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INTERNATIONAL SECONDARY CERTIFICATE EXAMINATION
NOVEMBER 2023

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 Mutation
- 1.1.2 Inbreeding
- 1.2 1.2.1 (a) 7 million years ago
- (b) Ocelot
- (c) Leopard cat
- 1.2.2 Fossils and DNA/genetic evidence/mtDNA/Y chromosomal DNA / Physical appearance/features/structures (Any 2 pieces of evidence)
- 1.3 The phylogenetic tree shows that the different *Felidae* species share a common ancestor They share similar anatomical characteristics /they share skeletal structures/ such as: muscular bodies/, powerful teeth and jaws/ sharp claws The cats were separated by a geographical barrier and evolved separately (2 reasons)
- 1.4 The snow leopard and the golden-brown leopard were isolated from the original population (Over time) they were geographically separated from each other /physical barrier created when the sea levels rose (The sea) prevented gene flow/ prevented interbreeding/ prevented mating between the different populations and over time each population evolved separately as they adapted to the different selection pressures/ different temperatures /different environments on the different land masses and over time became different species.
(Any 4 points)
- 1.5 (Although the leopards have different fur colours), the variation in fur colour is due to a single gene mutation/ only a small genetic change has taken place the two leopards still belong to the same species (Can mention the same species name – *Panthera pardus*)
The fur colours are not an example of macroevolution because there was no large-scale change in the genotype and the change happened over a relatively short space of time
Small-scale changes (fur colour) within a single population
(Any 2 points)
- 1.6 The snow leopard's environment changed and became snowy The leopard acquired/ needed/ used white fur (in its lifetime) The white fur helped the leopard hunt without being seen This white fur was passed onto its offspring Inheritance of acquired characteristics
(Any 3 points)

- 1.7 Deforestation (clears away the trees) creating an open habitat / habitat with more light / loss of habitat / no space for the leopards to hunt The black leopard is no longer camouflaged
Which means the black leopard will not be able to hunt/survive effectively/ having a negative impact on its survival/ declining numbers/ extinction
(One point -effect of deforestation; one point -impact on leopard)
- 1.8 The graph suggests that there are no cheetahs in the world / they are extinct
- 1.9 Cheetahs have low natality, poor sperm quality, high cub mortality
(Any 2 points)
- 1.10 Low genetic variation can reduce the cheetah's chances of survival If there is a sudden environmental change if there is a disease / lack of food / climate change / lack of mates (one mark for one example) creating selection pressure for the cheetahs, it is unlikely that some will have a favourable characteristic that will allow them to adapt to the changing environment The cheetahs without the favourable trait are less able to adapt and may die causing possible extinction
(4 facts needed)
- 1.11 1.11.1 Artificial selection Selective breeding
- 1.11.2 The Egyptians would have friendly pets/companions/selected friendliness who would kill rats thus protecting their crops /food supply /cats kill rats that can spread disease Egyptians were protected from disease spread by rats

QUESTION 2

- 2.1 Hominids are bipedal animals (in the fossil record) showing a mixture of ape-like and human-like features
 OR [Hominids include **humans and their ape-like** ancestors]
 OR [Hominids are a group of all **modern and extinct great apes**]

2.2 2.2.1 *Homo erectus*

2.2.2 *Australopithecus afarensis*
 OR *Australopithecus sediba*

2.2.3 2,6 – 2,8 mya (Accept one answer within the range or a range of answers within the range)

2.2.4	<i>Australopithecus africanus</i>	<i>Homo erectus</i>	
	Smaller cranial capacity	Larger cranial capacity	
	Prognathism/more sloped face	Flatter face/less sloped/less prognathism	
	Prominent cranial and brow ridges	Less prominent cranial and brow ridges	
	Bigger jaw size	Smaller jaw size	

Any 2 differences

2.2.5 $5 \text{ cm}^3 = 250 \text{ million neurons}$
 $1\ 400 \text{ cm}^3 = x \text{ million neurons}$
 Calculation: $1400 \times 250 \div 5 = 70\ 000 \text{ million neurons}$
 OR $1\ 400 \div 5 = 280$
 $280 \times 250 = 70\ 000 \text{ million}$

Answer can be written as **70 000 million OR 7×10^{10} OR 70 billion**

- 2.3 2.3.1 Bipedalism:
 Foramen magnum located **centrally** (in the bottom of the skull)/ foramen magnum **not at back of skull**/ foramen magnum **further forward**
 to maintain balance of the head/ to keep the head vertically above the vertebral column
 (Position + explanation)

2.3.2 Speech:
 More pronounced chin space more space in the mouth more space in the throat and neck U-shaped upper jaw more space for vocal tract more space for tongue movement enabled the expression of words
 (One well-explained reason)

- 2.4 Comparison of tools/differences in tools made by *Homo habilis* and *Homo erectus*.
OR Comparison of Oldowan tools and Acheulian tools

<i>Homo habilis</i> /Oldowan tools	<i>Homo erectus</i> /Acheulian tools	
Simple flake tools	Axe with a fat sturdy body and a sharp cutting edge	
Kill large animals to eat	Kill animals Strip bark off trees Dig holes in the ground	
Strong precision grip Manual dexterity Better mental capabilities	Manual dexterity More intelligence	

Table heading

Column heading

Two differences in tools

One difference in skill required to make tools

- 2.5 2.5.1 Cradle of Humankind OR
Sterkfontein Caves

2.5.2 Any TWO of the following points:
No, Mrs Ples was an Australopithecine/ belonged to *Australopithecus africanus*. The first tool maker was *Homo habilis* who came after *Australopithecus africanus*
Mrs Ples lived about 2,1 mya, (before tools were made) *Homo habilis* lived later (2,4 to 1,5 mya)

- 2.6 During the production of the Acheulian tools, the parts of the brain that were used were the frontal gyrus/ area 5 and Broca's area / area 6, which are needed for speech /More areas are activated during the production of Acheulian tools (than Oldowan tools)
The frontal gyrus/ area 5 is involved in thinking and reasoning, speech and language
Thinking and reasoning are skills that are needed for language development
(Any 4 points)

- 2.7 No, the results show that individuals who live in a social group have a lower brain mass than individuals who live alone.
Or They have fewer brain neurons when living in a group
(Any 2 points)
OR

Yes, the results do not contradict the social brain hypothesis, they show that evolution is continuing but on a different path/ in a different way / the results show a new evolutionary path for brain size evolution In the past, brains evolved (and became larger) due to social interactions, now brains are evolving to become smaller due to social interactions – the evolutionary path has changed
(Any 2 points)

Yes/No NOT awarded a mark

- 2.8 Humans have become more social /live in more complex societies. When people have others to rely on, their intelligence does not need to be as great. Technology decreases the need for a bigger brain Technology decreases the need to interact with other people large brain requires a lot of energy to maintain. If knowledge is shared / individuals have specific roles to play (in a social group) , brains may adapt to become more efficient by decreasing in size.

(Any 2 points)

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SECTION B**QUESTION 3**

Consider the following statement:

Evolution has had a positive impact on the control of disease in humans.	
Yes – evolution has had a positive effect on the control of disease	No – evolution has not had a positive impact on the control of disease
Source A As humans have been exposed to new diseases, they have adapted and evolved by natural selection When humans are exposed to selection pressures (such as disease, change in environmental conditions or availability of food), they evolve and adapt by natural selection favourable adaptations are passed on to offspring Humans have evolved less melanin(at low levels of UV radiation) – able to synthesise Vitamin D – keeps bones, teeth and muscles healthy. Humans have evolved higher levels of melanin to protect against skin cancer At high altitudes and low oxygen – evolved higher haemoglobin concentration to protect against disease Adaptation to arsenic in drinking water – protection against poisoning Adaptation to altitude – faster breathing/ higher lung capacities/ higher levels of nitric acid – protect against oxygen-deficiency diseases Syphilis bacteria have evolved over time and cause less severe symptoms Humans are evolving tolerance to lactose allowing them to digest lactose Milk is an important food source	Source A Pathogens have evolved to create new patterns of complex disease. Humans have evolved to not produce Vitamin C – can cause scurvy – a disease that causes bleeding gums/, muscle weakness/, pain/ and fatigue Use of fire by early humans caused the evolution of tuberculosis. More social behaviour caused infections to spread more easily
Source B	Source B Domestication of animals by artificial selection increased population density and spread of infectious disease. As animals have been domesticated, we have promoted the evolution of disease These diseases have become major killers of mankind: influenza, TB, malaria, smallpox, plague and syphilis

Source C The human immune system has evolved over time Disease is a powerful source of environmental pressure Strong immune systems are effective in controlling diseases an individual is exposed to	Source C People with weak immune systems help pathogens evolve to become more deadly. A severe immune response can kill people Many deaths in Covid patients caused by the immune system's over-reaction to the virus
	Source D Overuse of antibiotics is causing antibiotic-resistance in bacteria TB, gonorrhoea, food-borne diseases are more difficult to treat Farmers overusing antibiotics is a threat to global health. Antiretrovirals create HIV drug resistance More HIV infections Higher HIV death rate
Source E	Source E The Founder Effect increases the frequency of certain rare diseases in a population
Source F Sickle cell trait protects against malaria Natural selection has caused sickle cell carriers to become more widespread in Africa. Sickle cell trait is more prevalent in malaria areas in Africa	Source F Mosquitoes have evolved resistance to insecticides Malaria parasites are evolving resistance to drugs used to treat malaria
Source G Gut microbes have evolved alongside humans in a symbiotic relationship. Examples: Gut microbes help body produce serotonin – regulates and improves mood Gut microbes help build a strong immune system Gut microbes produce vitamins, amino acids, and lipids Gut microbiome protects against heart disease, diabetes, obesity, and metabolic disease. Gut microbiome protects against viral infections MAX 2 EXAMPLES	Source G

OWN Describe natural selection and survival of fittest – disease should result in survival of fittest organisms, which benefits the survival of any population. Disease kills off weaker and more susceptible members of the population. If antibiotics were better controlled, microbes would not have had the opportunity to evolve resistance. Human error creates resistance in micro-organisms and disease vectors Other examples of positive effects of evolution on human health: darker eyes protected against damaging UV rays Gut microbes produce Vitamin K necessary for blood clotting and building bones	OWN Explain how resistance to antibiotics can create worse disease. Multi-drug resistant TB bacteria Give examples of founder effect – Tay-Sachs disease and Huntington's disease. Explain how the founder effect works Humans have evolved less melanin at higher latitudes – can cause skin cancer if they move to equator. Humans have evolved more melanin at equator – problem if they move to higher latitudes – can't produce Vitamin D Syphilis has persisted due to evolution Hand sanitisers upset the skin's microbial balance and create drug-resistant bacteria Pesticides encourage insect resistance increase spread of dengue and yellow fever Sickle cell trait does not benefit a person living in an area with no malaria More people have sickle cell anaemia in Africa.
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Total: 100 marks

	1 mark	2 marks	3 marks	4 marks	Possible mark (40)
Planning × 2	- Decision given - Key points present for and against the argument	- Decision given - Key points developed for and against the argument	- Decision given - Key points developed for and against the argument - Sources referenced (e.g. Source A/own information)		6
Decision	- Vague - Changed position within essay	Clear decision made			2
Use of knowledge from sources × 2	Up to ¼ of potential detail in sources used to support argument	Up to ½ of potential detail in sources used to support argument	Up to ¾ of potential detail in sources used to support argument	Source detail – very close to full potential used to support argument	8
Use of own knowledge	Some facts beyond the source given to support argument	Many facts beyond the source given to support argument	- Some facts beyond the source given to support argument - Facts integrated into the argument	- Many facts beyond the source given to support argument - Facts integrated into the argument	4
Content relevance	- Repetition mostly avoided - Some minor digression - Supporting argument relevant	- Repetition mostly avoided - Some minor digression - Supporting argument relevant - Quality of source extracts acknowledged			2

	1 mark	2 marks	3 marks	4 marks	Possible mark (40)
Quality of argument supporting decision × 2	- Writing consists of facts with little linkage or reasoning - Reasoning incorrect	Maximum if no clear decision in support - Reasoning correct, but hard to follow - Ordinary: some linkage evident	- Supports the position - Reasoning is clear - Minor errors in flow - Linkage sometimes missed	- Strongly supports a clear position - Reasoning is very clear and succinct - Flow is logical - Compelling with regular linkage - Well-integrated argument	8
Fairness – counter opinions to decision	One to two counter opinions given from the sources	Three to four counter opinions given from the sources	Integration of one to two counter opinions from the sources into argument	Integration of three to four counter opinions from the sources into argument	4
Presentation	- Writing is almost unintelligible - Tone, language, terminology unscientific and very weak - Introduction and/or conclusion not present	- Tone, language, terminology weak - Introduction and conclusion present	- Tone is consistent and suited to scientific language - Good and appropriate language and terminology - Mostly appropriate paragraphing - Introduction and conclusion have merit	- Tone is mature and suited to scientific language - Excellent and appropriate language and terminology - Correct paragraphing with good transitions - Interesting introduction, satisfying conclusion	4
Scientific merit	Essay shows academic rigour, accurate reasoning, insight and cohesiveness.				2

	Symbols		Mark
Planning	D+ / D- – decision identified F – facts present S – sources of facts given I – facts developed. CA – counter argument O – own info (FOR)	PL	6
Decision	Agree with statement (D+); Disagree with statement (D-)	D	2
Knowledge from sources to support (x 2)	1–2 facts ($1 \times 2 = 2$) 3–5 facts ($2 \times 2 = 4$) 6–8 facts ($3 \times 2 = 6$) 9+ facts ($4 \times 2 = 8$) 1 at point of fact	K	8
Own Knowledge	O¹ = 1 O² = 2 O¹ integrated = 3 O² integrated = 4	O	4
Relevance	SR – source quality Rel – relevance Rep – repetition CE – conceptual error	R	2
Supporting argument (x 2)	S – where facts are well-supported / integrated / synthesised / linked (read descriptors)	S	8
Counter Argument / Fairness	CA₁ – CA₂ = 1 CA₃ – CA₄ = 2 CA₁ – CA₂ integrated = 3 CA₃ – CA₄ integrated = 4	CA	4
Presentation	(read descriptors)	P	4
Merit	(read descriptors)	Me	2
Total			40