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REDHILL HIGH SCHOOL
PRELIMINARY EXAMINATION

SEPTEMBER 2022

LIFE SCIENCES PAPER 1

Examiners: Mrs M Ho and Dr I Mwaba

Moderators: Mrs M Ho, Dr I Mwaba
and Ms J Page

Time: 3 Hours

200 marks

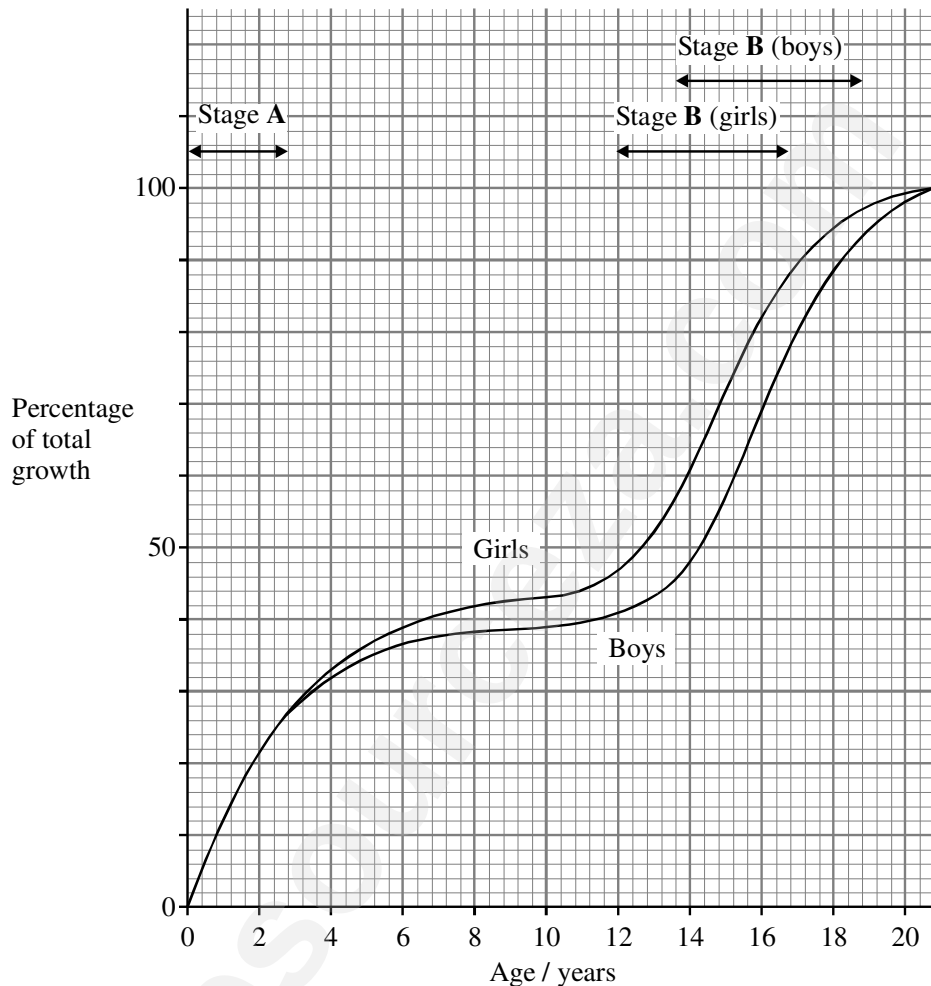
PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This question paper consists of 16 pages and an Answer Booklet of 18 pages. Please check that your question paper is complete.
2. QUESTION 1 must be answered in the Answer Booklet provided.
3. QUESTIONS 2, 3 and 4 must be answered on lined paper.
4. Read the questions carefully.
5. Number the answers exactly as the questions are numbered.
6. Use the total marks that can be awarded for each question as an indication of the detail required.
7. It is in your own interest to write legibly and to present your work neatly.

Question	Mark Allocation	Student Mark
1	80	
2	40	
3	40	
4	40	
Total	200	

QUESTION 2

2.1 The graph shows growth curves of boys and girls for the first 20 years of life. Use the graph and your own knowledge to answer the following questions.



2.1.1 State the function of growth hormone. (1)

2.1.2 During puberty a growth spurt occurs.

(a) Use the graph to determine at what age puberty starts in girls. (1)

(b) Calculate the total percentage growth that occurs in boys from the beginning of puberty until 20 years of age. (2)

2.1.3 During puberty, oestrogen and testosterone increase in girls and boys respectively. These have a positive feedback relationship with growth hormone.

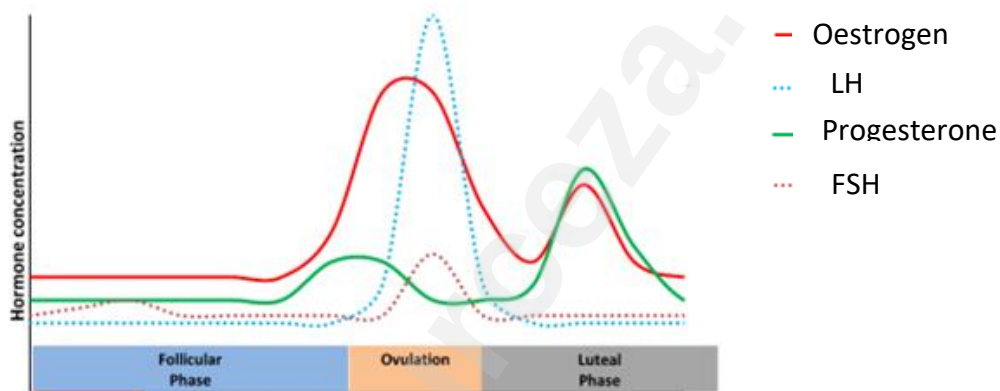
Draw a flow diagram to explain how this relationship leads to a growth spurt. (4)

2.2 Use the information in the graphs as well as the diagram of the female reproductive system on the **following page** to answer the following questions.

The Pill is a form of hormonal oral contraception. The Pill suppresses the normal menstrual cycle and replaces it with an artificial 28 day cycle.

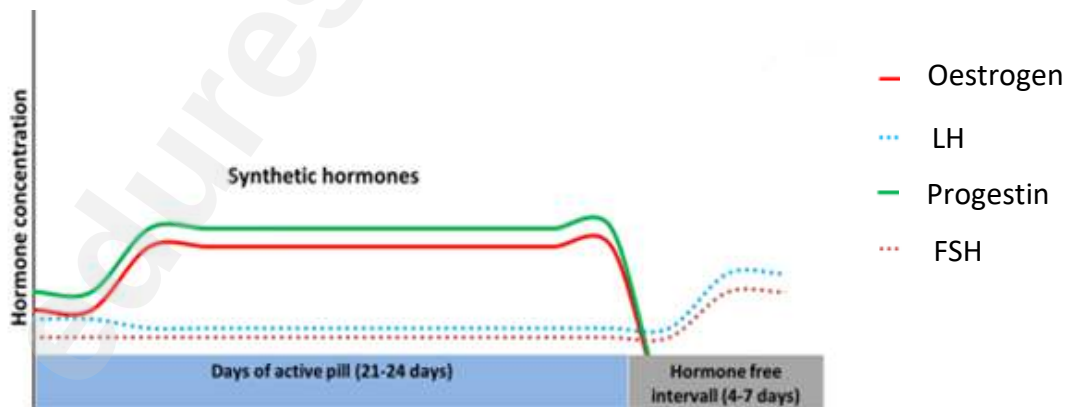
By providing a steady daily level of both progestin (a substitute for progesterone; green lines) and oestrogen (red lines), oral contraceptives work in the following way:

- Prevents the formation of an egg cell (ovum)
- Prevents ovulation
- Thickens mucus at the neck of the uterus (Y)
- Thins the lining of the uterus (X), so that implantation is less likely to occur.



Graph 1: Normal 28-day menstrual cycle

[SOURCE: www.miun.se/en/Research/research-centers/swsrc/news/2019-2/the-menstrual-cycle-and-female-athletic-performance]



Graph 2: Artificial 28-day menstrual cycle created by the Pill

SOURCE: <https://quizlet.com/female-reproductive-system>

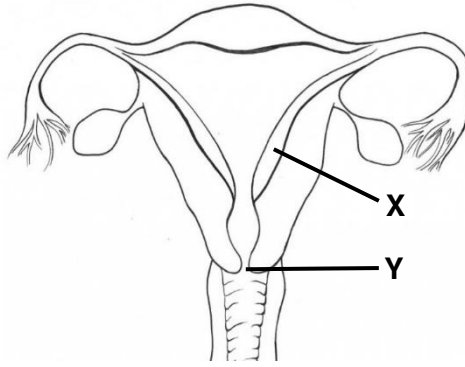


Diagram of the female reproductive system

2.2.1 Give the correct biological term for the following:

- a) Structure labelled X
- b) Structure labelled Y (2)

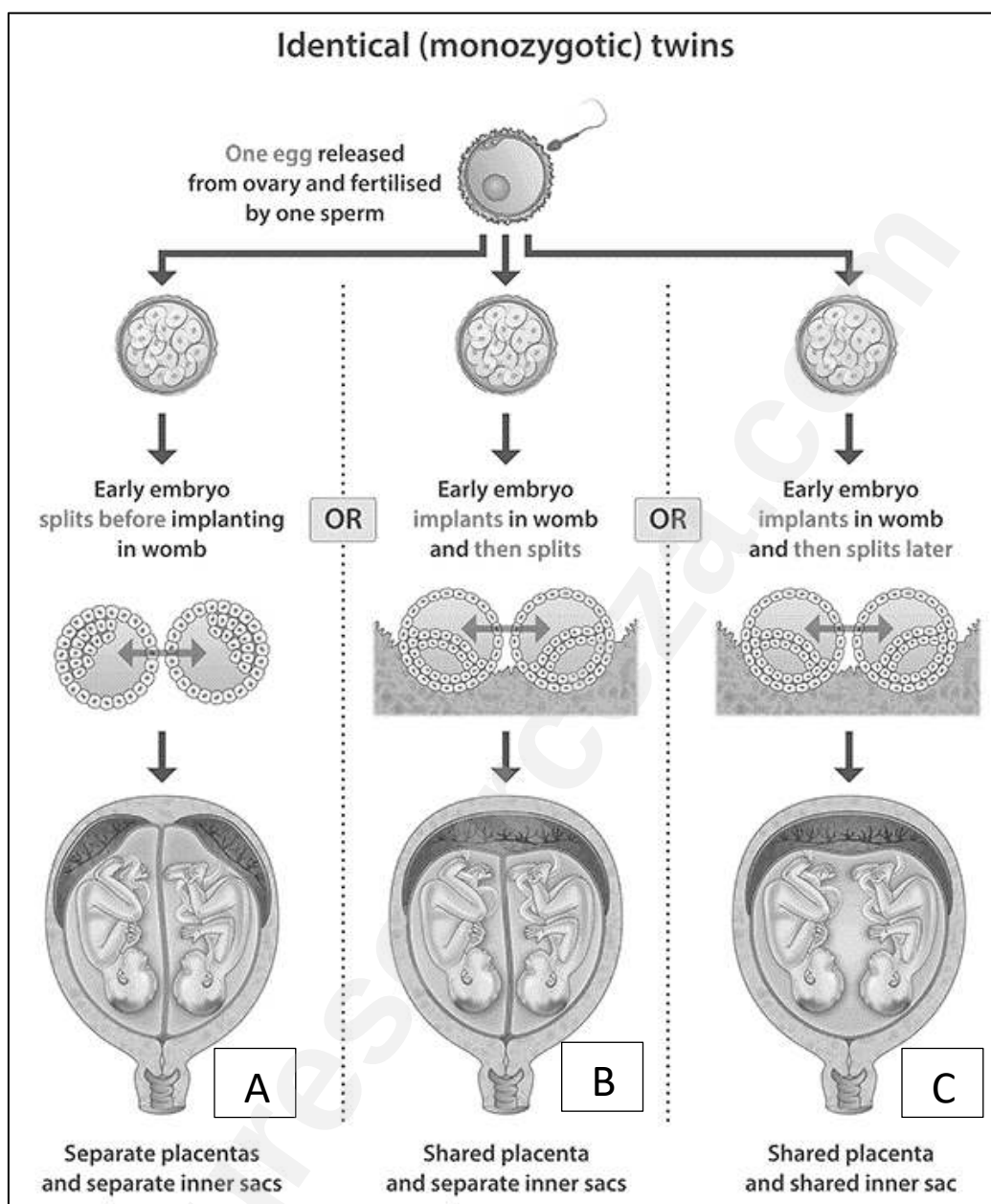
2.2.2 Explain how thickened mucus at point Y can assist with preventing pregnancy. (2)

2.2.3 Using information from the graphs 1 and 2, discuss exactly how the Pill influences hormonal secretions and functions to prevent ovulation (2)

2.2.4 Do you think that female contraceptive methods led to the improvement of equal rights for women? Provide one well explained reason to justify your answer. (2)

Adapted from Crawford International Prelim 2021

2.3 Study the figure below and answer the questions that follow



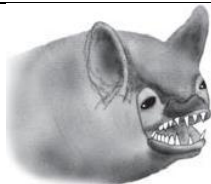
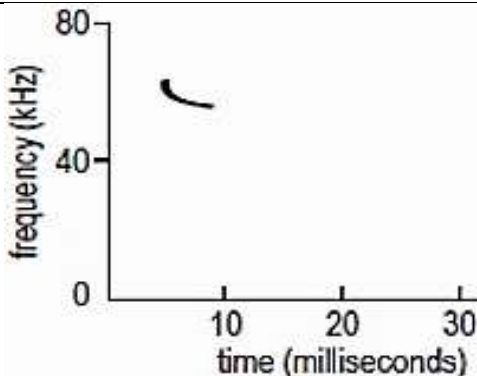
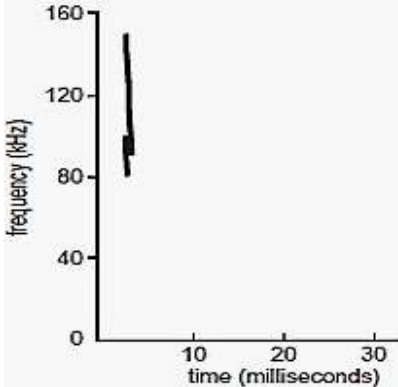
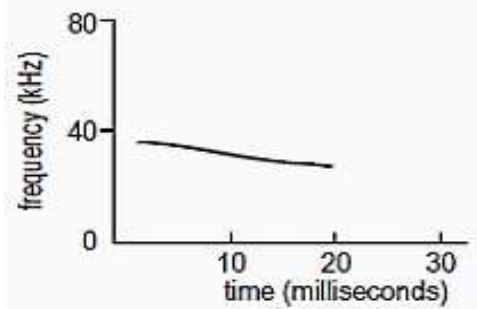
- 2.3.1 The diagram above refers to the foetal development of monozygotic twins. Explain how conception would differ for dizygotic (non-identical) twins. (2)
- 2.3.2 Based on the function of the amniotic sac, which option, A, B or C, would provide the best environment for the developing foetus. Explain your answer by referring to TWO functions of the amniotic sac. (4)
- 2.3.3 (a) Identify which blood vessel in the umbilical cord provides “nutrition” to the foetus. (1)
- (b) Name one substance in the vessel mentioned in 2.3.3 (a) that would be essential to the development of the foetus. (1)

Adapted from King David Linksfield Prelim Paper 1 2021

- 2.4 Read the following information and use the information and your own knowledge to answer the questions.

Barro Colorado Island is a small island covered by tropical forest in Central America. Seventy-four different species of bats live in the forest. Bats are nocturnal, flying mammals. To find their way around in the dark, many bat species emit high-frequency sound pulses that bounce off obstacles and prey. These pulses enable them to judge the distance to an object. This behaviour is called echolocation.

Male bats also use echolocation in courtship behaviour together with various other behaviours such as fluttering their wings to fan their scent and attract a female. Each of the three species of bats described below use different courtship behaviours which include echolocation sounds to attract a female.

Species Name	Facial appearance	Diet	Feeding Location	Echolocation signal
Black myotis bat <i>(Myotis nigricaris)</i>		Insects	Around trees at forest's edge and in clearings	
Mexican long-tongued bat <i>(Choeronycteris mexicana)</i>		Nectar and pollen of flowers that open at night, e.g. cactus	Narrow gaps and small spaces	
Velvety freetail bat <i>(Molossus molossus)</i>		Insects	Above trees, in open spaces	

- 2.4.1 Provide TWO reasons why courtship in bats is so important for reproductive success. (2)
- 2.4.2 From the information provided, state one selection pressure acting on the bats of Barro Colorado Island. (1)
- 2.4.3 Suggest a hypothesis to describe the relationship between **feeding location** of the different bats and **echolocation signal time**. (3)
- 2.4.4 Name the phenomenon used by bats on this island that allows them to co-exist in the same habitat. Explain this phenomenon in bats. (3)

Adapted from King David Linksfield Prelim Paper 1 2020

- 2.5 Pollen from many species of plants will develop pollen tubes in artificial conditions. Pollen tube formation in water is generally poor, and any pollen tubes formed usually burst.

Figure 1 shows the effect of sucrose concentration on pollen tube growth, with or without the addition of a very small amount of borate. (Borate is a salt containing the element boron.) The pollen tubes were measured at a fixed time after germination had occurred.

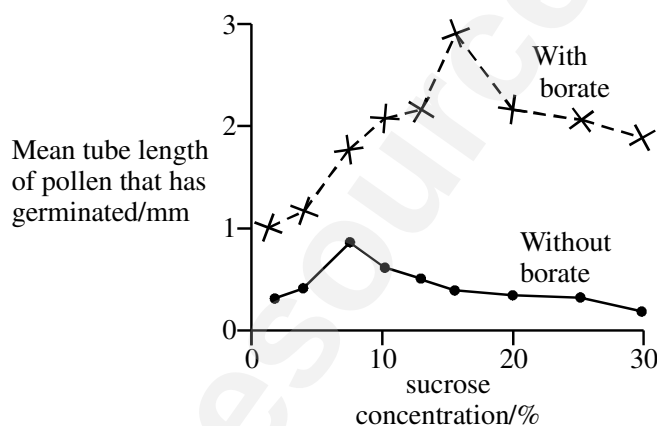


Figure 1

Two different hypotheses were put forward to explain the role of sucrose in pollen tube growth.

1. It is used to provide the pollen tube with energy.
2. It prevents the bursting of the pollen tube by osmosis.

- 2.5.1 Describe a simple experiment you could carry out to eliminate one of these hypotheses. State which hypothesis you will be eliminating. (4)
- 2.5.2 Where in the flower is the pollen produced? (1)
- 2.5.3 Describe the function of the pollen tube in fertilization in plants. (2)

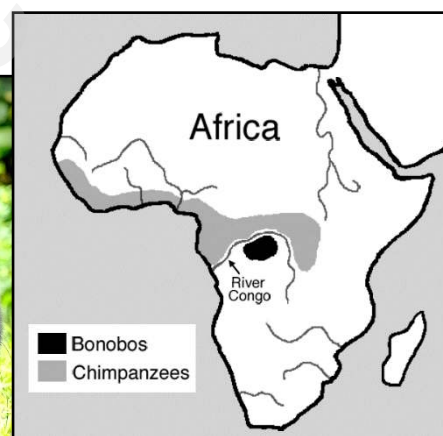
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QUESTION 3

3.1 Read the following information and answer the questions that follow

About 1.7 million years ago, chimpanzees (*Pan troglodytes*) and bonobos (*Pan paniscus*) diverged from one another and have remained relatively unchanged since then, following separate evolutionary paths. The Congo River separates the two species with chimps to the north, bonobos to the south. The divide is maintained by the apes' reluctance (or inability) to swim across the world's deepest river. Chimps tend to avoid the river altogether while bonobos regularly wade into the water. It is hypothesised that the river's flow dropped significantly at precisely the time when chimpanzees and bonobos are thought to have diverged. The river level's brief drop was just enough to enable a bold band of ancestral apes to take a fateful plunge and make their way to the opposite bank.

Peace is almost universal across the female-run, bonobo communities. They have evolved to avoid conflict and release a stress hormone that encourages social bonding. In contrast, chimps secrete testosterone, and live in a male-run society, ruled by competition exhibited through sexual aggression and conflict.



[SOURCE: [https://www.biographic.com/the-great-divide/Fischer, A., Pollack, J., Thalmann, O., Nickel, B. and Pääbo, S. \(2006\). Demographic history and genetic differentiation in apes. Curr. Biol. 16, 1133–1138](https://www.biographic.com/the-great-divide/Fischer, A., Pollack, J., Thalmann, O., Nickel, B. and Pääbo, S. (2006). Demographic history and genetic differentiation in apes. Curr. Biol. 16, 1133–1138)]

- 3.1.1 Give the species name for bonobos. (1)
- 3.1.2 Define the term "species". (2)
- 3.1.3 Identify the type of speciation described above and discuss fully how the early ancestral ape population became two distinct species. (5)
- 3.1.4 The bonobo have low levels of diversity, several times lower than the diversity in *Pan troglodytes*. What important driving force led to the evolution of the bonobos? Provide evidence to support your answer. (2)
- 3.1.5 Discuss ONE reproductive isolating mechanism that will prevent chimpanzees and bonobos from interbreeding should the river level drop in the future. (2)
- 3.1.6 When small populations, such as bonobos, become isolated from large populations, adaptations arise very rapidly.

Would the pace of evolution that resulted in the bonobo population be classified as gradualism or punctuated equilibrium? Provide TWO reasons for your choice. (3)

Adapted from Crawford School international Prelim paper 1 2021

- 3.2 Below is an image of the Venus fly trap plant. Use the image and your own knowledge to answer the following questions

Venus fly traps have to put their flowers really far away from their traps so they don't accidentally kill their pollinators and I love it so much.



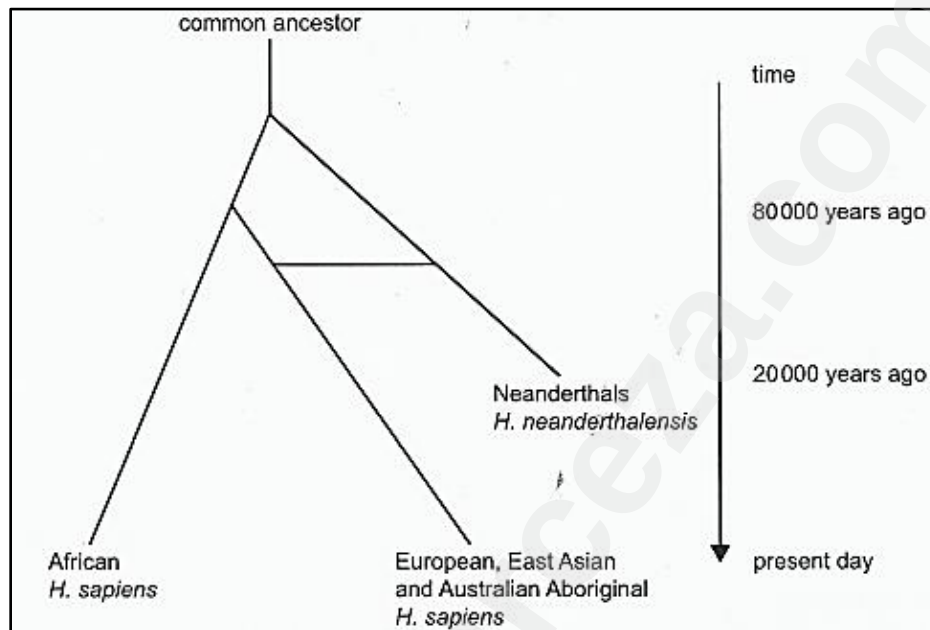
mac kahey
@MacDoesIt

The fact that it genetically grew to understand it needed to do that is cool

- 3.2.1 Explain the misconception shown in mac kahey's understanding of the evolution of the position of the Venus Fly Trap flower. (1)
- 3.2.2 Describe how the long-stemmed Venus fly trap flower would have evolved through natural selection. (5)
- 3.2.3 When Venus fly traps are grown in plant tissue culture, bleach is used to clean the petri dish before the growth medium is added. Suggest a reason for this. (1)

- 3.3 Fossil evidence indicates that between 30 000 years ago, populations of two hominin species – modern humans (*Homo sapiens*) and the extinct Neanderthals (*Homo neanderthalensis*) – lived close to one another in parts of the Middle East, Europe and Asia.

Researchers have constructed a theory about the relationship between ancient populations. This is represented in the following diagram.



Adapted from VCAA exams

Recent DNA evidence has shown that:

- The genome of living humans of African descent does not contain Neanderthal DNA
- The genomes of living humans of European, East Asian and Australian descent all contain small amounts of Neanderthal DNA (1-4%).

- 3.3.1 Suggest how DNA from *H. neanderthalensis* entered the genome of present-day European *H. sapiens* and continues to be found in modern populations. (1)
- 3.3.2 There are several theories about where *H. sapiens* originated. Scientists consider that the absence of Neanderthal DNA in present-day African *H. sapiens* as important evidence about the geographical origins of *H. sapiens*.
- (a) Name this hypothesis for the origins of modern humans. (1)
 - (b) Explain how the recent DNA evidence provided supports this theory. (2)
 - (c) What other form of evidence is used to understand human evolution? (1)

- 3.3.3 Identify ONE feature that will help scientists determine if a fossil find was a human or neanderthal. (1)
- 3.3.4 The development of bipedalism allowed hominins to travel such large distances. Provide TWO other benefits of bipedalism (2)
- 3.3.5 Explain how bipedalism led to the evolution of the very large brains in hominids. (3)

Adapted from King David Linksfield Prelim Paper 1 2021

- 3.4 Read the following extract and answer the questions that follow.

Hoodia traditional knowledge agreement

Hoodia gordonii, used by the San, was patented by the South African Council for Scientific and Industrial Research (CSIR) in 1998, for its presumed appetite suppressing quality. A licence was granted to Phytopharm, for development of the active ingredient in the Hoodia plant, P57 (glycoside), to be used as a pharmaceutical drug for dieting. Once this patent was brought to the attention of the San, a benefit-sharing agreement was reached between them and the CSIR in 2003. This would award royalties to the San for the benefits of their indigenous knowledge. The San have yet to profit from this agreement, as P57 has still not yet been legally developed and marketed.

Adapted from <https://www.wipo.int/ipadvantage/en/details.jsp?id=2594>

- 3.4.1 Who do you think has rightful ownership to the use of the *Hoodia* plant, the San or Phytopharm? Give an explanation for your answer. (2)
- 3.4.2 Suggest why the government should work with the San people instead of allowing private companies to exploit their indigenous knowledge? (2)
- 3.4.3 State TWO reasons why it would be beneficial to keep the seeds of the *Hoodia* plant in a seed bank. (2)
- 3.4.4 Of what importance are the San in our understanding of human evolution? (1)

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QUESTION 4

- 4.1 A game farmer in the Northern Cape had kudu and springbuck on his fenced farm. There were mice and mongoose colonies living on the farm which formed part of the territory of a pair of black eagles. A borehole supplied the animals with water all year round. Herding dogs ensured that there were no large predators on the farm. The mongooses' diet consists of insects, frogs, bird eggs and rodents.

Kudu are browsers and feed on leaves and shoots from a variety of plants. Bulls have massive long, spiral horns sought after as trophies and their meat is used to make biltong. Kudu are susceptible to the rinderpest virus which can be transmitted by domestic cattle.

Springbuck are generally browsers of shoots and succulent leaves and occasionally graze on succulent grass. Herd size is usually around 40 individuals. A study of vigilance behaviour of herds found that individuals on the borders of herds tend to be more cautious and that vigilance decreases as group size increases.



Kudu



Springbuck

Size of Animal Populations on a Northern Cape Farm

Year	Kudu	Springbuck	Mongoose
1991	0	0	102
1992	4	20	97
1996	10	36	95
1999	12	52	101
2001	15	70	100
2003	19	100	96
2005	21	96	98
2007	24	105	107
2009	21	100	102
2011	20	96	98

4.1.1 State True or False for the following statements.

- (a) Springbuck were introduced to the game farm in 1991. (1)
- (b) The Springbuck population of the farm could decrease due to mortality and emigration. (1)
- (c) The number of mongooses is a density dependent factor which will impact the size of the springbuck population. (1)
- (d) Disease, like the rinderpest virus, is a density independent factor which could have an impact on the kudu population. (1)

4.1.2 The farmer may use culling and controlled hunting as a population control factor for the kudu population. Explain the benefits of these suggested control factors to the kudu and to the farmer. (4)

4.1.3 Account for the rate of kudu population growth between 1992 and 1996. (2)

4.1.4 From the data collected, estimate the carrying capacity of the farm for Kudu. (1)

4.1.5 What is the value to springbok of feeding in herds? (2)

4.1.6 In your opinion, is this farm conserving or destroying the indigenous ecosystem? Use information in the source to justify your answer. (2)

4.1.7 Explain how the social organisation in wild dogs improves their hunting success. (4)

Adapted from IEB Paper 1 2015

4.2 Read the following information and use it and your own knowledge to answer the questions that follow.

Richards Bay Mining (RBM) is a company that operates in Richards Bay in Kwa-Zulu Natal. It is involved in dune mining – in which titanium is extracted from the sands making up the dunes on the beach and the forest along the coast. Dune mining begins with the removal of all surface vegetation and the collection of topsoil (which contains seeds) to be used in rehabilitation of the dunes afterwards. The sand containing the minerals is then sucked up, the minerals are removed and the sand is replaced in large piles and reshaped to resemble the shape of the dunes prior to mining.



Mining dune forest

[mineral-loy.co.za]



Rehabilitating dune after mining

[mindenpictures.co.za]

The topsoil collected prior to mining is then spread over the dune. A seed mixture comprising babala grass, sorghum, sun hemp, as well as seed from several indigenous species collected prior to mining, is sown on the dune. The growth of these plants results in a change in the soil characteristics of the area, which proves favourable for the germination and subsequent establishment of other indigenous species. After 6-8 months the initial plants die off, leaving the dunes covered by the indigenous grass *Eragrostis curvula*. All vegetation established after the initial plants occurs from the seeds in the topsoil and also from seeds dispersed from plants in the surrounding unmined areas such as milkwood (*Sideroxylon inerme*), stinkwood (*Celtis africana*) and ironwood (*Vepris lanceolata*). These species eventually out-compete the grass *Eragrostis curvula*.

A study conducted between 1992 and 1994 compared the percentage occurrence of each different species in three plots (one unmined, and two rehabilitating plots of forest of different ages) along a 40-km stretch of coast between Richards Bay and the Mapelane Nature Reserve in northern KwaZulu Natal, South Africa. 180 separate 1m² quadrats were randomly sampled in each plot.

The similarity in species between unmined plots and rehabilitating plots of different ages increased with increasing age of rehabilitating plots. This suggests that, in terms of species' composition, the rehabilitating communities become more similar to the unmined communities with age.

[Van Aarde, R. J., S. M. Ferreira, J. J. Kritzing, P. J. Van Dyk, M. Vogt & T. D. Wagenar. 1996. An Evaluation of Habitat Rehabilitation on Coastal Dune Forests in Northern KwaZulu-Natal, South Africa 4(4): 334–345.]

- 4.2.1 Define the term ecological succession? (1)
- 4.2.2 Name ONE pioneer species, and ONE climax species, mentioned in the article. (2)
- 4.2.3 What factor enables other plant species to start growing as the pioneer species die off? (2)
- 4.2.4 Provide a hypothesis for this study. (2)
- 4.2.5 Provide the
(a) Independent variable
(b) Dependent variable; in the study. (2)
- 4.2.6 Should dune mining be practiced in ecological sensitive areas such as the coastal forests of Kwa-Zulu Natal? Justify your answer. (4)

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- 4.3 Orange breasted sunbirds are small birds that are endemic in the Cape Fynbos. They feed on nectar. An ecologist estimated the size of the orange breasted sunbird population visiting the fynbos in April. She trapped 18 orange breasted sunbirds. She marked all of these birds with small metal rings on their legs. Two weeks later, she trapped another sample of orange breasted sunbirds. Of these birds, 6 were marked and 10 were not marked.



- 4.3.1 Use the data given above to estimate the size of the orange breasted sunbird population in this area of Cape Fynbos. Show your working. (3)
- 4.3.2 State two aspects that the ecologist would have to consider with regard to the metal rings she used, in order to make the estimation valid and reliable. (2)
- 4.3.3 This species of bird breeds at a certain time of the year. During this bird-breeding season, the mark-release-recapture technique might not give a reliable estimate. Suggest one reason why. (1)
- 4.3.4 The ecologists found that each species of bird had adaptations to its niche. One of these adaptations was the shape of its beak. Suggest how the shape of beak of the orange breasted sunbird is an adaptation to its niche. (2)

Adapted Roedean Prelim 2020

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