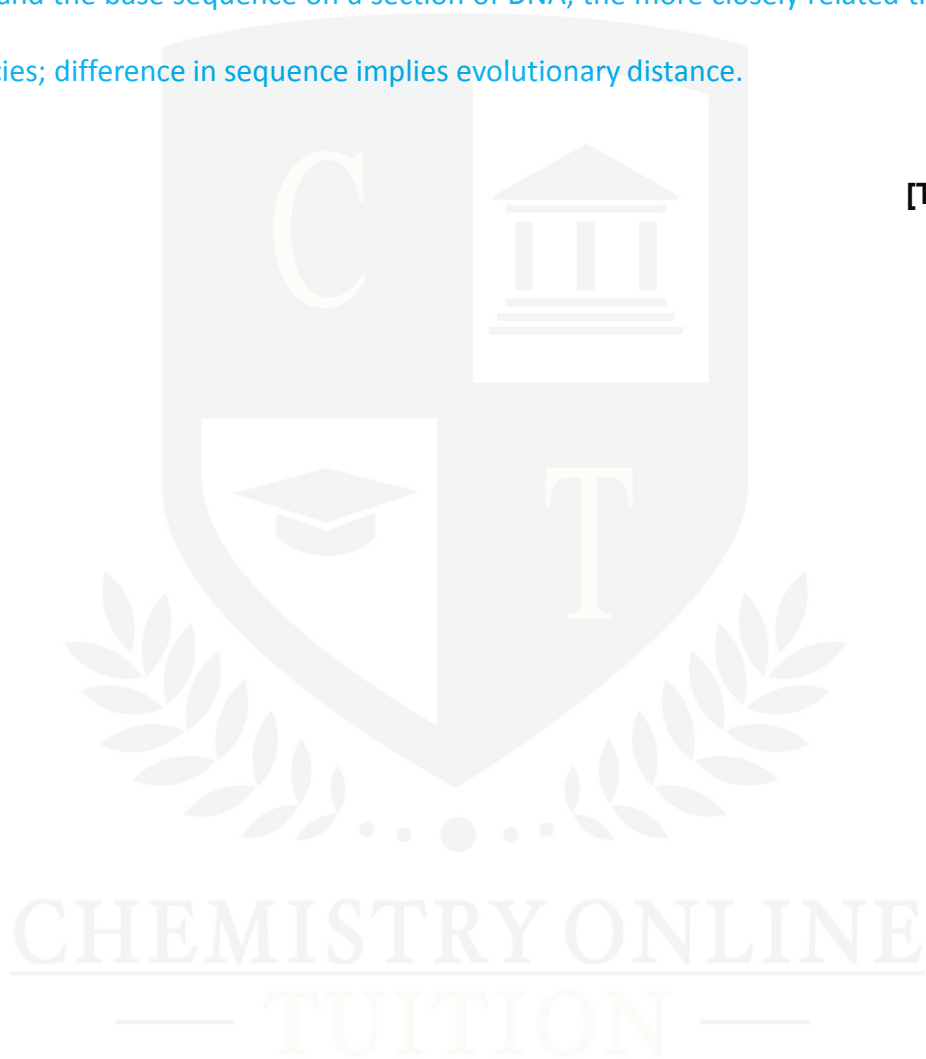
[6]

Evidence that supports the theory of evolution is:

- differences in DNA/ biochemistry
- differences in base sequence
- differences in cytochrome c
- differences in order of amino acids in proteins
- similarities between any of the above implies a close relationship
- idea of evolution within human history
- differences in physiology / behaviour

We assume that the earliest living creatures had identical versions of these, so then the differences seen today are result of evolution. Therefore two organisms with similar molecules are closely related, as they have not evolved separately for long, and vice versa. The more similar the sequence of amino acids in a shared protein, and the base sequence on a section of DNA, the more closely related the two species; difference in sequence implies evolutionary distance.

[Total: 10]



Question 4

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	Heterotrophic and autotrophic
Protocist	present	sometimes present – composition varies	heterotrophic and autotrophic
fungi	present	present – made of chitin	heterotrophic
plant	present	cellulose	autotrophic
animal	present	absent	heterotrophic

[6]

Heterotrophic nutrition involves getting energy from organic compounds which have been made by another organism. Primary consumers get their energy by feeding on producers which build up complex organic compounds from simple inorganic compounds (carbon dioxide and water), if they get the energy for this from light, then they show photoautotrophic nutrition. Examples of membrane bound organelles include mitochondria and chloroplasts. Plant cells, prokaryotes and fungi all have cell walls, but all three are made of different substances.

- (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]

- Fungi

Fungi are really unusual. They have a cell wall made of chitin (which is found in the external skeleton of crustaceans) and store glycogen found also in the liver and muscle of animals!

- (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.

[3]

- There are three domains and five kingdoms
- The domains are bacteria, archaea and eukaryotes
- The kingdoms are prokaryotes, protists, fungi, plants and animals
- The prokaryotes are split into two different domains
- Domains are classified by the size of their ribosomes, or RNA polymerase
- The cell walls of bacteria and archaea are different
- The archaea and eukaryotes have more in common and shared a more recent common ancestor

Eukaryote	Archea	Bacteria
True nucleus	No true nucleus (nucleoid)	No true nucleus (nucleoid)
No plasmids	Plasmids	Plasmids
80S ribosomes	70S ribosomes	70S ribosomes
Membrane bound organelles	No membrane bound organelles	No membrane bound organelles
DNA is linear and in a nucleus	Single circular chromosome	Single circular chromosome
Cell walls only in plant cells	Always have a cell wall	Always have a cell wall
Cell walls made of cellulose	Cell walls not made of peptidoglycan	Cell walls made of peptidoglycan
DNA has histones	DNA has histones	DNA has no histones
RNA polymerase has 14 sub units	RNA polymerase has 14 sub units	RNA polymerase has 4 sub units
Insensitive to antibiotics	Insensitive to antibiotics	Sensitive to antibiotics

[Total: 10]

Question 5

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. [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

- The ability to use echolocation would have evolved by natural selection
- This begins with a random mutation
- The selection pressure in this case, is competition for food or prey
- Individuals with the mutation enabling them to use echolocation will survive to reproduce
- The allele for echolocation will be passed on to the next generation
- Over many generations the frequency of this allele in the gene pool will increase

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 antibiotic 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

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

[1]

- **Pipistrellus**

The genus is the first term in the binomial system and is always written with a capital letter

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

[1]

- They were originally classified as one species because they had the same body mass of 5.5 g
- Their wingspans were similar
- They were both the same colour which was medium to dark brown
- Every characteristic was the same except those with echolocation
- When they were originally classified they were unable to measure echolocation as a characteristic

Organisms with the same or similar physical, physiological or behavioural characteristics and are able to interbreed to produce fertile offspring are classified as belonging to the same species

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

[2]

Molecular evidence that can be used to identify organisms includes:

- DNA profiling or DNA sequencing
- RNA sequencing
- Amino acid sequence or proteomics
- Amino acid sequence of cytochrome C for example

This evidence could be used to study the evolutionary relationships between organisms and when they shared a common ancestor. In other words, phylogeny.

(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. [2]

- To confirm whether two organisms belong to the same species you would have to interbreed them
- Then determine if their offspring are fertile
- If the offspring are infertile, or no offspring are produced then they belong to different species

Members of different species are **reproductively isolated** from other species. That's a term worth knowing!

(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.

[7]

- One type of variation is described as continuous
- Continuous variation is the effect of many genes controlling a characteristic
- Continuous variation is affected by the genotype and the environment
- Continuous variation is quantitative
- There are intermediate values which do not fall into distinct or discrete groups
- Body mass and wingspan are examples of continuous variation in the bats
- Discontinuous variation is the other type of variation
- Discontinuous variation is the effect of one or two genes
- It has little or no environmental effects
- Results fall into discrete categories with no intermediates and its results are qualitative
- High-pitched or low pitched echolocation are examples of discontinuous variation

[Total: 17]