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ST BENEDICT'S COLLEGE

SUBJECT	LIFE SCIENCES PRELIMINARY EXAMINATION PAPER II	DATE	18 JULY 2023
GRADE	12	MARKS	100
EXAMINER NAME	MRS S. STEGMANN	MODERATOR	MRS B. ZAJAC
CLASS		DURATION	2 HOURS

INSTRUCTIONS:

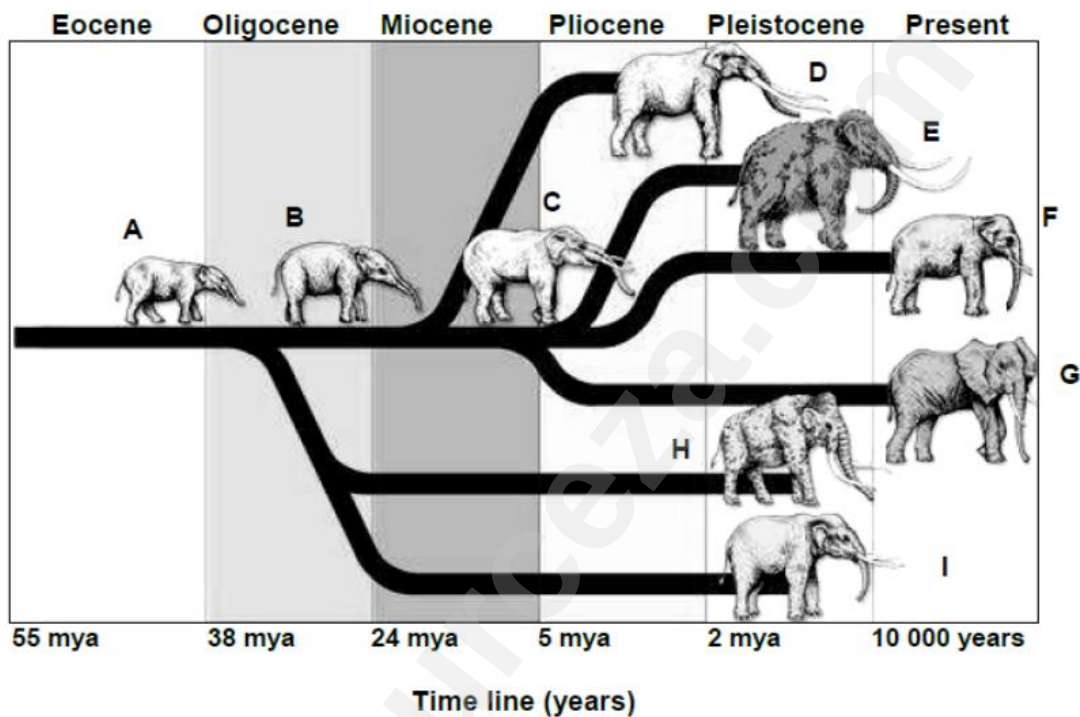
1. This paper consists of 22 pages. 19 pages of questions and 3 pages of additional writing space (20-22). Please check that your question paper is complete.
 2. Answer all questions on the question paper.
 3. Indicate clearly when the additional writing space has been used to answer a question.
 4. Write in blue or black pen only.
 5. Read all questions carefully and answer in as much detail as possible.
 6. All diagrams should have a clear heading.
 7. It is in your own interest to write legibly and to present your work neatly.
-

QUESTION	POSSIBLE MARK	MARK ACHIEVED
1	30	
2	30	
3	40	
TOTAL: 100		

SECTION A

Question 1:

- 1.1. Study the phylogenetic tree of nine elephant species over six geologic time periods from 55 million years ago (mya) to the present and answer the questions below.



A phylogenetic tree of nine elephant species

Key:

A: *Palaeomastodon* species
C: *Primelaphus* species
E: *Mammuthus* species
G: *Loxodonta* species
I: *Stegodon* species

B: *Gomphotherium* species
D: *Anancus* species
F: *Elephas* species
H: *Mammut* species

- 1.1.1. What is another name for a phylogenetic tree? (1)

- 1.1.2. According to the phylogenetic tree above, which is the ancestral species of ALL the named species? (1)

- 1.1.3. Name the TWO species of elephants that exist today. (2)

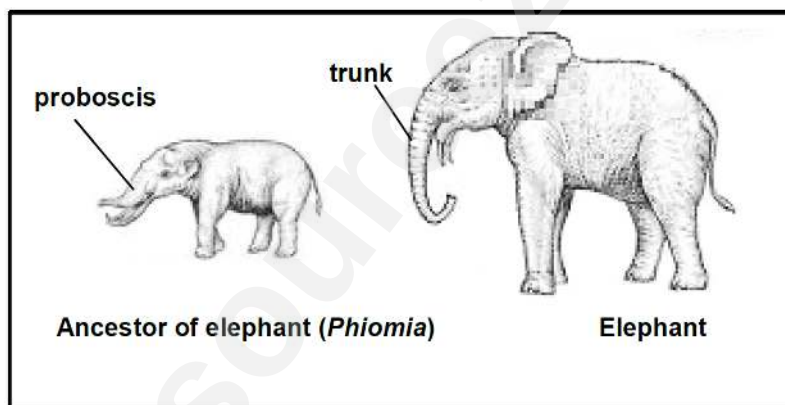
1.1.4. Name the immediate ancestor of the two species mentioned in QUESTION 1.1.3. (1)

1.1.5. In which period did:

(a) The Anancus species first appear? (1)

(b) The Stegodon species become extinct? (1)

1.1.6. An ancestor of the elephant, *Phiomia*, had a long nose-like structure called a proboscis which evolved into the trunk of the elephant. The proboscis was used to gather leaves as food. The proboscis of *Phiomia* and the trunk of the elephant are shown below. The diagrams have been drawn to scale.



Explain the evolution of the elephant's trunk in terms of Lamarckism. (6)

1.1.7. Was Lamarck's mechanism for evolution correct? Explain your answer. (3)

1.1.8. What idea about evolution was shared between Lamarck, Erasmus Darwin and Charles Darwin? (2)

[18]

1.2. Read the extract below and answer the questions that follow.

Darwin's Theory of Evolution

Charles Darwin, as a result of observations on a round-the-world expedition, backed by years of experimentation and discussion and linked to developing knowledge of geology and fossils, proposed the theory of evolution by natural selection.

Evolution can be defined as the change in the frequency of a phenotype in a population over many generations. Darwin's theory, very simply, is:

- Individuals in a species show a wide range of variation caused by differences in genes.
- Individuals with characteristics most suited to the environment have a higher chance of survival and more chances to reproduce.
- Therefore these characteristics are passed to their offspring at a higher rate than those with characteristics less suited to survival.
- Over many generations, these beneficial characteristics become more common in the population and the species changes (the species evolves)

1.2.1. Define evolution. (2)

1.2.2. What causes changes in an organisms phenotype? (1)

1.2.3. During his round-the-world expedition, Darwin made some very interesting observations.

Name TWO of these observations.

(2)

1.2.4. Once Darwin had collected all his data he provided two very acceptable explanations for evolution- Modification with descent and Natural selection.

a. Using the text above, explain what is meant by natural selection.

(3)

b. Using your own knowledge, explain what is meant by modification with descent.

(3)

1.2.5. Which other person (naturalist) is credited with discovering natural selection?

(1)

[12]

Total Question 1: 30 marks

Question 2

2.1. Read the extract below and answer the questions that follow.

Arctic Animals: Arctic Fox and Snowshoe hare

Scientific Name: *Vulpes lagopus*

Vulpes is from the Latin *vulpinus* which means “of or pertaining to a fox”. The prefix *lago* is Ancient Greek for “hare” and *pous* is Ancient Greek for “foot”. Arctic fox paws are sheathed in dense fur during the winter, which is why they are named *lagopus* (“rabbit- footed”).

FIGURE 1: Map obtained at Canadian Geographic http://www.canadiangeographic.co/kids/animal-facts/arctic_fox.asp



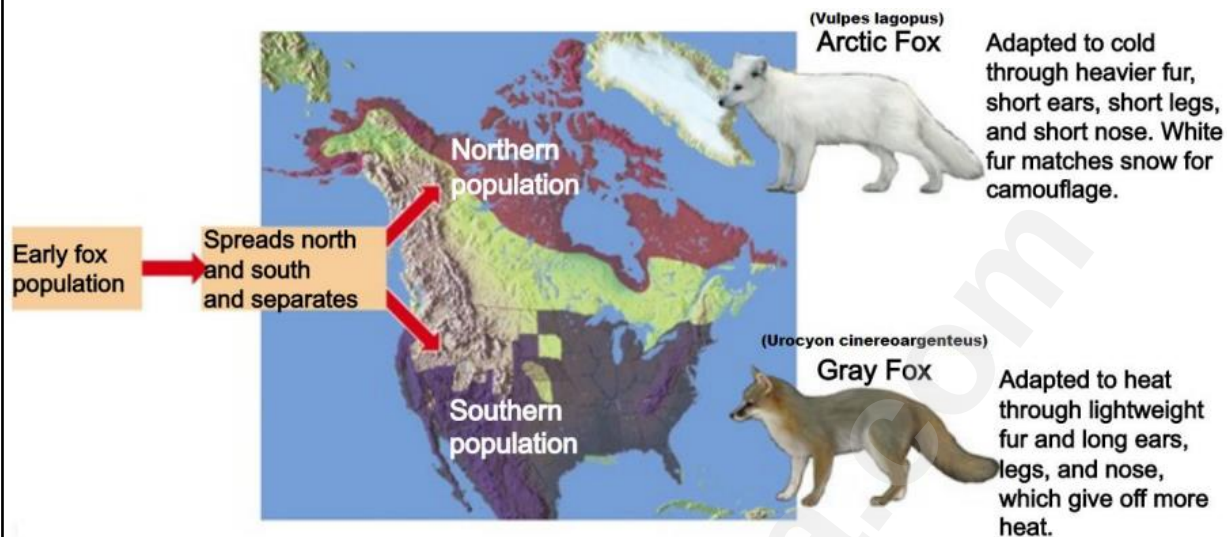
Snowy disguise



Snowshoe hares live in forests across the northern U.S. and Canada.

In the summer, brown coats help the hares blend in with the forest floor. As winter approaches, the changing amount of sunlight triggers a process inside the hares' bodies. They begin moulting, or changing coats. First the tips of a hare's ears and nose lose their colour, followed by its back and shoulders. After about six weeks, the animal is all white.

Predators have a much easier time catching prey that stand out. Mills and other scientists recently tracked snowshoe hares in Montana. They found that hares that didn't match their environments were less likely to survive the winter. In some areas, such as parts of Wisconsin, snowshoe hare populations are shrinking.



Adapted from: <https://slideplayer.com/slide/756562/>

FIGURE 2

Winter coats

Snowshoe hares aren't the only animals that turn white in the winter. Arctic foxes grow white fur to hide from predators like golden eagles. The colour also helps them sneak up on lemmings and other prey. Some species of lemmings, weasels, and caribou also make the seasonal switch.



In a world without snow, white winter colouring can have deadly consequences for all of these animals. And when one species disappears from an area, many others are affected. If prey animals become scarce, predators may go hungry. Without predators, prey populations can grow out of control. Despite the threats, scientists have hope for the colour changing animals. In January 2014 biologist Laura Gigliotti was tracking snowshoe hares in Pennsylvania. She expected the hares to have completely white coats. She was surprised to spot some hares that were partly or completely brown.

[Adapted from: <https://thewhiskerchronicles.com/2013/12/23/day-ten-of-twelve-days-of-arctic-animals-arctic-fox/> and <https://superscience.scholastic.com/issues/2018-19/120118/out-in-the-cold.html#880L>]

- 2.1.1. To which genus does the artic fox belong? (1)
-
- 2.1.2. What environmental pressure would lead to the adaptation (evolutionary changes) in the Arctic fox and Snowshoe hare? (1)
-
- 2.1.3. How would Charles Darwin explain the evolutionary trait in the Arctic fox? (3)
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- 2.1.4. Why is it in the best interest of the hare population to moult during winter months? (3)
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- 2.1.5. Describe TWO habitat conditions for the Gray fox's habitat by looking at the adaptations of the Gray fox. (2)
-
-
- 2.1.6. Provide reasons for your answer to QUESTION 2.1.5. (2)
-
-
-
- 2.1.7. The Arctic fox and the Red fox are more closely related than the Gray fox and the Arctic fox. In the space on the next page draw a simplified phylogenetic tree to illustrate the evolutionary path of these three foxes from a common ancestor. (4)

[16]

2.2. Study the information below and answer the questions that follow.

In a particular species of rat, there are three possible fur colours. This species is found in a desert area with mostly light brown sand and a few scattered plants. These rats are preyed upon by birds of prey in the area.



[Source: <<http://swegizmo.deviantart.com>>]

The table below describes the rats that live in the area in terms of various characteristics.

Characteristics of each female rat	Colour of Fur		
	Light Brown	Black	White
Average running speed (cm/s)	6	7	8
Total number of babies produced per female	11	5	2
Average age at death (months)	8	5	4

2.2.1. Which colour rats could be considered the 'fittest' to survive in terms of their environment?

Explain your answer. (3)

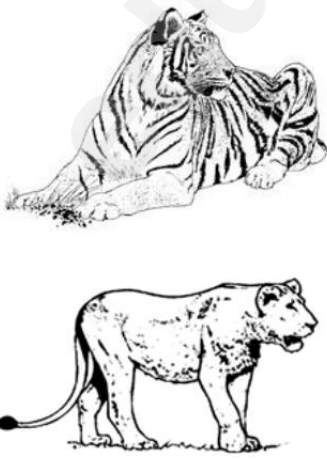
2.2.2. Which colour rats are most likely to become extinct? (1)

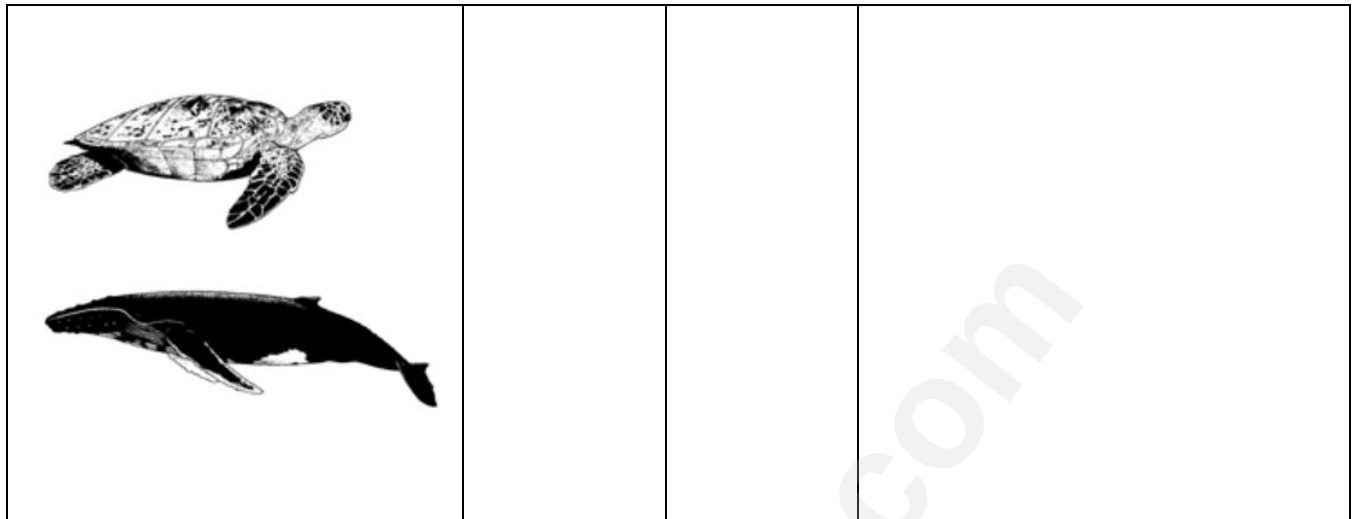
2.2.3. What was the most significant threat to the survival of these rats? Explain how you arrived at your answer. (3)

2.2.4. Why were only female rats used in this investigation? (1)

[8]

2.3. In the table below organisms are placed in pairs illustrating divergent and/or convergent evolution. The organisms are not drawn to scale. Study the diagrams of the organisms and place a tick in the column which indicates whether the pairs represent examples of divergent or convergent evolution. In the last column state ONE clearly explained reason for your choice.

Pairs of organisms	Convergent	Divergent	Reason for choice
			



[6]

Total Question 2: 30 marks

60 marks

SECTION B

Question 3

Do you think the value of bringing back species that are extinct is worth the effort?

Using the source material provided as well as your own knowledge, discuss your opinion on the above statement in the form of a 2 ½ - 3 page essay.

40 marks

To answer this question, you are expected to:

- Read the source material carefully and present a debated argument to present your point of view.
- Select relevant information from Sources A to E below.
- It is important to integrate your own relevant biological knowledge.
- Take a definite stand on the question and arrange the information to best develop your argument.
- Write in a way that is scientifically appropriate and communicates your point of view clearly.
- Provide a clear plan of your essay before you start writing. Note that the plan will be marked as part of the assessment of this question.

SOURCE A: MAMMOTH

Each new woolly mammoth carcass to emerge from the Siberian permafrost (frozen earth) triggers a heated debate about resurrecting (brining back to life) this Ice Age giant.

Researchers have refined some of the tools needed to turn that possibility into a reality. In November 2008, a Japanese team announced that they had cloned mice that had been frozen for 16 years.

Scientists predict that the same techniques could be used to clone mammoths and other extinct species preserved in the permafrost.

"I laughed when Steven Spielberg (film director) said that extinct animals was inevitable," says Hendrik Pionar, an authority on ancient DNA who served as scientific consultant on the film *Jurassic Park*. "But I'm not laughing anymore, at least about mammoths. This is going to happen. It's just a matter of working out the details."



[Adapted: National Geographic, May 2009]

SOURCE B: READER'S OPINIONS

Recipe for a Resurrection

With so many human beings dying daily and so many animals near extinction, why would anyone want to spend the time, money and research to have a mammoth walk again?

Let humankind try to save what is living now.

Leslie White.

Should we clone extinct animals?

This question was asked on the cover of the May 2009 National Geographic magazine.

Why not? Man has developed the science to do such things so we should use this knowledge to do something amazing. Just imagine being able to visit an animal park and be able to see a mammoth walking around.

Ann Creedy

[Adapted from: National Geographic, September 2009]

SOURCE C: QUAGGA WORK AT SOUTH AFRICAN MUSEUM OF CAPE TOWN

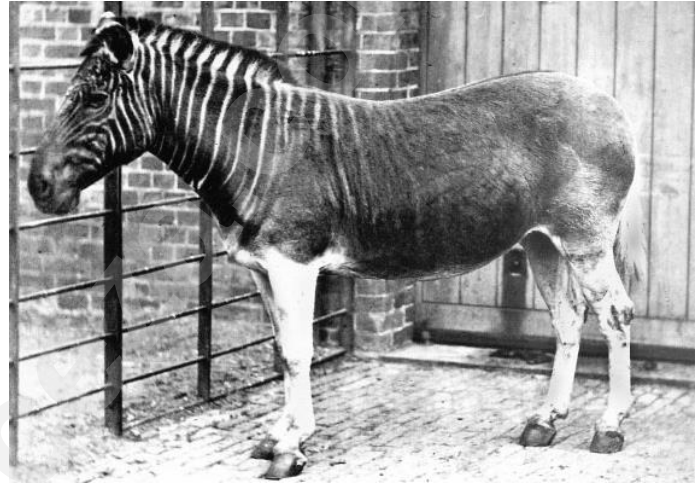
ON 12 August 1883 the last living quagga died at the Amsterdam zoo. They had been aggressively hunted into extinction. In 1971 Reinhold Rau, who was working at the South African Museum in Cape Town, visited museums in Europe where there were preserved specimens of quagga. He concluded that the quagga was related to the Plains zebra and could be brought back from extinction. He believed that it could be reintroduced into nature parks in the Karoo and Free State. Rau thought it could be done through selective breeding of the Plains zebra to produce a brown looking zebra with few stripes, i.e. an animal identical to the extinct quagga.

For years Rau received little support for his ideas from other scientists. But by 1984, mitochondrial DNA studies of quagga cells taken from an old skin showed that the quagga was a subspecies of the Plains zebra.

In April 1987 a quagga re-breeding programme started at Vrolijkheid farm near Robertson. The project was privately funded until June 2000. the national parks then took over the project.

On 20 June 2005 a third generation, quagga-like foal was born. After 15 years of looking for support, and 18 years of breeding, Reinhard Rau was successful. He has been quoted as saying:

“There are many people all over the world who are concerned about the destruction mankind is doing to the world and are trying to stop it. I am one of them. Maybe I’m conservative, but I see a chance to rectify a mistake that was made.”



[Adapted: bring back the quagga www.southafrica.info]

SOURCE D: FYNBOS STAGES A COMEBACK AT VERGELEGEN

Vergelegen wine estate in Somerset West has spent R14-million in 10 years to combat alien vegetation and nurture the return of natural vegetation. Unusable farmland between the Helderberg and Hottentots Hollands mountains will be restored to fynbos by 2014 with wetlands, birds and animals.

Worker training, job creation, scientific researches and education are part of the plan rolled out by the farm owner Anlo-American.

A team of 40 formerly unemployed local people were trained and the cleaning groups have already removed 8 million invasive trees. They sell the wattle and acacia wood for fires and barbeques. Fynbos uses 40-800 times less water than alien vegetation and so water flow has increased and the wetland areas and streams are starting to flow again for the first time in 50 years. In the first year of control there were 22 species of indigenous plants and now there are 35 species as the fynbos recovers. Two species of Lachenalia have been discovered for the first time in the area. Lachenalia liliflora was thought to be extinct, the other has yet to be identified.

[Adapted: *The Citizen*, 30 November 2010]

SOURCE E: NEANDERTHAL GENOME PROJECT

In July 2006, the Max Planck Institute for Evolutionary Anthropology in Germany together with support from USA organisations, announced that they would be sequencing the Neanderthal genome over a number of years. Modern man and Neanderthal appear to have 99.5% common DNA.

In 2006 the speech related gene of modern humans was found in the ancient Neanderthal DNA samples suggesting they could speak. The idea of cloning a Neanderthal began. In February 2009, the German team announced that they had finished the first draft of the Neanderthal genome.

New results suggested that they were lactose intolerant. (A genetic defect affecting the digestion of milk.)

On this question of potentially cloning a Neanderthal, the German team leader stated that 'Starting from the extraction from a fossil, it is and will remain impossible.'

[The Associated Press, 12 February, 2009]

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**ENSURE YOU INDICATE FOR WHICH QUESTIONS YOU USED THE ADDITIONAL SPACE FOR
TO ENSURE ALL QUESTIONS ARE MARKED.**

This image shows a blank sheet of white paper with horizontal blue or grey ruling lines. A diagonal watermark, "eduresourceza.com", is printed across the page from the bottom-left towards the top-right. The watermark is in a light grey font. There are approximately 20 horizontal lines visible on the page.

