

1 Prokaryotic and eukaryotic organisms can be classified depending on their cellular structure.

(a) Describe **three** structural differences between prokaryotic and eukaryotic cells.

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(b) In 1977, Carl Woese suggested that there are three domains of living organisms: the Archaea, the Bacteria and the Eukaryota.

He used molecular phylogeny to classify organisms into different domains.

Explain what is meant by the term **molecular phylogeny**.

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(c) The table below shows some of the cellular features of organisms belonging to the three different domains.

| Feature | Archaea | Bacteria | Eukaryota |
|---|---|--|--|
| Cell membrane | Branched hydrocarbon chains attached to glycerol by ether bonds | Unbranched fatty acid chains attached to glycerol by ester bonds | Unbranched fatty acid chains attached to glycerol by ester bonds |
| Ribosome size | 70S | 70S | 80S |
| Number of protein molecules in RNA polymerase | 10 | 5 | 12 |
| Peptidoglycan in cell wall | No | Yes | No |
| Type of chromosome | Circular | ircular | Linear |

(i) Using information from this table, give evidence that supports Woese's conclusion that the Archaea are distinct from **both** the Bacteria and the Eukaryota.

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(ii) Using information from the table, explain why the Archaea are thought to be more closely related to Eukaryota than to Bacteria.

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(Total for Question 1 = 10 marks)

2 The scientific article you have studied is adapted from articles in New Scientist.

Use the information from the article and your own knowledge to answer the following questions.

(a) Suggest why 'incredibly efficient cellular mechanisms' can increase the chance of obesity (paragraphs 4 and 5).

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(b) A larger VO_2 max means more oxygen can enter a mitochondrion and therefore more energy can be released from fuel (paragraph 8).

Name **two** substances, other than oxygen, that need to enter the mitochondrion to enable energy to be released from fuel.

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(c) Describe the structure of glycogen (paragraph 11).

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(d) Using the information in paragraphs 12 to 14, explain how lowered testosterone levels may help a cyclist to race harder on successive days.

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(e) Explain why Coyle suggests that greater muscle efficiency may be linked to an increase in the percentage of **slow twitch** muscle fibres (paragraph 20).

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*f) Suggest how 'the development of a leak in a specific class of calcium channel in muscle cells' can lead to muscle fatigue (paragraph 23).

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(g) The ACE gene codes for the synthesis of angiotensin converting enzyme (ACE) (paragraph 25).

Complete the table by naming two nucleic acids involved in each of the processes described.

(2)

| Process | Two nucleic acids involved in the process |
|--------------------------------|--|
| Transcription of the ACE gene | 1 2 |
| Synthesis of ACE at a ribosome | 1 2 |

(h) A variant of the APOE gene could put individuals at increased risk in contact sports. DNA profiling is a technique that can be used in genetic screening.

Suggest how DNA profiling could be carried out to identify this variant of the APOE gene (paragraph 27).

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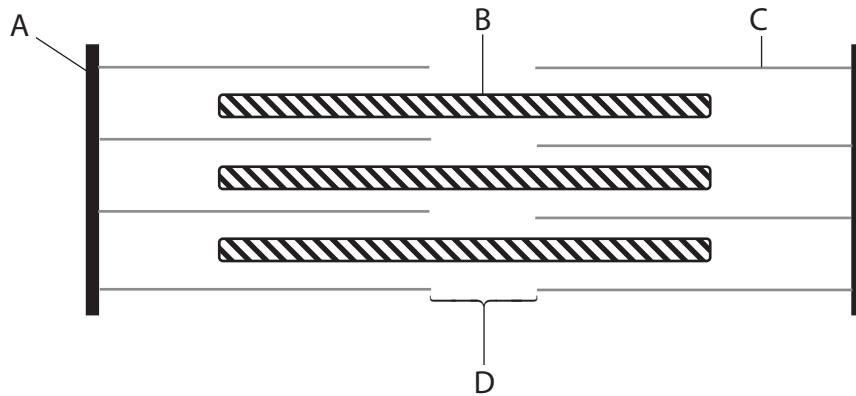
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(i) The titin gene produces a protein that attaches to myosin in a sarcomere (paragraph 30).



Place a cross (☒) in the box that identifies myosin shown in the diagram.

(1)

- A
- B
- C
- D

(j) The colder the water Japanese Ama divers swim in, the higher their resting metabolic rate (paragraph 50).

Suggest and explain why this might be an advantage to these divers.

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(k) Pugh noticed the effects of climate change (paragraph 53).

Name **two** greenhouse gases that contribute to climate change.
Give **one** source of each of these gases.

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(l) Using the information in paragraph 55, calculate the percentage increase in Pugh's core body temperature due to his "anticipatory thermogenesis".

Show your working.

(2)

Answer = %

(Total for Question 2 = 30 marks)
