NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2019

LIFE SCIENCES: 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 False

1.1.2 True

1.1.3 True

1.2 A

1.3 Table showing adaptations of rosette shrubs/giant groundsels and giant lobelias to the environment / advantages of adaptations

Adaptation	Advantage of adaptation (both headings) (these can be row headings)
Water storage tissue	To store water/keep water in stem as water in ground is frozen
Leaves that remain on the stem	Protect stem from cold
Leaves curl around bud	To protect growing tip from cold
Antifreeze present	Prevents water freezing in stem
Woody stem with rapid growth	To raise plant above ground to get away from cold

Mark first 2 features and corresponding advantages. Adaptations MUST relate to preventing damage from the cold.

1.4 1.4.1 The development of similar / analogous characteristics in unrelated species / different mutations gave rise to the similar characteristics / characteristics are not genetically related, the functions are the same but the characteristics just look the same two species do not share a recent (common) ancestor

1.4.2 The DNA / genes for characteristics in one plant are different to the DNA /genes for the same characteristics in the other species.
Two species are therefore not (closely) related. DNA is not passed from a common ancestor. Characteristics look the same as they have similar selection pressures / occur in the same environment DNA/genetic profiling of DNA coding for characteristics produces unique set of bars / will have different bars / positions of bars

1.5 1.5.1 A

1.5.2 B

1.5.3 B

1.6 Inbreeding results in individuals being very similar genetically; / decreases genetic variation / increases homozygosity / increases the chance that unfavourable alleles will be expressed / less fertile/ genetic abnormalities increased / more susceptible to diseases

The same alleles are passed on from each parent increased risk that if environment changes, no individuals will have the alleles required to provide phenotype to fit that change

1.7 1 / 36 000 = 0,000027 = $2,7 \times 10^{-5}$ g (accept rounded off to 3×10^{-5} g, any decimal place is fine. Can get a mark for saying 36 000 seeds has a mass of 1g)

1.8 C

1.9 The environment on the mountains differs from that between the mountains like islands separated by the sea.
Populations on the mountains are isolated (like organisms on islands in a sea) and cannot interbreed.
Each mountain has a different environment; therefore each species on them has evolved differently like isolated populations evolving on islands with different environments.

1.10 A reduced level of genetic diversity could result in a higher risk of extinction of species; decrease in genetic diversity as inbreeding will occur; will result in localised extinctions survival will decrease; due to unfavourable conditions / possibly warmer weather / lack of water these plants require / plants have adaptations for colder weather / require water for storage in stems, etc.

QUESTION 2

2.1 2.1.1 C

2.1.2 A

2.1.3 D

2.1.4 B

2.2 New species arising (without the presence) of geographic barriers (anything implying no physical barriers)

2.3 Up to 40% of the mtDNA differ between the animals in the two regions (suggesting limited gene flow).
Differences in certain genes across the genome in the hard chalk and soft chalk soil populations.
Female and male mole rats taken from one soil type prefer to mate with each other (even in the presence of mole rats from the other soil type).
Despite being the same species, the two populations appear to have mostly stopped mating with one another (at some point in the past).
Many of the individuals in hard chalk soil have the mutant allele of p53.

2.4 Mutations, e.g. subject to high UV radiation / change in nucleotide sequence of gene / low oxygen levels / anything that causes the mutation eg mistake during DNA replication.

2.5 The two populations still look similar; they can still interbreed; only small changes occurred (e.g. Galilee mole rats in hard chalk soils receive less oxygen/ a mutation in codon 172 of a gene called ***p53*** is more common in the hard chalk population; they are not different species; not a lot of changes have occurred can still produce fertile offspring; there still is gene flow; most mtDNA (60%) is the same

2.6 2.6.1 Peer review is an important part of the scientific process to enable checking of the process or conclusions reached /science is an open body of knowledge, new evidence constantly comes to light that will change conclusions; can assist in pooling of knowledge so new knowledge can be more quickly confirmed

2.6.2 There is no actual 'solid' geographic barrier to gene flow therefore it is not definite that gene flow has ceased to allow differences to accumulate. (Difficult to establish whether breeding has stopped between the two groups)

2.6.3 Apple maggot fly/ Darwin finches/ Cichlid fish any other correct example

2.7 2.7.1 Hard chalk soil holds more water than soft chalk soil this means that Galilee mole rats in hard chalk soil receive less oxygen which could lead to cell death – ***p53*** allele allows cells to die when conditions are unfavourable. Mutant allele means that cells do not die due to less oxygen

2.7.2 B C A

2.8 2.8.1 mtDNA passed intact from mother to child (no recombination), therefore the more similar it is, the closer related higher mutation rate therefore allows differences between populations to be seen more easily

2.8.2 Biogeography /structural similarities, fossil evidence vestigial structures / embryological similarities

2.9 Evolution underpins all of biological sciences – medicine – study of antibiotic resistance – antibiotics destroy susceptible bacteria, therefore resistant survive and pass on resistance, therefore allows us to understand this process, palaeontology – human evolution – to understand human origins, conservation – predictions of effects of fragmentation and isolation of habitats on biodiversity, plant and animal breeding and effects of inbreeding – heterosis, artificial selection of characteristics – breeding of pedigree animals or desired varieties of crops/farm animals – also how to avoid inbreeding when doing this and understanding consequences; medicine – founder effect/bottleneck – looking at prevalence of certain genetic conditions in population groups, climate change – future effects of climate change on populations – punctuated equilibrium/phyletic gradualism. Similarity between organisms in terms of development – we can use species related to humans (such as chickens) to see how they develop. Similarity determined by genetics. Biodiversity explained by evolution of large number of species. Reasons for high diversity explained by change in environments and occupying of niches by new species. Large number of related species in close proximity explained by evolution (e.g. Galapagos finches). Ecological interactions such as symbiotic relationships explained by co-evolution, niche differentiation occurs through favourable mutations in either species allowing them to acquire new characteristics diverging niches. Medicine – use of animal models relies on evolution – these organisms show similarities. Mutations giving rise to resistance to disease, e.g. CCR5 to HIV infection.

Reasons must be SPECIFIC

SECTION B

QUESTION 3

Consider the following statement:

The need to access food efficiently, rather than a need for social cooperation, was the most important selection pressure for the evolution of a large brain in hominids.	
Food	**Social**
Source A Brains evolved due to: Find challenging food in a seasonally changing savannah Store food to be eaten later Find shelter Prepare and cook food to assist digestion Tool use Find a wide variety of food See in colour	**Source A** Brains evolved due to: Avoid being cheated To raid other human populations For cooperative hunting To get food from competitors in group To learn lessons from social group Enable speech
Source B Bigger brain – more complex tools are produced Bigger brain – more varied diet	**Source B** Bigger brain (Broca's area) – language development
Source C Neanderthals have large brain but smaller social group (to rebut social reason)	**Source C** As community size increases, brain size increases Lots of mental ability required to exist in large social groups Need to stay in social groups to access food , mates Brain is large to keep track of rapidly changing social relationships and manipulate for access to resources – manipulation (and avoiding manipulation) is linked to brain size Those best at this will leave more descendants Those individuals who can avoid being manipulated will also be at an advantage Primates evaluate group members in terms of what they can get out of them Also an advantage for individuals to be able to evaluate others when raiding another group Manipulation still common in modern humans

Source D	**Source D** Large brain allowed communication/ teamwork / language for dispersal Cooperative hunting possible with good communication Children stay with parents for longer – requires bigger brain for teaching and learning skills Emotions used to gain a greater share of resources
Source E Brain size correlated with percentage fruit in diet Bigger brains in species that are omnivores/ frugivores NB to learn to recognise safe fruit High diversity of different plants, foods occur at different times and occur clumped – therefore need to learn where food is. Fruits may be hard to reach or protected by defences, primates also need problem-solving skills or even tools – bigger brains are needed to deal with these foraging conditions	**Source E**
Source F	**Source F** Human brain size evolved most rapidly when there was climate change bigger brains allowed more interaction with one another, as environment became more unpredictable, bigger brains assisted survival
Source G Lots of credible studies to show that tool use is correlated with increase in brain size Tool use advanced in monkeys and apes – have large brains Brain size correlates well with tool use; innovation in tool use	**Source G**
Source H Increase in brain size correlates with tool complexity. Fishing – larger brains to track tides, catch fish, force open shellfish Cooking food – softer, therefore can eat easier and get more energy – brain size increase allowed evolution of cooking Correlation between increase in brain size and first appearance of cooking	**Source H**

OWN	**OWN**
Cerebrum is the part of the brain that increased the most Development of fire to cook food– linked to brain size increase *Homo habilis* tool use Ability to access variety of food meant healthier individuals – bigger brain needed Climate change – less food available – advantage to access food – bigger brain needed	Presence of food allowed for big brain development Cerebrum is the part of the brain that increased the most Development of laws in societies – need big brain Out-of-Africa discussion linked to migration and brain size K selection in humans – more parental care – bigger brain Neanderthals – had large brain but outcompeted by humans as they were able to compete better for food therefore food not linked to large brain Neanderthals – large brain and advanced social systems Better predator defence in groups

Total: 100 marks

Note: Essay should be 2½ to 3 pages long.
Time allocation suggestion: Reading of sources 10 min.; Planning 10 min.; Writing essay 40 min.

	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 • Source references identified (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 given beyond the source to support argument	• Many facts given beyond the source to support argument	• Some facts given beyond the source to support argument • Facts integrated into the argument	• Many facts given beyond the source 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