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INTERNATIONAL SECONDARY CERTIFICATE EXAMINATION
MAY 2024

BIOLOGY: PAPER II
MARKING GUIDELINES

Time: 2 hours

100 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

SECTION A**QUESTION 1**

1.1 1.1.1 1 & 2

1.1.2 2

1.1.3 1

1.2 Table comparing adaptations of the anteaters and pangolins to eating insects.

Adaptation	Pangolins	Anteaters	
Tongues	Flexible, sticky tongues that insects stick to.	Covered with tiny hooks that hold insects.	
Jaws	Toothless – no need to chew insects.	Toothless – no need to chew insects.	
Noses	Special muscles seal their noses shut while they eat	Acute sense of smell/ Long noses to smell insects	
Forelimbs	Powerful arms and claws to dig open the ground to find insects	Strong forelimbs and claws to dig open the ground to find insects	

Mark heading of table and column headings (2 marks max).

Mark first two adaptations. Adaptations must relate to diet (eating of insects).

Construction of table with a ruler

1.3 Elephants are more closely related to anteaters because elephants and anteaters share a common ancestor 70 mya, but anteaters and pangolins share a common ancestor 80 mya /elephants and anteaters share the same branch.

OR

Elephants are more closely related to anteaters because elephants share a common ancestor with anteaters more recently than pangolins and anteaters /pangolins and anteaters are on different branches.

(Any 2 points)

1.4 There was variation in pangolin offspring. Some pangolins had the mutation that caused the hairs to fuse/and form scales. These mutations were passed on to their offspring (the mutations are heritable).

Environmental pressure, in the form of predators or disease favoured the pangolins that had scales to protect them from predators and disease.

These pangolins were more likely to survive/find mates and pass the favourable mutation onto their offspring. Over time all pangolins had inherited the favourable mutation.

(Any 5 points)

- 1.5 1.5.1 The adapted forelimb has shorter forearm /radius and ulna are fuse /fewer/larger/sturdier wrist bones.
(Any 1 reason)
- 1.5.2 Needed for greater strength/shovel-like to dig for insects.
- 1.6 1.6.1 A mutation is a (permanent/random) change in the DNA/nucleotide sequence of a gene.
- 1.6.2 (a) Genes that code for scale proteins – allow scales to form which protect the pangolin.
Receptor genes involved in the sense of smell – superior sense of smell to find insects.
Interferon genes not required as scales protect from bacterial infections
(Any 2 mutations and their benefits)
- (b) Vision genes or genes that code for tooth enamel or interferon genes
- (c) Individuals with the stress gene/harmful gene mutation are less likely to survive, eliminating the harmful gene from the population and not affecting genotypic variation.
OR
The stress gene/harmful gene mutation could cause the death of the pangolins, creating a smaller population decreasing genotypic variation.
(Any 2 points)
- 1.7 1.7.1 Inbreeding results in homozygosity /smaller gene pool /which leads to less genetic variation prevents the likelihood of an organism adapting/evolving to changes in the environment. Increased expression of recessive/harmful genes Population more susceptible to disease. Decreased fitness of offspring. Reduces a species' ability to survive and reproduce. Increases risk of extinction.
(Any 2 points)
- 1.7.2 80% of Africa's population uses traditional medicine. Traditional healers use pangolin scales and bones to treat medical or spiritual problems. Traditional healers do not know about plant-based alternatives. If traditional healers are involved in conservation, they will be educated about alternatives. They have influence over their patients can educate them to not require pangolin scales or bones.
(At least one point referencing harmful practices of traditional healers; 2 points referring to importance of involving traditional healers)

QUESTION 2

- 2.1 2.1.1 C
- 2.1.2 D
- 2.1.3 B
- 2.1.4 A
- 2.2 2.2.1 Fires provided warmth allowed exploration to new (colder) environments without freezing to death, so could survive in new environment.
Sitting around a fire encouraged cooperative behaviour such as organised hunting /building of shelters encouraged communication, which allowed hominids a better chance of surviving in new environments.
Fire enabled the cooking of food – more nutrients for the brain / better brain development allowed *Homo erectus* to adapt and modify their environments allowing hominids a better chance of surviving in new environments.
Fires scare away predators safer to explore new environments
Fire allowed access to a greater range of food better nutrition increases chances of survival in new environments.
Cooked food – kills bacteria – can eat variety of food increasing chances of survival in different environments
Any two points – each must be explained for the second mark.
- 2.2.2 Back pains /more pressure on the lower back
Shock-absorber function of the shoulder blade/scapula is lost
Narrow birth canal /more pain/difficulties during childbirth
Knee joint injuries occur more frequently
Loss of bone minerals
Increased exposure to predators
(Any 2 disadvantages)
- 2.2.3 Fossil evidence – So many different fossils found in Africa/Oldest *Homo sapiens* fossils found in Africa.
Archaeological evidence – Oldest evidence of symbolic thought found in Africa/Burial of dead/Tools/artefacts.
DNA from Y-Chromosome – Every man alive is traced to a common ancestor in east Africa 60 000 years ago.
Mitochondrial DNA – Leads to ancestral female in East Africa 150 000 years ago.
(Any 1 form of evidence, explained)
- 2.3 2.3.1 Skulls and bones were found.
Geological age of 235 000–336 000 years old – more likely to be *Homo* based on age/too recent to be *Australopithecus*
Scans of skull reveal a human-like brain case
- 2.3.2 Extraction of ancient DNA/mtDNA/proteins – prove that *H. naledi* and *H. sapiens* are closely related/both belong to same genus/*Homo* / can be used to determine the age when the hominids diverged

- 2.3.3 Evidence of fire use is typical of *Homo*, (not *Australopithecus*)
Huge lumps of charcoal – pieces of burned wood. /Thousands of burned bones /The remains of giant fireplaces /Baked clay – baked by the heat of a fire
Evidence that *H. naledi* disposed of their dead
(Any 1)
- 2.4 All hominids (except *Homo sapiens*) are extinct and the number of fossils is limited /fossil record is incomplete /
Fossils are usually incomplete, and interpretations differ
New discoveries challenge previously accepted ideas
Humans can be subjective and biased in their interpretation of evidence
Hominid evolution did not occur in a linear pattern /it is more complex making classification more challenging.
Advances in technology provide more evidence but this can cause more disagreements when they conflict with fossil evidence (e.g. *Homo naledi*)
New discoveries, like evidence of fire use by *Homo naledi* can lead to revision in classification of hominids
(Any 3 points)
- 2.5 2.5.1 Flat face /little prognathism /no sloping face
Similar sized jaws
Eyes facing forward /Optical plane same
Both have small teeth /similar sized teeth
Any 1 similarity
- 2.5.2 Small cranial capacity /small skull /small brain case
Prominent eyebrow ridges
- 2.6 2.6.1 Foramen magnum
- 2.6.2 (a) Foramen magnum: Further back in the skull/less central position
- (b) *Australopithecus africanus* has a mix of ape-like and human like-characteristics. A foramen magnum placed less centrally indicates quadrupedal movement/ape-like movement
OR
Homo sapiens was fully upright and bipedal
- 2.6.3 (a) 2,6 – 2,8 million years ago (accept only one value within the given range, not a range of values. Must write unit (million years ago)).
- (b) $650 \text{ ml/minute} \div 6 = 108,33 \text{ ml/minute}$
OR
If using the graph, $1,6 - 1,8 \text{ ml/second} = 96 - 108 \text{ ml/minute}$
Values must be within these ranges.

SECTION B**QUESTION 3**

Consider the following statement:

Species can overcome the challenges created by climate change, by adapting, evolving, and surviving.

Yes – species can adapt, evolve, and survive	No – species cannot adapt, evolve, and survive
Source A Organisms evolve (adapt/thrive) by natural selection in changing environments If selection pressures are strong, evolution can happen quickly Climate change produces selection pressures which encourage evolution	Source A Rapid and extreme changes due to climate change make it more challenging to evolve successfully If organisms cannot adapt and evolve fast enough, they may go extinct
Source B Smaller species with shorter reproductive cycles can adapt faster	Source B Present climate is changing too quickly, not enough time to adapt Larger species take longer to evolve and may go extinct Woolly mammoth went extinct when climate changed In the past, all the major extinction events coincide with periods of rapid temperature change Large herbivores are less likely to evolve fast enough
Source C African birds have evolved by changing their behaviour or phenotypic characteristics Table corals have adapted and evolved to become heat tolerant Table corals can regenerate coral reefs 14 times faster than other corals due to their ability to adapt Tawny owl – evolved to become darker brown in a warmer climate Climate change could speed up mosquito evolution Humans are developing abnormal sickle haemoglobin gene as an evolutionary response to malaria Birds evolve by changing their behaviour or phenotypic characteristics Over time, phenotypic changes can become an evolutionary adaptation Birds adapt to warmer climates by using more energy to keep cool	Source C When birds need to keep cool, they have less energy for breeding Changes in rainfall changes development of testes and ovaries – negative impact on reproductive success Later breeding times of birds means fewer offspring are produced Changing rainfall patterns affects nesting behaviour and birds breed less regularly The squirrels' feet can only evolve to a certain maximum length and then no more If temperatures continue to rise, these adaptations will not be enough for continued survival

Source D Hybridisation allows rapid exchange of beneficial genes – temperature tolerance and disease resistance Hybrids can cope better with challenges caused by climate change Cichlid hybrids can adapt and survive in changed aquatic environment	Source D Climate change affects interactions between species – one species may adapt but the other may not Plants and pollinators have evolved together over millions of years The timing of bee and plant can be disrupted by climate change, affecting survival of both bee and plant Climate change affects the bond between pollinator and fynbos plant Hybridisation with alien species can decrease genetic diversity of cichlid fish
Source E Climate change causes changes to migration patterns of animals Migration increases gene flow Increased gene flow increases genetic diversity Gene flow enhances a population's ability to adapt	Source E
Source F	Source F Climate change reduces population sizes Smaller populations have less genetic diversity Habitat fragmentation isolates populations and reduces gene flow Less gene flow means less genetic diversity and less ability to adapt Genetic bottlenecks reduce populations, and the recovered population is smaller Genetic bottlenecks can lead to extinction Climate change results in a smaller variety of alleles in the new population
Source G Temperature changes increase the rate of mutations Mutations can be beneficial to organisms Plant DNA activity changes in response to climate change Gene expression changes help plants become drought resistant	Source G Temperature changes increase the rate of mutations Mutations can be harmful to organisms

Source H Assisted evolution can speed up naturally occurring evolutionary processes Controlled hybridisation ensures that species receive the best traits Genetic modification – produces crops that reduce greenhouse gas Genetic modification – produces crops that are disease-resistant Assisted gene flow – speeds up species adaptation by bringing in genetic diversity to populations Selective breeding – produces drought- resistant and pest-resistant crops and animals Drought resistant sorghum in Namibia – more crops for people	Source H Artificially bred plants can take resources away from naturally selected plants
Source K Climate change has resulted in an increase in brain size for humans	
Own Smaller species can adapt and evolve more quickly. Climate change selects different/ more mutations – that can help an organism survive. Humans with bigger brains are better adapted to environments. <i>Homo sapiens</i> evolved and survived where other hominids did not.	Own The evolution of sickle-shaped red blood cells can cause more people to suffer from sickle-cell anaemia. Assisted evolution may have unforeseen consequences that do not benefit the survival of organisms in the long run. GMOs – may have unforeseen consequences for the environment. Climate change reduces the size of populations – Founder effect – lack of genetic diversity, unlikely to adapt and survive

Total: 100 marks