6.5 Classification of living organisms

Name: _____ Class: _____ Date: _____ **Total: 17 marks**

KEY WORDS binomial • domain • evolutionary tree

Objective

Use the Linnaean system, binomial naming and the three-domain system, and interpret evolutionary trees. Original questions for spec statement 4.6.4.

1 Key knowledge and worked examples

Linnaeus classified living things by **structure and characteristics** into: **kingdom, phylum, class, order, family, genus, species** (recite the order).

The **binomial** system names each organism by **genus + species** – e.g. *Homo sapiens*. The genus name is written with a capital and the species name lower case, both in italics.

Developments that changed classification: better **microscopes** revealed internal structures; **biochemical** understanding progressed; **chemical analysis** of organisms became possible – so new models were proposed.

Three-domain system (Carl Woese), built on chemical-analysis evidence:

- **Archaea** – primitive bacteria, usually living in extreme environments;
- **Bacteria** – true bacteria;
- **Eukaryota** – protists, fungi, plants and animals.

Evolutionary trees show how scientists believe organisms are related, using **current classification data** for living organisms and **fossil data** for extinct ones. Closer branch points = more recent common ancestor.

Worked example (3 marks). Two species share the same genus but different families' rank neighbours – wait: species P and Q are in the same genus; species R is in the same family but a different genus. Which is P most closely related to?

Q; the same genus means the most recent common ancestor – classification groups living things by shared characteristics, and genus is the smallest listed group; R shares only the wider family, so its common ancestor with P is further back.

2 Practice

2.1 List the Linnaean ranks from largest to smallest. [1]

2.2 What are the two parts of a binomial name? [2]

2.3 Name the three domains. [3]

3 Exam-style questions

3.1 Describe how developments in biology led from Linnaeus's system to the three-domain system. [4]

3.2 Archaea often live in hot springs; bacteria live in ordinary environments. Explain why they are placed in different domains despite both being single-celled. [3]

3.3 Use an evolutionary tree to explain which of three named species share the most recent common ancestor, and state the two data sources used to build trees. [4]

Solutions

2.1 Kingdom, phylum, class, order, family, genus, species.

2.2 Genus; species.

2.3 Archaea; bacteria; eukaryota.

3.1 Linnaeus classified by structure and characteristics into kingdom → species; improvements in microscopes revealed more about internal structures; progress in understanding biochemical processes, and chemical analysis of organisms, showed deeper relationships; Carl Woese proposed the three-domain system – archaea, bacteria and eukaryota – from that chemical evidence.

3.2 Chemical analysis of their genetic material/biochemistry shows they are only distantly related; archaea are primitive bacteria adapted to extreme environments, while bacteria are true bacteria; classification now reflects evolutionary relatedness from chemical evidence, not just single-celled appearance.

3.3 The two species whose branches meet at the closest branch point share the most recent common ancestor; a species on a branch that splits earlier diverged longer ago. Trees are built from current classification data for living organisms and fossil data for extinct organisms.