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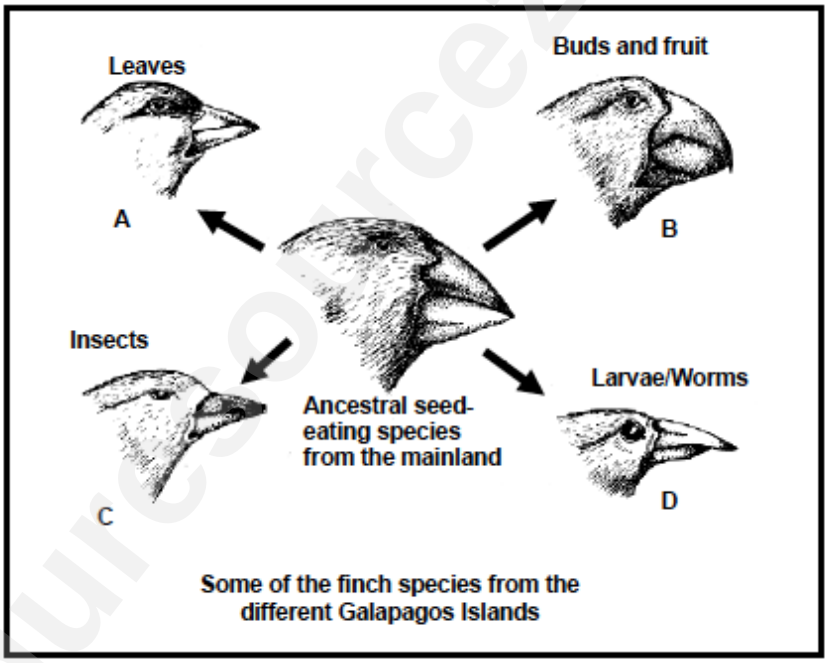
THEORIES OF EVOLUTION PART 1

Learner Note: Evolution is a theory. Evolution is change over time. Diversity is the RESULT of this change over time. If a trait is good, the organism survives and is able to reproduce ,thereby passing this good trait to the offspring. If the trait is not good/bad, then the organism dies and, therefore, does not reproduce.

SECTION A: TYPICAL EXAM QUESTIONS

Question 1: 6 minutes *(Taken from DoE Exemplar 2008 Paper 2)*

The different species of finches (A, B, C and D) below are found on different Galapagos Islands and are thought to have originated from a seed-eating ancestral species from the mainland of South America. They resemble each other with respect to their internal body structure, but differ with respect to the shapes and sizes of their beaks and hence their feeding habits.



Some of the finch species from the different Galapagos Islands

1.1. Explain what is meant by *geographical isolation of a population*. (2)
(Geographical will mean the geography of the land masses. Isolation means to be on one's own)

1.2. Why do you think the different finch species became adapted to eat different food types? (1)

1.3. Explain the process by which the different species adapted and evolved to eat different types of food. (5)
[8]

(Please make sure that you know Darwin's theory – Natural Selection)

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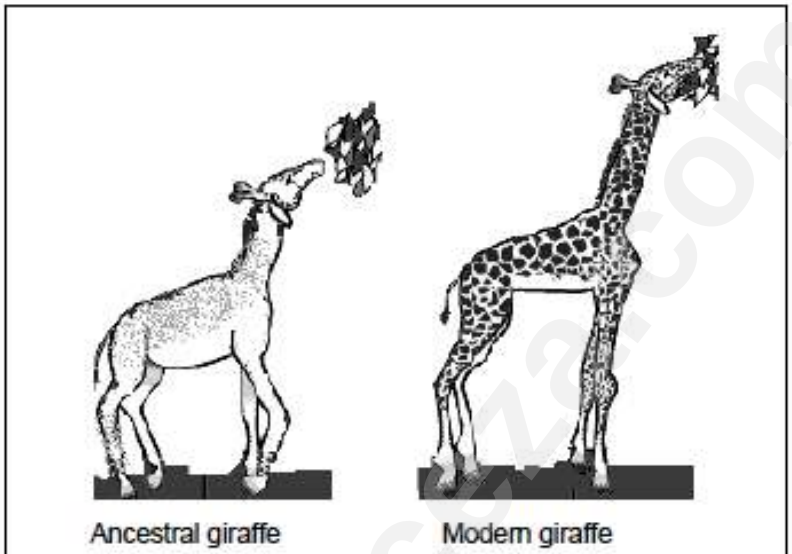
Question 2: **10 Minutes** *(Taken from DoE November 2008 Paper 2)*

Tens of thousands of years ago, the animals that evolved into giraffes, were not as tall as modern giraffes. Over a long period of time, the necks of giraffes became longer. They could reach leaves high in the trees and reach down for water.



Ancestral and modern giraffes feeding

2.1 Describe how the long necks of modern giraffes would have been explained by the following:
(a) Darwin (4)
(b) Lamarck (4)

2.2 Explain why Lamarck's theory is not accepted. (2)
[10]

(You must know Lamarck's theory and you should also be able to explain the difference between Lamarck and Darwin's theories)

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Question 3: **20 minutes** *(Taken from DoE Additional Exemplar 2008 Paper 2)*

Since 1972, biologists Peter and Rosemary Grant from Princeton University USA, have studied finch populations in the Galapagos Archipelago. The table below shows their data for one finch population on one island (Daphne Major), for a period of 7 years.

Year	1974	1975	1976	1977	1978	1979	1980
Rainfall (mm)	-	-	130	20	130	70	50
Number of finches	1 200	1 400	1 200	150	350	300	200
Small seeds (mg/m^2)	-	800	600	90	300	70	50

3.1. Use the information in the table to draw a line graph to show the number of finches from 1974 until 1980. (11)

(Your clue here is in the question; you must show the number of finches and the years (time). Time ALWAYS goes onto the X-axis because it is the INDEPENDENT variable. The number of finches will be on the Y-axis because it is the DEPENDENT variable. Remember to do a heading for your graph and make sure that the spacing of the points on the X-axis is the same as the spacing on the Y-axis.)

3.2. In which year were the largest drop in rainfall, number of seeds and number of finches recorded? (1)

3.3. Explain how the three events mentioned in QUESTION 3.2. are related to each other. (3)

3.4. When the number of finches decreased, there were still plenty of large seeds on the island. What does this tell you about the seed eating habits of the finches that died? (2)

3.5. Do you think there was a difference in the beak sizes of the dead finches and the surviving finches? Explain your answer. (3)

[20]

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SECTION B: SOLUTIONS AND HINTS

Question 1:

1.1 When a geographical barrier ✓ e.g. mountain, river, sea, etc. separates a subpopulation of breeding individuals from the parent population ✓ (2)

1.2 (Less) seeds are available on the island ✓/competition for seeds available/availability of different sources of food (1)

1.3
- There was a great variety within the species because of genetic variation ✓
- leading to natural selection ✓
- Many seed-eating finches died ✓
- Those finches that were able to eat different foods/non-seed food survived in greater numbers ✓
- to pass on their genes to their offspring ✓
- Species became distinct and adapted to the specific food on that island ✓ (5)

(Mark any 5 of the above)

Question 2: 10 Minutes *(Taken from DoE November 2008 Paper 2)*

2.1 **(a) Darwin**
- As a result of genetic variation ✓in the giraffe population
- some giraffes have longer necks ✓ than others
- Environmental change ✓/competition for resources occurred
- causing those with shorter necks to die ✓
- and those with longer necks to survive ✓
- This is natural selection ✓/survival of the fittest
- The genes ✓/genotype for longer necks
- were passed on to subsequent generations ✓ most of which now have long necks (4)

(Mark any of the 4 above)

(b) Lamarck
- All giraffes had short necks ✓ originally
- Giraffes frequently stretched ✓/used their necks to reach
- for leaves of tall trees ✓
- necks become longer ✓
- The long necks acquired ✓ in this way could be passed on to the next generation ✓ /were inherited (4)

(Mark any of the 4 above)

2.2 **Acquired characteristics** ✓are **not inherited** ✓ /do not cause any change to the DNA of an organism's gametes (sperms or ova)
OR
Organisms did not evolve because they want to evolve ✓✓/
Lamarck's theory is deterministic ✓✓ (2)

[10]

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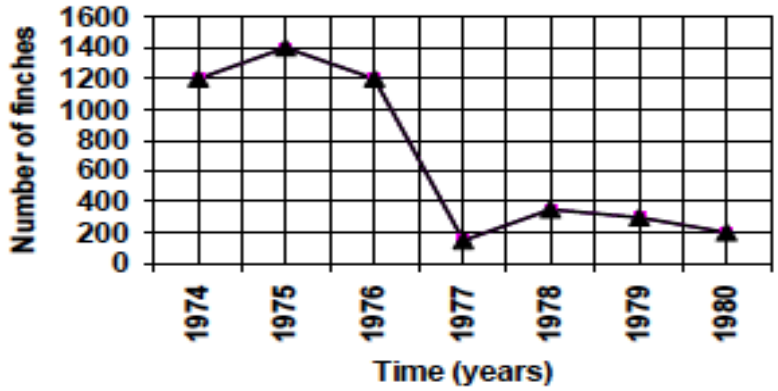
Question 3:

3.1. Number of finches from 1974 to 1980



Rubric for the mark allocation of the graph

Correct type of graph	1
Title of graph	1
Correct label for X-axis	1
Correct label for Y-axis	1
Appropriate scale for X-axis	1
Appropriate scale for Y-axis	1
Correct unit for X-axis	1
Plotting points	1: 1 - 2 correctly plotted 2: 3 - 5 correctly plotted 3: 6 - 7 correctly plotted
Joining of points	1

(11)

NOTE:

If the wrong type of graph is drawn: marks will be lost for "correct type of graph" as well as for the "joining of points".

3.2 1977✓ (1)

3.3 A drop in rainfall ✓causes the a drop in seeds/plants because of drought ✓ that causes a lack of seeds ✓/food for finches ,therefore less finches ✓ (3)

(Mark any of the 3 above)

3.4 These finches✓ were not able to eat the large seeds✓ (2)

3.5 Yes ✓
The surviving finches had bigger beaks to be able to eat the bigger seeds ✓
The dead finches had smaller beaks and were not able to eat the bigger seeds ✓(3)

[20]

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SECTION C: ADDITIONAL CONTENT NOTES

Introduction:

Millions of species of organisms are found throughout the biosphere, from the Antarctic to the steaming hot desert. Many of the organisms are adapted to live in seawater and fresh water. Each organism type is different and shows diversity. Adaptations result in diversity allowing organisms to survive in completely different and diverse environments.

Organisms must change and adapt to survive in a specific environment. Variation and diversity is as a result of **gene mutations** which cause changes in organisms. When these changes assist the organism, they survive and the genes can be passed on to the next generation. This is called **natural selection** and can result in evolution. If the characteristics are not suitable for survival, the organism will die, resulting in the eventual extinction of the species. Conservation ensures that populations do not become extinct.

Evolutionary Theories

Evolution is **the slow process of change** where organisms acquire distinct characteristic. For many years, the common belief was that all life on earth was created over six days, as described in Genesis in the Bible, with one day representing 24 hours. This would mean that all life as we know it, has been in existence from the beginning and no changes have taken place. We are now going to take a brief look at various theories. During the 18th century, Scientists began to look for scientific explanations to explain the changes that were evident in some species.

- **Jean Batiste de Lamarck**

Jean Batiste de Lamarck, a scientist during the 18th century, presented one of the many evolutionary theories. He suggested that it was the **'inheritance of acquired characteristics'** that caused change in organisms. When the organism reproduced, it passed the acquired characteristic on to the offspring. He used the giraffe to explain the theory. He stated that as the giraffe stretched its neck to reach higher leaves, so the neck grew longer with each generation. Today, we agree that Lamarck's theory is incorrect because we know that physically stretching the neck cannot alter the gene make-up of the animal. Only the genetics of the organism can cause a physical change, like the vertebral bones growing longer and bigger. Think about this: if a mother has plastic surgery to her nose, the changed nose will not be passed on to the next generation. Her children will

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- **Darwin's Theory of Evolution**

Charles Darwin wrote a book called ***'On the origin of species'***, published in 1859. Darwin wrote that organisms evolve by small, gradual changes that take place over many successive generations to ensure survival. His theory rests on five principles:

1. All species show **structural and functional variations** that affect the organism's chances of survival.
2. Each species has the **ability to reproduce** and, if the population of the species is not **controlled**, they will eventually run out of food and living space.
3. Individuals in the species that have **advantageous variations,** will survive the battle for food, mates and living space.
4. **Constant selection** of the better-adapted and stronger individuals, and the elimination of the weaker ones, result in the **evolutionary changes** that occur.
5. The stronger individuals pass their **genes** on to the **next generation**. (Survival of the fittest)

Darwin used his 5 principles to explain that the present species on earth today, are modified descendents from the species of the past.

Evolution can be explained as **the constant change that has taken place**. Darwin's book was the first theory about evolution to be published. His theory was supported by scientific evidence and was regarded as credible.

The **PROCESS** of change was called **NATURAL SELECTION**.
The combined **LONG-TERM** changes in the species were called **EVOLUTION.**

During Darwin's travels, he spent time on the **Galapagos Islands** (about 965 km west of Ecuador) where he studied the fauna and flora (plants and animals). He carefully recorded the appearance of the Galapagos finches. There are 14 species of dull, unremarkable looking birds, which evidently come from a common ancestor where each species is specialised for a specific diet and habitat. Darwin drew the conclusion that the **variation** between the finch species was due **to lifestyle and behaviour**. He suggested that this proved his theory of natural selection.

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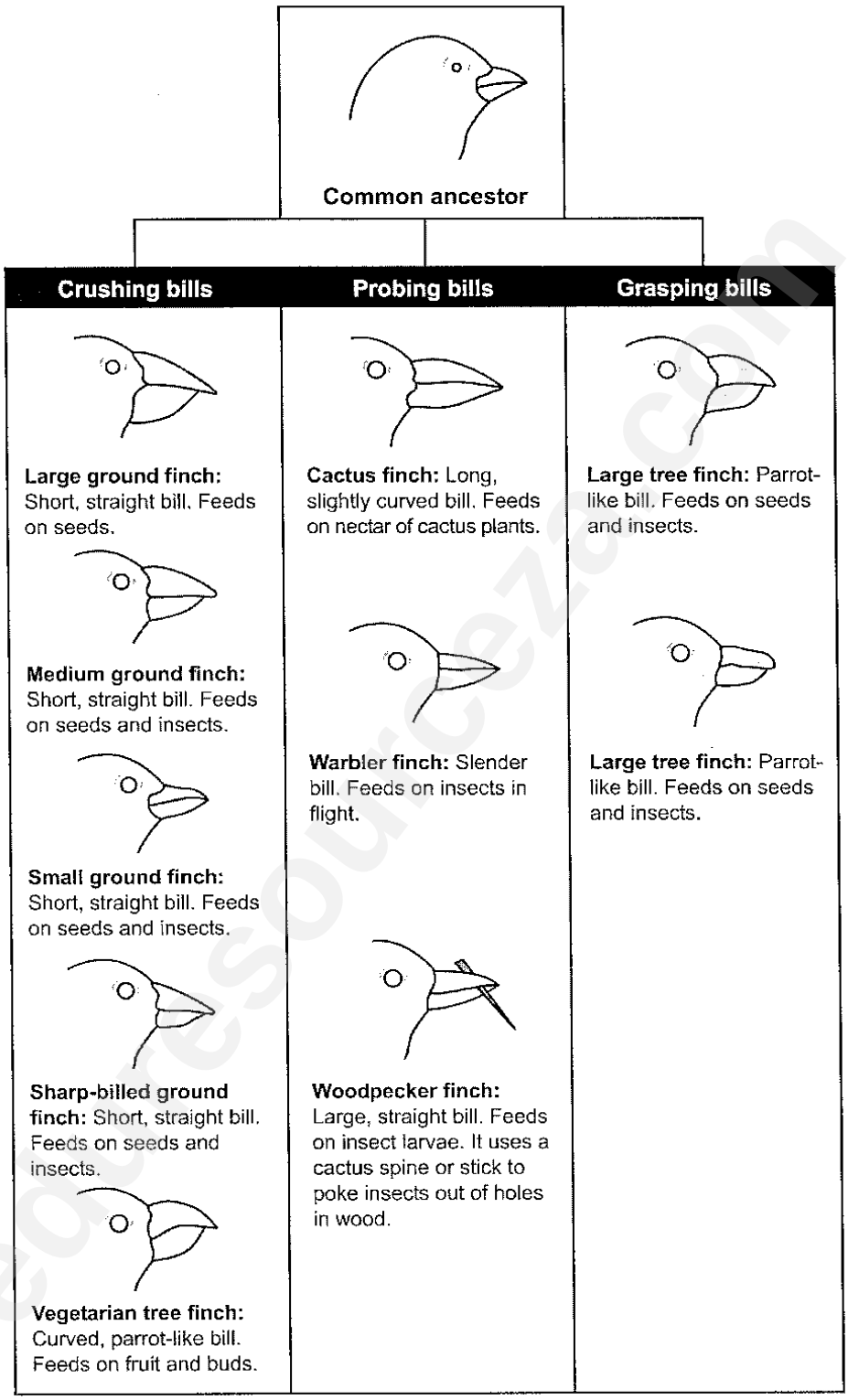

Darwin's finches on the Galapagos Islands

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Modern Theory

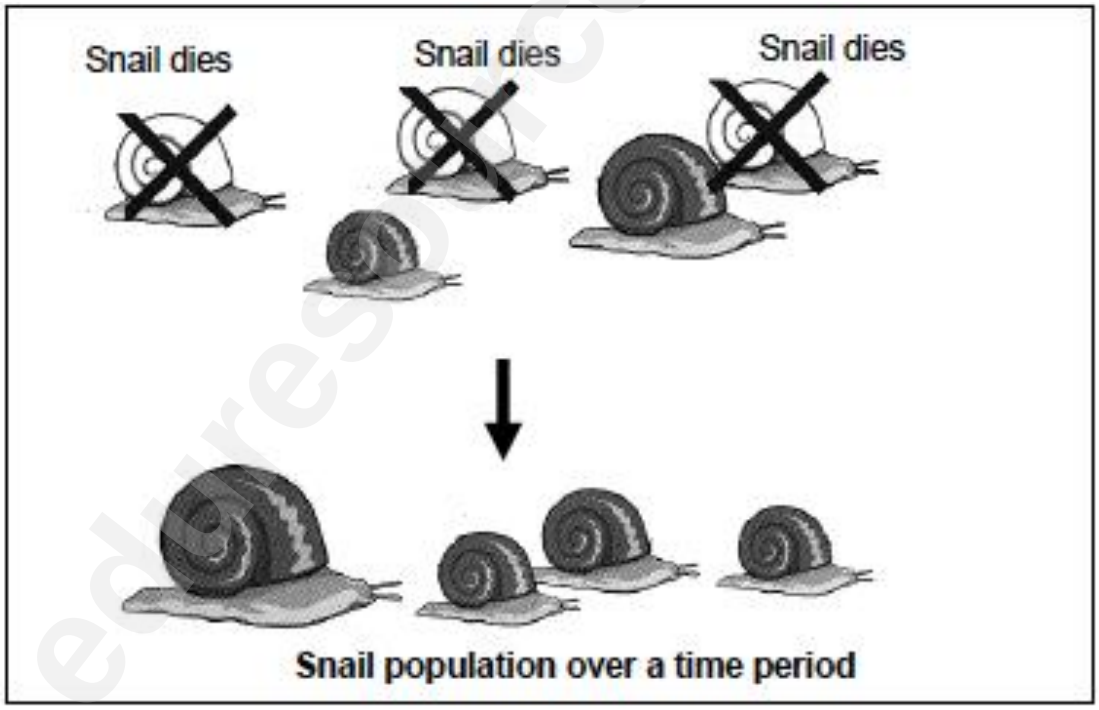
The modern theory is called **neo-Darwinian** evolution and is based on Darwin's principles of variation, natural selection and over-production of offspring.
Today, scientists agree that individual organisms **change to adapt** to the environment. Sometimes this process occurs when genes mutate by accident. If the mutation is good, the individual survives by natural selection and breeds so the 'good' genes are passed on to the next generation.

SECTION D: HOMEWORK

Learner Note: As you attempt the homework, you need to be able to answer the questions in the allocated time frames. If you get stuck, you should refer to either the additional notes or your class teacher.

Question 1: **8 Minutes** *(Taken from DoE Preparatory Examinations 2008 Paper 2)*

Study the diagram below and answer the questions that follow.



1.1. Explain the phenomenon illustrated in the diagram. (2)
1.2. Describe the observations on which Darwin based his theory of evolution. (6)

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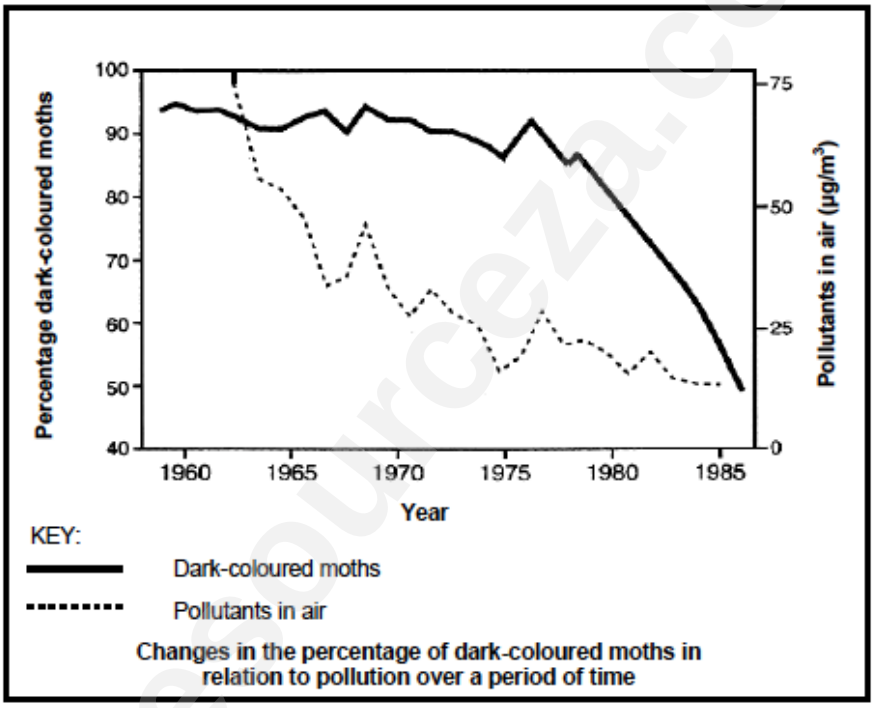
Question 2: **10 minutes** *(Taken from DoE Exemplar 2008 Paper 2)*

Before the Industrial Revolution took place in Britain in the 19th century, light-coloured moths that blended with the lichen-covered bark of trees, were far more common than dark-coloured moths. However, pollution from factories killed the lichens on the trees leaving their dark bark exposed. The light-coloured moths were easily identified against the black background. The dark-coloured moths that were easily camouflaged on the dark bark, soon became far more common than the lighter varieties. Now that pollution is decreasing the light-coloured moths are increasing in numbers again.

Study the graph below that shows the changes in the percentage of dark-coloured moths.



Changes in the percentage of dark-coloured moths in relation to pollution over a period of time

2.1. What was the percentage of the dark-coloured moths in 1970? (1)
2.2. What is the general relationship between the dark-coloured moth population and pollution from 1965 to 1985? (2)
2.3. Explain the relationship mentioned in QUESTION 2.2. (2)
2.4. Briefly outline Lamarck's theory of evolution. (5)

SECTION E: SOLUTIONS TO SESSION 20 HOMEWORK

No Homework was allocated in Session 20.

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