



# **BIOLOGY 2017**

## **Unit 4**

### **Key Topic Test 5 – Human change over time**

Recommended writing time\*: 45 minutes

Total number of marks available: 45 marks

## **SOLUTIONS**

**SECTION A: Multiple-choice questions (1 mark each)**

**Question 1**

*Answer: C*

*Explanation:*

In modern humans all toes point in the forwards direction, which is an adaptation that facilitates bipedalism.

**Question 2**

*Answer: C*

*Explanation:*

As a member of the Homo genus, *Homo erectus* would have been a hominin. This term applies to all modern humans and the species identified as our recent ancestors. Orang utans and chimpanzees are both primates and spider monkeys are primates but not hominins.

**Question 3**

*Answer: D*

*Explanation:*

As a result of being bipedal the human pelvis has become more bowl shaped compared to that of other primates. The reason for this is believed to relate to the bowl shape of the pelvis providing support for the internal organs as well as support to a foetus during development.

**Question 4**

*Answer: A*

*Explanation:*

The Out of Africa theory states that modern humans developed in Africa and then migrated out to other areas of the world. As a result, all of the oldest hominin fossils would be expected to be found in Africa. To date this evidence and that of mitochondrial DNA still seems to support this theory to a greater extent than any other theory.

**SECTION B: Short-answer or Analysis questions**

**Question 1**

a. Hominin.

1 mark

b. *Homo neanderthalensis* and *Homo erectus*.

1 mark

c. In the model shown in diagram 1 *Homo erectus* shares a common ancestor with *Homo sapiens*, but divergence occurs about 1.3 million years ago.

1 mark

AND

In the second diagram *Homo erectus* seems to have evolved into *Homo heidelbergensis*, which is shown as the direct ancestor of *Homo sapiens*.

1 mark

d. Ideas relating to human evolution change as new evidence is found or determined.

1 mark

AND

The most common example of appropriate evidence involves finding fossils of hominins that are different to any existing example. Other appropriate evidence is the study of genomic or mitochondrial DNA in more recent hominin species.

1 mark

e. Information includes

- The inclusion of *Homo floresiensis* (discovered in 2003).
- The inclusion of *Homo denisova* (discovered in 2008).
- Showing that *Homo sapiens* and *Homo neanderthalensis* (and now *Homo denisova*) diverged recently enough from each other that interbreeding was still possible (the theory that humans and Neanderthals were able to interbreed has only gained recent support).
- Any other appropriate answer

1 mark for each correct response to a maximum of 2 marks

Total 8 marks

**Question 2**

a. *Homo heidelbergensis*.

1 mark

AND

*Homo denisova* and *Homo neanderthalensis* are believed to have descended from the same group of *Homo heidelbergensis* that left Africa about 300 000 years ago. Modern humans are believed to have descended from another group of *Homo heidelbergensis* that remained in Africa until about 60 000 years ago.

1 mark

**b.** The DNA from the finger bone was compared to that of Neanderthals and modern humans because these were the only known hominins in that area at that time. As a result, it was expected that the bone would have come from one of these species, not a previously unknown species.

1 mark

**c.** The DNA of the girl was more similar to that of Neanderthals as these two hominins are believed to have diverged from a common ancestor, and it was only long after this event that modern humans evolved in Africa.

1 mark

**d.** The evidence that supports the idea that this girl was a member of a previously unknown species of hominin was the fact that the genomic DNA was distinctly different from that of Neanderthals and modern humans.

1 mark

**e.** The diagram needs to be altered to show the divergence of modern humans from a recent common ancestor.

1 mark

AND

The diagram appears to show that Denisovans and Neanderthals diverged from modern humans, rather than diverging from an ancestral species.

1 mark

AND

There is no indication of the species that Denisovans, modern humans and Neanderthals descended from. This should be made clearer.

1 mark

AND

A point of divergence is shown from organism A, but it is not clear what species were produced at the point of divergence.

1 mark

**f.** Members of the Denisovan species could have migrated to Asia and Oceania and interbred with the populations already existing there. As a result, their genetic material would be incorporated into the genomes of those populations. This genetic material has been passed down to their descendants, the modern humans who come from these areas.

1 mark

**g.** Denisovan genetic material is not incorporated into the genome of modern humans with European ancestors as the Denisovans did not interbreed with their ancestors.

1 mark

**h.** The diagram conveys the information that interbreeding occurred between *Homo sapiens* and Neanderthals after *Homo sapiens* migrated out of Africa.

1 mark

- i. This individual must have been a hybrid.

1 mark

AND

The mother of the individual is believed to have been a Neanderthal as mitochondrial DNA is passed down through the maternal line.

1 mark

AND

The father of the individual is believed to have been a member of *Homo sapiens*. As the genomic DNA was that of *Homo sapiens* the only way for the individual to have genomic *Homo sapiens* DNA is for one of the parents to be a member of *Homo sapiens*.

1 mark

- j. Modern humans whose ancestors never left Africa would not have any Neanderthal mitochondrial or genomic DNA as interbreeding between *Homo sapiens* and Neanderthals only occurred with members of *Homo sapiens* after they left Africa.

1 mark

Total 16 marks

### Question 3

- a. Species B.

1 mark

AND

The centralised position of the foramen magnum in species B indicates that the skull was balanced over the rest of the body indicating that this individual was bipedal. The foramen magnum of species A is further towards the rear of the skull indicating that this species would not have stood straight and was not fully bipedal.

1 mark

- b. Options include:

Species B has a larger cranial capacity than species A.

Species B has reduced canines compared to species A.

The jaw shape of species B is more parabolic, while the jaw of species A has a squarer shape.

The jaw of species A is larger and more robust than that of species B.

Any other reasonable answer.

1 mark for each correct answer to a maximum of 2 marks

Note: the question asks for trends that can be seen in these skulls, so other traits such as flatter faces, reduced brow ridges and definite chin are not correct answers to this question because they cannot be seen in the aspects of the skulls shown.

Total 4 marks

**Question 4**

- a. Cranial capacity only changed slightly in the period from 7 mya to 2 mya, remaining fairly constant at about 500 cubic centimetres.

1 mark

AND

Cranial capacity increased at a much greater rate in the time between 2 mya and the present day. Cranial capacity has approximately tripled, from about 500 to about 1500 cubic centimetres.

1 mark

- b. The abilities of problem solving and abstract reasoning provided a strong selective advantage.

1 mark

Total 3 marks

**Question 5**

- a. Possible answers include:

- The ability to make and use complex tools: enabled people to build shelters or butcher their prey. Both of these increased the ability to survive in challenging conditions.
- Making fire: enabled people to cook food, decreasing the chance of disease. Also provided warmth.
- Domestication of plants and animals: less effort needed to be applied in finding sources of food enabling the formation of permanent settlements and more time available for developing technology.

2 marks for each identification and accompanying reason to a maximum of 4 marks

- b. Communication and language are the means of passing of information on from one generation to the next. It is thought that the ability to pass information on in this manner was a major contributor to the shift from a hunter-gatherer lifestyle to a settled lifestyle.

1 mark

- c. Cultural evolution refers to the practice of passing information from one generation to the next by non-biological means.

1 mark

AND

Technological evolution is the changes that occur in technology over time. This gives humans an increased level of control over their environment and enables the further development of technology.

1 mark

Biological evolution involves the transfer of genes from one generation to the next and the alteration of phenotypes due to the impact of natural selection due to environmental factors.

1 mark

- d.** The ability to produce and use tools was dependent on two major evolutionary events in earlier humans. Initially the development of adaptations that enabled bipedalism freed the hands from being involved in locomotion to be used for other purposes.

1 mark

AND

The increased size of the cerebral cortex increased the capacity for complex thought and problem solving, resulting in the ability to produce increasingly complex tools. These biological changes provided both the cognitive and structural framework for cultural and technological evolution to occur.

1 mark

Total 10 marks