

Exam practice questions

- 1 Which of the following represents the correct hierarchy of classification?
- A phylum → class → family → order → genus → species
 B phylum → class → order → family → genus → species
 C phylum → class → order → genus → family → species
 D phylum → class → family → genus → order → species (1)
- 2 Which of the following applies to all members of the same species?
- A have identical external features
 B have the same DNA
 C cannot interbreed with any other species
 D produce fertile offspring with other members of the same species (1)
- 3 *Halobacterium salinarum* is a bacterium found in very saline environments.
- a) Name two cellular features of this bacterium that could be investigated to show that it is not a eukaryote. (2)
- b) Analysis of the genes for ribosomal RNA (rRNA) is often used to distinguish Archaea from prokaryotes and eukaryotes. Explain why this molecule is particularly useful for this purpose. (3)
- c) Many Archaea are extremophiles, which live in harsh environmental conditions. Some live in hot springs at temperatures of 80 °C or higher.
- What are the major problems faced by cells at these temperatures and how might the modifications of Archaea cell structure help to overcome them? (4)
- 4 The table shows the base sequence of the same section of DNA taken from the gene for 12S ribosomal RNA in three different animals. All are mammals but the dog and mole are modern placental mammals where the young develop inside the uterus supplied with nutrients through the placenta. Marsupial mammals are largely confined to Australia and are much more primitive, giving birth to tiny underdeveloped young, which are then kept in an external pouch to develop further.

Animal	12S rRNA DNA base sequence
Dog	GGTCCTAGCCTTCCTATTAGTTTTTAGTAGACTTAC
Mole	GGTCCCAGCCTTTCTATTAGCTGTCAGTAAAATTAC
Marsupial mole	GGTCCTAGCCTTATTATTAA TTA TTGCTAGTCCTAC

- a) How many amino acids would be coded by these base sequences? (1)
- b) Count the number of differences in base sequence between:
- i) the mole and the dog ii) the mole and the marsupial mole. (2)
- c) Which two animals are most closely related? Explain your answer. (2)
- d) Explain how the evolutionary history of these animals may account for the relationships between them. (4)

- e) i) The strands of DNA from each animal were treated with the restriction enzyme *HpaII*, which breaks the bond between the bases G–C. How many fragments would be formed from each of the DNA samples shown in the table? (1)
- ii) Following this enzyme treatment each sample was separated by electrophoresis. Which sample would produce a band on the electrophoresis gel that was closest to the negative electrode? Explain your answer. (4)

Stretch and challenge

- 5 Peptic ulcer disease is a common complaint. Sections of the stomach wall become damaged and the highly acidic contents cause severe pain and can lead to perforation, with the risk of septicaemia. It is also a strong risk factor for stomach cancer.

For many years the main cause was thought to be excess stomach acid. Treatments ranged from simple antacids taken orally to more sophisticated drugs such as hydrogen ion pump inhibitors to limit acid production. Most doctors around the world treated patients in this way and the pharmaceutical industry spent many millions of pounds producing a range of ingenious ways to limit acid production.

This view was challenged by two Australian doctors, Marshall and Warren, between 1980 and 1990. Their story leads from an initial rejection of their research paper to the award of a Nobel prize in 2005. It illustrates that research is a human activity, not always as objective as it might be and subject to many influences. It is also a good example of the role played by peer review, journals and conferences in the process of validation.

You will need to read the story, which is presented as a timeline and can be found by searching for ‘Marshall and Warren *Helicobacter* timeline’ in a search engine.

Further research into *Helicobacter pylori* will also provide you with interesting background information.

Use this timeline and your own understanding of scientific research to answer the following questions. The abbreviation PUD is used for peptic ulcer disease.

- a) What did Marshall and Warren suggest about the role of *Helicobacter pylori* in PUD?
- b) Describe two pieces of evidence that suggested a bacterium might be involved in PUD well before Marshall and Warren began their work.
- c) Describe the role played by meetings, conferences and congresses held in 1982, 1983, 1984 and 1990.
- d) In 1984, Marshall carried out a very unusual demonstration. Why would the scientific community consider this to be of very low validity?
- e) In 1994 the patents for the popular drugs used to reduce acid in the stomach ran out. Why would this make drug companies less likely to oppose the introduction of the new antibiotic treatment?

Tip

Question 4 is a very long question for an AS paper but it is a good example of how you will need to follow through several parts of a question that may require knowledge taken from different sections of the specification. These are synoptic questions and a common feature of the full A level examination.