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SCHOOL LOGO

PRELIMINARY EXAMINATION

SEPTEMBER 2024

LIFE SCIENCES: PAPER I

NAME OF CANDIDATE _____

TIME: 3 HOURS

200 MARKS

EXAMINER: M. NYIKA

MODERATOR: J. NYALUGWE

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 34 pages. Please check that your question paper is complete.
2. This question paper consists of four questions.
3. Read the questions carefully.
4. Answer ALL the questions on the question paper in the spaces provided and hand it in at the end of the examination. Remember to write your name in the space above.
5. Use the total marks that can be awarded for each question as an indication of the detail required.
6. It is in your own interest to write legibly and to present your work neatly.
7. Two blank pages 33 and 34 are included at the end of the paper. If you run out of space for a question, use these pages. Clearly indicate the number of your answer should you use this extra space.

QUESTION 1

- 1.1 Select the term in Column B that best matches a description in Column A. write the letter of the term in the corresponding space provided between the brackets. Each letter may only be used once.

Column A	Column B
[] The outward projection of the face in hominoids	A Bipedal
[] The species of homo that appeared about 200 000 years ago.	B Diastema
[] Any animal that walks only on two legs.	C Homo ergaster
[] Probable user of stone hand axes and cleavers	D Hand axe
[] The opening of the skull through which the spinal cord leaves the brain.	E Arboreal
[] Tear drop shaped stone tools associated with homo erectus and archaic homo sapiens (homo heidelbergensis)	F Prognathism
[] The space in the tooth row that allows the canine of the lower jaw to slide past the third premolar in apes and early hominids.	G Homo sapiens
[] Animals adapted to life in the trees.	H Ardipithecus
[] 98,5% of same genes as homo sapiens	I Foramen magnum
[] Possibly the earliest hominin genus (4.4-5.6 mya)	J Ornaments
	K Molars
	L Orthonathism
	M Chimpanzee

(10)

- 1.2 Seven multiple-choice questions are given below. Choose the most correct option for each question and write the letter of your choice in the space provided in the table below.

1.2.1	1.2.2	1.2.3	1.2.4	1.2.5	1.2.6	1.2.7

1.2.1 If the order in a strand of DNA is: adenine – guanine – cytosine – thymine, the order of the bases transcribed from it would be:

- A thymine – cytosine – guanine – adenine
 - B uracil – guanine – cytosine – adenine
 - C uracil – cytosine – guanine – adenine
 - D thymine – cytosine – guanine – uracil
- (2)

1.2.2 The RNA that can join up with codons as well as amino acids is:

- A mRNA
 - B tRNA
 - C rRNA
 - D none of the above
- (1)

1.2.3 A zygote with XX gonosomes:

- A is haploid
 - B will develop into a baby girl
 - C will develop into a baby boy
 - D cannot exist
- (1)

1.2.4 In South Africa, the following have been genetically modified to be herbicide and insecticides- resistant except for:

- A soybeans
 - B rice
 - C cotton
 - D canola
- (1)

1.2.5 The process shown in the diagram below takes place during:



- A anaphase
 - B telophase
 - C metaphase
 - D interphase
- (1)

1.2.6 An allele which has an effect in both homozygous and heterozygous conditions is called:

- A lethal
 - B recessive
 - C multiple
 - D dominant
- (1)

1.2.7 Which step is **NOT** true in a somatic cell nuclear transfer process?

- A the genetic material originates from an embryonic donor cell
 - B an electric pulse stimulates the donor cell nucleus and recipient cell to fuse
 - C chemicals or another electric pulse then stimulate cell division
 - D the embryo is transferred to the uterus of a female host to develop until birth.
- (2)

- 1.3 Study the following table which consists of two items (numbered 1 and 2) in the first column and a term in the second column. Decide which item(s) relate to the term.

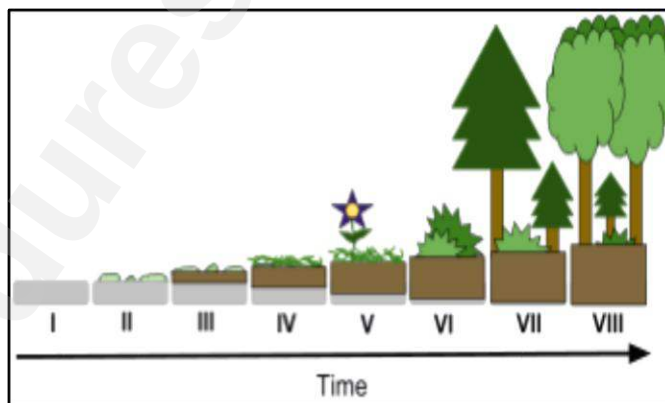
Write down your choice in the space provided in the "answer" column, making use of the following codes:

- A only item 1 relates to the term.
 B only item 2 relates to the term
 C both item 1 and 2 relate to the term
 D neither item 1 or 2 relates to the term

Statements	Items	Answer
1. More developed country 2. Less developed	A population with a large number of senior citizens	
1. Improved health care 2. Large scale food production	Human population explosion	
1. Rapid decrease in population size 2. Build-up of environmental resistance	Exponential growth	
1. Quadrat method 2. Mark and recapture	Indirect method of determining population size	
1. Evolution by acquired characteristics 2. Visited Galapagos Islands	Lamarck	

(5)

- 1.4 Study the diagram below and answer the questions that follow.



[\[https://www.google.com/searchq=Images+succession\]](https://www.google.com/searchq=Images+succession)

1.4.1 Name the type of succession is represented by the diagram above?
Explain your choice.

(2)

1.4.2 Write down the names of the stages represented by numbers:

(a) I – III

(1)

(b) (IV – VI

(1)

(c) VII – VIII

(1)

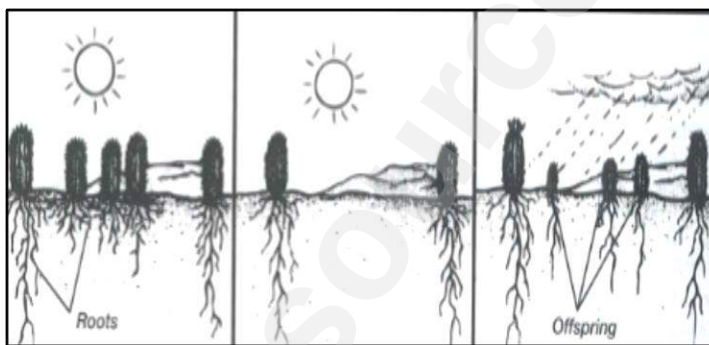
1.4.3 Describe the features of species found in the stage I-III.

(4)

1.4.4 Tabulate **three** differences between stages I-III and VII-VIII

(4)

1.5 Study the diagram below that illustrates a mechanism of evolution.



[<https://www.google.com>]

1.5.1 Which characteristic of the cacti will enable them to survive in long periods of hot, dry weather conditions.

(2)

1.5.2 Name the mechanism suggested by Darwin to explain his theory of evolution that is illustrated in these diagrams.

(1)

1.5.3 Use the diagram above to explain the mechanism which is stated in 1.5.2 above.

(5)

1.5.4 What would Lamarck's explanation of this mechanism have been?

(3)

1.5.5 How would the plants have appeared if the climate had changed, and high rainfall had occurred

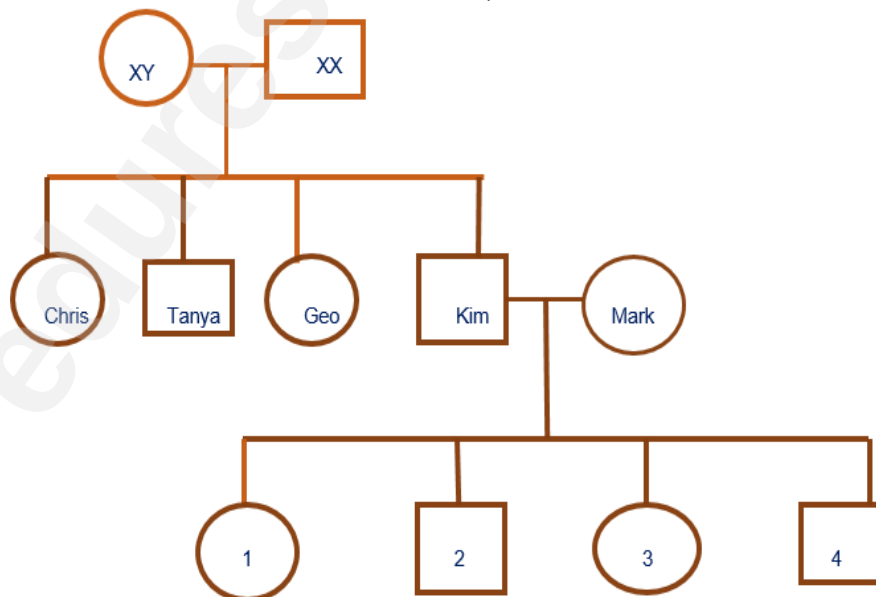
(2)

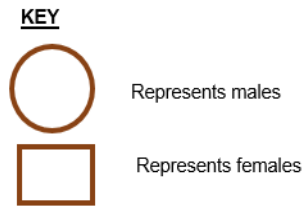
1.5.6 Many fossils found in Africa were discovered in the Cradle of humankind. Why is the Cradle of humankind fossils so important in the study of evolution?

[illegible]

(4)

1.6 Study the family tree below that illustrates the presence of colour blindness and answer the questions that follow. Chris, Tanya, Kim and Geo's mother are not a carriers of colour blindness, but their father is colour blind.





Examiner's diagram

1.6.1 On which chromosome is the allele for colour blindness carried?

(1)

1.6.2 What is Kim's

a) phenotype?

(1)

b) genotype?

(1)

1.6.3 Will Geo be colour blind? Use a punnet square below or a cross to explain your answer.

(4)

1.6.4 Kim marries Mark who is not colour blind. What is the possibility (in percentage.) that Kim will have:

a) sons that are colour blind? Illustrate how you arrived at your answer.

(3)

b) daughters that are colour blind?

(2)

1.6.5 Explain why Chris could only be colour blind if his mother was either a carrier or colour blind?

(3)

1.7 The diagram below shows a group of wild dogs. Using the picture and your own knowledge answer the questions that follow.



[<https://www.google.com/search?q=Images+animals+showing+social+organis>]

1.7.1 Define the term eusocial in social organisations.

(2)

1.7.2 Discuss the importance of social organisations?

(3)

1.7.3 With reference to the diagram of wild dogs above, discuss the packs as a successful hunting strategy.

(4)

- 1.7.4 Wild dogs are the second most endangered carnivore after the Ethiopian wolf. Suggest **two** ways in which the government can ensure the preservation of these wild dogs.

(2)

Question 1 total: [80]

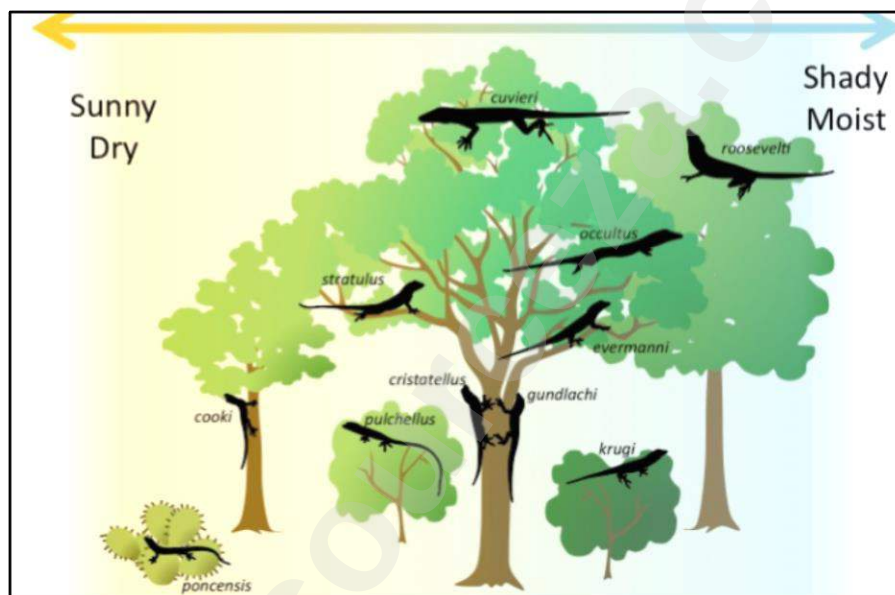
QUESTION 2

- 2.1 Read the text and study the diagram below. Use the information in the text and your own knowledge to answer the questions that follow.

Four different species of *Anolis* lizards live on the West Indian island of Jamaica. Although these species all live together in the same trees and shrubs and eat similar foods, there are differences among them. The height and the thickness of the branches they live on and the time they spend in the sun or shade differs from species to species.

Also, species found near one another, tend to differ considerably in size. As a result, they are likely to consume different foods.

[Adapted: <<https://ecology3e.sinauer.com>>



[<https://www.google.com/search?q=Images+showing+resource+partitioning&sca>]

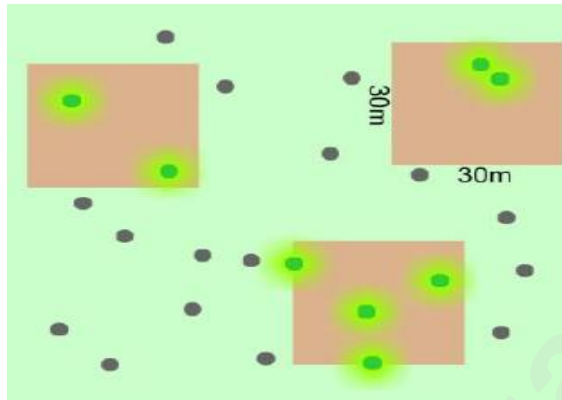
- 2.1.1 State the type of competition evident amongst the different lizard species?

(1)

- 2.1.2 Describe strategies employed by the different species of lizards to reduce competition.

(4)

2.1.3 A method shown in the diagram below was used to estimate the population of bugs in a crop field of dimensions 100m x 100m.



[\[https://www.google.com/search?sca_esv=7143342e902a7826&sxsrf=ADLYWIKVtxDgrPPGnG5Q7LmSIOMUeJ2g:1723420247440&q=images+of+quadrat+method&udm=2&source\]](https://www.google.com/search?sca_esv=7143342e902a7826&sxsrf=ADLYWIKVtxDgrPPGnG5Q7LmSIOMUeJ2g:1723420247440&q=images+of+quadrat+method&udm=2&source)

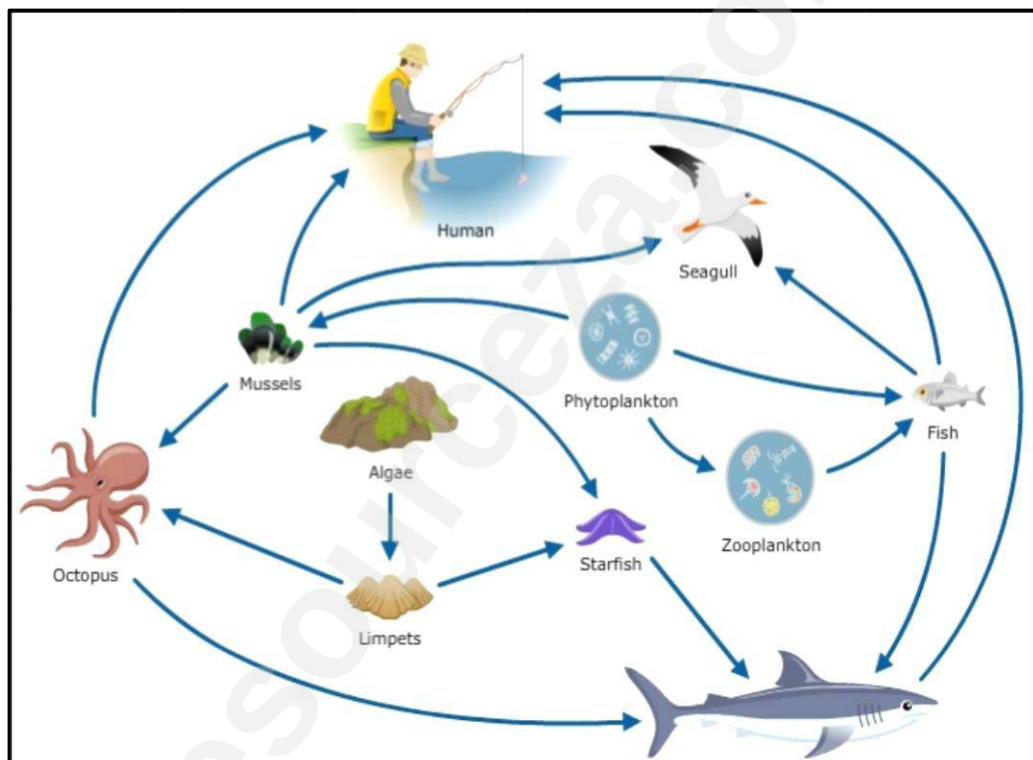
Calculate the estimated bug population in this field. Show all working

(4)

- 2.2 In ecosystems there are a variety of organisms most of the information on food webs comes from theory as actual webs are rather difficult to observe in nature (eg. Long lived organisms; field studies may indicate stability in most all cases due to longevity) This could be accounted for by scaling to generation time

[\[https://lens.google.com/search?ep=gsubu&hl=en-ZA\]](https://lens.google.com/search?ep=gsubu&hl=en-ZA)

Study the image below of a food web in a coastal area. Use the information provided and your own knowledge to answer the questions that follow:



[\[https://www.google.com/search?q=information+about+food+webs&sca\]](https://www.google.com/search?q=information+about+food+webs&sca)

- 2.2.1 Refer to the above diagram to explain what a food web is.

(2)

2.2.2 Identify **ONE** producer from the diagram above.

_____ (1)

2.2.3 State the type of relationship between an octopus and a human?

_____ (1)

2.2.4 Draw a well labelled graph to represent the relationship between an octopus and a human mentioned above.

_____ (4)

2.2.5 Explain the meaning of the following terms:

(a) Ecosystem

_____ (2)

(b) Population

_____ (2)

2.2.5 State **TWO** roles played by the phytoplankton in the coastal ecosystem.

(2)

2.2.7 State any **THREE** density dependent factors that would limit the size of the fish population.

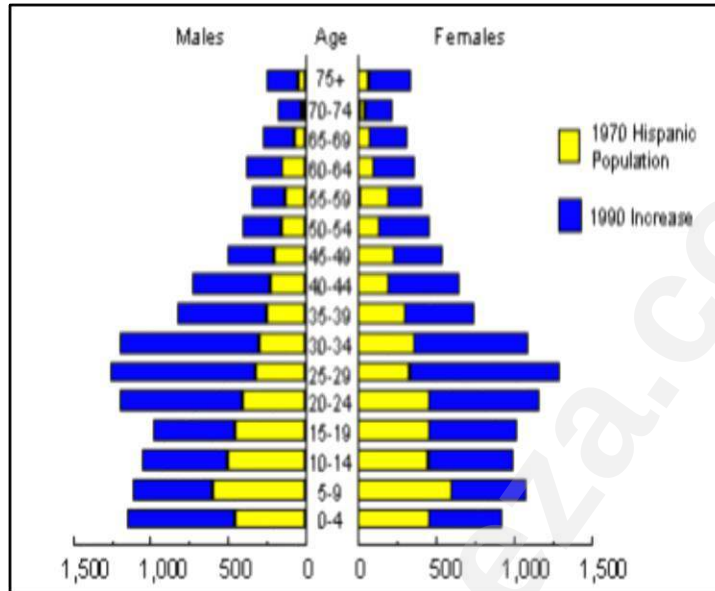
(3)

2.2.8 About 41% of mussels are threatened with extinction. Explain **TWO** effects that the removal of the mussels' species in the diagram would have on the food web.

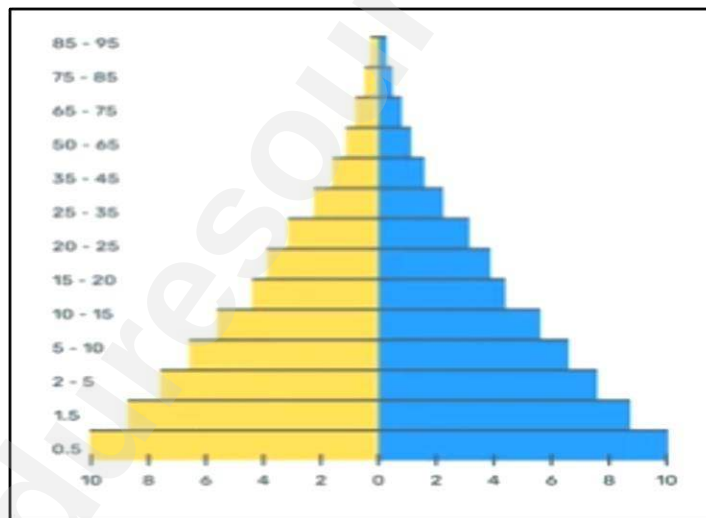
(4)

- 2.3 Study the population pyramids provided below, one is for a developing country and another is for a more developed country, then answer the questions that follow.

Pyramid A



Pyramid B



- 2.3.1 "Today's rapid population growth is driven by longevity, and no longer by high fertility. This is why we can experience both declining fertility and rapid population growth at the same time." Wolfgang Fengler: Economist from World Bank.

(a) Longevity means "living for a long time". Discuss **TWO** factors that have contributed to increased longevity in both **A** and **B** populations

(2)

(b) Why do you think fertility (the number of offspring produced per individual) is declining in pyramid **A**? Discuss **TWO** reasons.

(2)

2.3.2 Analyse the population pyramid **A** and read the following figures off the pyramid:

(a) The number of males in the 40–44 years category in pyramid **A**

(1)

(b) The number of females in the 0–4 years category in 1970.

(1)

2.3.3 Which pyramid **A or B** represents a less developed country?

(1)

2.3.4 Population graphs are an essential tool for governments. What are they used for?

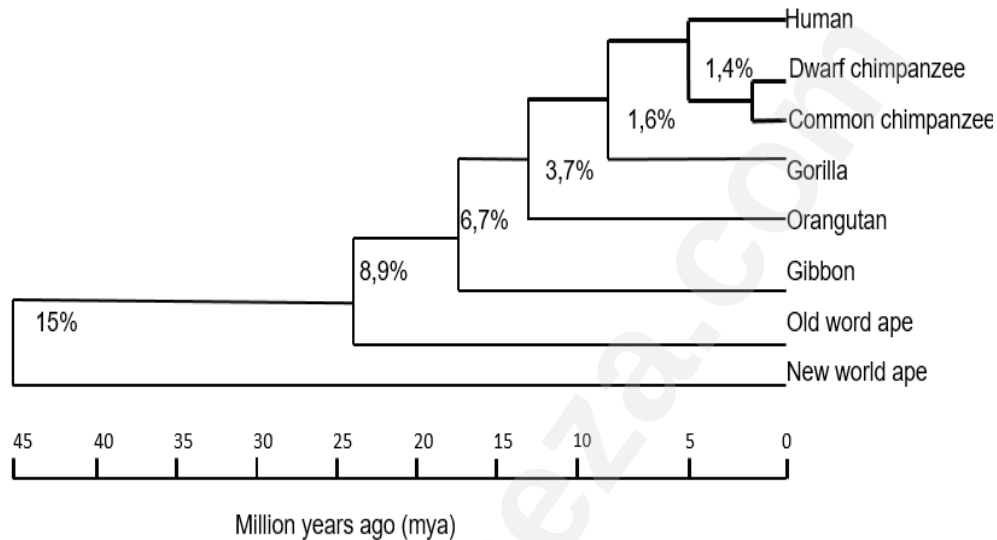
(3)

[40]

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QUESTION 3

- 3.1 The following diagram illustrates a phylogenetic tree based on similarities in DNA. The percentage difference between the genomes (DNA - nucleotide sequence) of the two relevant groups, are indicated next to each branch.



Examiner's diagram

- 3.1.1 What is the percentage difference between the DNA of chimpanzee and humans?

(2)

- 3.1.2 Determine how long ago chimpanzees descended from the line to humans.

(2)

- 3.1.3 Calculate the similarities in the DNA between the genomes of :
Gorilla and man

(3)

- 3.2 Read the text below and use it together with your own knowledge to answer the questions that follow.

The evidence for evolution was first comprehensively assembled by Charles Darwin, who succeeded in convincing essentially all his scientific contemporaries of the fact of descent with modification. A signal factor in Darwin's achievement was that he was able to weave together numerous strands of natural history palaeontology, systematics, embryology, morphology, biogeography—into a coherent framework. Since Darwin, genetics has joined this synthesis, and, in a development that might have surprised Darwin, evolution in natural populations has proven to occur sufficiently rapidly that it can be observed on human timescales. The most direct evidence of evolution comes from the fossil record, in which the dynamic changes of life over time are recorded, including many transitions between major taxa. A host of phenomena in comparative biology (e.g., systematics, morphology, embryology, genomics) and biogeography that otherwise appear inexplicable or anomalous (deviating from what is standard, normal or expected) are readily explained under the hypothesis of descent with modification. In addition, direct observation of natural and artificial populations shows the process of evolutionary change in action. Together, these sources of evidence lead to a “consilience of inductions”(meaning one class of facts coincides with facts obtained from a different class of facts) that makes the fact of evolution one of the most securely established generalizations in science.

- 3.2.1 Distinguish between a theory and hypothesis.

(3)

- 3.2.2 Fossils are the most commonly used to explain evolution of organisms. Explain what is meant by a 'living fossil' Give an example of a living fossil.

(3)

3.2.3 Describe how embryology and biogeography can be used as evidence of evolution.

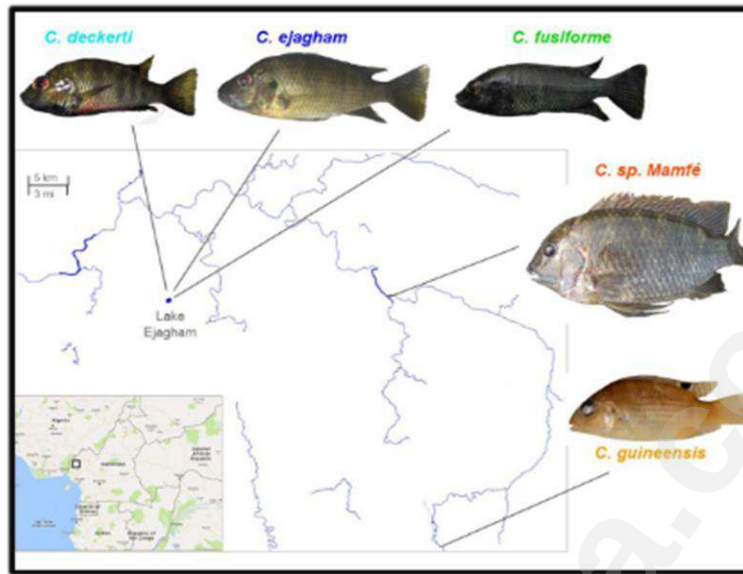
a) Embryology

(3)

b) Biogeography

(3)

3.3 The diagram below depicts a certain type speciation.



[\[https://www.nature.com/articles/s41540-024-00332-w\]](https://www.nature.com/articles/s41540-024-00332-w)

3.3.1 What type of speciation is shown above? Give a reason for your answer.

(2)

3.3.2 Describe the steps that lead to the type of speciation shown in the diagram above.

_____ (4)

3.3.3 Name any **two** factors responsible for formation of new species.

_____ (2)

3.3.4 Give **two** ways in which organisms can be reproductively isolated.

_____ (2)

3.4 Study the two skulls below and answer the questions that follow.

Skull A



Skull B



[Adapted: <https://www.quora.com/How-do-we-know-that-Australopithecus-walked-upright>]

3.4.1 The skulls above show an australopithecine and a homo. Identify the genus 's of skull A and skull B.

Skull A

(1)

Skull B

(1)

3.4.2 Which progression (development) can you identify in the skulls A and B? In your answer include skills, eating habits, position of foramen magnum and making of tools.

3.4.3 Using the scale line given, calculate the actual size of skull B. From forehead to chin. (a to b) Show all working.

Figure 1

[40]

QUESTION 4

4.1 Deoxyribonucleic acid (abbreviated DNA) is the molecule that carries genetic information for the development and functioning of an organism. DNA is made of two linked strands that wind around each other to resemble a twisted ladder — a shape known as a double helix.

4.1.4 In the space provided below draw a double stranded DNA molecule with **three nucleotides** (the nucleotides must have adenine, cytosine and thymine in that order). Rules of drawing must be followed.



(5)

- 4.1.2 During an investigation on the structure of DNA. Watson and Crick were interested in the relationship of the nucleotides in the cells of a specific organism. They compared the results of three laboratories as follows:

			1				2				3	
Nucleotides in DNA	A	T	C	G	A	T	C	G	A	T	C	G
Percentage present	21	19	29	31	30	29	20	21	29	32	19	20

- (a) What was the independent variable in this experiment?

(2)

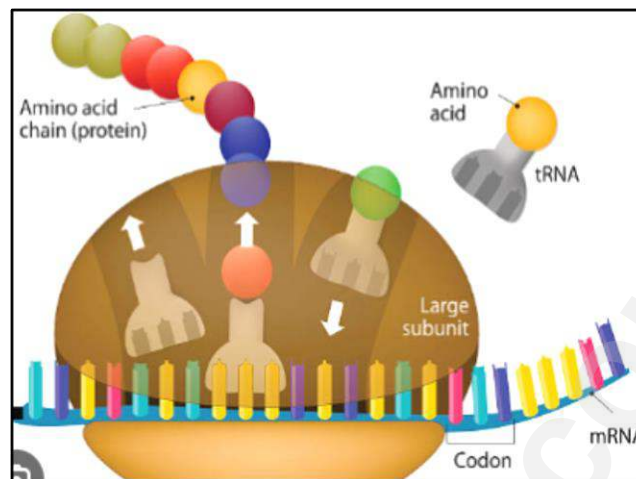
- b) What was the dependent variable in the above experiment?

(1)

- c) Draw a suitable conclusion from the table of results above.

(2)

4.2 The diagram below shows part of a very important process in a human body.



[Adapted: <https://www.istockphoto.com>]

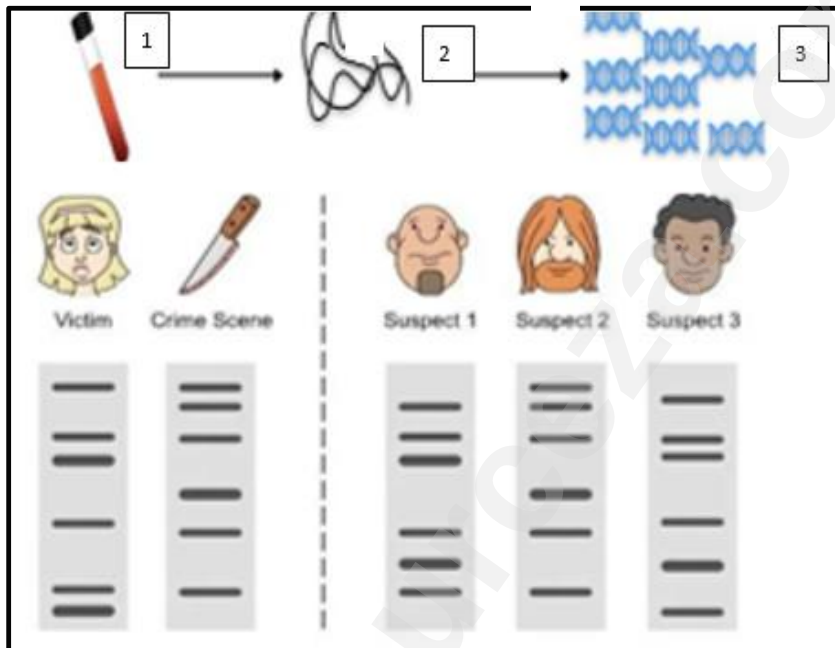
4.2.1 What process is being shown above?

(1)

4.2.2 Name and describe the process which takes place before the one shown in the diagram above

(4)

- 4.3 Investigate the following case study where a young girl was raped. The rapist did not use a condom so the semen was collected and knife was also found on the crime scene. DNA samples are obtained from three suspects that were in the area during the rape. During gel electrophoresis their DNA fingerprints were compared with the evidence taken from the rape scene. Below are some of the steps (1-3) taken in processing the DNA fingerprints.



[Adapted: <https://geneticeeducation.co.in/dna-fingerprinting-definition-steps-methods-and-applications>]

4.3.1 Who in your opinion is the rapist? Give a reason for your choice.

(2)

4.3.2 A process called PCR is done at stage 2 on the diagram. The results are shown on stage 3.

a) What does PCR stand for?

(1)

b) What is the purpose of this process?

(2)

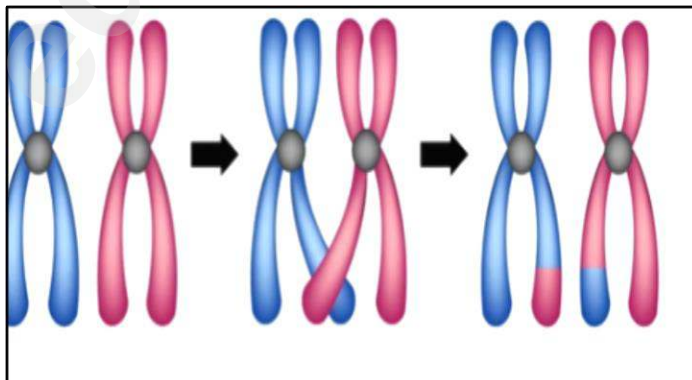
4.3.3 In as much as this process may be very useful in criminology and forensics, some concerns have been raised against it.
Give **two** possible arguments against DNA fingerprinting.

(4)

4.3.4 Why was it also necessary to take a specimen from the girl?

(2)

4.4 Study a phase of meiosis shown in the diagram below.



[Adapted: <https://www.shutterstock.com>]

4.4.1 What phase of meiosis is above?

_____ (1)

4.4.2 Explain what is happening in the diagram.

_____ (2)

4.4.3 What is the biological importance of what is taking place here? (why must this occur?)

_____ (2)

4.4.4 Distinguish between meiosis and mitosis in terms of the end products.

_____ (2)

4.5 Recombinant DNA technology involves using enzymes and various laboratory techniques to manipulate and isolate DNA segments of interest. This method can be used to combine (or splice) DNA from different species or to create genes with new functions.

4.5.1 Using of a flow diagram outline how DNA recombinant technology is used in production of insulin. (use of sketch diagrams is optional.)

(4)

4.5.2 Discuss **three ethical** viewpoints on cloning.

(3)

[40]

Grand total marks: 200

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