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INTERNATIONAL SECONDARY CERTIFICATE EXAMINATION
MAY 2025

BIOLOGY: PAPER I
MARKING GUIDELINES

Time: 3 hours

200 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.

QUESTION 1

1.1

COLUMN A**COLUMN B**

- [**C**] All the plants and animals in an environment that interact with each other and with the non-living environment.
- [**J**] The one-way movement of organisms out of an area.
- [**D**] A group of organisms of the same species that live in a particular area at the same time and can breed with each other.
- [**G**] The sum of all the limiting factors that affect the growth of a population.
- [**A**] The one-way movement of organisms into an area.
- [**B**] The number of individuals that can be sustained by the environment.
- [**L**] The ecological process by which the mix of species and habitat in an area change over time.
- [**I**] An indirect method used to estimate the size of a population.
- [**K**] A factor that alters the population size regardless of the size of the population.
- [**F**] A direct method used to estimate the size of a population.
- A Immigration
- B Carrying capacity
- C Ecosystem
- D Population
- E Species
- F Census
- G Environmental resistance
- H Density dependent factor
- I Mark-recapture
- J Emigration
- K Density independent factor
- L Succession

1.2

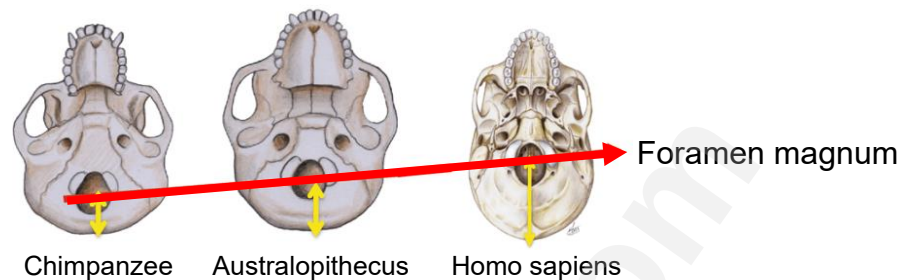
1.2.1	1.2.2	1.2.3	1.2.4	1.2.5	1.2.6	1.2.7	1.2.8	1.2.9
D	A	A	C	B	C	D	B	C

1.3

1.3.1	1.3.2	1.3.3	1.3.4	1.3.5	1.3.6	1.3.7	1.3.8	1.3.9	1.3.10
1	1	2	1	none	2	1	2	1	1 & 2

- 1.4 1.4.1 (a) foramen magnum
(b) bipedal/bipedalism

1.4.2 (a)



Can label on any of the skulls.

- (b) The foramen magnum has moved more forward / more centrally placed / chimpanzee foramen magnum more to the back of the skull this means that the spinal cord was directly underneath the skull./Chimpanzee spinal cord placed more to back of skull.

- 1.4.3 (a) *africanus*
(b) Taung child
(c) Mrs Ples

1.4.4 (type/size of) teeth

- 1.4.5
- Predators lived in the area and after they fed on an animal, they left all the bones behind/feeding ground for predators.
 - Well inhabited area due to available food for variety of animals.
 - They collected the bones to possibly make simple tools.
 - Humans' ancestors ate small animals and left the bones in the caves.

Any other suitable explanation.

Mark first well-explained answer.

- 1.4.6 A has larger canines/gaps in-between teeth/C has small canines/no gaps in between teeth.

1.4.7 **Yes,**

- many human ancestor fossils found in Africa.
- humans originated in Africa.
- only australopithecines found in Africa – they gave rise to *Homo* genus/modern humans.

Any other suitable answer.

No,

- according to the multi-regional model modern humans evolved in various locations from *H. erectus* that moved out of Africa.
- *H. erectus* moving out of Africa and may not be seen as 'human'

Any other suitable answer.

- 1.5 1.5.1 (a) somatic
(b) gene
(c) mutation

- 1.5.2 • bruising
• nosebleeds
• bleeding in joints
• lameness/stiffness

Any two, mark first two only.

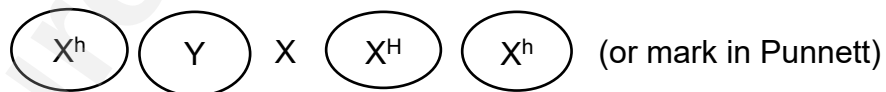
- 1.5.3 Haemophilia is an x-linked / sex-linked disorder / females will need to inherit two recessive X-linked genes to get haemophilia and males only have one X chromosome/only need to inherit one gene to get haemophilia

- 1.5.4 • The mRNA containing the codons/instructions to make the clotting factor protein moves out of the nucleus/to the ribosome.
• The ribosome reads/translated the mRNA code; tRNA picks up the corresponding amino acids that match anticodon/triplet of N bases from cytoplasm.
• The tRNA with the amino acid arrives at the ribosome with the codon and anticodon being complementary to each other.
• Amino acids are aligned in correct order.
• Peptide bonds form between amino acids and a polypeptide chain/clotting factor protein is produced.

Any five logical steps.

- 1.5.5 (a) Phenotype: haemophiliac male dog X unaffected female dog
Parental Genotypes: X^hY X X^HX^h

Gametes:



	X^h	Y
X^H	X^HX^h	X^HY
X^h	X^hX^h	X^hY

each row of offspring are correct

Genotype: 25% X^HX^h , 25% X^hX^h , 25% X^HY , 25% X^hY

Phenotype: 25% unaffected female; 25% affected female; 25% unaffected male; 25% affected male.

- (b) The breeding is not recommended because there is a 50% chance of the pups being born with haemophilia and they would be more likely to die.

1.5.6 **Yes,**

It is only a treatment and not a cure it must be repeated weekly or daily making it expensive/difficult to administer more beneficial to use on humans rather than dogs.

No,

The treatment is available so rather use on dogs instead of letting them die cruel to let dogs die knowing that there is a treatment.

Accept Yes or No with TWO good reasons.

1.6 1.6.1 (a) Adeno-associated virus/AAV

- (b)
- The healthy/functioning factor viii gene was cut out of the DNA of a healthy person using restriction enzyme.
 - The factor viii gene was inserted into DNA of the AAV and joined using ligase.
 - The virus with the factor viii gene was inserted into the liver cells of the haemophiliac patient.
 - The factor viii gene is integrated into/becomes part of the patient's DNA.
 - Liver cells produce factor viii.

Any five logical steps.

- (c)
- The treatment is in very early-stage clinical trials.
 - Even though there was initial success, there was a drastic decline in factor viii production after a year.
 - Immune response to AAV vector.

Any two reasons, mark first two only.

(d) **Accept any one of the following:**

- Production of insulin.
- Production of vaccines.
- Production of GM plants – can give examples.
- Production of GM animals – can give examples.

Any valid example that is produced using recombinant DNA technology.

1.6.2 $14/18 * 100 = 78\%$

- 1.6.3 (a)
- Lack of awareness around haemophilia.
 - Lack of medical facilities / infrastructure / equipment / funding.
 - Lack of doctors.

Any other suitable answer.

Mark first one only.

- (b)
- The study was published in a medical journal/New England Journal of Medicine indicating that the results were peer reviewed before being published.

QUESTION 2

2.1 Biogeography

- 2.2 2.2.1 1. Fossil evidence
2. DNA evidence
3. Comparative anatomy

Any two.

2.2.2 1. **Fossil evidence** – shows how organisms from the past are related to organisms that exist today / shows relationships between organisms / indicates common ancestry / shows similarities or changes to bone structure in successive species.

2. **DNA evidence** – shows common ancestry amongst organisms/ similarities and differences in structure between species / shows relatedness / more shared DNA means closer relatedness.

3. **Comparative anatomy** – shows similarities and differences in the anatomy of different species / can be used to understand changes that organisms have undergone as they evolved from common ancestors / homologous structures indicate a common ancestor / analogous structure do not indicate common ancestry.

Any 2 × 1 – must link to answer mentioned in 2.2.1.

2.3 2.3.1 A group of organisms that share similar characteristics capable of interbreeding with each other and producing fertile offspring.

- 2.3.2 • Only small changes have occurred – only small structural differences.
• The lions still belong to the same species/not different species indicating that speciation has not yet taken place/can still interbreed.
• The split amongst the African lions started only 300 000 years ago, this is too short a time for evolution to occur.

Any two well-explained answers.

2.4 Expanding human populations **OR** climate change

2.5 **Table showing differences between the African lion and the Asian lion**

African lion	Asian lion
4% have abdominal fold	98% have abdominal fold
1 small hole in the skull	2 small holes in the skull
More variation	Less variation
Found on African continent	Found on Asian continent

Heading

Column headings

Any two correct differences

2.6 (a) Geographical barriers / the Rift Valley / expansion of the African rain forests are keeping the lions apart in Africa.

- (b)
- The population of lions are separated into two groups due to the presence of a geographical barrier / they are separated by the Rift Valley / expansion of African rain forests.
 - The two populations are reproductively isolated and gene flow will stop.
 - Each group will start adapting to new environmental conditions.
 - Random mutations/new variations will occur within the small populations.
 - Over time an accumulation of these changes will result in a new species of lion developing.

Any five logical steps.

2.7 2.7.1 A smaller population led to more inbreeding which reduced variation.

- 2.7.2
- Can find ways to conserve the remaining lion population so that they don't become extinct.
 - Find new ways for lions to adapt to the changing environment and this can prevent them from becoming extinct.
 - Breeding programmes to enhance favourable characteristics.

Accept any one well-explained answer.

- 2.8
- The local communities are more aware of the lions in their natural environment as they live in close proximity to the animals in the wild. They understand the interactions of the lions with their environment and what they require to survive.
 - They know what factors affect the populations negatively, so they will have a better idea of what is happening to the lion population and what are the best methods to put in place to conserve the lions.
 - They would provide more feasible solutions that would benefit the conservation of the lions.
 - They can disperse information about the plight of the lions to rural communities to encourage their conservation.

Any three logical reasons.

2.9 2.9.1 The diagram/timeline shows that the original ancestor of the lion existed about 1,8 million years ago.

2.9.2 Only their fossils exist today / died out about 1 to 1,2 mya.

2.9.3 The lions evolved from one common ancestor and they then adapted to different environments/on different continents.

2.9.4 Scientists are not certain about this branch on the tree as there was not enough evidence/lack of fossils to support/confirm this branch.

OR

Since there has not been enough evidence to prove this branch, scientists made assumptions based on the evidence they found.

2.9.5 Lamarck

QUESTION 3

3.1 3.1.1 Alleles

3.1.2 (a) Nucleus

- (b) Contains the genetic code sequence of nucleotides that codes for a protein/helicase enzyme which is used to repair DNA.
- (c) Nucleotides
- (d) Autosome
- (e)
- They have a reduced viral load.
 - They have a lower risk of transmitting the virus.
 - The progression of HIV/development of AIDS is delayed.

Mark first two only.

3.1.3 $650\,000 / 1,5 \text{ million } (1\,500\,000) * 100 = 43\% / 43,3\% / 43,33\%$

3.1.4 (a) Complete set of genes/all the genetic material present in an organism.

- (b) A project that sequenced (mapped) the entire human genome/ identified genes in the human genome.
- (c) Helps to identify genes that cause inherited disorders therefore easier to diagnose and treat the disorders.

- 3.1.5
- Historically there has been bias / unfairness / prejudice against Africa/Africans. Most genetic studies focused on people of European descent / people that were not African / people or countries that were richer.
 - Due to lack of resources in Africa/lack of resources needed for collection of data (e.g. biobank in Europe) studies could not be carried out on African people.
 - Lack of funding/infrastructure in African countries for genome / genetic / DNA research limits the ability to conduct research.
 - Conducting research in Africa may result in ethical challenges since scientists have to ensure that the studies will in fact benefit the local communities/results to be shared with local communities.
 - Logistical challenges as is hard to collect data in African countries/people may be scared to provide information for the purpose of research.

Any other suitable answer.

Any two well-explained answers.

3.2 3.2.1 (a) The fungus contains foreign DNA/DNA from another species inserted into its genome.

(b) Blue Mountain funnel web spider/spider.

3.2.2 1,6 million/1 600 000

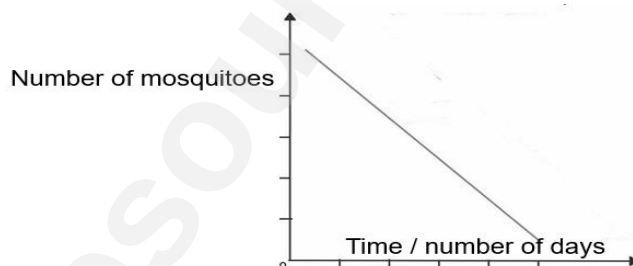
- 3.2.3
- There is genetic variation in the population of mosquitoes, some are resistant to insecticides while other are not.
 - Due to random changes/mutations in the gene, some mosquitoes survived to reproduce.
 - The insecticide resistant gene was passed on to offspring.
 - Those mosquitoes that were not resistant died out.
 - Over many generations there was a higher frequency of mosquitoes that were resistant to the insecticide creating a larger population of insecticide-resistant mosquitoes.

Any six logical points related to insecticide resistant mosquitoes.

3.2.4 Not enough is known about the genetically modified fungus and it could have detrimental effects on the environment / kill other species of insects / negatively affect the food chain.

3.2.5 (a) Huts that contained unmodified fungus/no fungus.

(b)



x-axis label

y-axis label

correct downward trend

- 3.2.6 (a) A wide base indicates a high birth rate.
A narrow top indicated low life expectancy.
Wide base because of a high birth rate indicates lack of knowledge around contraceptives/poor family planning.
Low life expectancy indicates lack in medical care.

Any other suitable answer.

(b) Census

(c) 2,8%

QUESTION 4

4.1 4.1.1 Soil / air / rocks / water / sunlight

Any one.

4.1.2 An animal/organism that eats plant material only.

4.1.3 B

4.1.4 (lack of) food / grass / type of grass

4.1.5 Grass → zebra / wildebeest / gazelle → lion / cheetah / leopard
Correct direction of arrows/correct representation of a food chain.

4.2 4.2.1 (a) A

(b) They require fresh/high quality grass – this only grows after the zebra and wildebeest have eaten the tall/poor quality grass.

OR

After the zebra and wildebeest have eaten the tall/poor quality grass this exposes nutritious grass for the gazelle.

4.2.2 (a) Interspecific

(b) Resource partitioning (must have)
The zebra and the wildebeest share the food resources. The zebras migrate first to get enough tall grass to meet their energy requirements. The wildebeest migrate second and eat the remainder of the tall grass – in this way they both can co-exist in the same area.

1 + Any three points.

4.3 4.3.1 An animal that hunts/kills and eats another animal/the prey

4.3.2 (a) B

(b) Prey numbers are lower than predator numbers / predators lag behind the prey / as prey increases, predators increases / as prey decreases predators decrease.

Any one.

4.3.3 • They live in herds with many pairs of eyes and ears they can easily pick up on predators in their vicinity.
• When a predator approaches, they run in different directions/ scatter to confuse the predator.
• The many stripes in the herd confuses the predator/cannot single out one animal.

Any two well-explained.

- 4.4 4.4.1 Secondary land used previously / already contains soil / plants were established.
- 4.4.2 Pioneer/coloniser species
- 4.4.3 Fire burns off the long/poor quality grass. this exposes the more nutritious grass closer to the ground/allows the regrowth of new grass.
- 4.4.4 Fire weakens the relationship between the migratory herbivores. The order of migration will change, with the gazelle migrating first. they will migrate earlier to eat the new freshly germinating grass after the fire. They will migrate in isolation and this easily exposes them to predators.
Any four points.
- 4.5 Studying the migratory patterns of herbivores helps scientists understand how to protect them so that their numbers don't drastically drop.

OR

It is important for scientists to understand the impact of climate change on the environment and the animals so they can develop new strategies to help the herbivores alter their migration pattern.

- 4.6 4.6.1 A zebra eat *Cenchrus ciliaris* grass. The DNA found in the dung has matching bands to the DNA found in the *Cenchrus ciliaris* grass.
- 4.6.2 To amplify/make more copies of the DNA.

Total: 200 marks