

SENIOR SECONDARY IMPROVEMENT PROGRAMME 2013



education

Department: Education

GAUTENG PROVINCE

GRADE 12

LIFE SCIENCES

TEACHER NOTES

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TEACHER NOTES

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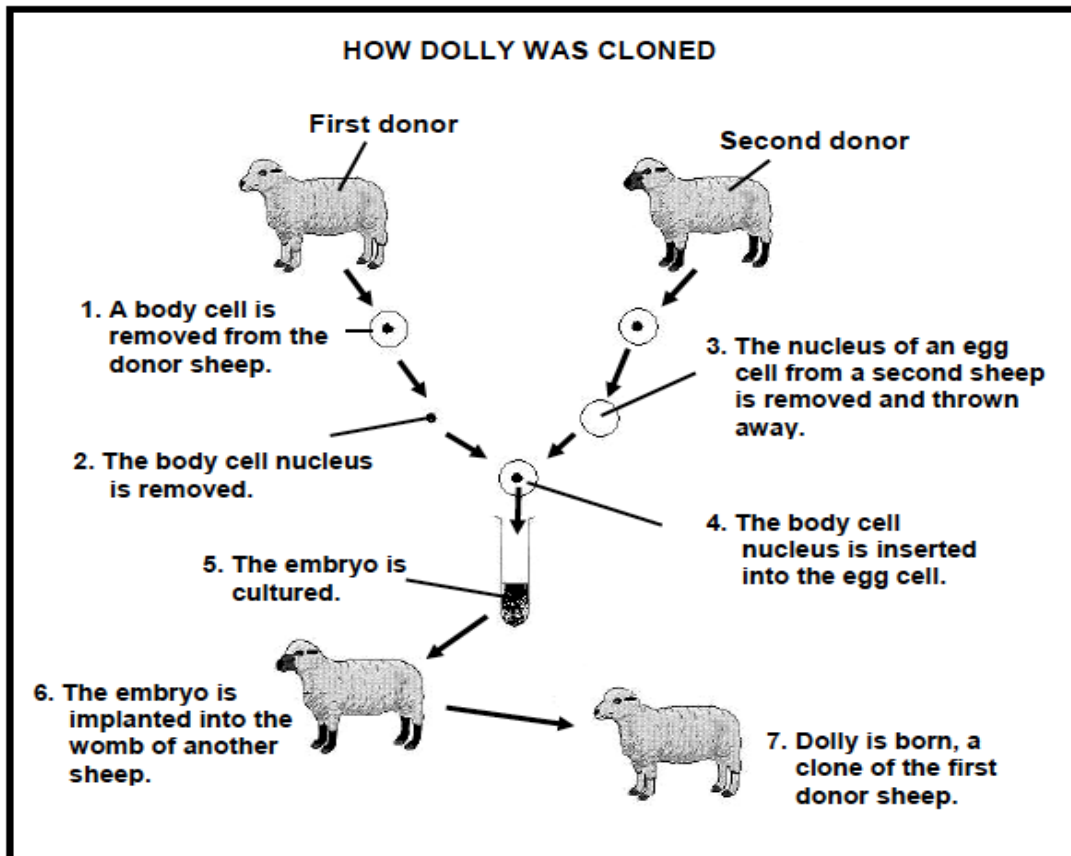
SESSION 3: TOPIC 1: MUTATIONS AND NATURAL SELECTION, GENETIC ENGINEERING

Teacher Note: This section is a small section in the work but relates to LO3 and is often examined. In fact, most of the past exam papers contain questions on mutation, natural selection and genetic engineering. It is important that learners are encouraged to read about genetic engineering so that they form an opinion of whether this is good or bad, but also so that they understand the basic process and the benefits to human beings.

SECTION A: TYPICAL EXAM QUESTIONS

QUESTION 1: 10 minutes (Taken from DoE Additional Exemplar 2008 Paper 1)

Study the diagram below that shows the cloning of a sheep named Dolly.



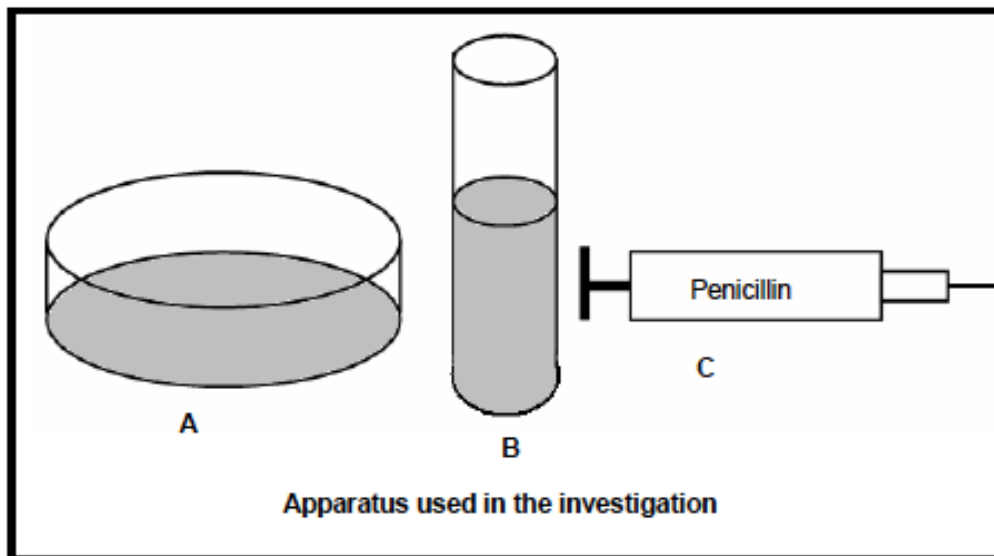
- 1.1. Why was it necessary to remove the nucleus from the egg cell of the second donor before the sheep could be cloned? (2)
 - 1.2. Would Dolly have any characteristics of the second donor sheep? (1)
 - 1.3. Explain your answer to QUESTION 1.2. (2)
 - 1.4. Number 5 on the diagram states that 'the embryo is cultured'. Through which process of cell division does the embryo develop? (1)
 - 1.5. Describe TWO reasons why people could be against genetic engineering. (4)
- [10]

QUESTION 2: 4 minutes*(Taken from DoE Exemplar 2008 Paper 1)*

Antibiotics work by interfering with various stages of protein synthesis in a bacterial cell. A group of Grade 12 learners wanted to test the effect of the antibiotic penicillin on the bacterium *Staphylococcus aureus*.

They were provided with the following apparatus:

1. Petri dishes containing agar (agar supports bacterial growth) (A)
2. Culture of *Staphylococcus aureus* (B)
3. The antibiotic penicillin (C)



List the steps that you would follow to determine the effect of the antibiotic penicillin on the bacterium *Staphylococcus aureus*. [4]

HINT: Just think of a step by step process. Write it down on this question paper first and then write it on your answer sheet. It must follow a logical order.

QUESTION 3: 14 minutes*(Taken from DoE Feb/March 2009)*

Read the passage below and answer the questions that follow.

GENETICALLY MODIFIED PIG BRED WITH 'GOOD FAT'

Scientists in the United States of America have produced genetically modified pigs with fat containing omega-3 fatty acids. These fatty acids, which are usually found in salmon, mackerel and fresh tuna, are thought to be responsible for a number of benefits, from combating heart disease to improving intelligence.

Researchers from the University of Pittsburgh – School of Medicine created piglets capable of converting less useful omega-6 fatty acids into omega-3 fatty acids. They implanted 1 800 embryos into 14 female pigs. Ten live offspring, which were able to make high levels of omega-3 fatty acids, were born.

[Adapted from: Cape Argus, 27 March 2006]

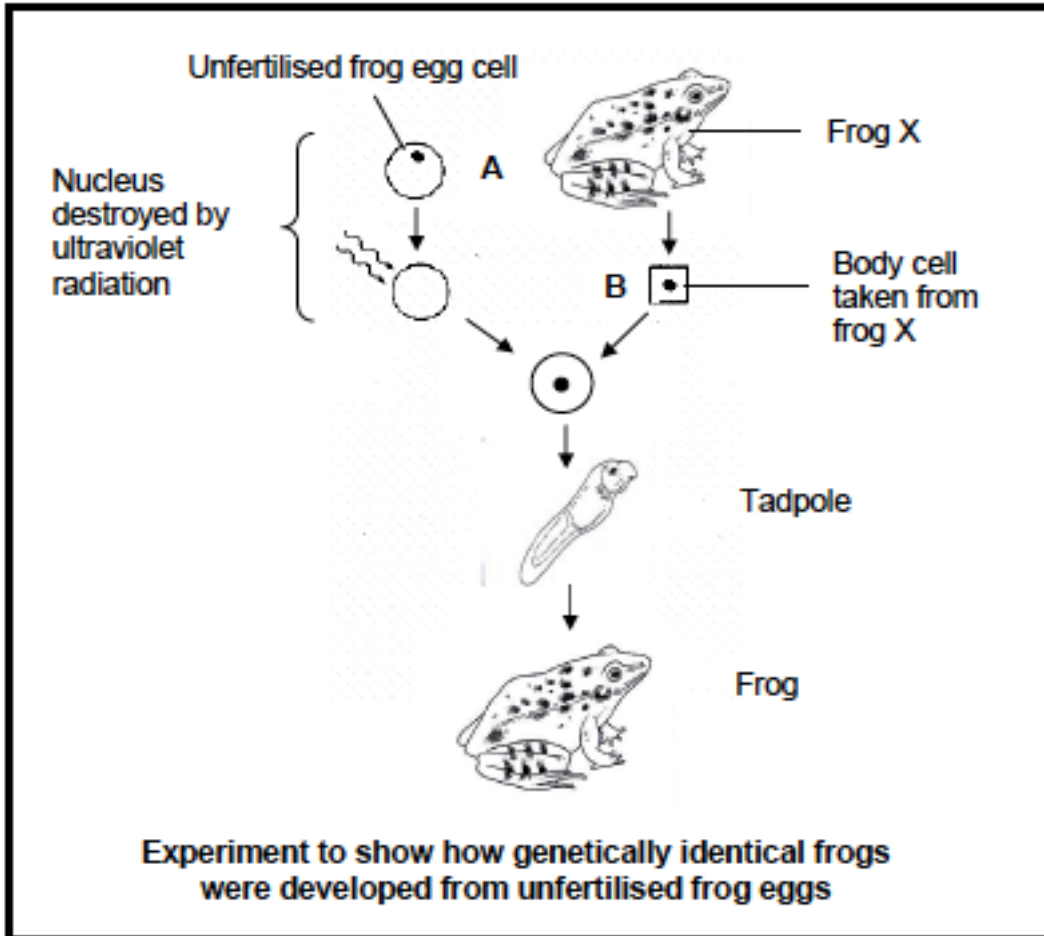
HINT: Read the passage through and underline what you think will be the important facts. Read the passage again, now answer the questions.

- 3.1. Name TWO health benefits of omega-3 fatty acids. (2)
- 3.2. What percentage success did the scientists have with the implanted embryos in forming a clone of pigs capable of producing omega-3 fatty acids?
Show ALL working. (3)
(Show each step of the calculation.)
- 3.3. To produce genetically modified pigs, the gene that produces omega-3 fatty acids is inserted into the pig embryos. Describe the steps in forming and introducing many copies of the desirable gene (using bacteria) into the pig embryos. (4)
- 3.4. Give TWO reasons why:
- (a) Some people may support the use of genetically modified pigs to produce omega-3 fatty acids. (2)
- (b) Some people may be against the use of genetically modified pigs to produce omega-3 fatty acids. (2)

[13]

QUESTION 4: 12 minutes*(Taken from DoE November 2008 Paper 1)*

The diagram below shows the steps of an experiment in which a large number of genetically identical frogs were developed from unfertilised frog eggs. The nucleus of each unfertilised egg was destroyed and replaced by a nucleus obtained from a body cell from frog X.



- 4.1. The diploid number of chromosomes in the above frogs is 26. How many chromosomes are present in the nucleus of the following cells? (1)
- (a) Cell A (1)
- (b) Cell B (1)
- 4.2. Why can an egg containing a nucleus from the body cell of a frog develop into a tadpole? (2)
- 4.3. Explain why all the frogs produced from the treated eggs are genetically identical. (2)
- 4.4. Name the method of producing genetically identical offspring as shown in the diagram. (1)
- 4.5. State ONE reason why some people might: (2)
- (a) Favour the process shown in the diagram (2)
- (b) Be against the process shown in the diagram (2)
- [11]

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| SECTION B: SOLUTIONS AND HINTS TO SECTION A |
|--|

QUESTION 1

- 1.1 To insert the DNA ✓/nucleus of the sheep that you want to clone ✓ (2)
- 1.2 No ✓ (1)
- 1.3 Dolly will have exactly the same DNA ✓ as the first donor sheep ✓/DNA of the second donor was removed and replaced (2)
- 1.4 Mitosis ✓ (1)
- 1.5 They might feel that scientists want to play God ✓ in creating new life ✓
The purpose ✓ of the clones might be questioned – will they be used for „spare“ organs ✓
The possibility of harmful micro-organisms being released either accidentally or purposely ✓ (Mark first TWO only) any (2 x 2) (4)
- [10]**

QUESTION 2

2. (i) Add *S. aureus* into the petri dishes ✓
(ii) Allow a few hours for bacterial growth ✓ (incubation)
(iii) Add the antibiotic ✓ in a specific area
(iv) Observe the effect of the antibiotic after several hours ✓
(v) Set up a control where no antibiotic is added ✓
- (Mark any FOUR in the correct order) [4]**

QUESTION 3

- 3.1 - Combating heart diseases ✓ - Improving intelligence ✓ (2)
(Mark first TWO only)
- 3.2 $10 \times 100 = 1\ 800$
 $= 0,55\%$ (3)
- 3.3 The gene responsible for producing omega-3 fatty acids is located ✓
in the DNA of salmon ✓/fresh mackerel/tuna
This gene is cut ✓ from the donor organism, inserted into a plasmid of a bacterium ✓
Bacteria replicate to form many copies of the gene ✓
These genes are then inserted into the cells of the zygote ✓/embryo any (4)
- 3.4 (a) Support - Healthier for humans to eat ✓/combating heart disease
- Mass production of healthy fat ✓
- Improves intelligence ✓ (Any 2) (2)
(Mark first TWO only)
- (b) Against - Cultural objection to eat meat from pigs ✓
- The success rate is very low ✓ - Expensive procedure ✓
- No value for vegetarians ✓
- Objection to eating any genetically modified food ✓ (Any 2) (2)
(Mark first TWO only) [13]

QUESTION 4

- 4.1 (a) 13 ✓ (1)
 (b) 26 ✓ (1)
- 4.2 Has a full set ✓ of chromosomes ✓ /Diploid number of chromosomes/ complete set of chromosomes (2)
- 4.3 They have same/identical chromosomes ✓/genetic material / DNA from the nucleus of the somatic/body cell collected from the same frog/X ✓ (2)
- 4.4 Cloning ✓ (1)
- 4.5 **(a) In favour:**
- Producing individuals with desired traits ✓✓
 - Better yield ✓✓
 - Resistant to diseases ✓✓
 - Organisms produced in a shorter time ✓✓
 - Saving endangered species ✓✓
 - Producing body parts ✓✓
 - Produce offspring for organisms that cannot have offspring ✓✓ (1 x 2) (2)
- (Mark FIRST answer only in learner's script)**

(b) Against:

- Objection to interfering with God's ✓✓/Supreme Being's creation/nature
 - Reducing the gene pool by reducing variation ✓✓/ Reduces genetic diversity
 - Cloned organisms may have developmental/morphological problems ✓✓
 - Costly process ✓✓
 - May generate more experimental waste ✓✓
 - May lead to killing of clones to obtain spare body parts ✓✓
 - Cruelty to animals ✓✓ (1 x 2) (2)
- (Mark FIRST answer only in learner's script)**

[11]**SECTION C: HOMEWORK****QUESTION 1: 5 minutes***(Taken from DoE Nov 2008 Paper 1)*

Since the 1980s, human insulin has been produced using genetically modified bacteria and yeast.

- 1.1. State THREE advantages of producing human insulin by genetic modification. (3)
- 1.2. Give TWO reasons why some people might be against genetic modification. (2)
- [5]**

QUESTION 2: 5 minutes*(Taken from IEB Nov 2009 Paper 1)*

Porphyria variegata is a group of diseases caused by over 200 different genetic mutations. It can cause paralysis, skin sensitivity in sunlight and death. In South Africa 96% of *porphyria* sufferers carry the same dominant mutation on chromosome 1. It is believed that it was brought to South Africa in 1688 by a Dutch orphan sent to South Africa to marry an early settler. This condition has since spread widely.

If the symptoms show, a simple blood test can confirm if a patient is suffering from *porphyria*.

'If we unpack our pasts, we will also be unpacking our health risks,' says Lynne Smit of the Africa Genome Education Institute.

- 2.1 What is a 'mutation'? (2)
- 2.2 What in the text indicates that *porphyria* is an autosomal condition? (1)
- 2.3 A *porphyria* sufferer visits a medical expert trained to predict and advise on inherited conditions.
The sufferer is concerned that other members of his family may also have inherited his condition. What is such a medical expert called? (1)
- [4]

QUESTION 3: 15 minutes*(Taken from IEB Nov 2009 Paper 1)*

This adapted version of an article appeared in a South African newspaper on Thursday May 8, 2003. Use the article to answer the questions that follow.

SA SCIENTISTS CLONE CALF

Futhi a first for Africa

JOHANNESBURG: Africa's nutrition problems could one day disappear thanks to animal cloning. This was said by one of the scientists who succeeded in Africa's first cloning of appearance to the public in the North West province. The calf name means „repeat“ or „replica“ in Zulu.

The donor cow is a South African milk-production record-holder. Producing 78 litres per day “There is no reason why the calf will not produce the same amount of milk as the donor” said De la Rey, a veterinarian from the Embryo Plus Centre. De la Rey and his colleague have been working on the cloning project for nearly two years. “It is quite an achievement for us as it was the first time we tried cloning”. He said “We were lucky it was a success first time round.

Their technique is different from normal cloning methods in that the protective covering around the egg is removed before cloning takes place. They took DNA from the donor cow's ear. This was inserted into an empty cow egg. The egg was then planted into the recipient cow. “Again we were lucky that the recipient cow did not reject the egg” De la Rey said.

By cloning it is possible to replicate the characteristics of high-quality animals and prevent the unknown variability that can occur in normal breeding. But De la Rey said that the process was currently very expensive and the procedures need more development. He said cloning could be very useful to countries in Africa where there are increasing food shortages

- 3.1 On what date was Futhi first shown to the public? (1)
- 3.2 Explain why Futhi is a suitable name for the new calf. (3)
- 3.3 De la Rey makes the statement that cloning can prevent the 'unknown variability that can occur during normal breeding'.
 - (a) What does he mean by 'normal' breeding? (1)
 - (b) Why does normal breeding lead to 'unknown variability'? Give two reasons. (2)
- 3.4 In what way does normal cloning differ from De la Rey's method? (1)
- 3.5 In what organ of the recipient cow would the cloned egg develop? (1)
- 3.6 Futhi is just one cow. How does this make cloning useful in solving the food shortages of whole countries? (1)
- 3.7 The process of producing a cloned animal is difficult. Write down ONE difficulty mentioned in the article. (1)
- 3.8 Recombinant DNA technology may be another way to make cows that produce large amounts of milk. Briefly outline the steps such a procedure might involve. (3)

[14]

| |
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| SECTION D: SOLUTIONS TO HOMEWORK |
|---|

QUESTION 1

- 1.1. May have fewer side effects ✓
 May not be contaminated ✓/will be in its natural form
 No problem from a religious perspective ✓
 Can be mass produced ✓/produced faster
 Avoids killing animals ✓ **(Mark first THREE answers only)** (3)
- 1.2. Against:
 - risk to human health ✓
 - risk to the environment ✓
 - risk to the health and well-being of other organisms ✓
 - interference with nature ✓/God's creation
 - cultural sensitivity ✓ e.g. objection to the use of pigs and cows (2)
(Mark first TWO answers only) [5]

QUESTION 2

- 2.1 a sudden/rapid ✓
 unexpected/random/unpredictable ✓
 change/mistake ✓
 in DNA ✓ **(Mark any 2)** (2)
- 2.2 It affects chromosome 1/no indication it is sex-linked or affects gonosomes ✓ (1)
- 2.3 Genetic counsellor/geneticist ✓ (1)
- [4]

QUESTION 3

- 3.1 May 7 2003 (full date) ✓ (1)
- 3.2 Futhi means replica/repeat ✓
 A replica is an exact ✓ copy ✓
 The calf is a genetically identical/a clone of/has the same DNA as the parent ✓ (3)
- 3.3 (a) sexual reproduction (or explanation thereof) ✓ (1)
 (b) **Any 2 of** ... crossing over random fusion of gametes; ✓ independent assortment/random alignment during meiosis ✓ (2)
- 3.4 Protective covering of the egg left on in normal cloning ✓ (1)
- 3.5 Uterus ✓ (1)
- 3.6 Many (clones) can be made of highly productive livestock ✓ (1)
- 3.7 Producing the clone, i.e. viable embryo itself ✓
- OR**
- When the egg is inserted into the recipient ✓ (1)
- 3.8 Isolation phase: **Any 1 of** Remove gene for high yield ✓ from high yielding donor ✓
 Engineer phase: **Any 1 of** ... Genetically engineer a bacterium/plasmid to contain this gene ✓
 Insertion phase: **Any 1 of** ... Infect the cow with the bacterium ✓ (3)
OR Any other reasonable 3 step process [14]

SESSION 3: TOPIC 2: THEORIES OF EVOLUTION (PART 1)

LESSON OVERVIEW

1. Introduce session: 5 minutes
2. Typical exam questions: 35 minutes
3. Review/solutions/memo: 20 minutes

Teacher Note: This module of work generally poses many challenges when it is taught, because of religious beliefs around evolution. Make it clear from the onset that this subject is Life Sciences, and within the sciences, the theory of evolution forms a possible scientific explanation for the diversity and changes that occur to ensure that a species survives. Avoid getting into any discussions about religious belief systems, and adhere solely to the content within this section. Teach evolution as 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. If the trait is not good, then the organism dies and, therefore, cannot reproduce.

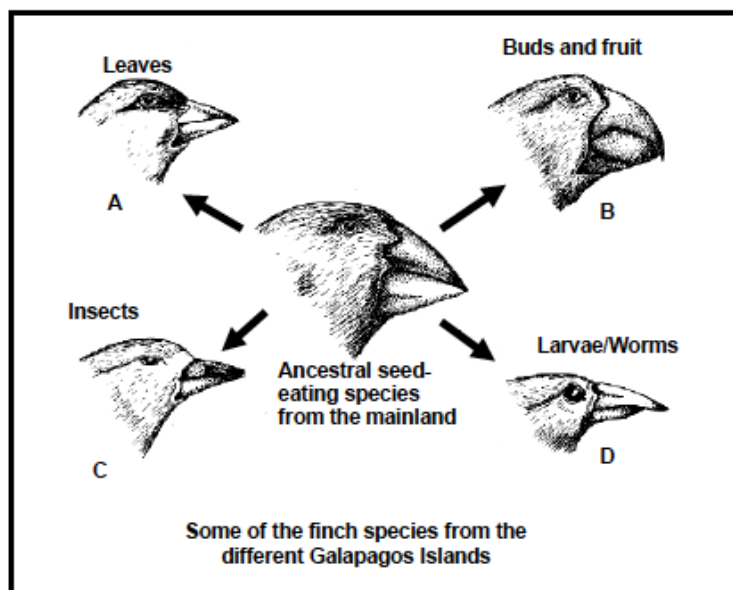
SECTION A: TYPICAL EXAM QUESTIONS

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.



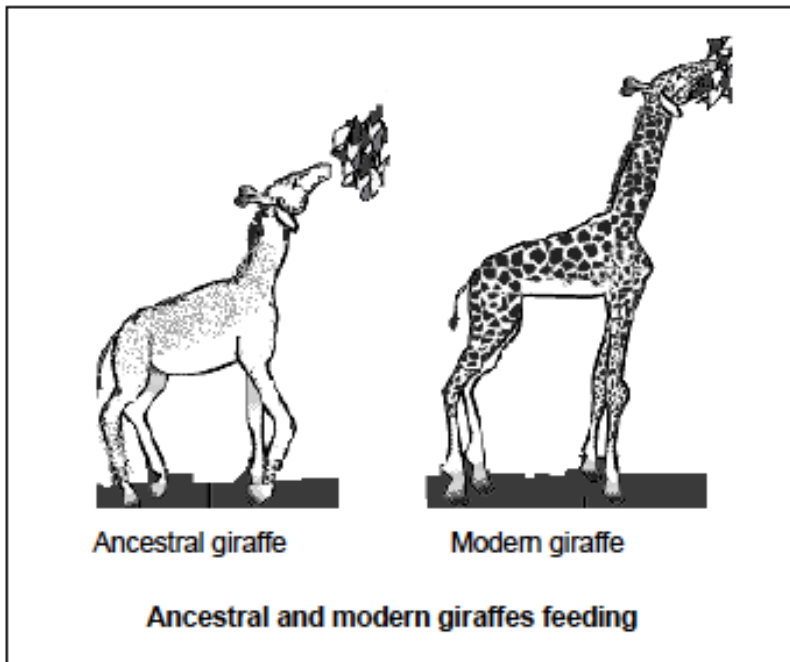
- 1.1. Explain what is meant by *geographical isolation of a population*. (2)
(Geographical will mean the geography of the land masses. Isolation means to be on one's own.)
- 1.2. Why do you think the different finch species became adapted to eat different food types? (1)
- 1.3. Explain the process by 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)

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.



- 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]

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

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)

HINT: 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]

SECTION B: SOLUTIONS AND HINTS TO SECTION A**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)***[8]****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** ✓✓/

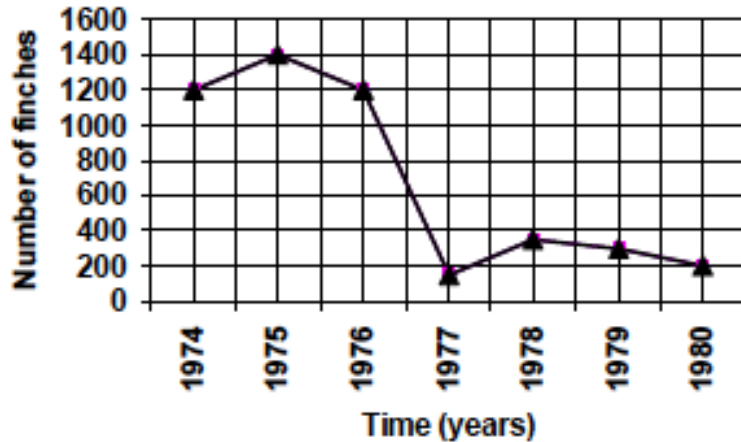
Lamarck's theory is deterministic ✓✓

(2)

[10]

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)

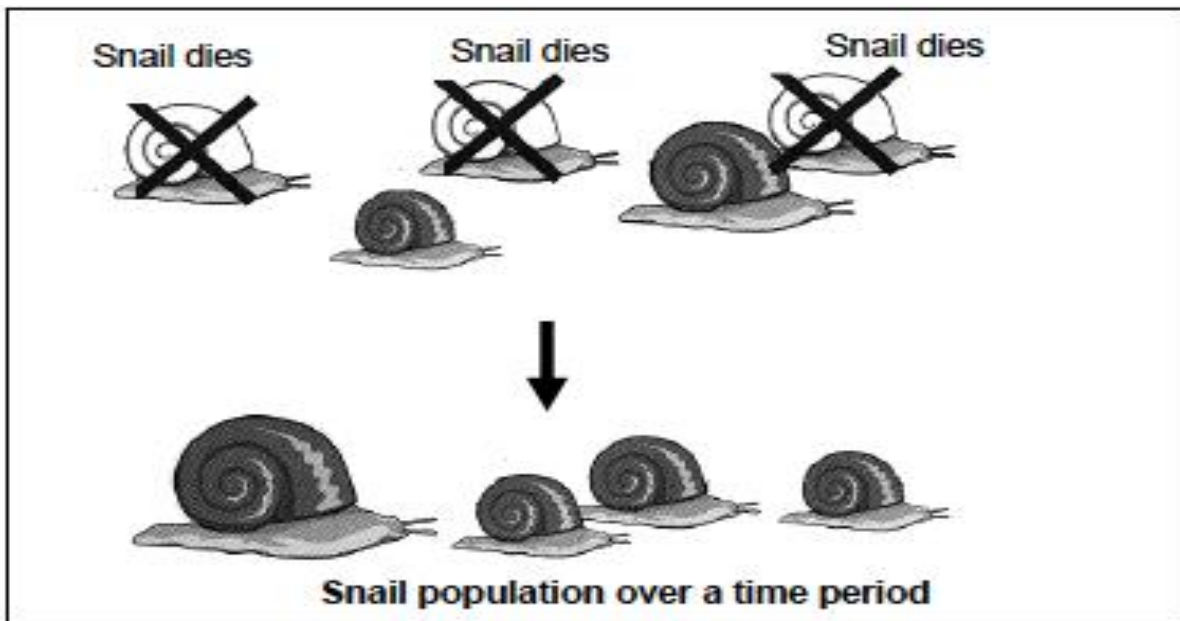
[20]

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| SECTION C: HOMEWORK |
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Teacher Note: Stress that as learners attempt the homework, they need to ensure that they are able to answer the questions in the allocated time frames. If they get stuck, they should refer either to the additional notes or their class teacher.

QUESTION 1: **8 minutes** (*Taken from DoE Preparatory Examinations 2008 Paper 2*)

Study the diagram below and answer the questions that follow.

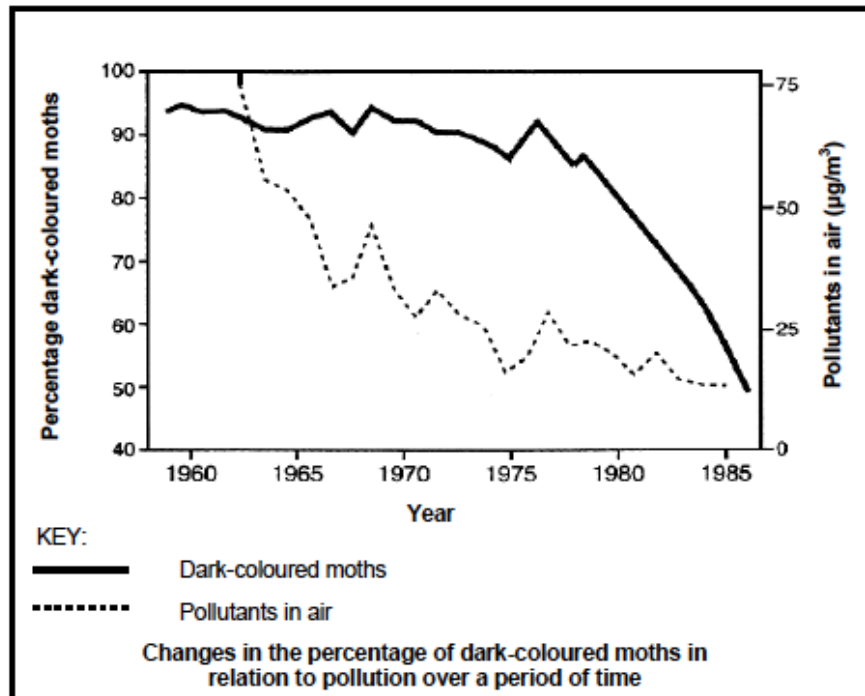


- 1.1. Explain the phenomenon illustrated in the diagram. (2)
- 1.2. Describe the observations on which Darwin based his theory of evolution. (6)
- [8]

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.



- 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)
- [10]

| |
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| SECTION D: SOLUTIONS TO HOMEWORK |
|---|

QUESTION 1

- 1.1 Natural selection– those organisms with the most beneficial ✓ traits are more likely to survive and reproduce✓. (2)
- 1.2 Organisms produce more offspring ✓ than can survive. These organisms compete for limited resources✓
 There is variation ✓ in populations. Organisms change over time; those living today are different to those who lived in the past✓, i.e.
 Change is gradual and slow, taking place over a long time✓
 The mechanism of evolutionary change was natural selection✓
 All organisms are derived from common ancestors ✓ by a process of branching, i.e. organisms pass genetic traits to the next generation✓
(Any 6) (6)
[8]

QUESTION 2

- 2.1 93 ✓% (accept 92 - 95) (1)
- 2.2 - As the pollution decreased ✓
 - the percentage of the dark-coloured moths also decreased ✓ (2)
- 2.3 - The dark-coloured moths are not being camouflaged ✓/can easily be seen against the light lichen-covered bark
 - and have become easier targets/prey for birds✓ (2)
- 2.4 Lamarck believed that structures✓ of individuals in a population became better✓ or less adapted✓ to the environment ✓ depending on the frequency of their use ✓ and that these adaptations could be inherited from generation to generation ✓
 He suggested that change was driven by living things themselves ✓ as they strove to perfect their way of life ✓
 More complex organisms developed from less complex organisms ✓
 He supported the idea of common descent and linked diversity with adaptation to the environment ✓
 He supported the idea of the inheritance of acquired characteristics ✓
(Any 5) (5)
[10]

SESSION 4: TOPIC 1: DIVERSITY: EVOLUTION BY NATURAL SELECTION, FORMATION OF NEW SPECIES AND EVIDENCE OF EVOLUTION

Teacher Note: Please ensure that the learners know the following terms: Sympatric and Allopatric Speciation, Variation, Fixed, Neutral and Lethal Mutations, Inbreeding, Outbreeding, Artificial Selection and Natural Selection, Geographical Barriers, and link this to allopatric speciation, homologous versus analogous organs.

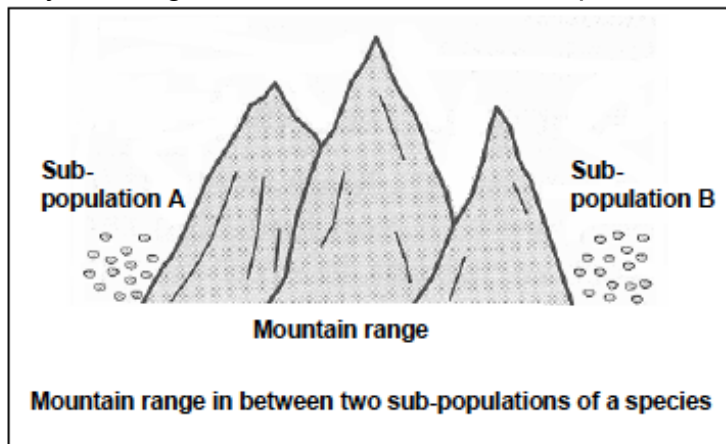
LESSON OVERVIEW

1. Introduce session: 5 minutes
2. Typical exam questions: 50 minutes
3. Review/solutions/memo: 35 minutes

SECTION A: TYPICAL EXAM QUESTIONS

QUESTION 1: 6 minutes (Taken from DoE Preparatory Examination 2008 Paper 2)

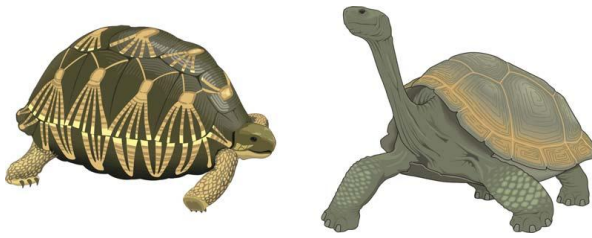
Study the diagram below and answer the questions that follow.



- 1.1. Define a *species*. (3)
- 1.2. Describe how sub-population B could form a new species. (6)

QUESTION 2: 9 minutes (Taken from WC DoE September 2009 Paper 2)

Darwin discovered two different varieties of tortoises on two different islands on the Galapagos Islands. One had a domed shell and short neck and the other one had a longer neck. The two islands had very different vegetation. One of the islands (island X), was rather barren, dry and arid. It had no grass but rather short tree-like cactus plants. On the other island (island Y), there were no cactus plants but it had a good supply of water and grass grew freely across the island. The diagrams below show the two main varieties of tortoises on the Galapagos Islands.



Tortoise A

Tortoise B

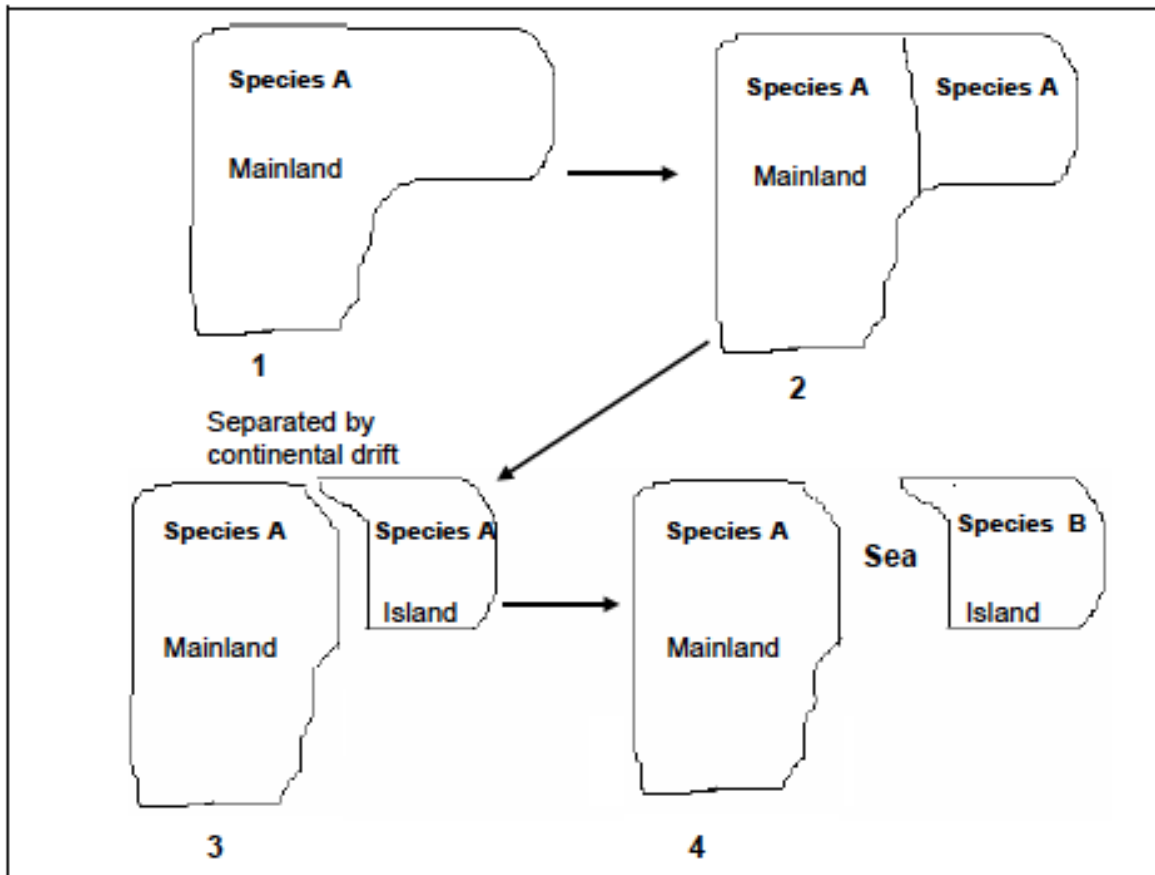
Two main varieties of tortoises on the Galapagos Islands

- 2.1. Which tortoise (A or B) would have been found on
 (a) island X? (1)
 (b) island Y? (1)
- 2.2 Explain your answer to QUESTION 2.1 (b) (2)
- 2.3 Describe the concept of allopatric speciation as it applies to the two tortoise types. (5)
 [9]

QUESTION 3: 6 minutes

(Taken from DoE Feb/March 2010 Paper 2)

Study the following diagrams which show different stages (1 to 4) of a process in evolution.



- 3.1. Name the evolutionary process that resulted from the continental drift shown. (1)
- 3.2. Describe how the original population of species A split to become two species as indicated in the diagrams above. (5)
[6]

QUESTION 4: 6 minutes (Taken from DoE Exemplar 2008 Paper 2)

The following questions are based on mutation.

- 4.1. Define a *gene mutation*. (2)
- 4.2. Name TWO factors that can cause mutations. (2)
- 4.3. Differentiate between *neutral* and *lethal mutations*. (4)
[8]

QUESTION 5: 8 minutes (Taken from Additional Exemplar 2008 Paper 2)

Study the passage below and answer the questions that follow.

CHARLES DARWIN

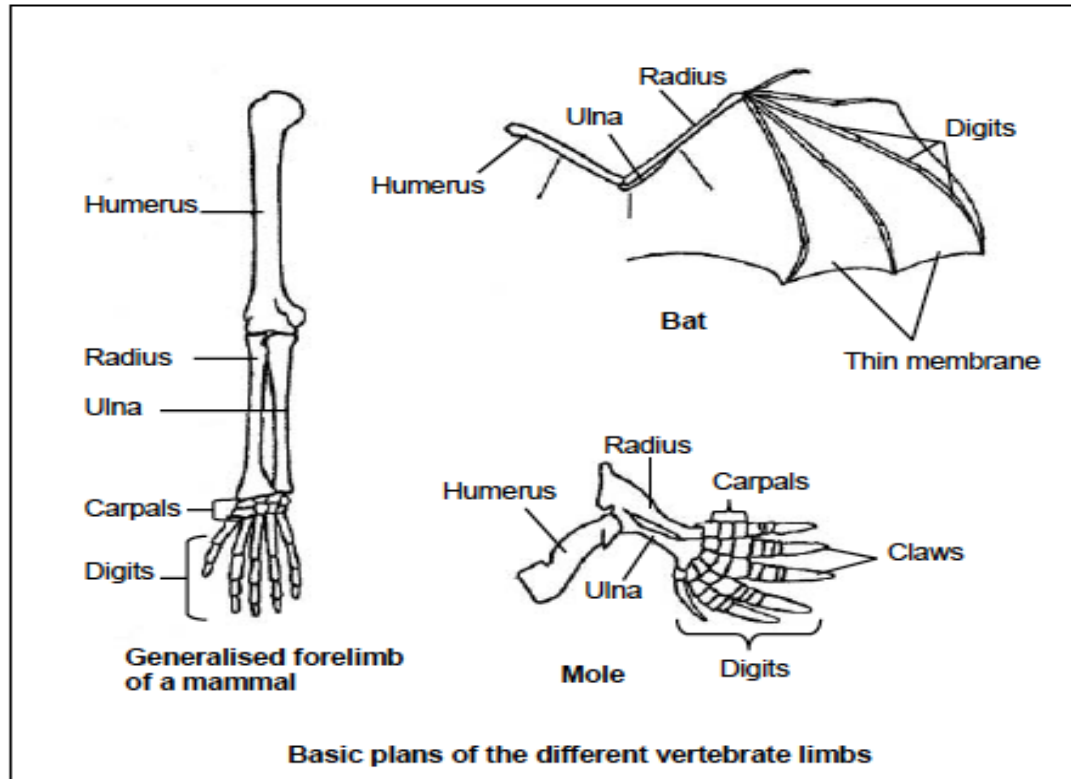
In 1831 Charles Darwin set out on a trip around the world in the HMS Beagle. At the Cape Verde Islands, he saw the fossil remains of sea creatures in the cliffs, many metres above sea level.

The unique forms of life he found on the Galapagos Islands, such as the giant tortoises, convinced him that living organisms had evolved over many millions of years. He noticed that these tortoises were quite different from those found elsewhere in the world. Each island also had a distinct type of tortoise, differing in the shape of the shell and mating behaviour.

- 5.1. Explain how Darwin would have used the example of the tortoises to explain speciation. (4)
- 5.2. How do fossils provide evidence for evolution? (2)
- 5.3. Give ONE reason why there are gaps in the fossil records. (2)
[8]

QUESTION 6: 5 minutes*(Taken from DoE November 2008 Paper 2)*

Study the basic plans of three different vertebrate limbs shown below:



- 6.1. Are the above examples of homologous or analogous structures? (1)
- 6.2. Explain your answer to QUESTION 6.1. (2)
- 6.3. State ONE way in which the forelimbs of the:
- bat are adapted for flying (1)
 - mole are adapted for digging holes (1)
- [5]

QUESTION 7: 6 minutes*(Taken from DoE November 2010 Exam Paper 2)*

Read the following passage and answer the questions that follow.

Thousands of wildebeest were migrating across the great plains of the Serengeti in Africa. Some of them were large, some small, some strong and some weak. Lions followed the wildebeest, catching and eating the slowest ones. Water was scarce and only the strongest were brave enough to stop to drink from the waterholes.

- 7.1. Identify ONE phrase in this passage which describes variation among the wildebeest. (1)
- 7.2. Explain how Darwin's idea of evolution by natural selection can be applied to this passage. (5)
- [6]

QUESTION 8: 6 minutes*(Taken from various DoE exam papers)*

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A – D) next to the question number (8.1 – 8.6).

Learner Note: Please do not waste time when you answer multi-choice questions. Read the question, underlining the operative words, while covering the answers. Then think of the correct answer. Now uncover the answer options and check if their answer is there. If it is, then tick next to the letter. If it is not, re-read the question and try to see exactly what is being asked. Then review the answer options again to find the correct answer. Always answer Section A last - the multi-choice questions must be answered right at the end of the exam paper.

- 8.1. Micro-evolution is a term that describes ...
- A the process by which new genera and families of organisms are formed.
 - B small changes that occur in the genotypes of organisms within the same species.
 - C changes that can be seen without a microscope.
 - D an increase in the size of individuals of a population over a long period of time.
- 8.2. According to Charles Darwin, organisms that will be most successful biologically, are those that ...
- A are best adapted to their environment.
 - B are the largest in the population.
 - C reproduce the slowest.
 - D do not change.
- 8.3. The evidence that related species in similar biomes across the world developed from a common ancestor, is obtained from ...
- A micro-evolution.
 - B embryology.
 - C biochemistry.
 - D biogeography.
- 8.4. Extinction occurs....
- A. When a species is unable to survive in their environment.
 - B. When only a few of a species survives.
 - C. When a species goes into hiding until conditions improve.
 - D. The gradual depletion of a population.
- 8.5. Discontinuous distribution is...
- A. When the organisms live in one area and distribute within their environment.
 - B. Organisms originate on one area and disperse outward.
 - C. When organisms originate in different areas and migrate towards one another.
 - D. When different species are distributed evenly among one another.

8.6 Pangea is said to be...

- A. The continents which made up two large masses of land.
- B. The continents, which made up one large mass of land.
- C. The seven continents that exist today.
- D. The continents, which made up three masses of land.

(6 x 1) [6]

SECTION B: SOLUTIONS AND HINTS TO SECTION A

QUESTION 1

- 1.1 A species is one or more populations whose members actually or potentially interbreed ✓ under natural conditions, produce fertile offspring ✓ and are reproductively isolated ✓ from other such groups. (3)
- 1.2 Geographic speciation ✓
- Physical isolation such as mountains turns a single population into two ✓
 - Once two populations are reproductively isolated, they are free to follow different evolutionary paths ✓
 - Different geographic regions are likely to have different selective pressures ✓ such as temperature, rainfall, predators and competitors are likely to differ between two areas ✓
 - Thus, over time, the two populations will differentiate ✓ to the point that reunion of the two populations does not occur if contact is re-established ✓
 - The fate of the populations depends upon time and factors related to their different environments ✓
- (Any 6) (6)**
[9]

QUESTION 2

- 2.1 (a) Tortoise B ✓ (1)
(b) Tortoise A ✓ (1)
- 2.2 Short - necked tortoise A can feed on grasses ✓ at ground level
Grasses are found on island Y ✓ (2)
- 2.3 Allopatric speciation occurs when new species evolve ✓ because populations are physically separated from the original population ✓
In the case of the tortoises (A and B) they were physically separated from the original mainland population ✓ and from each other on separate islands. ✓
The two island populations adapted to their particular environments ✓ and changed genetically and physically (phenotype) ✓ over a long period of time became reproductive isolated ✓. **(Any 5) (5)**
[9]

QUESTION 3

- 3.1. Speciation ✓ (1)
- 3.2. The population of species A has split up into two
 The sea forms a physical barrier ✓ and each group adapts to the new environmental factors ✓
 Each group undergoes natural selection independently ✓ and develops separately / micro-evolution
 Each group may become genotypically ✓ and phenotypically different ✓
 Might prevent them from interbreeding ✓ when they come into contact again/become reproductively isolated leading to the formation of a new species ✓ (Any 5) (5)

[6]**QUESTION 4**

- 4.1 A mutation is a mistake ✓/alteration due to a change in the composition of DNA ✓
OR
 Sudden change ✓ in the structure of a gene ✓ (2)
- 4.2 - by accident during meiosis ✓
 - some chemicals ✓/mutagens/high energy radiation (2)
- (Mark first TWO only)*
- 4.3 **Neutral mutation** - these are of no benefit ✓ to the organism and they are not harmful (Any 2) (2)
Lethal mutation - they are harmful ✓/ cause the death of the individuals that inherit ✓ them because natural selection selects against them ✓ (Any 2) (2)

[8]**QUESTION 5**

- 5.1. During continental drift ✓ the tortoise populations were isolated/separated ✓ from the original population on different islands ✓ living under different environmental conditions ✓ and through natural selection developed into new species ✓ not able to interbreed after a period of time ✓ (Any 4) (4)
- 5.2 Fossils provide evidence of life forms that existed in the past/that are now extinct ✓ Intermediate forms of organisms ✓ have been discovered that illustrate the changing forms of plants/animals ✓ (Any 2) (2)
- 5.3 Only a few of the ancient organisms are preserved as fossils ✓ because they need to be covered soon after death otherwise they will be decomposed by bacteria ✓ Only organisms with a solid and resistant skeleton ✓ are easily preserved ✓ We have not found all the fossils ✓ that exist in the earth ✓ (Any 1 x 2) (Mark first ONE only) (2)

[8]

QUESTION 6

6.1 Homologous ✓ (1)

6.2 - Because the structures may have different functions ✓
- but are similar in structure ✓ suggesting a similar/common origin/ancestor (2)

6.3 (a) - There is a wing ✓ /web of skin/membrane
- Forelimb and digits are thin ✓ /light/long
(Any) (Mark **FIRST** answer only) (1)

(b) - The bones are short ✓ /thick and, therefore, strong
- and the digits (fingers) ends in long claws ✓
(Any) (Mark **FIRST** answer only) (1)

[5]**QUESTION 7**

7.1. "some large, some small" ✓ / "some strong and some weak" (1)

7.2 - Variation in the wildebeest population ✓ * (1)

| | | | |
|---|------------------|--|----------------|
| <p>slow and weak ✓, were eaten by the lions ✓ and do not pass on their characteristics to their offspring ✓</p> | <p>OR</p> | <p>some large and strong ✓ survive ✓ and pass on their favourable characteristics to their offspring ✓</p> | <p>max (3)</p> |
|---|------------------|--|----------------|

- If this process continues from generation to generation the characteristic of the population will change ✓ *

[5]*** compulsory marks****QUESTION 8**

8.1 B

8.2 A

8.3 D

8.4 A

8.5 B

8.6 B

(6 x 1) **[6]**

| |
|----------------------------|
| SECTION C: HOMEWORK |
|----------------------------|

Teacher Note: Remind the learners that as they attempt the homework, they **MUST** stick to the time frames.

QUESTION 1: **6 minutes** *(Taken from WC DoE September 2009 Paper 2)*

Habitat destruction is one of the ways in which humans contribute to the loss of biodiversity. A South African environmental protection agency completed the following study in a forest to find out if leaving some patches of undisturbed forest will help to preserve the bird species in that area.

In an area of forest which was being cut down for human development, the scientists left two areas (A and B) of different sizes as undisturbed habitat. They then counted the number of bird species in these areas before, and at different times after the removal of the forest around them.

The results of their investigation are shown in the table below:

| TIME | NUMBER OF BIRD SPECIES | |
|--|--|---|
| | AREA A (One hectare patch of undisturbed land) | AREA B (10 hectare patch of undisturbed land) |
| Before removal of forest around patch | 30 | 23 |
| 6 weeks after isolation in patch | 58 | 30 |
| 36 weeks after isolation in patch | 20 | 25 |
| 66 weeks after isolation in patch | 18 | 20 |
| 96 weeks after isolation in patch | 17 | 21 |

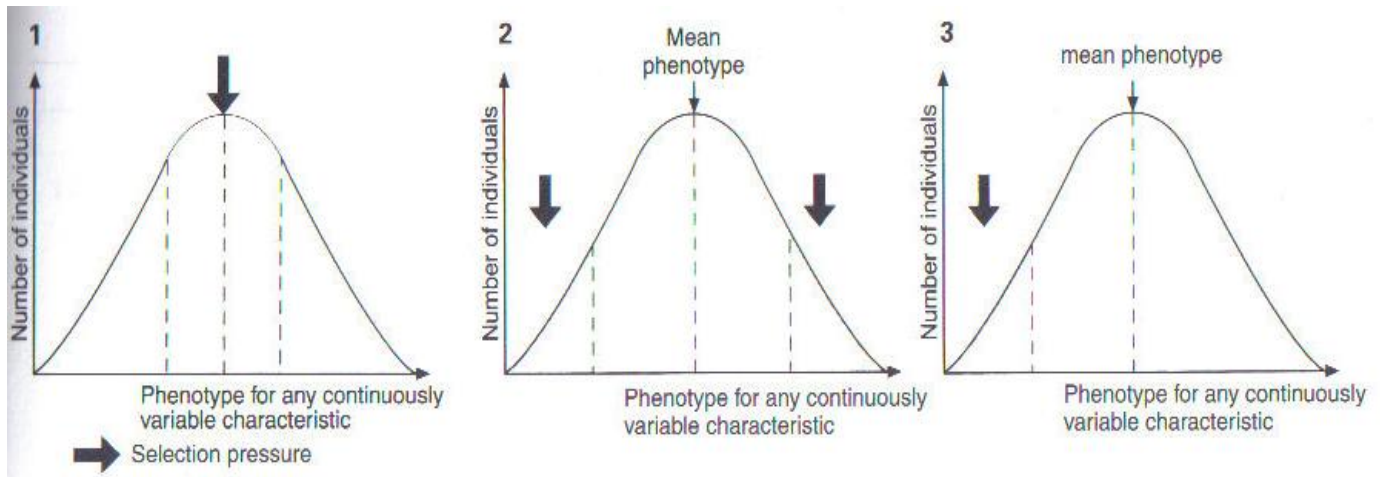
- 1.1 Suggest ONE reason why you think that the number of bird species caught in the two areas increased in the few weeks after the surrounding forest was cut down, compared with before. (1)
 - 1.2 Explain why the number of bird species in each area gradually decreased to below the original levels. (2)
 - 1.3 Explain what these results suggest about the usefulness of isolated patches of undisturbed habitat as wildlife reserves. (3)
- [6]

QUESTION 2: 7 minutes (Taken from St Mary's DSG September 2009 Paper 2)

2.1. The following table compares sympatric and allopatric speciation. Put a tick in the appropriate column if the phrase applies, and a cross if it does not. (4)

| | Sympatric speciation | Allopatric speciation |
|--|----------------------|-----------------------|
| The most common type of speciation in animals | | |
| Hybrids may result | | |
| Occurs in populations living in the same geographical area | | |
| Breeding is between members of the same species | | |

2.2. Name the selection pressure in operation in the graphs 1, 2 and 3 shown in the figures below. (3)



[7]

QUESTION 3: 8 minutes (Taken from DoE November 2009 Paper 2)

The shell of the banded snail, *Cepaea nemoralis*, displays a wide variety of both colour and banding (rings). Birds, such as thrushes, eat these snails. The birds break open the shells by striking the snails against a stone.

It was found that there were equal numbers of light- and dark-banded snails in a specific grassland habitat where no thrushes were found. A population of thrushes was then introduced to this grassland habitat.

An investigation was done to determine which colour snails (dark-banded or light-banded) were eaten most by the thrushes. The results are shown below:

| Time (days) | Number of dark-banded shells found around stone | Number of light-banded shells found around stone |
|-------------|---|--|
| Day 1 | 2 | 1 |
| Day 2 | 3 | 0 |
| Day 3 | 5 | 1 |
| Day 4 | 7 | 0 |
| Day 5 | 8 | 1 |

- 3.1. Write a possible hypothesis for this investigation. (3)
 - 3.2. What phenomenon does this investigation illustrate? (1)
 - 3.3. Which snails were better adapted to prevent them from being eaten by the thrushes? (1)
 - 3.4. Explain your answer to QUESTION 3.3. (2)
 - 3.5. Why can the number of snails at the start of the investigation be considered a controlled variable? (1)
- [8]

QUESTION 4: 10 minutes

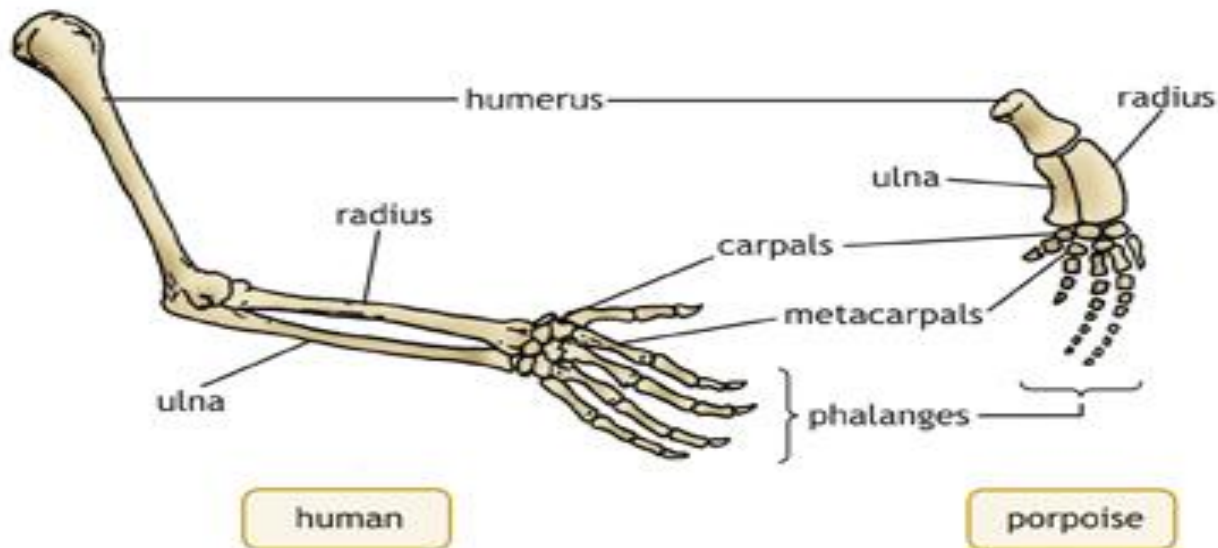
(Taken from DoE November 2008 Paper 2)

Scientists believe that variation in populations can lead to the formation of new species.

- 4.1. List FOUR sources of variation in populations. (4)
 - 4.2. Explain how speciation occurs if a population becomes separated into two groups by a geographical barrier such as a mountain. (6)
- [10]

QUESTION 5: 5 minutes (Taken from St Mary's DSG September 2009 Paper 2)

Below are the forelimbs of a human and a porpoise. Study the diagrams carefully and answer the questions that follow.



How would you use the diagram to provide evidence for evolution as a possible explanation for diversity.

[5]

QUESTION 6: 5 minutes

Various possible options are provided as answers to the following questions. Choose the correct answer and write only the letter next to the number on your answer sheet.

- 6.1 Which ONE of the following is an example of a pair of analogous structures?
- A A whale's flipper and a bat's wing
 - B A bird's wing and an insect's wing
 - C A hawk's wing and a sparrow's wing
 - D A dog's leg and a horse's leg
- 6.2 The following is needed for new species to form....
- A an extinction event
 - B an homologous structure
 - C an analogous structure
 - D reproductive isolation
- 6.3 Macroevolution is a term that describes ...
- A an increase in the size of individuals of a population over a long period of time.
 - B the process by which new genera and families of organisms are formed.
 - C a gradual change in the number of species found in the fossil record.
 - D changes that can be seen without the need for a microscope.

- 6.4 Which of the following is NOT a fossil?
- A *Tyrannosaurus rex* skull, 65 million years old
 - B Oil formed from microorganisms, 150 million years old
 - C Stone tool made by ancestors of human, 2,6 million years ago
 - D 195 million-year-old dinosaur footprint imprinted in rock
- 6.5 The theory of evolution based on the principle of use and disuse was proposed by ...
- A Darwin
 - B Mendel
 - C Lamarck
 - D Wallace.

[5]

SECTION D: SOLUTIONS TO HOMEWORK

QUESTION 1

- 1.1 Birds flew into the unaffected areas from the affected areas ✓. (1)
- 1.2 Remaining patches may not have had the habitat/food resources needed for some of the bird species ✓/competition
These species may have become extinct ✓ in that area/left the area. (2)
- 1.3 Bird species that would have been made extinct ✓ in that area are preserved ✓.
The larger the area, the more useful the preservation ✓. (3)

[6]

QUESTION 2

2.1.

| | Sympatric speciation | Allopatric speciation |
|--|----------------------|-----------------------|
| The most common type of speciation in animals | X | ✓ |
| Hybrids may result | X | X |
| Occurs in populations living in the same geographical area | ✓ | X |
| Breeding is between members of the same species | ✓ | ✓ |

(4)

- 2.2. 1. Disruptive ✓ 2. Stabilising ✓ 3. Directional ✓ (3)

[7]

QUESTION 3

- 3.1 Equal ✓ number of light and dark-banded snails ✓ will be eaten ✓
OR
More ✓ light-banded snails ✓ will be eaten ✓
OR
Less ✓ light-banded snails ✓ will be eaten ✓
OR
More ✓ dark-banded snails ✓ will be eaten ✓
OR
Less ✓ dark-banded snails ✓ will be eaten ✓ (3)

- 3.2 Natural selection ✓/camouflage/predation/survival of the fittest/
micro-evolution (1)
- | | | | |
|-----|--|--|-----|
| 3.3 | Light-banded ✓ | Dark-banded ✓ | (2) |
| 3.4 | Lower number ✓ of light-banded shells found, indicating that they are not easily detected ✓ by the birds | Higher number ✓ of dark-banded shells found, indicating that they are not easily detected ✓/camouflaged by the birds | (4) |
- 3.5 Started with equal numbers ✓ of light and dark-banded snails in the environment (1)
- [8]**

QUESTION 4

- 4.1 - Random assortment ✓/segregation/recombination of chromosomes during meiosis in the formation of gametes
- Crossing over ✓
- Chance/random fertilisation of gametes ✓/sexual reproduction
- Mutation ✓
- Outbreeding ✓/Gene flow (Mark first FOUR answers only) (4)
- 4.2. - Within each of the two groups there is variation ✓
- Each group undergoes natural selection ✓
- as a result of varying environmental conditions ✓
- and develops differently ✓
- genotypically ✓ and phenotypically ✓
- since the geographical barrier prevents gene flow ✓/reproduction between the two populations
- The differences that develop between the two populations prevent them from interbreeding ✓ even if they were to mix
- such that one or both of the groups becomes a new species ✓ (Any 6) (6)
- [10]**

QUESTION 5

- 5.1 Evolutionists believe that this is biological evidence ✓ for evolution ✓
OR
All evolved ✓ from a common ancestor ✓ (2)
- 5.2 A ✓ (1)
- 5.3 Vertebrates thought to develop from aquatic form ✓ which breathes by means of gills ✓ (2)
- [5]**

QUESTION 6

- 6.1. B
6.2. D
6.3. B
6.4. C
6.5. B (5 x 1) [5]

SESSION 4: TOPIC 2: DIVERSITY: HUMAN EVOLUTION, EVOLUTION IN PRESENT TIMES AND ALTERNATIVE EXPLANATIONS

LESSON OVERVIEW

Teacher Note: Please review terms like Anthropology, Palaeontology and Archaeology. The Chemical and Hominid Evolution theories are important. Ensure that the learners know about the Cradle of Humankind, Genetic Eve, Mrs Ples, Taung Child, Little Foot, Adaptive Radiation and the Out-of-Africa and Multi-regional Hypotheses. Questions on this section of work are often comparative questions.

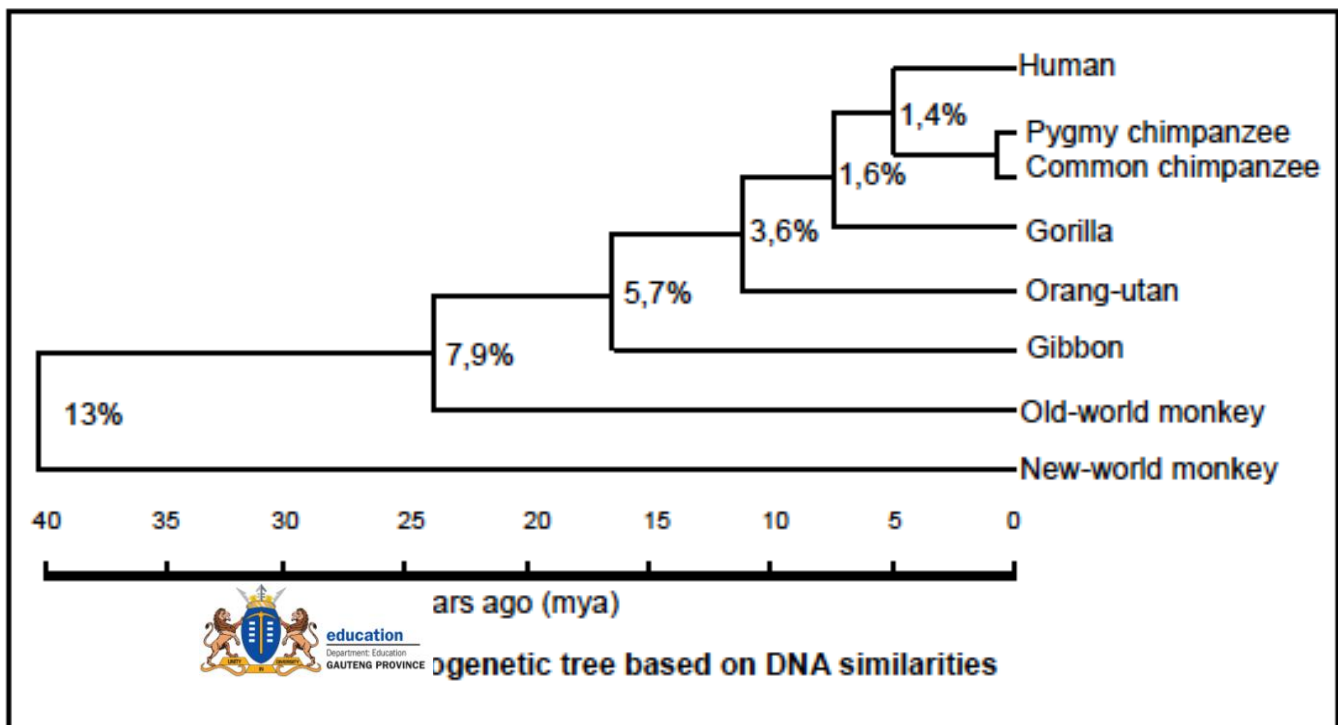
1. Introduce session: 5 minutes
2. Typical exam questions: 55 minutes
3. Review/solutions/memo: 30 minutes

SECTION A: TYPICAL EXAM QUESTIONS

QUESTION 1: 5 minutes

(Taken from DoE Feb/March 2010 Paper 2)

The diagram below shows a phylogenetic tree based on DNA similarities. The percentage next to each branch shows the amount of difference in the genome (DNA nucleotide sequence) of the two relevant groups.

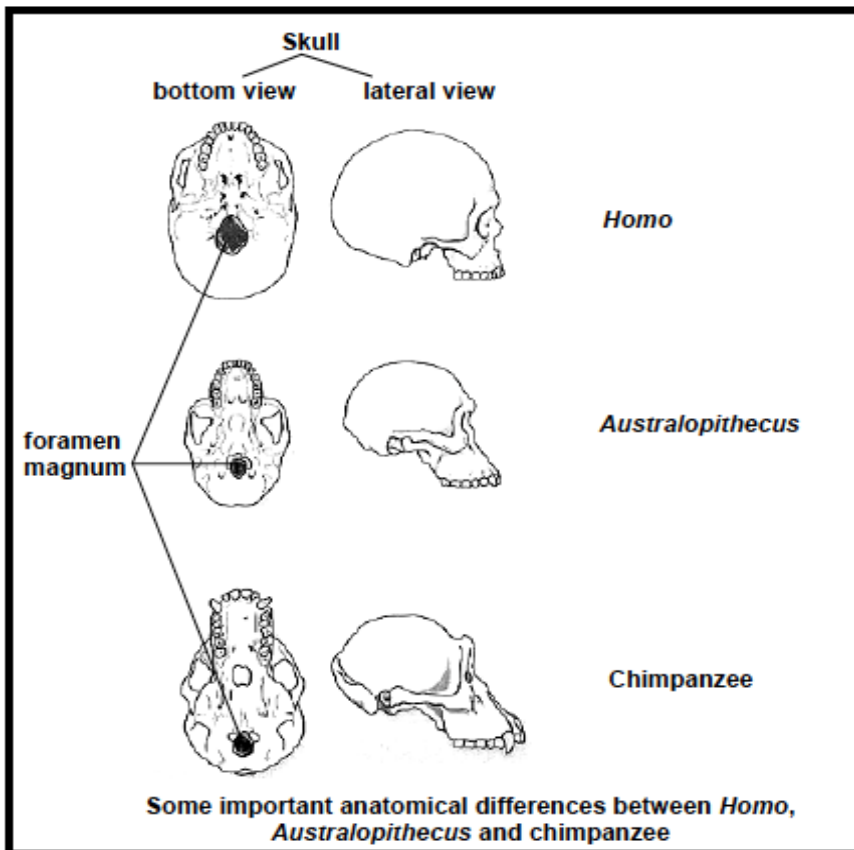


[Adapted from: Senior Biology 2]

- 1.1. From the diagram, determine how long ago the chimpanzees split from the line to humans. **(HINT: Use a ruler so that you are accurate in your readings)** (2)
 - 1.2. Which organism is most closely related to humans? (1)
 - 1.3. Calculate the DNA similarity between the genome of the chimpanzee and the human. (2)
- [5]

QUESTION 2: 9 minutes*(Taken from DoE Feb/March 2009 Paper 2)*

A comparison of the anatomical features of organisms has helped scientists to propose evolutionary relationships. Please study the following diagram and answer the questions that follow:



- 2.1. Tabulate THREE observable differences between the side view of the skulls of *Homo* and the chimpanzee.

HINT: When you are asked to tabulate, you must draw a table. You get marks for this. Always compare the same things in each point

- 2.2. Which ONE of the organisms (*Australopithecus* or chimpanzee) is/was a quadruped? **(Quad means 4)** (1)
 - 2.3. Give ONE observable reason for your answer to QUESTION 2.2. (1)
- [9]

QUESTION 3: 8 minutes *(Taken from DoE Preparatory Examination 2008 Paper 2)*

In an investigation a biotechnologist injected chimpanzee blood into a rabbit. The immune system of the rabbit recognised the chimpanzee blood protein as foreign and produced antibodies. The rabbit's antibodies were then extracted and developed as a serum.

When the serum is added to blood samples in different test tubes removed from of a variety of different animals, a precipitate forms. The more precipitate forms, the more closely related the animal is to the chimpanzee.

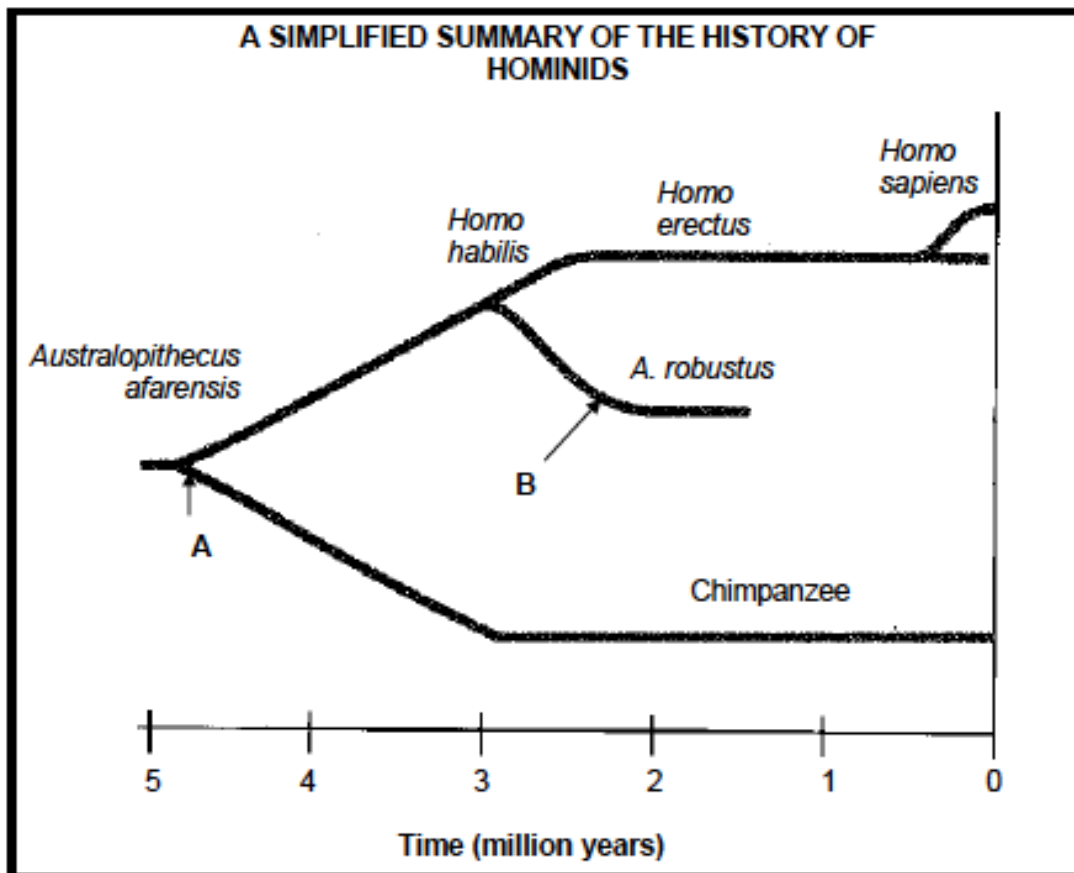
Study the table below that shows the percentage precipitate formed in this investigation, and answer the questions that follow.

| Animal species | Percentage precipitate formed |
|-----------------------|--------------------------------------|
| Gorilla | Very high |
| Baboon | High |
| Monkey | Moderate |
| Pig | Very low |

- 3.1. What is the composition of the serum? (2)
- 3.2. According to the above information, which animal is least closely related to chimpanzees? Give a reason for your answer. (2)
- 3.3. Formulate a hypothesis for the investigation above. (2)
- 3.4. Name TWO variables that had to be kept constant in this investigation. (2)
- [8]**

QUESTION 4: 13 minutes (Taken from DoE Additional Exemplar 2008 Paper 2)

During the study of the fossil records the following timeline of hominids were constructed. Study it and answer the questions that follow.

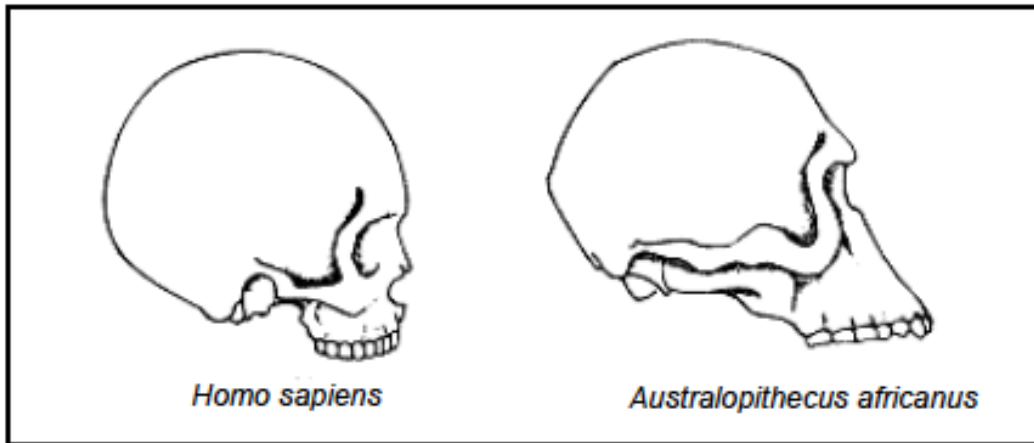


- 4.1. How many million years ago did the hominid group split (at **A**) into two groups? (1)
- 4.2. What is the main characteristic that caused the hominids to split into two separate groups at **A**? (1)
- 4.3. Which organism is thought to be the immediate ancestor of *A. robustus*? (1)
- 4.4. What are the common names of TWO *Australopithecus* species fossils that were discovered in South Africa? (2)
- 4.5. List FOUR characteristics that primates and humans have in common. (4)
- 4.6. Scientists accept the theory that the dinosaurs became extinct as a result of a comet or an asteroid striking the earth. Describe how this event could have led to the extinction of the dinosaurs. (5)

[14]

QUESTION 5: 10 minutes*(Taken from DoE Feb/March 2010 Paper 2)*

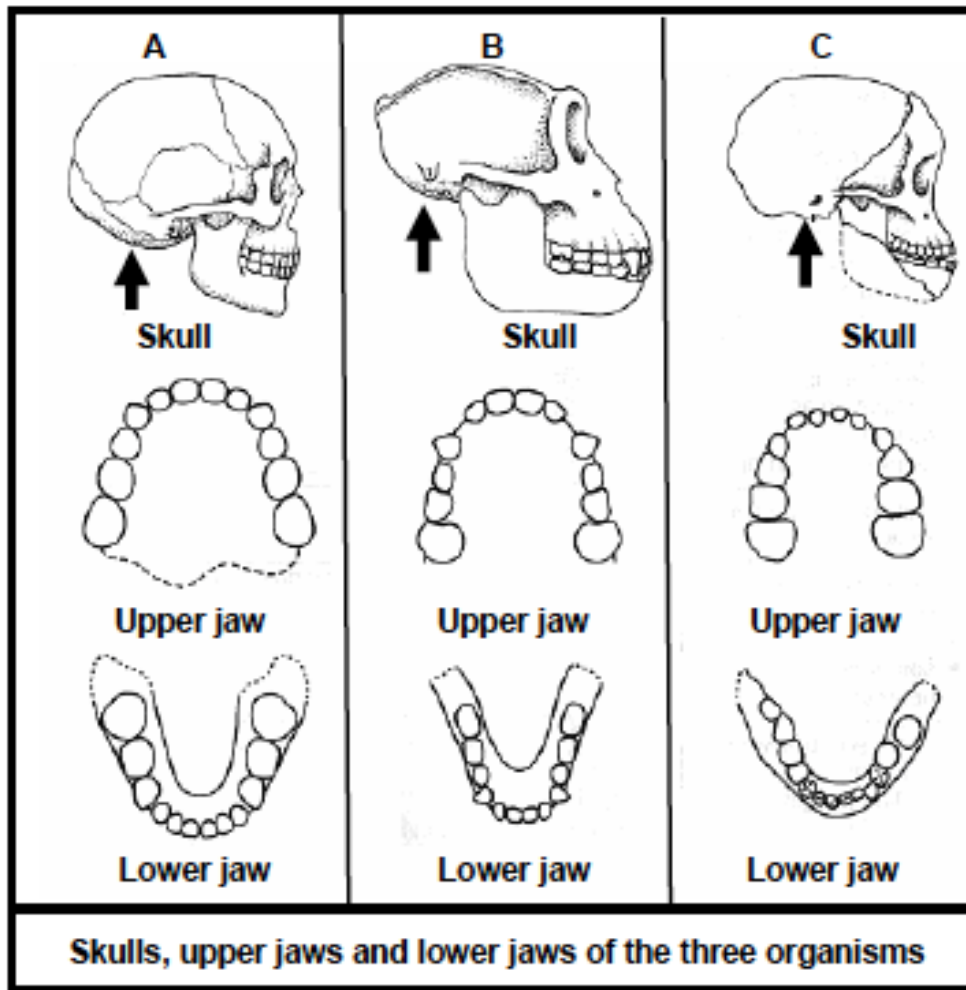
Study the two skulls on the next page (drawn to the same scale) and answer the questions that follow.



- 5.1. Tabulate THREE visible differences from the two skulls shown above that scientists have used to differentiate between *Homo sapiens* and other primates. (7)
 - 5.2. Give THREE examples of fossils of *Australopithecus* that were discovered in Southern Africa. (3)
 - 5.3. Explain the importance of the discoveries of the skulls of *Australopithecus* in understanding the evolutionary development of humans. (2)
- [12]

QUESTION 6: 12 minutes*(Taken from DoE Exemplar 2008 Paper 2)*

The diagrams that follow represent the skull, the upper jaw and lower jaw of three organisms: the Taung child (*Australopithecus africanus*), a modern human (*Homo sapiens*) and a gorilla (*Gorilla gorilla*). The arrow indicates the position of the foramen magnum (the opening that allows the spinal cord to connect with the brain). Study the diagrams and answer the questions that follow on the next page.



Skulls, upper jaws and lower jaws of the three organisms

- 6.1. Identify the organisms that are represented by each of A, B and C. (3)
 - 6.2. Assuming that the diagrams were drawn to scale, name TWO observable differences between the skulls of organisms A and B. (4)
 - 6.3. Which organism (A, B or C) represents a carnivore? (1)
 - 6.4. Explain your answer to QUESTION 3.3 using features visible in the diagram. (2)
 - 6.5. Name TWO organisms that are best adapted for walking on two legs rather than four legs, by looking at the position of the foramen magnum (indicated by the arrows). (2)
- [12]

SECTION B: SOLUTIONS AND HINTS TO SECTION A

QUESTION 1

- 1.1 5P mya ✓ (2)
 - 1.2 Chimpanzee ✓ (1)
 - 1.3 98,6 ✓% ✓ (2)
- [5]

QUESTION 2

2.1.

| Homo | Chimpanzee |
|--|--|
| 1. Canines not well developed ✓ | 1. Canines well developed ✓/form fangs |
| 2. Less protruding jaws ✓/not prognathus | 2. Protruding jaws/prognathus ✓ |
| 3. Brow-ridge less pronounced ✓ | 3. Heavily pronounced brow- ridge ✓ |
| 4. Proportionally large cranium ✓ | 4. Proportionally smaller cranium ✓ |
| 5. Proportionally shorter cheek bone ✓ | 5. Proportionally larger cheek bone ✓ |
| 6. No ridge at base/back of skull ✓ | 6. Ridge at base/back of skull ✓ |

(Mark first THREE only) (Any 3 x 2) 1 mark for table (7)

2.2 Chimpanzee ✓ (1)

2.3 The foramen magnum is towards the posterior/back of the skull ✓ (1)

[9]**QUESTION 3**

3.1 The serum contains antibodies ✓ against chimpanzee protein ✓ (2)

3.2 Pig, ✓ it only forms an very low % ✓ precipitate when the blood is exposed to serum. (2)

3.3 A high percentage ✓ of precipitate formed indicates a close relationship ✓ with chimpanzees **OR**A low percentage ✓ of precipitate formed indicates a no ✓ relationship with chimpanzees **OR**A high percentage ✓ of precipitate formed indicates a weak ✓ relationship with chimpanzees **OR**

A low percentage ✓ of precipitate formed indicates a strong ✓ relationship with chimpanzees (2)

3.4 Temperature ✓, pH ✓, concentration of serum ✓ amount of serum and blood the same ✓ (Any 2) (2)

[15]**QUESTION 4**

4.1 4,6 – 4,8 ✓ million years ago (1)

4.2 Bipedalism ✓ (1)

4.3 *Australopithecus afarensis* ✓ (1)

4.4 -Little foot

-Mrs Ples

-Taung child

(Any 2) (Mark first TWO only) (2)

4.5 Bare finger tips ✓

Long arms ✓

Freely rotating arms ✓

Stereoscopic vision ✓

Eyes with cones (in addition to rods) ✓

Large brain compared to body mass ✓

Portions of brain centres that process information from hands and eyes enlarged ✓

Olfactory brain centres ✓

Few offspring ✓

(Mark first FOUR only) (4)

- 4.6. -Formation of large clouds of dust ✓
- blocking out the sun ✓
- global cooling ✓
- stopping photosynthesis ✓
- no producers in food chains ✓
- food chains involving dinosaurs destroyed ✓
- causing extinction

(Any 5) (5)
[14]

QUESTION 5

5.1

| | <i>Homo sapiens</i> | <i>A. africanus</i> |
|---|--|--|
| 1 | No prominent brow ridge ✓ | 1 Prominent brow ridge present ✓ |
| 2 | Flat face ✓ | 2 Prognathous face ✓ |
| 3 | More rounded skull ✓ | 3 Less rounded skull ✓ |
| 4 | Teeth arranged on a gentle(round) curve ✓/more rounded upper jaw | 4 Teeth arranged in a less curved way ✓/less rounded upper jaw |
| 5 | Smaller upper jaw ✓ | 5 Larger upper jaw ✓ |
| 6 | Smaller cheekbone ✓ | 6 Larger cheekbone ✓ |
| 7 | Deeper set eye sockets ✓ | 7 Shallower set eye sockets ✓ |

(Mark first THREE only) (3x2 + 1 for table) (7)

- 5.2 Little foot ✓
- Mrs Ples ✓
- Taung child ✓

(Mark first THREE only) (3)

- 5.3 Foramen magnum of the australopithecine was towards the centre ✓ indicating that these were the first bipedal hominids ✓ on Earth OR Large jaws ✓ indicate a mainly vegetarian diet ✓

(Any 2) (2)
[12]

QUESTION 6

- 6.1 A - Modern human (*Homo sapiens*) ✓
- B - Gorilla (*Gorilla gorilla*) ✓
- C - Taung child (*Australopithecus africanus*) ✓

(3)

6.2.

| Organism A | Organism B |
|---|--|
| Flat face ✓ | Protruding jaws ✓ |
| Chin prominent ✓ | Chin not prominent ✓ |
| Foramen magnum occurs towards middle of the skull ✓ | Foramen magnum towards the back of the skull ✓ |
| No central ridge on the cranium ✓ | Central ridge on the cranium ✓ |
| Eye sockets in front of skull ✓ | Eye sockets on top, front part of the skull ✓ |
| Less pronounced eyebrow ridge ✓ | Pronounced eyebrow ridge ✓ |

(Mark first TWO only) (2x2) (4)

- 6.3 B ✓
- 6.4 It has most developed ✓ canines ✓
- 6.5 A ✓ and C ✓

(Mark first TWO only) (2)
[12]

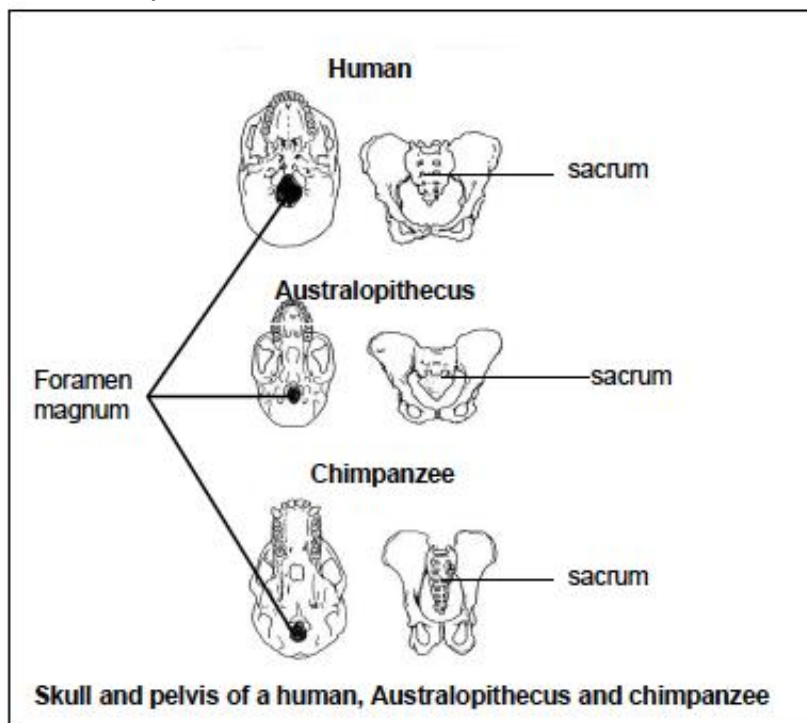
SECTION C: HOMEWORK

Teacher Note: Ensure that learners understand that they **MUST** stick to the time frames. This will be the expected pace for any test or exam if they wish to complete within the given time frames.

QUESTION 1: 15 minutes (Taken from DoE Preparatory Examination 2008 Paper 2)

HINT: This question is very similar to the question in Section A. Please note how a similar question can be asked around the same topic.

The diagram below shows the skull and pelvis of three mammals. Study the diagram and answer the questions that follow.



- 1.1. Tabulate FOUR observable differences of the skull and pelvis of a human and a chimpanzee. (9)
- 1.2. Which organism(s) is/are bipedal? (2)
- 1.3. Give ONE reason, observed from the diagram, for your answer to QUESTION 1.2. (2)
- 1.4. State ONE visible difference between the skull of *Australopithecus* and a human. (2)
- 1.5. In table form show the differences between anthropology, palaeontology and archaeology. (6)
- 1.6. List the SIX main hominid types that form part of Hominid Evolution and discuss the variation in the formation and development of the skulls. (7)
- 1.7. Bipedal locomotion and upright posture is a distinctive trait of human beings. Describe FIVE advantages of bipedalism to humans today. (5)

[33]

QUESTION 2: 5 minutes

- 2.1. Why is the Cradle of Humankind World Heritage site an area that is regarded as universally valuable? (1)
- 2.2. In which Hominid type would we place the Taung child and Little Foot. (2)
- 2.3. Describe the „African Hypothesis“. (2)
- [5]

QUESTION 3: 6 minutes

The size of the cranial cavity is used to estimate the size of the brain. The size of the brain is used to roughly indicate intelligence. The table below shows the brain size of apes and humans.

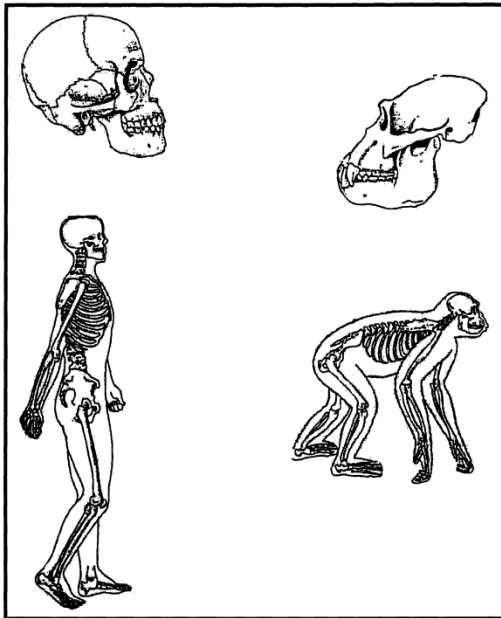
| Name of living or fossil primate | Cranial capacity (in mm ³) |
|----------------------------------|--|
| Modern apes | |
| Gibbon | 100 |
| Orang-utan | 395 |
| Chimpanzee | 400 |
| Gorilla | 510 |
| Australopithecines | |
| Early forms | 450 |
| Late forms | 660 |
| Early humans | |
| Java man | 870 |
| Peking man | 1050 |
| Neanderthal man | 1450 |
| Modern humans | |
| Cro-Magnon man | 1660 |
| Living man | 1450 |

The early *Australopithecines* lived about 3 million years ago and the late *Australopithecines* about 1,7 million years ago. It took about one million years for the size of the human brain to double.

- 3.1. What is the size difference between the brain of Living man and Java man? (1)
- 3.2. Which early humans had the same size brain as Living man? (1)
- 3.3. Think of possible reasons why Cro-Magnon man, who lived during the Stone Age, had a larger brain than Living man. (2)
- 3.4. Which of the *Australopithecines* had a brain size more or less the same size as the modern apes? (1)
- 3.5. What type of person would have dug up and studied the different types of skulls in order to record the size of the brain? (1)
- [6]

QUESTION 4: 18 Minutes (Taken from GDE Preparatory Examination 2009 Paper 2)

Study the pictures below on the parts of the skeletal structures of primates and answer the questions that follow:



- 4.1. State ONE reason why apes and humans are referred to as „hominids“. (2)
- 4.2. Name the term used to describe the locomotion of
 a) humans (1)
 b) chimpanzees (1)
- 4.3. Suggest TWO ways in which locomotion of modern humans will be disadvantaged if they had the skeletal structure of apes and chimpanzees. (2)
- 4.4. Distinguish between the skeletal structure of man and the chimpanzee, other than those mentioned in Question 4.3. (5 x 2) (10)
- 4.5. Predict the shortcomings (challenges) the ape would experience if it had the phalanges of *Homo sapiens*. (2)

[18]

| |
|---|
| SECTION D: SOLUTIONS TO HOMEWORK |
|---|

QUESTION 1

1.1

| HUMAN | CHIMPANZEE |
|---|---|
| Foramen magnum more central / in the middle/ Spinal cord exits underneath skull ✓ | Foramen magnum at back of skull /Spinal cord exits at the back of skull ✓ |
| Rounded / bigger skull ✓ | Narrower / smaller skull ✓ |
| Small canines ✓ | Large canines ✓ |
| No gap between teeth ✓ | Gaps between teeth ✓ |
| Dental arch /teeth arrangement more rounded ✓ | Dental arch / teeth arrangement more rectangular ✓ |
| Pelvis wide/ bowl shaped ✓ | Pelvis tall / narrow ✓ |
| Sacrum bigger / shorter ✓ | Sacrum longer / narrow ✓ |

(Any 4 x 2) Tabulate ✓ +1 (9)

1.2 Human ✓ and *Australopithecus* ✓ (2)1.3 The foramen magnum of both Human and *Australopithecus* is placed in the middle of the skull ✓ adaptation for upright walking/bipedalism ✓ (2)1.4 Human has larger skull ✓/brain than *Australopithecus* / rounder skulls (Any 1 x 2) (2)

1.5.

| Anthropology | Palaeontology | Archaeology |
|---|--|---|
| Is the study of the human race, including the different belief systems, customs and social habits. ✓✓ | Is the study of the earliest known periods of human existence, for example the Stone Age. ✓✓ | Is the study of ancient times by examining the buried remains of buildings, tool and animal and plant fossils. ✓✓ |

(6)

1.6. - *Australopithecus afarensis* ✓- *Australopithecus africanus* ✓- *Australopithecus robustus* ✓- *Homo habilis* ✓- *Homo erectus* ✓- *Homo sapiens* ✓

The formation and development of the skull varies because the brain capacity increased as the mass of the brain tissue increased. ✓ (7)

1.7.

- the hands became free for carrying food, tools and babies ✓
- a better view of the surroundings in search of food and predators ✓
- movement from place to place becomes more efficient ✓
- faster cooling of the body, as an increased surface area is exposed to the air - which was essential in their original hot tropical environments ✓
- display of the male sex organs as part of courtship behaviour ✓

(5)

[33]

QUESTION 2

- 2.1. The site contains fossils and evidence of the origin of humankind ✓ (1)
- 2.2. Taung child - *Australopithecus africanus* ✓
Little Foot - *Australopithecus afarensis* ✓ (2)
- 2.3. Evidence proves that humans moved from Africa to Europe at the time of the glacial period. ✓ Some of the people underwent a process of bleaching which resulted in the fair-skinned, light eyed, blonde-haired people of Britain, Scandinavia and Germany. ✓ (Remember that these countries are cold – so the need for melanin in the skin and hair decreased over the years.) (2)
- [5]**

QUESTION 3

- 3.1. 580 mm³ ✓ (1)
- 3.2. Neanderthal ✓ (1)
- 3.3. They were larger than modern man because they lived in the Stone Age and competed with other large animals. ✓ They lived a very physical life and needed to be bigger and more powerful. ✓ (2)
- 3.4. The early form ✓ (1)
- 3.5. Archaeologist ✓ (1)
- [6]**

QUESTION 4

- 4.1 No ✓ tails present ✓ / tails ✓ are absent ✓ (2)
- 4.2 (a) Bipedal ✓ (1)
(b) Quadrupedal ✓ (1)
- 4.3 Their view of surroundings would have been limited. ✓
They would have been slow in ✓ moving (in their current environment)
(Any reasonable answer) (2)
- 4.4

| MAN | CHIMPANZEES |
|---------------------------------|-----------------------------|
| Straight finger bones | Curved finger bones |
| Fully opposable thumbs | Longer thumbs |
| Legs longer than arms | Arms longer than legs |
| Legs and spine almost straight | Spine rectangular to legs |
| Reduced snout (nose) - s-shaped | Noticeable snout – c shaped |
| Smaller teeth | Bigger teeth |

(Any) (5 x 2) (10)

- 4.5 Makes branchiation (swinging from branches) ✓ more difficult ✓ (2)
(Any reasonable and logical answer)

[18]

SESSION 5: TOPIC 1: PLANT RESPONSES TO THE ENVIRONMENT**TOPIC 2: ANIMAL RESPONSES TO THE ENVIRONMENT**

Teacher Note: For Topic 1, make sure that the learners know and understand plant hormones, geotropism, phototropism and plant defence mechanisms. For Topic 2, make sure that the learners know and understand the nervous system and all its components, the different types of nerves and also the reflex arc.

LESSON OVERVIEW

- | | | |
|----|------------------------|------------|
| 1. | Introduce session | 5 minutes |
| 2. | Typical exam questions | 53 minutes |
| 3. | Review/solutions/memo | 32 minutes |

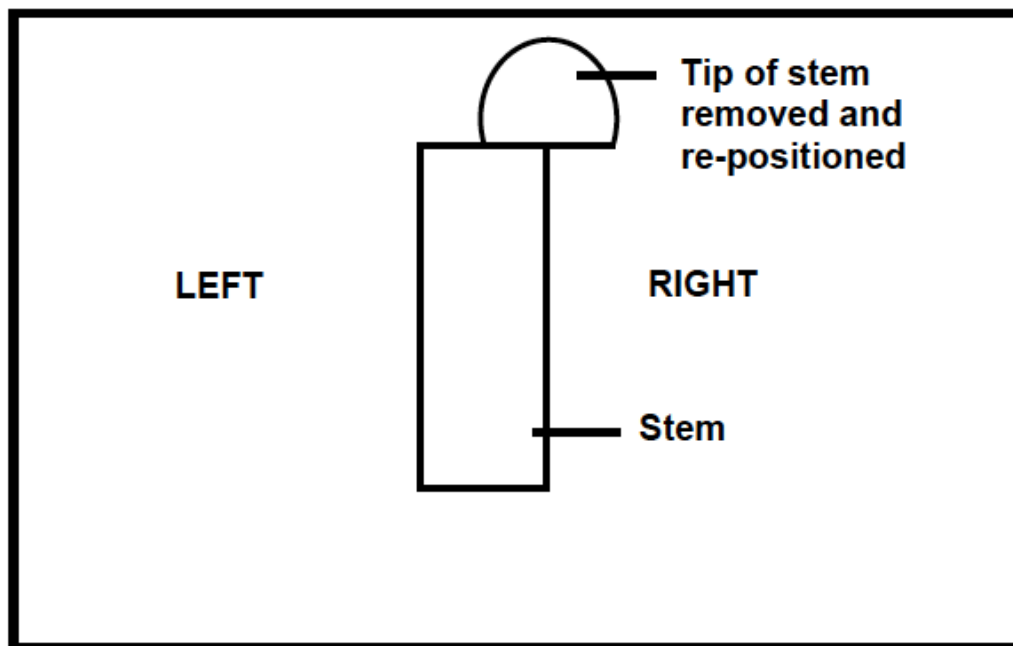
SECTION A: TYPICAL EXAM QUESTIONS**QUESTION 1: 8 minutes**

(Taken from various DoE HG Paper 2 exams)

Various possible options are provided as answers to the following questions. Choose the correct answer and write only the letter (A – D) next to the question number.

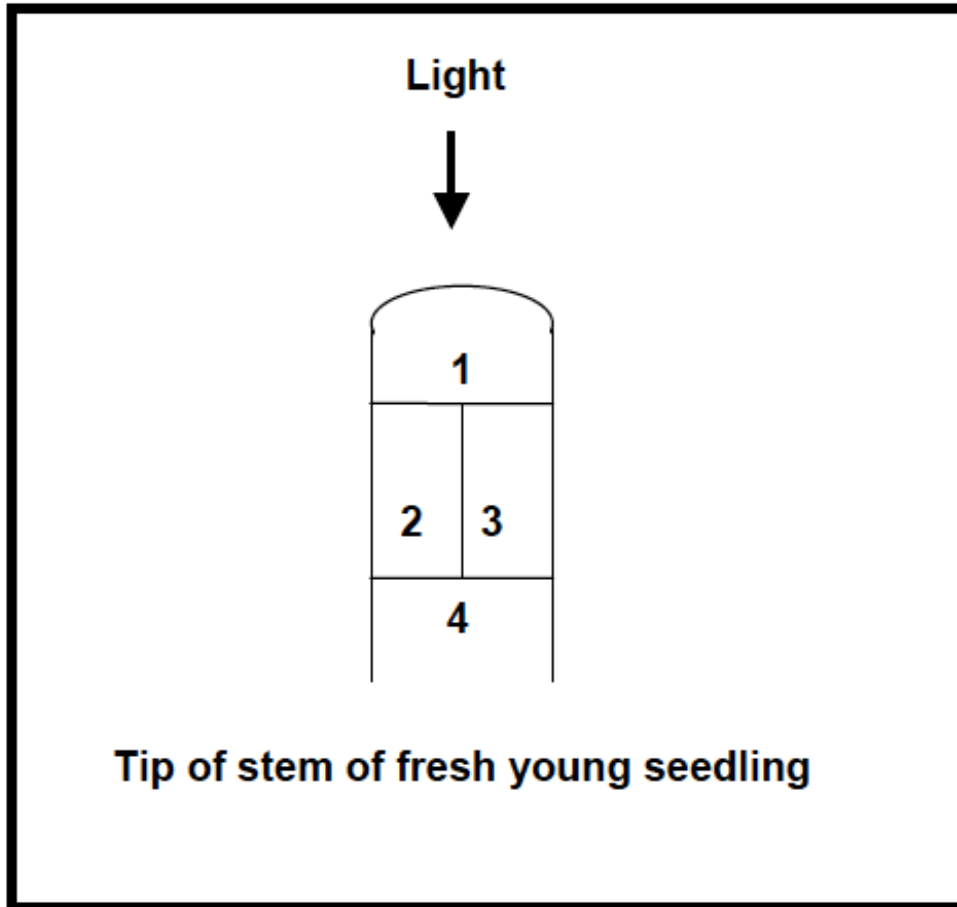
QUESTIONS 1.1 and 1.2 are based on the following diagram.

The tip of an actively growing seedling was removed and then placed on one side of the stem as shown in the diagram below. The seedling was kept in a dark room.



- 1.1. The following is the expected result of the investigation:
- A No further lengthening of the stem will take place
 - B The stem will grow straight upwards
 - C The stem will bend to the left
 - D The stem will bend to the right
- 1.2. This investigation could also be used to show the following:
- A Negative phototropism in plants
 - B Geotropism in plants
 - C That substances which promote growth are formed at the tip of the stem
 - D That the tip of the stem is not necessary for the lengthening of the stem
- 1.3 Which of the following structures will enable a dancer to carry out dance movements?
- 1. Cerebellum
 - 2. Proprioceptors
 - 3. Hypothalamus
 - 4. Cerebral cortex
- A 1 only
 - B 1 and 2
 - C 1, 2 and 3
 - D 1, 2, and 4
- 1.4 Which of the following parts of the brain regulates appetite?
- A Medulla oblongata
 - B Cerebellum
 - C Hypothalamus
 - D Cerebrum
- 1.5 Which ONE of the following factors does NOT play a direct role in geotropism?
- A Gravity
 - B Water
 - C Auxin
 - D Cell elongation
- 1.6 Regular removal of the tips of a plant causes it to become thicker because ...
- A it allows the plant to develop a shape that is suitable for reproduction.
 - B the plant gets more light and air.
 - C the fruit yield of damaged plants is higher.
 - D apical dominance is eliminated.

1.7 Study the diagram below showing areas in the tip of a stem.



The auxin concentration will be ...

- A higher at 3 than at 2.
- B higher at 2 than at 3.
- C the same at 2 and 3.
- D the same at 1 and 4.

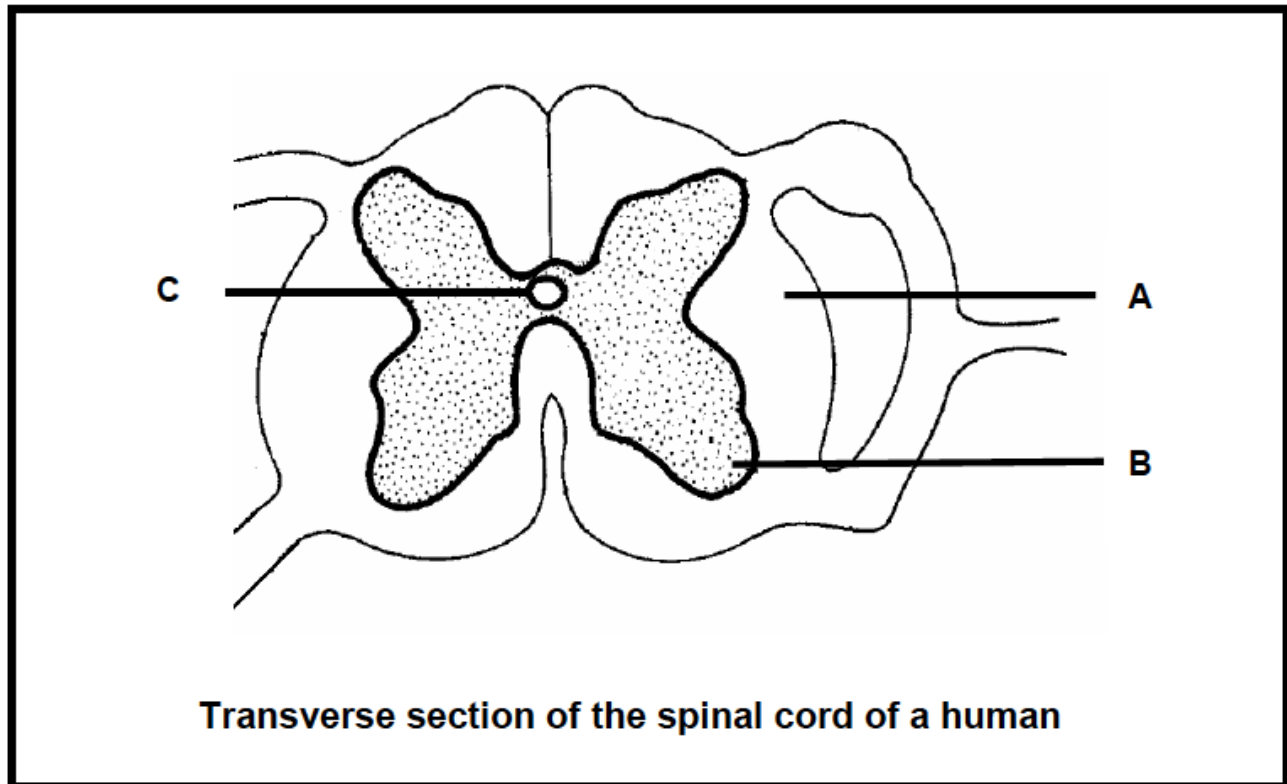
1.8 The autonomic nervous system controls ...

- A the skeletal muscles.
- B the senses.
- C the contraction of involuntary muscles.
- D reflexes.

(8 x 1) [8]

QUESTION 2: 5 minutes (Taken from DoE May/June 2008 HG Paper 2)

Study the following diagram and answer the questions that follow.



- 2.1 Identify parts A, B and C. (3)
- 2.2 State TWO ways in which the spinal cord is protected. (2)
- [5]

QUESTION 3: 8 minutes (Taken from DoE May/June 2008 HG Paper 2)

Answer the following questions on the nervous system.

- 3.1 Make a labelled diagram showing the external structure of the brain. (5)
- 3.2 Name the part of the brain:
- a) Where the reflex centre for swallowing is found (1)
 - b) Which receives impulses from the sacculus and utriculus (1)
 - c) Involved in reasoning (1)
- [8]

QUESTION 4: 9 minutes

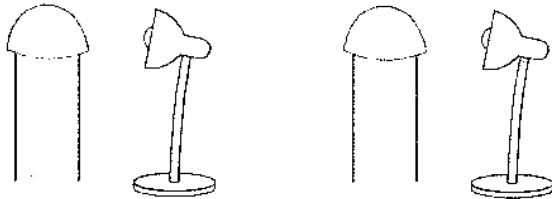
(Taken from various sources)

The experiment below shows how shoots respond to light. Two shoots were used, both belonging to the same species of plant. The shoots were observed after a few days.

Shoot A

Procedure

Observation

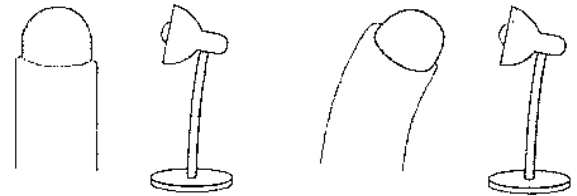


Tip of shoot covered with a tin foil cap. Seedling then illuminated from the right

Shoot B

Procedure

Observation



Sides of shoots covered with a tin foil sleeve. Shoot then illuminated from the right

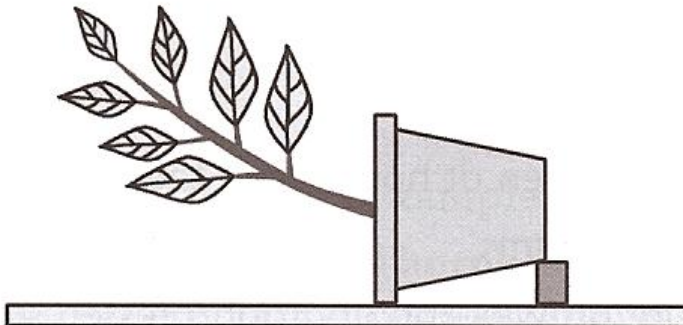
- 4.1. What is the aim of this experiment? (1)
- 4.2. Give the results of the experiment. (4)
- 4.3. Name the hormone responsible for the growth of the plant as shown by shoot B in the diagram. (1)
- 4.4. Name three other plant hormones that play a role in the growth and development of a plant. (3)

[9]

QUESTION 5: 8 minutes

(Taken from various sources)

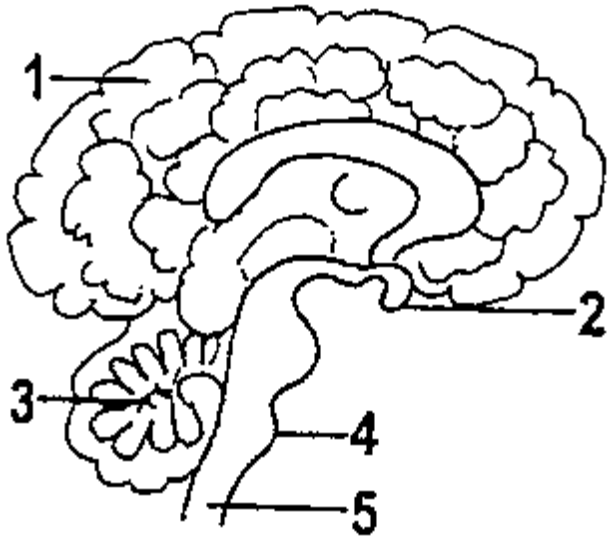
5. The pot plant in the diagram below was placed onto its side. After a day the stem started to grow upwards.



- 5.1. Give the term used to describe this phenomenon. (1)
- 5.2. Provide a definition for the term. (1)
- 5.3. Which chemical substance is involved in this phenomenon? (1)
- 5.4. What is meant by the term apical dominance? (2)
- 5.5. How could you apply the theory of apical dominance to grow a thick hedge around your home? (3)

[8]

QUESTION 6: 15 minutes (Adapted from: Taken from various DoE Exams Paper 2 exams)



- 6.1. Identify parts numbered 1 to 5. (5)
- 6.2. Number 1 is made up of two similar halves. How are these two halves attached to one another? (1)
- 6.3. What type of tissue is controlled by number 3? (1)
- 6.4. Name TWO functions of number 4. (2)
- 6.5. List THREE ways in which the brain is protected. (6)
- [15]

SECTION B: SOLUTIONS AND HINTS TO SECTION A

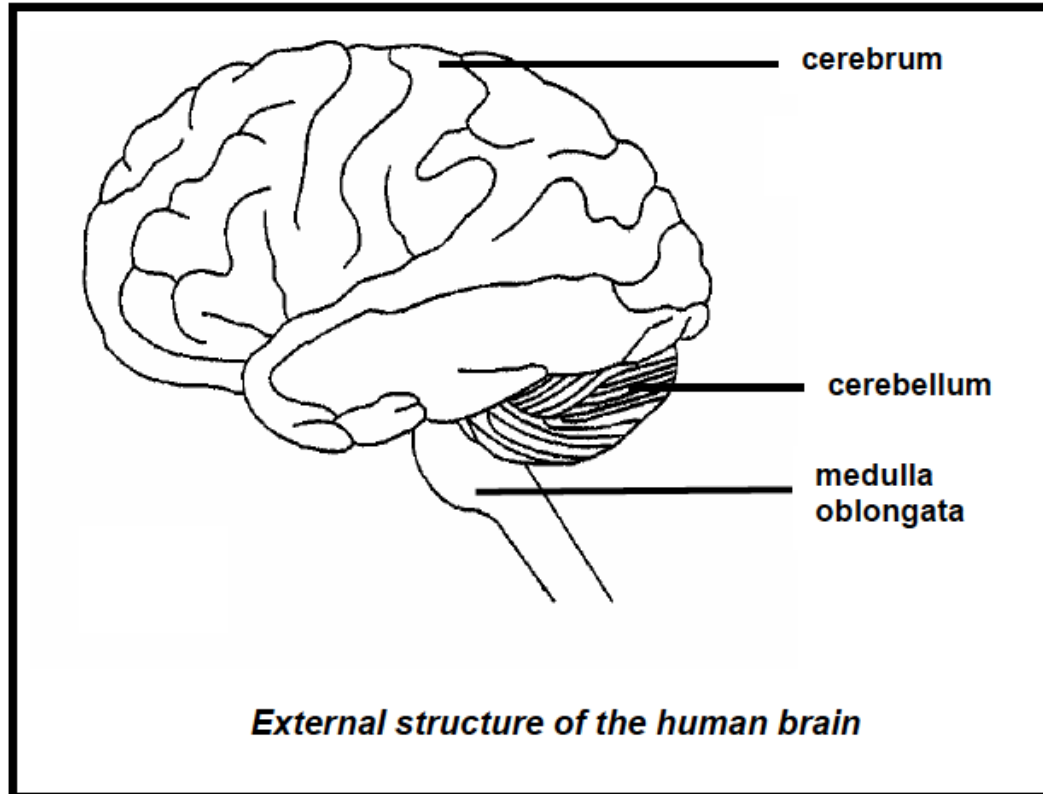
QUESTION 1

- | | |
|--------|--------|
| 1.1. C | 1.5. C |
| 1.2. C | 1.6. D |
| 1.3. D | 1.7. C |
| 1.4. C | 1.8. C |
| 1.9. | |
- (8 x 1) [8]

QUESTION 2

- 2.1 A: White matter
B: Grey matter
C: Central canal / Cerebrospinal fluid (3)
- 2.2 - By three meninges
- it is inside the bony vertebrae
- cerebrospinal fluids **Mark first 2 answers only** (2)
- [5]

QUESTION 3



- 3.1 Quality of lines in the diagram (1)
 Must draw cerebrum much larger than cerebellum (1)
Three correct labels (3)
- 3.2 (a) medulla oblongata (1)
 (b) cerebellum (1)
 (c) cerebrum (1)
[8]

QUESTION 4

- 4.1. To demonstrate apical dominance. (1)
 4.2. In shoot A the tip of the stem continued to grow upwards (2). In shoot B the tip of the stem grew towards the source of light (2) (4)
 4.3 Auxin (1)
 4.4. Gibberellins, abscisic acid, indole acetic acid (3)
[9]

QUESTION 5

- 5.1. Phototropism (1)
 5.2 The growth movement of a plant when stimulated by light. (1)
 5.3 Plant hormone / auxin (1)
 5.4 When the growth point at the tip of the stem grows upwards ✓ and development of the auxillary buds on the lateral branches is inhibited ✓ (2)
 5.5. The growth point at the tip of the stem continues to grow upwards ✓ and inhibits ✓ the development of auxillary buds ✓ on the lateral branches below. (3)
[8]

QUESTION 6

- 6.1. 1 cerebrum
 2 pituitary gland / hypophysis
 3 cerebellum
 4 medulla oblongata
 5 spinal cord (5 x 1) (5)
- 6.2. Corpus callosum (1)
- 6.3. Skeletal muscles (1)
- 6.4. Medulla oblongata contains the reflex centres which control and regulate the following:
- The breathing rate and depth
 - The heartbeat rate
 - Vaso-motor activity /dilation and constriction of the blood vessels
 - The secretion of saliva
 - Controls peristalsis (Any two functions) (2)
- 6.5.
- Bones of the skull ✓ – protects against physical injury✓
 - The 3 meninges ✓ – added protection✓
 - Cerebrospinal fluid ✓ found between the arachnoid and piamater protects against friction✓
- (6)
[15]

SECTION C: HOMEWORK**QUESTION 1**

State three functions of auxins in plants. [3]

QUESTION 2

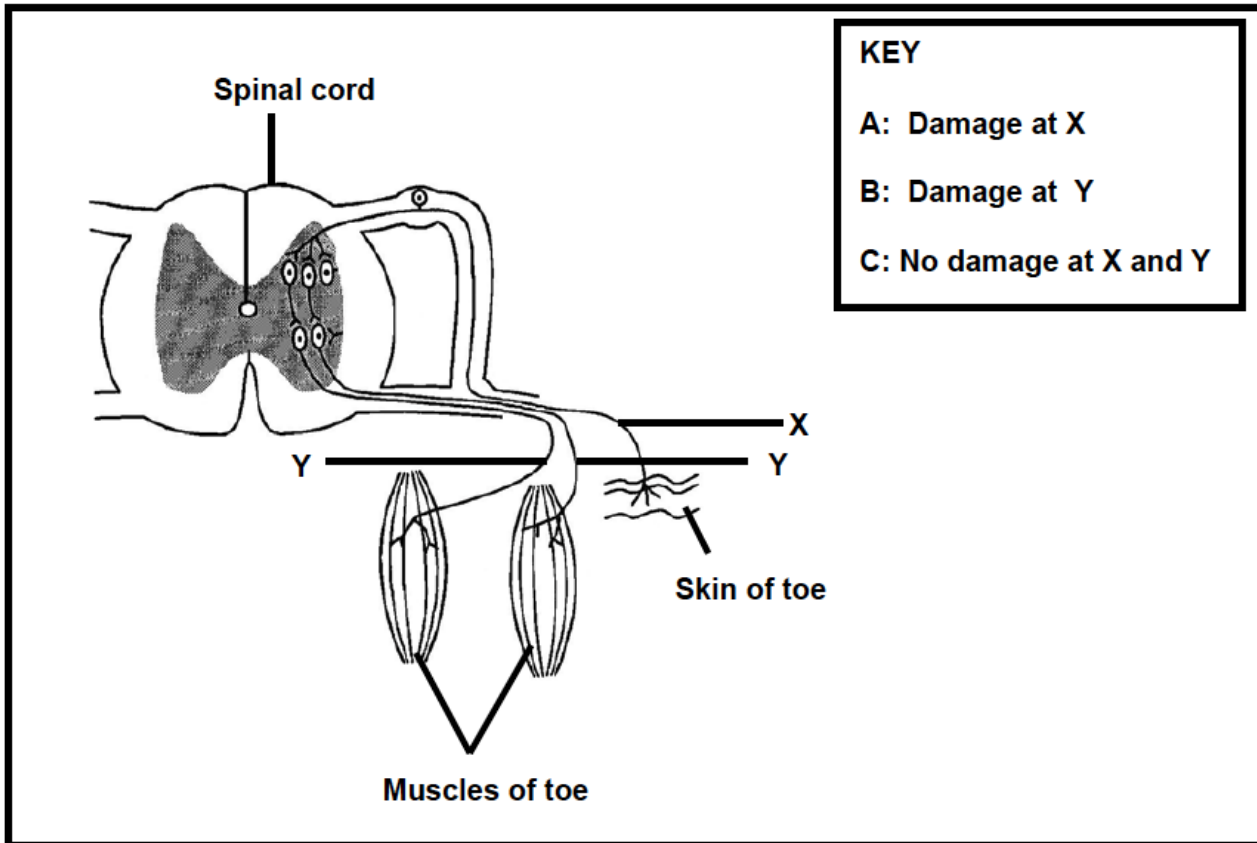
What is the advantage of phototropism in plants? [1]

QUESTION 3

Discuss how you would set up an experiment to demonstrate phototropism. [7]

QUESTION 4

Letters X and Y represent neurons that conduct impulses to and from the brain via the spinal cord. Study the diagram on the following page and answer the questions that follow.



Using the given key, write down the correct letter (A, B or C in key) of the condition that explains each of the following:

- 4.1 When the skin of the toe is stimulated, the toe moves and the person knows that it is moving. (1)
 - 4.2 The person can move the toe, but cannot feel the movement. (1)
 - 4.3 The person can feel a pin pricking the toe, but cannot move the toe. (1)
- [3]

SECTION D: SOLUTIONS TO HOMEWORK**QUESTION 1**

- Auxins cause cell division (1)
 - Form adventitious roots in cuttings (1)
 - Stimulate the development of flowers and fruit (1)
 - Stimulate the abscission of leaves (1)
- (Mark the first three answers only) [3]**

QUESTION 2

To place the leaves in a favourable position for photosynthesis [1]

QUESTION 3

- Place a pot plant on a **stationary clinostat** (1)
 - in a box with a hole on one side (1)
 - This is the experiment (1)
 - Place another pot plant on a **revolving clinostat** (1)
 - In a box with a hole on one side (1)
 - This is the control (1)
 - Leave both sets of apparatus in the sunlight for a few days (1)
- [7]**

QUESTION 4

- 4.1. C (1)
- 4.2. A (1)
- 4.3. B (1)
- [3]**

SESSION 6: TOPIC 1: THE HUMAN EYE**TOPIC 2: THE HUMAN EAR**

Teacher Note: Please ensure that the learners know the following:

Topic 1: Knowledge and application: structure and function of the human eye, formation of the image, binocular vision, accommodation of the eye, pupillary function, short and long sightedness, astigmatism and cataracts.

Topic 2: Knowledge and application: Structure and functioning of the human ear, hearing and balance, middle ear infections, deafness, link between hearing defects and speech disorders.

LESSON OVERVIEW

- | | | |
|----|------------------------|------------|
| 1. | Introduce session | 5 minutes |
| 2. | Typical exam questions | 55 minutes |
| 3. | Review/solutions/memo | 30 minutes |

SECTION A: TYPICAL EXAM QUESTIONS

Teacher Note: Please remind learners not to waste time when they answer multi-choice questions. They must read the question, underlining the operative words, while covering the answers. Then think of the correct answer. Then uncover the answer options and check if their answer is there. If it is, then tick next to the letter. If it is not, re-read the question and try to see exactly what is being asked. Then review the answer options again to find the correct answer. They must always answer Section A, the multi-choice questions, last.

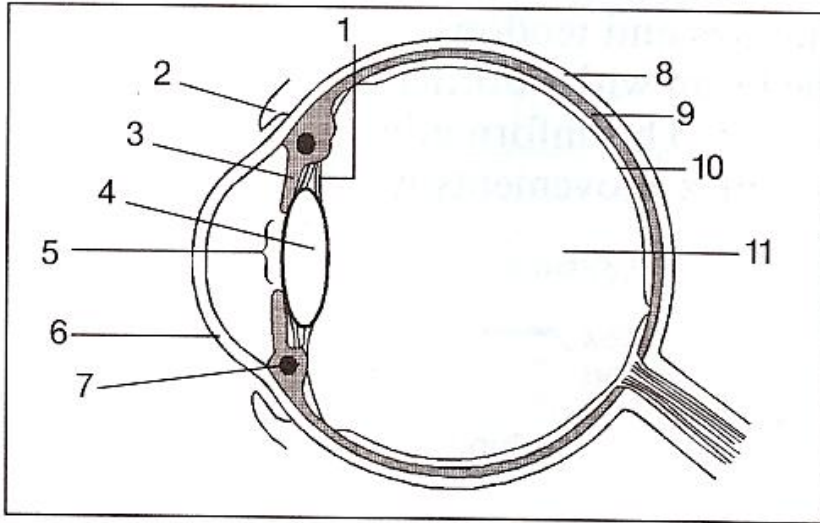
QUESTION 1: 15 minutes *(Taken from Study and Master Grade 12 Biology)*

Various possible options are provided as answers to the following questions. Choose the correct answer and write only the letter (A – D) next to the question number.

- 1.1. The tough, non-elastic tissue covering the outer portion of the eyeball is the
- A choroid
 - B sclera
 - C conjunctiva
 - D iris
- 1.2. The shape of the lens in the human eye may be altered by the contraction or relaxing of the....
- A optic nerve
 - B muscles of the iris
 - C muscles of the ciliary body
 - D pupil

- 1.3. The sensation of sight in human beings originates in the
- A yellow spot
 - B optic nerve
 - C cerebrum
 - D retina
- 1.4. The yellow spot of the human eye:
- A cone cells only
 - B more cone than rod cells
 - C cone and rod cells in equal number
 - D rod cells only
- 1.5. The following are part of the human eye:
1 cornea 2 lens 3 retina 4 iris 5 choroid
- Which parts are respectively concerned with/in:
- Adjusting the focus?
 - Preventing internal reflection?
 - Recording changes in light intensity?
- A 2, 4 and 3
 - B 3, 4 and 1
 - C 2, 5 and 4
 - D 4, 1 and 5
- 1.6. When the tension of the suspensory ligaments in the human eye is slackened, the....
- A lens becomes less convex
 - B eye is focused for distant vision
 - C pupil enlarges
 - D lens bulges

QUESTIONS 1.7 to 1.9 refer to the diagram of the human eye.



- 1.7. The parts that control the amount of light rays that enter the eye are.....
- A 1 and 2
B 1 and 3
C 2 and 3
D 3 and 4
- 1.8. The greatest convergence takes place when light rays pass through the part numbered.....
- A 4
B 5
C 6
D 11
- 1.9. The function of part numbered 9 is to:
1. reflect light
 2. change the shape of the eyeball
 3. refract light rays
 4. prevent reflection
 5. supply the retina with nutrients and oxygen
 6. absorb excess light

Choose from the options numbered 1 to 6 to provide the functions of part numbered 9:

- A 1, 2, 3
B 4, 5, 6
C 2, 4, 6
D 1, 3, 5

- 1.10. When the tension of the suspensory ligaments in the human eye increases, the...
- A lens becomes more convex
 - B eye is focused for distant vision
 - C pupil opens wide
 - D lens bulges
- 1.11. When the pupil of the human eye constricts, the receptors and effectors are respectively the....
- A fovea centralis and ciliary muscle
 - B pupil and ciliary muscle
 - C pupil and radial muscles of the iris
 - D fovea centralis and the circular muscles of the iris
- 1.12. In accommodation of the human eye, the....
- A pupil enlarges
 - B ciliary muscles are involved
 - C suspensory ligaments are always in a state of tension
 - D circular muscles of the iris contract
- 1.13. Images of objects less than 6m from the eye are clearly focused onto the retina, when the....
- A ciliary muscles contract
 - B pupil widens
 - C muscles of the iris contract
 - D curvature of the lens decreases
- 1.14. The optical disc where the fibres of the optic nerve leave the eyeball, is the....
- A yellow spot
 - B iris
 - C blind spot
 - D retina
- 1.15. Which of the following occurs when you look up from reading a book to look at a distant mountain on a clear, sunny day? The....
- A radial muscles of the iris contract
 - B the pupil becomes more dilated
 - C the ciliary muscles contract
 - D the lens becomes thicker and rounder
- (15 x 1) (15)

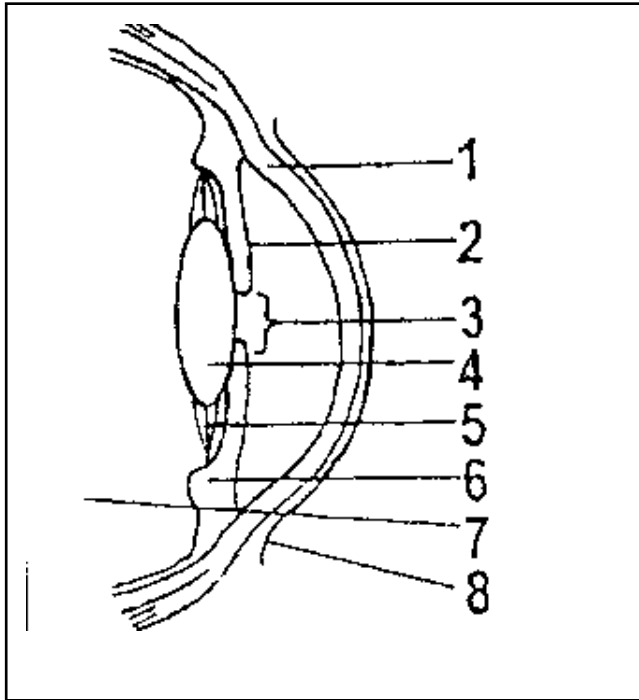
QUESTION 2: 4 minutes*(Taken from DoE May/June 2008 Paper 2)*

Explain why, when a person enters a dimly lit room after being in bright sunlight, objects only become visible after a while.

[4]

QUESTION 3: 18 minutes*(Taken from Bios best 2008 Grade 12 Biology)*

The diagram below represents a section through part of the human eye.

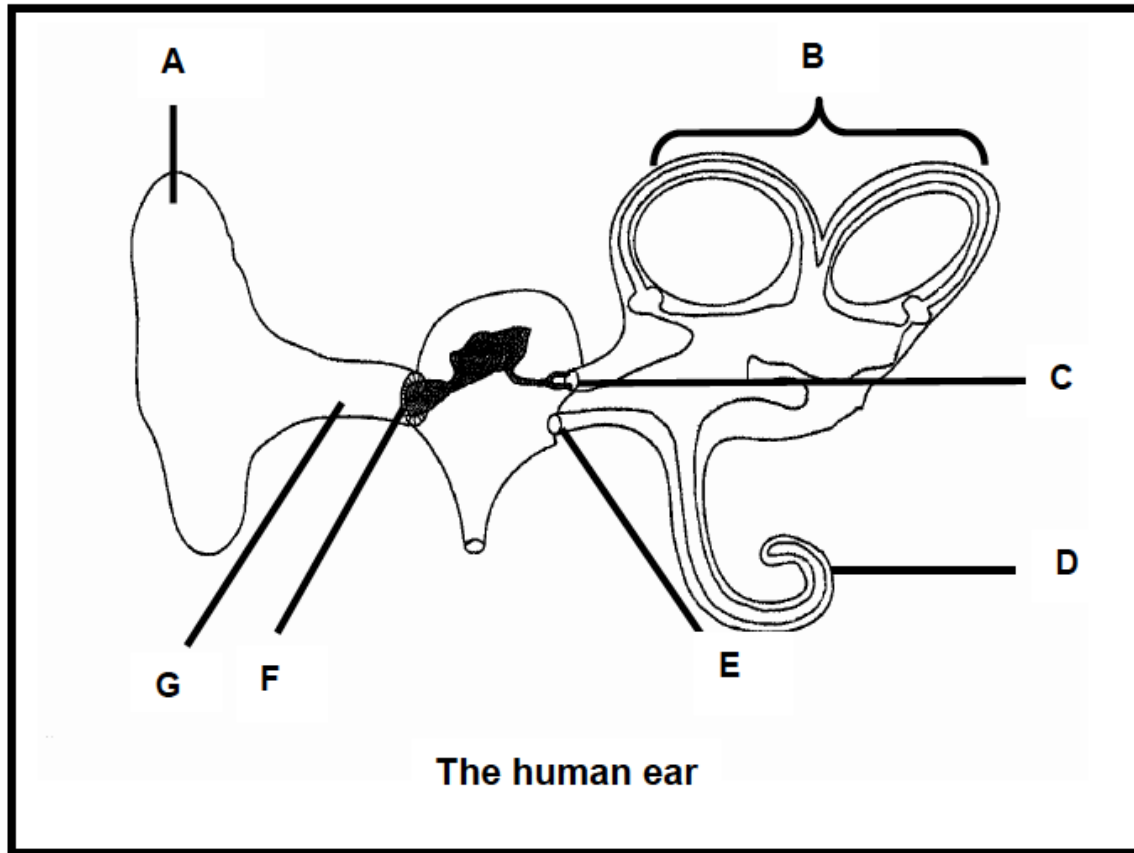


! Teacher Note: Remind the learners to learn the diagram of the eye very well. They must know the labels and the structure versus function for each of the parts of the eye. They must write the functions of each part next to the label on the diagram and learn them together.

- 3.1. Supply labels for the parts numbered 1, 3 and 5. (3)
- 3.2. Supply the number and name the part that controls the amount of light that enters the eye. (2)
- 3.3. Mention the changes that the part names in Question 3.2 will undergo when exposed to bright light. (4)
- 3.4. List one function for each of parts 4 and 7. (2)
- 3.5. Supply the number and the name of the part that is responsible for the accommodation of the eye. (2)
- 3.6. Explain the changes that will take place when the part named in Question 3.5 views an object closer than 6m. (5)
- [18]

QUESTION 4: 18 minutes*(Taken from DoE May/June 2008 Paper 2)*

Study the following diagram of the human ear and answer the questions that follow.



Teacher Note: Remind the learners to learn the diagram of the eye very well. They must know the labels and the structure versus function for each of the parts of the eye. They must write the functions of each part next to the label on the diagram and learn them together.

- 4.1 Identify parts B and G. (2)
- 4.2 State the function of each of parts C and E. (2)
- 4.3 Explain: (3)
- Why you can often clear a buzzing/humming in the ear by swallowing (2)
 - Why the membrane labelled F is much larger than membrane C (2)
- 4.4 A dog has lost part A in an accident. Part A is replaced with a stiff, non-elastic, solid, plastic structure. (1)
- Is the plastic structure as effective as the original ear of the dog? (2)
 - Explain your answer to QUESTION 4.4 (a). (4)
- 4.5 Explain how part D and the retina of the eye function in similar ways. (2)
- 4.6 Give ONE reason for part D being spirally shaped. (2)

[18]

SECTION B: SOLUTIONS AND HINTS TO SECTION A

QUESTION 1

- | | |
|--------|---------|
| 1.1. B | 1.9. B |
| 1.2. C | 1.10. B |
| 1.3. C | 1.11. D |
| 1.4. A | 1.12. B |
| 1.5. C | 1.13. A |
| 1.6. D | 1.14. C |
| 1.7. C | 1.15. C |
| 1.8. C | |
| 1.16. | |

(15 x 1) [15]**QUESTION 2**

- In bright light the pupil size was small (1)
 - to reduce the amount of light entering the eye (1)
 - Now in dimly lit room the pupil size has to increase (1)
 - to increase the amount of light entering the eye (1)
- [4]**

QUESTION 3

- 3.1. 1 = cornea ✓ 2 = pupil ✓ 3 = suspensory ligaments ✓ (3)
- 3.2. Number 2 ✓, the iris ✓ (2)
- 3.3. The radial muscles of the iris relax ✓ (1)
 the circular muscles contract ✓ (1)
 this will cause the pupil to constrict ✓ (1)
 allowing less light to enter into the eye ✓ (1)
- 3.4. Part 4 = the lens focuses the light rays onto the retina at the back of the eye ✓ (1).
 Part 7 = the vitreous body / vitreous humor is part of the refracting medium of the eye and helps to maintain the shape of the eyeball ✓ (1)
- 3.5. Number 6 = the ciliary muscles in the ciliary body ✓✓ (2)
- 3.6. - Releasing the tension on the suspensory ligaments so they become relaxed ✓ (1)
 - The tension on the elastic lens becomes less ✓ (1)
 - The lens becomes rounder/more convex ✓ (1)
 - This increases the refraction of light through the lens so that the image focuses on the retina ✓ (1)

[18]

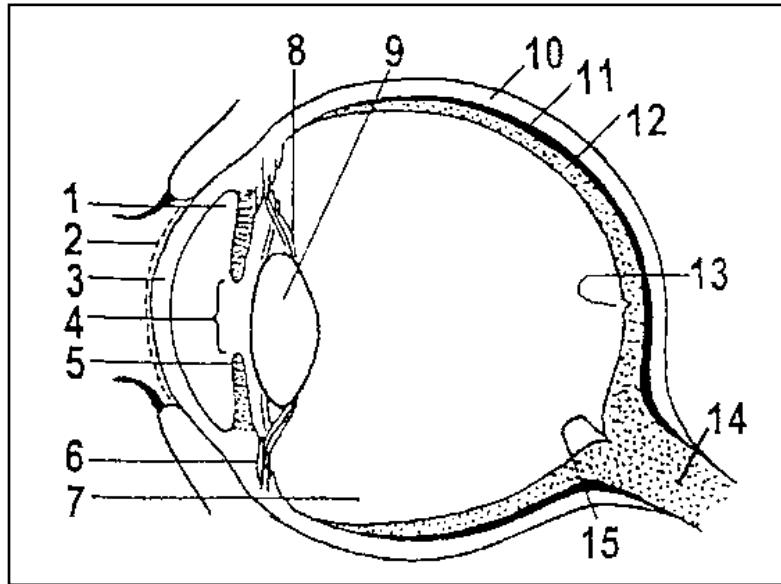
QUESTION 4

- 4.1 B : Semi-circular canals ✓✓ (2)
G : Auditory meatus/canal ✓✓ (2)
- 4.2 C : Transmits pressure waves to the perilymph of the inner ear ✓✓ (2)
E: Prevents pressure build-up of sound waves / distortion /eases vibrations out of the inner ear/ absorbs vibrations ✓✓ **(Any 2)** (2)
- 4.3 (a) -A buzzing sound is caused by a difference in the pressure between the and the middle ear ✓ (1)
- Swallowing opens / closes the Eustachian tube ✓ (1)
to equalise the pressure ✓ (1)
- (b) - To amplify ✓ (1)
- Sound ✓ (1)
- 4.4 (a) No ✓ (1)
(b) It is not moveable or flexible ✓
for more accurate collection of sound ✓
for finding the direction ✓ that the sound is coming from ✓ **(Any 2)** (2)
- 4.5 Both receive ✓ (1) stimuli ✓ (1) and convert ✓ (1) to impulses ✓ (1) which they send ✓ (1) through the sensory neuron ✓ (1) **(Any 2 x 2)** (4)
- 4.6 Larger surface area ✓ (1)
to accommodate more receptors ✓ (1)
fits into smaller area / takes up less space ✓ (1)
(Any 2) (2)
[18]

SECTION C: HOMEWORK

QUESTION 1: 35 minutes

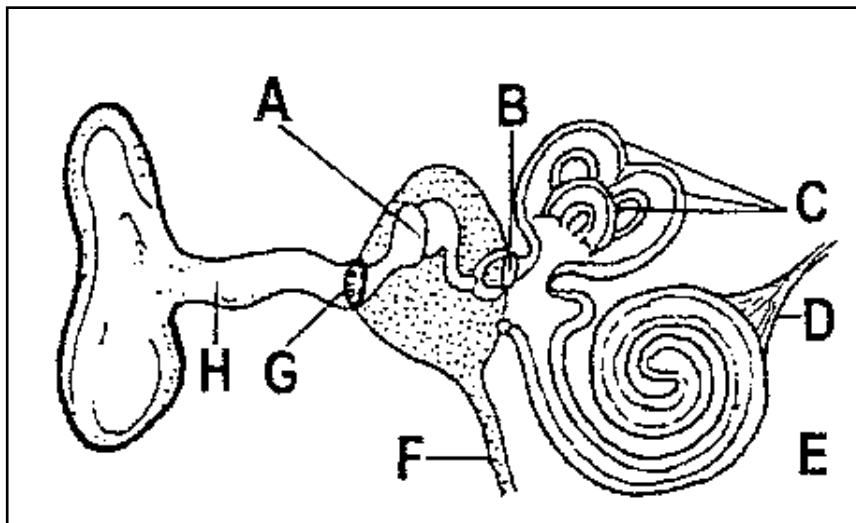
Study the diagram of the eye and answer the questions that follow:



- 1.1. Name the parts numbered 1 to 15. (15)
 - 1.2. Name the functions of the iris, choroid and lens. (12)
 - 1.3. Label, in the correct order, all those parts that would indicate the path of light stimulus from the point where it enters the eye until it reaches the brain. Provide the number and the name of each structure in order. (8)
- [35]**

QUESTION 2

Study the diagram below and answer the questions that follow:



- 2.1. State the letter and name of the part associated with each of the following statements:
- the part that secretes cerumen (2)
 - the part that intensifies sound waves (2)
 - the part that carries impulses to the brain (2)
 - the part that is responsible for balance (2)
 - the part that ensure that the air pressure is equal on both sides of the eardrum (2)
- 2.2. Explain what would happen if part F were blocked. (4)
- 2.3. The ear is responsible for maintaining balance. Discuss this statement with regard to the process and function of the semi-circular canals, the utriculus and the sacculus. (17)
- 2.4. Describe the sequence of events that occurs between the entry of a sound wave into the ear canal until it reaches the auditory nerve. (14)
- 2.5. Briefly discuss what a middle ear infection is, and how this is solved. (10)
- [55]

SECTION D: SOLUTIONS TO HOMEWORK

QUESTION 1

1.1.

- | | |
|--------------------------------------|--|
| 1. aqueous humor in anterior chamber | 8. suspensory ligaments |
| 2. conjunctiva | 9. lens |
| 3. cornea | 10. sclera |
| 4. pupil | 11. choroid |
| 5. iris | 12. retina |
| 6. ciliary body | 13. yellow spot in the fovea centralis |
| 7. vitreous humour / vitreous body | 14. optical nerve |
| | 15. blind spot |

(15 x 1) (15)

1.2.

- Iris: controls the size of the pupil ✓ to regulate the amount of light that passes through into the retina ✓
- Choroid: contains blood vessels ✓ to supply oxygen and nutrients to the layers of the eye ✓ and remove wastes ✓. It contains dark pigment ✓ to prevent internal light reflection and scattering of light within the eye ✓
- Lens: the lens is elastic and able to alter its shape for accommodation. ✓ When the lens is round/more convex ✓ the light rays from a nearby object are refracted to focus onto the retina. ✓ When the lens is flatter/less convex ✓ light rays from a distant object are refracted less so that they are focused onto the retina. ✓

(12)

- 1.3. 2 = conjunctiva \Rightarrow 3 = cornea \Rightarrow 1 = anterior chamber with aqueous humour \Rightarrow
4 = pupil \Rightarrow 9 = lens \Rightarrow 7 = vitreous humour \Rightarrow 13 = yellow spot \Rightarrow 14 = optic
nerve

(Must be in the correct order. 1 mark each point. Mark only from first point until is included or a point is deleted.)

(8)
[35]

QUESTION 2

2.1.

- a) H = external auditory canal
- b) A = bony ossicles
- c) D = auditory nerve
- d) C = semicircular canals
- e) F = Eustacian tube

(5 x 2) (10)

2.2. If the Eustacian tube were blocked:

- The air external to the eardrum will have a different pressure \checkmark to the air in the middle ear. \checkmark This will cause pressure to build on one side of the eardrum \checkmark and cause it to bulge and possibly burst. \checkmark

(4)

2.3. **Balance and equilibrium:**

- The semi-circular canals: there are three canals which lie at right angles \checkmark to each other and are filled with endolymph. \checkmark
- At the base of each semicircular canal is a swelling called the ampulla, \checkmark which contains fine sensory hair cells called crista. \checkmark
- The crista are embedded in a dome-shaped gelatinous capsule called the Cupula. \checkmark
- When the head moves, the endolymph in the ampulla moves as well. \checkmark
- This stimulates the crista and a nerve impulse is discharged \checkmark , and transmitted via the vestibular branch of the auditory nerve, to the cerebellum. \checkmark
- Function to maintain balance and equilibrium with regard to the perception of head movements. \checkmark

The Sacculus and Utriculus: lie below the semicircular canals. They are filled with endolymph \checkmark and contain sensory hair cells called macula. \checkmark

The hairs are embedded in the otolithic membrane. \checkmark

Otoliths are calcium carbonate granules \checkmark which lie on the hair cells.

When the head position changes, the otoliths move according to the pull of gravity. \checkmark

This stimulates the maculae, which convert the stimulus into an impulse. \checkmark

The impulse is transmitted via the vestibular branch of the auditory nerve, to the cerebellum. \checkmark

Function to maintain balance and equilibrium with regard to perception of the position of the head in relation to gravity. \checkmark

(17)

2.4.

- Sound waves move from the **vibrating source** (e.g. a person talking, a car driving past, etc.) in horizontal waves. ✓
- Humans hear sounds with a vibration **frequency of between 16 and 20 000Hz**. ✓
- Sound waves are **collected by the pinna** and passed down the **external auditory canal**. ✓
- We become conscious of sound when the vibrations reach our **ear-drums** (tympanic membrane). ✓
- The **ear-drum vibrates** according to the frequency of the sound waves. ✓
- These vibrations are transmitted to the **three ossicles (the hammer, anvil and stirrup)** in the middle ear, which **amplify** the vibrations. ✓
- The stirrup passes the vibration through the **oval window**, into the inner ear. ✓
- The oval window vibrates and causes vibrations of the **perilymph** in the form of wave movements. ✓
- The wave movements are transferred to the **endolymph of the scala media** (inside the cochlea). ✓
- This causes the **Reissner's membrane** and the **basilar membrane** to vibrate. ✓
- The **hair cells of the Organs of Corti** (the mechanoreceptors) brush or bend against the **tectorial membrane** ("tickle it"). ✓
- The **mechanical stimulus** of the sound wave is converted into an **impulse** by the hair cells. ✓
- The impulse is passed via the **cochlear branch** of the auditory nerve to the **auditory centre** in the cerebral cortex, where the sensation of sound is perceived. ✓
- **Excess vibrations** are passed out through the **round window**, to prevent sound pressure and echoes. ✓

[14]

2.5. Middle ear infection:

- An inflammation of the middle ear. ✓
- When the middle ear becomes infected by bacteria, there is **extreme pain** as pressure builds up behind the eardrum. ✓
- The pressure is caused by pus, which collects in the middle ear cavity. ✓
- The **Eustachian tube** becomes blocked so there is a lack of the ability to **equalise the pressure** on both sides of the eardrum. ✓
- In some cases, the eardrum may burst and pus drains out of the ear. ✓
- Antibiotics are generally prescribed. ✓
- Severe scarring of the eardrum can affect the person's hearing. ✓
- When a person gets middle ear infections often, an Ear Nose and Throat specialist (ENT) ✓ will insert grommets ✓ into the eardrum to assist to drain excess fluid out of the middle ear. ✓

[10]

[55]

SESSION 7: TOPIC 1: CONSOLIDATION – EXAMINATION PAPER 1

Teacher Note: Please ensure that the learners adhere to the time limits for each question. This is so that they learn to work quickly and efficiently. Please remind the learners of the **NEW** exam format:

Paper 1:

- DNA – code of life and RNA
- Cell division – Meiosis
- Genetics and genetic engineering
- Biodiversity - theories of the origin of plants and animals
- Biodiversity – theories of human evolution and alternative explanations

Paper 2:

- Population ecology, community structure and ecological succession
- Plant responses to the environment (plant hormones and tropisms)
- Animal responses to the environment – nervous system, endocrine system, thermoregulation, the human eye and ear
- General reproduction and flowers as reproductive structures
- Human reproduction

LESSON OVERVIEW**SECTION A: TYPICAL EXAM QUESTIONS**

- | | | |
|----|-------------------------|------------|
| 1. | Typical exam questions: | 56 minutes |
| 2. | Review/solutions/memo: | 34 minutes |

QUESTION 1: 10 minutes *(Taken from DoE Exemplar 2011 Paper 1)*

Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A–D) next to the question number.

- 1.1. In humans, the allele for brown eyes is dominant over the allele for blue eyes. The probability of two parents, heterozygous for brown eyes, having children with blue eyes is ...
- A 75%.
B 50%.
C 25%.
D 0%.
- 1.2. The nitrogenous base which replaces thymine in a RNA molecule is ...
- A guanine.
B uracil.
C adenine.
D cytosine.

- 1.3. Human blood type is determined by three different alleles known as IA, IB and i. The IA and IB alleles are codominant and the i allele is recessive.

The possible human phenotypes for blood groups are type A, type B, type AB and type O.

Blood type A and B individuals can be either homozygous (IAIA or IBIB respectively) or heterozygous (IAi or IBi respectively).

A woman with type A blood and a man with type B blood could have offspring with the following blood types:

- A A and B only
 B B and AB only
 C O only
 D A, B, AB or O

- 1.4. During an investigation, the DNA of an animal cell was analysed in a laboratory and the results are shown in the table below.

| BASE COMPOSITION | | | |
|------------------|---------|-------|-------|
| X | Adenine | Y | Z |
| 30,0% | 20,0% | 30,0% | 20,0% |

Which of the following is a CORRECT identification of the bases called X, Y and Z?

- | | X | Y | Z |
|---|----------|----------|----------|
| A | Cytosine | Guanine | Thymine |
| B | Adenine | Thymine | Cytosine |
| C | Thymine | Cytosine | Adenine |
| D | Guanine | Adenine | Thymine |

- 1.5. Assume that plant A has an unknown genotype but shows the dominant trait. This means that plant A could be either homozygous or heterozygous for that trait. To determine which of these two genotypes apply, plant A can be crossed with another plant showing the recessive trait.

Which of the following predictions can be made by studying the offspring from such a cross of complete dominance?

- A If all the offspring show the dominant phenotype, then plant A is heterozygous.
 B If all the offspring show the recessive phenotype, then plant A is homozygous.
 C If 50% of the offspring show the dominant phenotype and 50% of the offspring show the recessive phenotype, then plant A is heterozygous.
 D If all the offspring show an intermediate characteristic, then plant A is heterozygous.

- 1.6. If all 18 nucleotides of a DNA strand code for amino acids, how many amino acids will be present in the polypeptide that is formed?

- A 9
 B 18
 C 7
 D 6

QUESTIONS 1.1.7 and 1.1.8 refer to the information below.

Some characteristics are controlled by more than one gene. Human skin colour is controlled by at least three genes (three different pairs of alleles). There is incomplete dominance between the allele for dark pigmentation and the allele for light pigmentation. A heterozygous individual will therefore have an intermediate colour. Assume that the alleles A, B and C control dark pigmentation and the alleles a, b and c control light pigmentation. A person with the genotype AABBCc would have a very dark skin colour and someone with the genotype aabbcc would have a very light skin colour.

- 1.7. The phenomenon whereby a characteristic is controlled by more than one pair of alleles is called ...
- A incomplete dominance.
 - B complete dominance.
 - C polygenic inheritance.
 - D dihybrid cross.
- 1.8. Which ONE of the following is a possible heterozygous combination of the three genes for skin colour?
- A AABBCc
 - B AaBbCc
 - C aabbcc
 - D ABC
- 1.9. Study the following statements:
- 1 The same characteristic has more than two different alleles for the same gene.
 - 2 The different alleles for the same characteristic are on the same locus.
 - 3 The alleles for the same characteristic are on different loci.
 - 4 More than one gene controls a characteristic.
- The following combination of statements refer to multiple alleles:
- A 1, 2, 3 and 4
 - B 1 and 2 only
 - C 1, 2 and 3 only
 - D 3 and 4 only
- 1.10. During protein synthesis, the following steps take place in order:
- A DNA unwinds, transcription by mRNA, anticodons produced by tRNA, amino acids combine to form polypeptides
 - B DNA unwinds, anticodons produced by mRNA, transcription by tRNA, amino acids combine to form polypeptides
 - C DNA unwinds, transcription by mRNA, codons produced by tRNA, amino acids combine to form polypeptides
 - D DNA unwinds, transcription by mRNA, anticodons produced by rRNA, amino acids combine to form polypeptides

(10 x 1) [10]

QUESTION 2: 8 minutes *(Taken from DoE Exemplar 2011 Paper 1)*

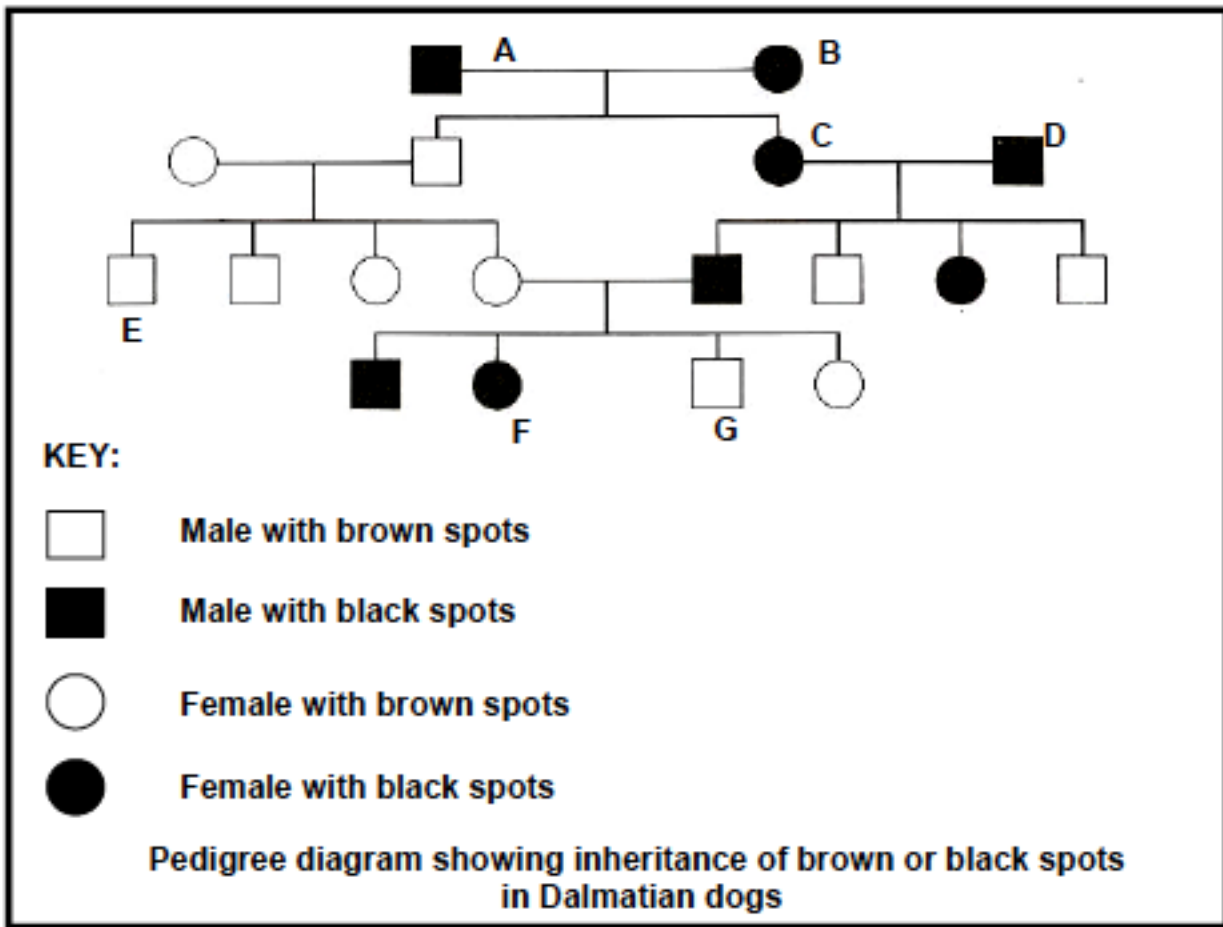
Indicate whether each of the statements in COLUMN 1 applies to A only, B only, both A and B or none of the items in COLUMN 2. Write A only, B only, both A and B or none next to the question number.

| COLUMN 1 | COLUMN 2 |
|---|--|
| 2.1 Provides genetic evidence for the 'out of Africa' hypothesis | A: Mitochondrial DNA B: DNA from X chromosomes |
| 2.2 Organism(s) which is/are bipedal | A: Homo habilis B: Australopithecus africanus |
| 2.3 Proposed natural selection as an explanation of evolution | A: Wallace B: Lamarck |
| 2.4 Genetic disorder(s) which lead(s) to absence of bloodclotting factors | A: Down's syndrome B: Haemophilia |
| 2.5 Natural shape of a DNA molecule | A: Double helix B: Single-coiled strand |
| 2.6 Evidence for evolution | A: Biogeography B: Fossil records |
| 2.7 Fossil(s) found in South Africa | A: Australopithecus sediba ('karabo') B: 'Nutcracker Man' |
| 2.8 Transfer of a gene for drought resistance from one species to another | A: Cloning B: Genetic engineering |

(8 x 1) [8]

QUESTION 3: 10 minutes *(Taken from DoE Exemplar 2011 Paper 1)*

Study the pedigree diagram on the following page showing the inheritance of black or brown spots in Dalmatian dogs. The colour of the spots is determined by a gene which has two alleles. The allele for black spots (B) is dominant over the allele for brown spots (b).



- 3.1 Name the colour and gender of each of the following:
- (a) B (2)
 - (b) G (2)
- 3.2 Name the genotype of:
- (a) A (1)
 - (b) F (1)
 - (c) E (1)
- 3.3 If C and D have another puppy, what is the percentage probability of each of the following:
- (a) The puppy being female (1)
 - (b) The puppy having black spots (2)
- [10]

QUESTION 4: 9 minutes (Taken from DoE Exemplar 2011 Paper 1)

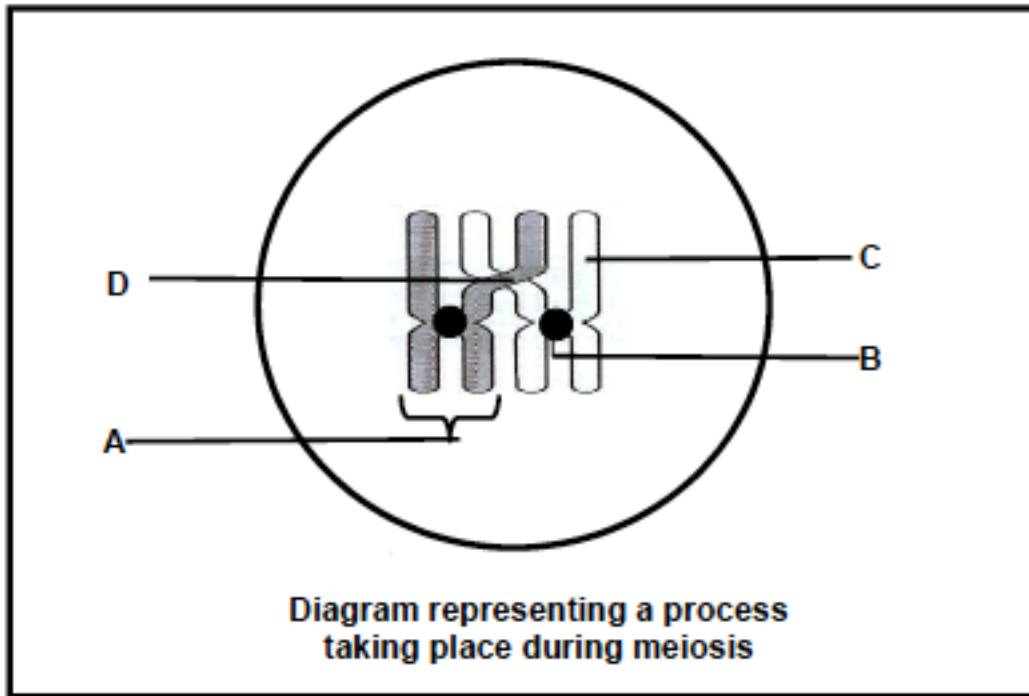
People with the phenotype known as 'hitch-hiker's thumb' are able to curve their thumb backwards without assistance so that it forms an arc shape. The allele for 'hitch-hiker's thumb' is dominant over the allele for the normal thumb.

After making their own observations, grade 12 learners formulated the following question around which they were then required to develop an investigation:

Is the 'hitch-hiker's thumb' more common than the normal thumb in a population?

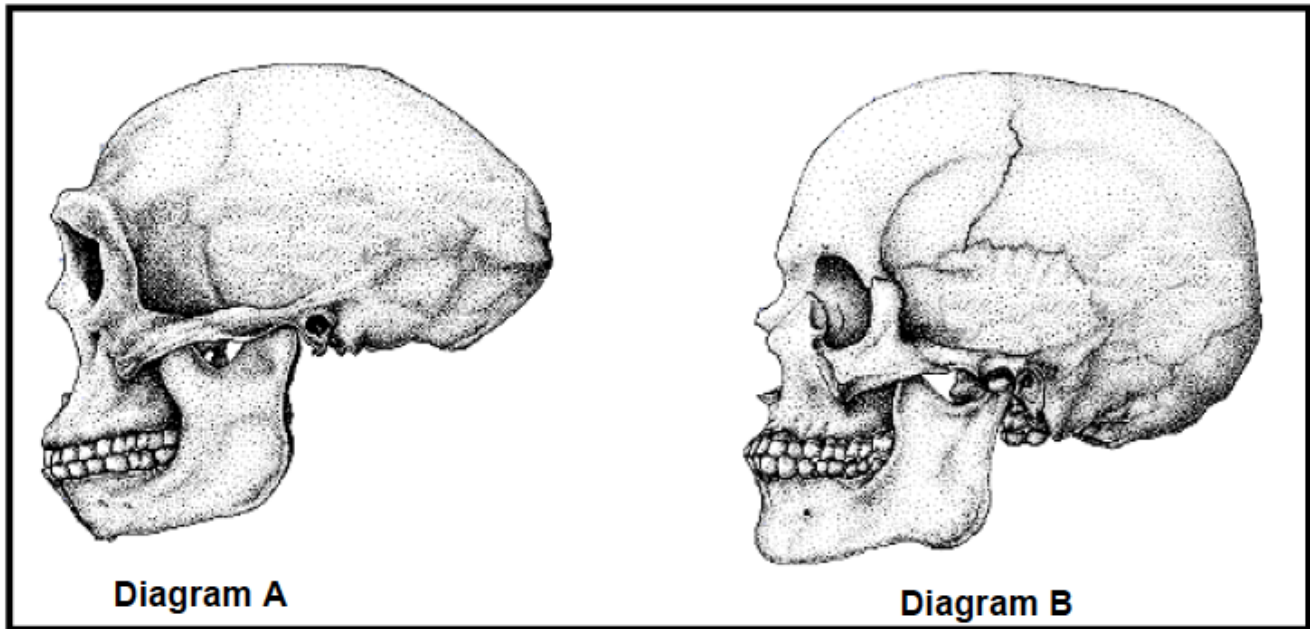
- 4.1. Formulate a hypothesis for this investigation. (3)
 4.2. State FOUR planning steps for the investigation. (4)
 4.3. Name the scientist who formulated the concept of dominance after experimenting with pea plants. (1)
 4.4. State TWO ways of ensuring that the findings of the investigation are reliable. (2)
 [10]

QUESTION 5: 7 minutes (Taken from DoE Exemplar 2011 Paper 1)
 Study the diagram of a phase in meiosis below and answer the questions that follow.



- 5.1. Give labels for parts B, C and D. (3)
 5.2. Name the process in meiosis that is illustrated in the diagram above. (1)
 5.3. State ONE importance of the process named in Question 5.2. (1)
 5.4. Draw a diagram of the structure labelled A to show its appearance immediately after the process named in Question 5.2. (2)
 [7]

QUESTION 6: 12 minutes (Taken from DoE Exemplar 2011 Paper 1)
 Diagrams A and B on the following page illustrate the skulls of Homo sapiens and Homo erectus. The diagrams are drawn to scale.



- 6.1. Which of the diagrams (A or B) represents the following: (1)
- (a) *Homo sapiens* (1)
- (b) *Homo erectus* (1)
- 6.2. Tabulate TWO visible differences between the skulls in diagrams A and B that represent changes in the structure that characterises human evolution. (5)
- 6.3. Describe the significance of *Homo erectus* to the 'out of Africa' hypothesis. (3)
- 6.4. List FOUR similarities between *Homo sapiens* and other primates. (4)
- [14]

SECTION B: SOLUTIONS AND HINTS TO SECTION A

QUESTION 1

- | | |
|-------|--------|
| 1.1 C | 1.6 D |
| 1.2 B | 1.7 C |
| 1.3 D | 1.8 B |
| 1.4 A | 1.9 B |
| 1.5 C | 1.10 A |

(10 X 1) [10]

QUESTION 2

- | | |
|------------------|------------------|
| 2.1 A only | 2.5 A only |
| 2.2 Both A and B | 2.6 Both A and B |
| 2.3 A only | 2.7 A only |
| 2.4 B only | 2.8 B only |

(8 x 1) [8]

QUESTION 3

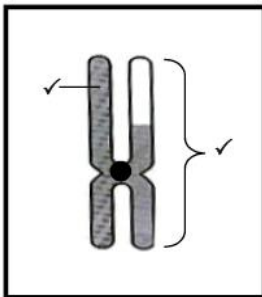
- 3.1 (a) Female ✓black spots ✓ (2)
 (b) Male ✓brown spots ✓ (2)
- 3.2. (a) Bb ✓ (1)
 (b) Bb ✓ (1)
 (c) bb ✓ (1)
- 3.3. (a) 50% ✓ (1)
 (b) 75% ✓ (2)
- [10]**

QUESTION 4

- 4.1. Most ✓/fewer learners ✓in the population have the 'hitchhiker's thumb' trait ✓
OR
 The number of learners ✓that have the 'hitch-hiker's thumb' ✓is the same ✓
 as the number that have the normal thumb (3)
- 4.2. - Seek permission from participants to collect the data ✓
 - Determine the sample size ✓
 - Determine how to do random sampling ✓
 - Train data capturers/trial collecting ensuring that all are able to identify the traits correctly ✓
 - Designing a table to record the data ✓ **max 4 marks** (4)
- 4.3. Gregor Mendel ✓ (1)
- 4.4. - Repeat the investigation ✓
 - Do investigation in other populations ✓
 - Increase the sample size ✓ **max 2 marks** (2)
- [10]**

QUESTION 5

- 5.1. B – Centromere ✓
 C – Chromatid ✓
 D – Chiasma ✓ (3)
- 5.2. Crossing over ✓ (1)
- 5.3. Mixing of genetic material introduces variation ✓/gametes are different from each other (1)
- 5.4

**Mark allocation:**

- Chromosome drawn ✓
 Chromosome has shaded and unshaded part in the correct proportion ✓ (2)
- [7]**

QUESTION 6

- 6.1 (a) B ✓ (1)
 (b) A ✓ (1)

6.2

| DIAGRAM A | DIAGRAM B |
|---------------------------------|---------------------------------|
| 1 Brow ridges more pronounced | 1 Brow ridges less pronounced |
| 2 Smaller cranium/brain | 2 Larger cranium/brain |
| 3 Jaw protrudes (prognathous) | 3 Jaw does not protrude |
| 4 No obvious chin | 4 Pronounced chin |
| 5 Elongated cranium | 5 shorter cranium |
| 6 Zygomatic arch well developed | 6 Zygomatic arch less developed |

(Any two matching differences = 4 + 1 for table) (5)

- 6.3. - H. erectus was the first *Homo* species ✓ to move out of Africa.
 - Their large bodies ✓ and well adapted pelvic girdles ✓ made them better bipedal runners and walkers ✓ over long distances than H. sapiens **Max 3** (3)

- 6.4. - Large brains/skulls compared to their body mass ✓
 - Olfactory brain centres reduced/reduced sense of smell ✓
 - Parts of the brain that process information from the hands and eyes are enlarged ✓
 - Eyes in front/binocular vision/stereoscopic vision ✓
 - Eyes with cones/colour vision ✓
 - Freely rotating arms ✓
 - Long upper arms ✓
 - Elbow joints allow rotation of forearm ✓
 - Rotate hands at least 180°. ✓
 - Flat nails instead of claws/bare finger tips ✓
 - Opposable thumbs which work in opposite direction to their fingers ✓
 - Upright posture ✓
 - Sexual dimorphism/distinct differences ✓
 - Two teats only ✓

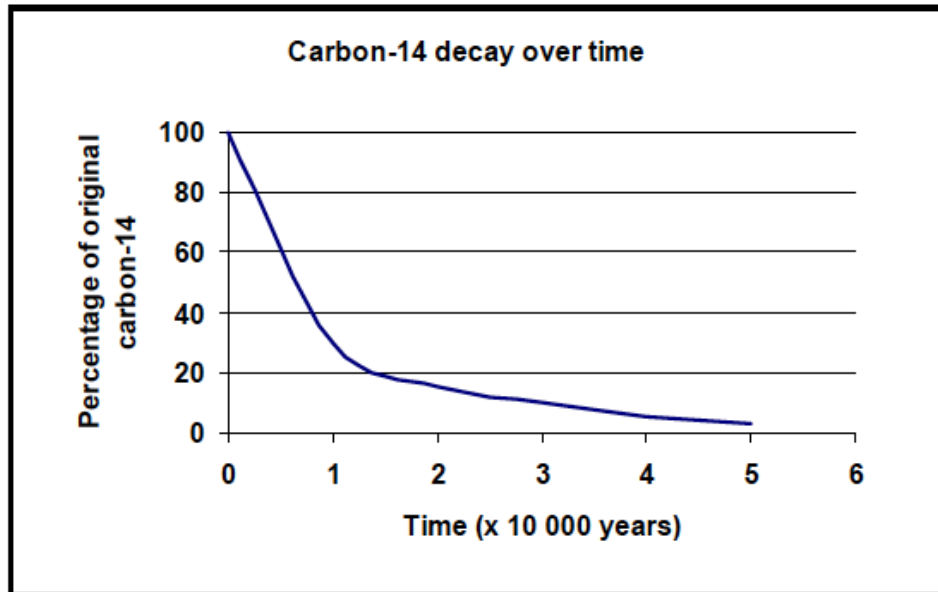
(Any 4) (4)
[14]

SECTION C: HOMEWORK**QUESTION 1: 10 minutes***(Various sources)*

- 1.1. Micro-evolution is a term that describes ...
 - A. the process by which new genera and families of organisms are formed.
 - B. small changes that occur in the genotypes of organisms within the same species.
 - C. changes that can be seen without a microscope.
 - D. an increase in the size of individuals of a population over a long period of time.
- 1.2. According to Charles Darwin, organisms that will be most successful biologically, are those that ...
 - A. are best adapted to their environment.
 - B. are the largest in the population.
 - C. reproduce the slowest.
 - D. do not change.
- 1.3. The evidence that related species in similar biomes across the world developed from a common ancestor, is obtained from ...
 - A. micro-evolution.
 - B. embryology.
 - C. biochemistry.
 - D. biogeography.
- 1.4. Extinction occurs....
 - E. When a species is unable to survive in their environment.
 - F. When only a few of a species survives.
 - G. When a species goes into hiding until conditions improve.
 - H. The gradual depletion of a population.
- 1.5. The fossil records reflect that the first meteor collision occurred
 - A. About 5 billion years ago
 - B. About 8 billion years ago
 - C. About 3,5 billion years ago
 - D. About 2,5 billion years ago
- 1.6. Which ONE of the following is an example of a pair of analogous structures?
 - A. A whale's flipper and a bat's wing
 - B. A bird's wing and an insect's wing
 - C. A hawk's wing and a sparrow's wing
 - D. A dog's leg and a horse's leg
- 1.7. The following is needed for new species to form....
 - A. an extinction event
 - B. an homologous structure
 - C. an analogous structure
 - D. reproductive isolation

- 1.8. Macroevolution is a term that describes ...
- A. an increase in the size of individuals of a population over a long period of time.
 - B. the process by which new genera and families of organisms are formed.
 - C. a gradual change in the number of species found in the fossil record.
 - D. changes that can be seen without the need for a microscope.
- 1.9. Which of the following is NOT a fossil?
- A. *Tyrannosaurus rex* skull, 65 million years old
 - B. Oil formed from microorganisms, 150 million years old
 - C. Stone tool made by ancestors of human, 2,6 million years ago
 - D. 195 million-year-old dinosaur footprint imprinted in rock
- 1.10. The theory of evolution based on the principle of use and disuse was proposed by ...
- A. Darwin.
 - B. Mendel.
 - C. Lamarck.
 - D. Wallace.
- 1.11. Structures that perform similar functions but have different evolutionary origins are called ... structures.
- A homologous
 - B homozygous
 - C analogous
 - D heterozygous
- 1.12. Study the following characteristics:
- 1. Olfactory brain centres reduced
 - 2. Bare fingertips
 - 3. Flat face (not prognathous)
 - 4. Always bipedal
- Which combination of characteristics makes humans different from other primates?
- A 2, 3 and 4 only
 - B 1, 2 and 3 only
 - C 3 and 4 only
 - D 1, 2 and 4 only

- 1.13. One way to determine the age of a fossil is to use the rate of decay of carbon-14. The graph below shows how carbon-14 decays over time.



A fossil snail was found to have 30% of its carbon-14 remaining. According to the graph on the previous page, the age of the fossil is approximately ...

- A 5 000 years.
 - B 15 000 years.
 - C 10 000 years.
 - D 20 000 years.
- 1.14. An example of non-random mating is
- A. artificial selection.
 - B. inbreeding.
 - C. natural selection.
 - D. macroevolution.

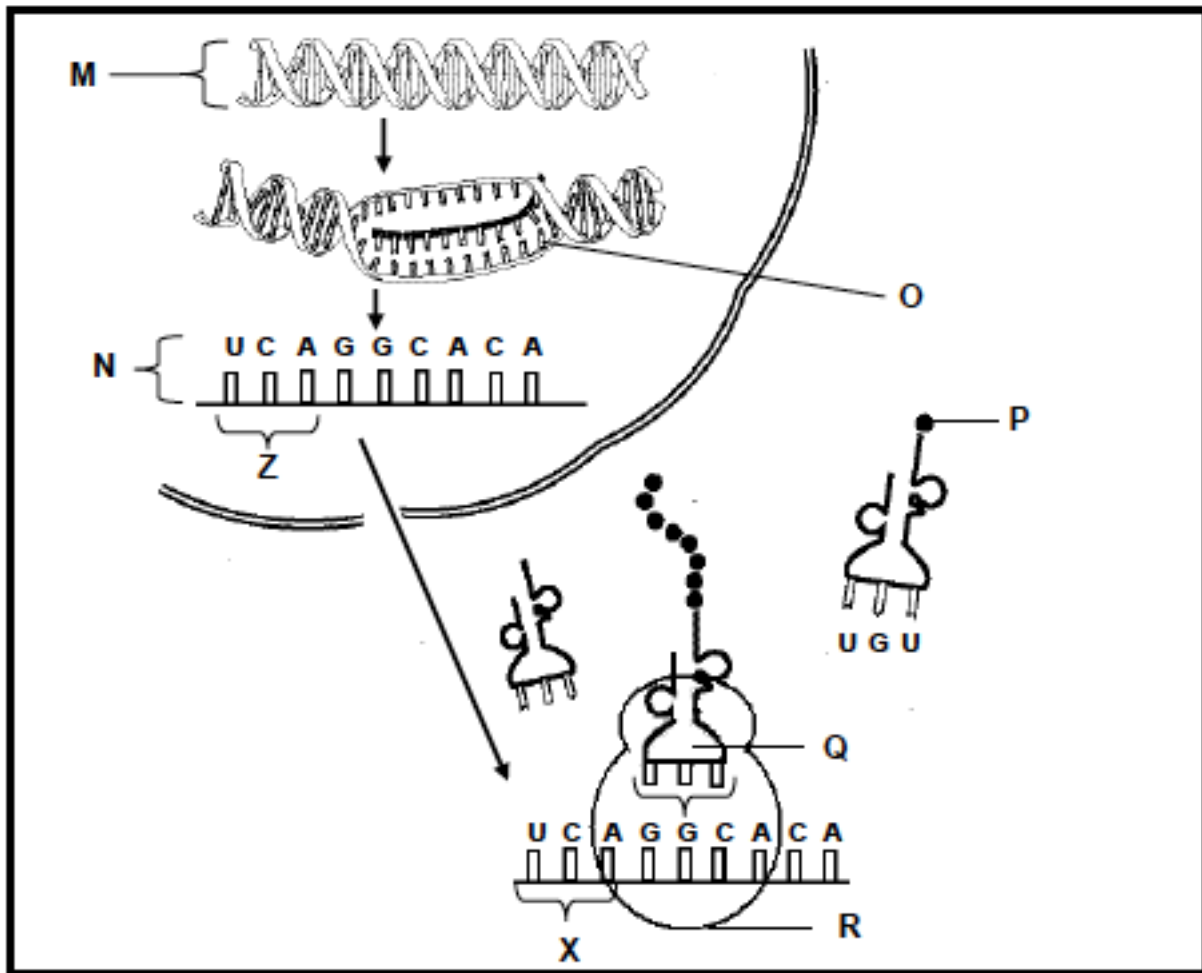
(14 x 1) [14]

QUESTION 2:

12 minutes

(Taken from DoE Feb/March 2011 Paper 1)

The diagrams below represent the process of protein synthesis.



- 2.1. Identify compound M and organelle R. (2)
- 2.2. Write down the sequence of the FIRST THREE nitrogenous bases on the DNA strand that led to the formation of Z. (2)
- 2.3. Name the part/stage of protein synthesis that is illustrated in O. (1)

2.4. The table below shows the base triplets of DNA and the amino acid each codes for.

| Base triplet of DNA | Amino acid coded for |
|---------------------|----------------------|
| AGT | Serine |
| CCG | Glycine |
| TGT | Threonine |
| GTA | Histidine |
| CAA | Valine |
| TCC | Arginine |
| ACA | Cysteine |

With reference to the diagram in QUESTION 2 and the table above:

- (a) Name the amino acid labelled P. (2)
- (b) State the base sequence of the molecule labelled Q. (2)
- (c) What name is given to the triplet of tRNA bases that codes for each amino acid? (1)
- (d) Describe how the composition of the protein molecule changes if the base sequence at X is UGU instead of UCA. (2)

[12]

SECTION D: SOLUTION TO HOMEWORK

QUESTION 1

- | | | | | | |
|------|---|------|---|------|---|
| 1.1 | B | 1.6. | B | 1.11 | C |
| 1.2. | A | 1.7. | D | 1.12 | C |
| 1.3. | D | 1.8. | B | 1.13 | C |
| 1.4. | A | 1.9. | C | 1.14 | A |
| 1.5. | C | 1.10 | C | | |

(14 x 1) [14]

QUESTION 2

- 2.1 M – DNA ✓ R – Ribosome ✓ (2)
- 2.2 AGT ✓✓ (2)
- 2.3 Transcription ✓ (1)
- 2.4 (a) Threonine ✓✓ (2)
- (b) CCG ✓✓ (2)
- (c) Anticodon ✓ (1)
- (d) A different protein may form because it has cysteine ✓ instead of serine ✓/have different amino acids (2)

[12]

SESSION 7: TOPIC 2: CONSOLIDATION – EXAMINATION PAPER 1

Teacher Note: Please ensure that the learners adhere to the time limits for each question. This is so that they learn to work quickly and efficiently. Please remind the learners of the **NEW** exam format:

Paper 1:

- DNA – code of life and RNA
- Cell division – Meiosis
- Genetics and genetic engineering
- Biodiversity - theories of the origin of plants and animals
- Biodiversity – theories of human evolution and alternative explanations.

Paper 2:

- Population ecology, community structure and ecological succession
- Plant responses to the environment (plant hormones and tropisms)
- Animal responses to the environment – nervous system, endocrine system, thermoregulation, the human eye and ear
- General reproduction and flowers as reproductive structures
- Human reproduction

LESSON OVERVIEW

1. Typical exam questions: 55 minutes
2. Review/solutions/memo: 35 minutes

SECTION A: TYPICAL EXAM QUESTIONS

QUESTION 1: **4 minutes** *(Taken from DoE Exemplar 2011 Paper 1)*

Give the correct biological term for each of the following descriptions. Write only the term next to the question number.

- 1.1. The pair of chromosomes in a diploid individual that have the same shape and size, and control the same set of characteristics.
- 1.2. The type of genetic cross where an intermediate phenotype is expressed in F₁, while parental phenotypes reappear in F₂.
- 1.3. The law that accounts for gametes having only one allele for a characteristic due to a separation of the pair of alleles during meiosis.
- 1.4. A ring of DNA found in bacteria that is used in the production of insulin.
- 1.5. A study of the transmission of characteristics from parents to offspring.
- 1.6. Chromosome condition of a cell resulting from meiosis, having only one set of chromosomes.

(6 x 1) [6]

QUESTION 2: 12 minutes (Taken from DoE Exemplar 2011 Paper 1)

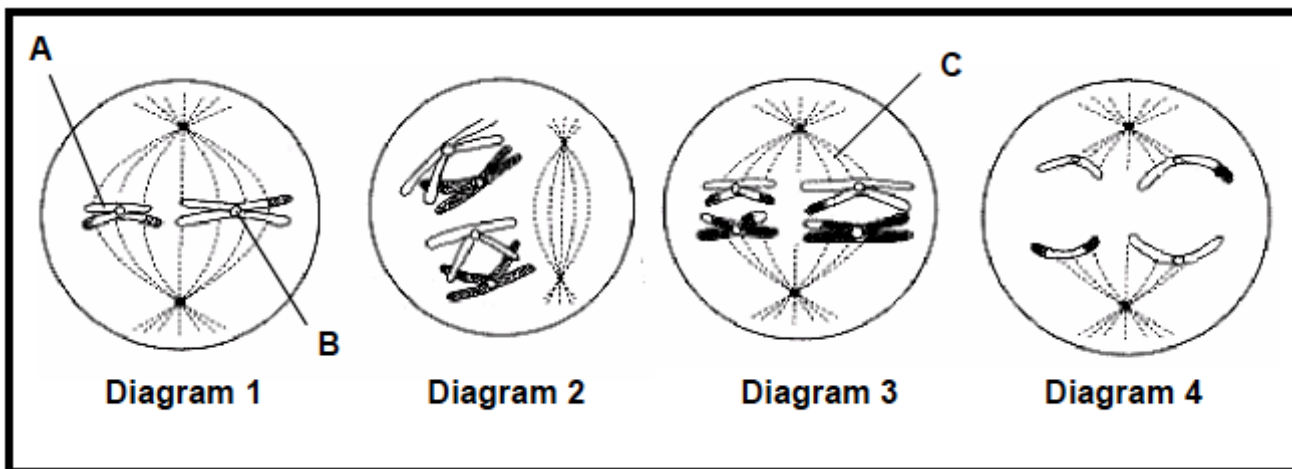
Study the genotypes and phenotypes below that show how the alleles for colour-blindness are inherited. X and Y represent sex chromosomes. A carrier does not suffer from colour-blindness but can pass the allele for colour-blindness to their children.

| NAME OF PERSON | GENOTYPE | PHENOTYPE |
|----------------|-----------|---------------------|
| Lindi | $X^B X^B$ | Normal female |
| Beauty | $X^B X^b$ | Carrier female |
| Sarah | $X^b X^b$ | Colour-blind female |
| Paul | $X^B Y$ | Normal male |
| Thabani | $X^b Y$ | Colour-blind male |

- 2.1. State why colour-blindness is referred to as a sex-linked disorder? (2)
 - 2.2. Is colour-blindness caused by a dominant or a recessive allele? (1)
 - 2.3. Explain your answer to QUESTION 2.2 above. (2)
 - 2.4. Explain why Thabani is colour-blind. (2)
 - 2.5. Sarah and Paul marry and have two children, a son and a daughter. Represent this genetic cross by using the information in the table above to determine the genotypes and phenotypes of the son and the daughter. (6)
- [13]

QUESTION 3: 14 minutes (Taken from DoE Feb/Mar 2011 Paper 1)

Study the following diagrams representing different phases of meiosis:



- 3.1. Label structures A, B and C. (3)
 - 3.2. Which phase is represented by: (1)
 - (a) Diagram 1 (1)
 - (b) Diagram 2 (1)
 - 3.3. Write down the numbers of the diagrams to show the correct sequence in which the phases occur. (2)
 - 3.4. Tabulate THREE differences between the first and second stages of meiosis. (7)
 - 3.5. Name and explain TWO processes/mechanisms that ensure that the gametes produced at the end of meiosis are genetically different from each other. (4)
- [15]

QUESTION 4: 5 minutes *(Taken from DoE Nov 2010 Paper 2)*

Indicate whether each of the statements in COLUMN 1 applies to A only, B only, Both A and B, or None of the items in COLUMN 2. Write A only, B only, both A and B, or None next to the question number.

| COLUMN 1 | COLUMN 2 |
|--|---|
| 4.1. Fossil(s) of <i>Australopithecus</i> found in South Africa | A: Mrs Ples B: Lucy |
| 4.2. Similarities between <i>Homo sapiens</i> and apes | A: Opposable thumb B: Two mammary glands |
| 4.3. Evidence from comparative embryology supporting the theory of evolution | A: Similar sequence of genes B: Presence of embryonic gill slits |
| 4.4. Study of ancient humans and their cultural activities | A: Biogeography B: Archaeology |
| 4.5. Possible cause(s) of mass extinctions | A: Volcanic eruptions B: Freezing of parts of the earth |
| 4.6. Mutation(s) that influence(s) biodiversity | A: Neutral B: Lethal |

[6]

QUESTION 5: 20 minutes *(Taken from DoE Exemplar 2011 Paper 1)*

5.1. The information and question below are based on natural selection.

Antibiotics are used to kill bacteria that cause diseases. In 1972, there was an epidemic of typhoid in Mexico. Normally, an antibiotic called chloramphenicol cured it. This time the antibiotic did not work and more than 14 000 people died. Eventually, doctors found an antibiotic that did work.

Using your understanding of natural selection, explain why chloramphenicol did not control the epidemic mentioned above.

(5)

5.2 Study the information below on an investigation based on artificial selection and answer the questions that follow.

In 1965, an investigation was started to find out if artificial selection could increase the milk yield of cows. In one set of cows, artificial selection for high milk yield was carried out in each generation. This set of cows was called the SELECTED LINE. In the other set of cows, there was no artificial selection. This set was called the CONTROL LINE.

Both sets of cows were kept under the same conditions. The average milk yield from both sets of cows that were born in each year from 1965 to 1990, was recorded. The results are shown in the table below.

| YEAR OF COW'S BIRTH | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 |
|---|------|------|------|------|------|------|
| Selected line: average milk yield (litre per kg) | 7,2 | 8,2 | 8,8 | 10,0 | 9,7 | 11,0 |
| Control line: average milk yield (litre per kg) | 7,2 | 7,1 | 6,0 | 6,8 | 6,6 | 5,8 |

5.2.1. Plot line graphs, on the same set of axes, using the information in the table above. (12)

5.2.2. Calculate the change in average milk yield (litre per kg) between 1965 and 1990 for the selected line. Show your workings. (3)

[20]

SECTION B: SOLUTIONS AND HINTS TO SECTION A

QUESTION 1

- 1.1 Homologous ✓
- 1.2 Incomplete dominance ✓
- 1.3 Law of Segregation ✓
- 1.4 Plasmid ✓
- 1.5 Genetics ✓
- 1.6 Haploid ✓

(6 x 1) [6]

QUESTION 2

- 2.1. The genes for colour-blindness ✓ is carried on the sex chromosomes ✓ (2)
- 2.2. Recessive ✓ (1)
- 2.3. The trait only shows up if it is in the homozygous ✓ recessive ✓ / not in the heterozygous state. (2)
- 2.4. Thabani has only one X chromosome with a recessive allele ✓ for colour-blindness, the Y chromosome does not carry an allele for the characteristic ✓ (2)

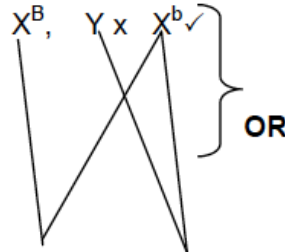
2.5.

P₁/parent phenotype Paul Sarah
 genotype Normal x Colour-blind ✓
 $X^B Y$ x $X^b X^b$ ✓

Meiosis

G/gametes

Fertilisation



| | | |
|---------|-----------|-----------|
| gametes | X^b | X^b |
| X^B | $X^B X^b$ | $X^B X^b$ |
| Y | $X^b Y$ | $X^b Y$ |

1 mark for correct gametes
 1 mark for correct genotypes

F₁/offspring genotype $X^B X^b$ & $X^b Y$ ✓

Phenotype carrier daughter and colour-blind son ✓

Parents and offspring ✓ / P₁ and F₁
 Meiosis and fertilisation ✓

Max (6)
 [13]

QUESTION 3

- 3.1 A – Chromatid ✓ / chromosome
 B – Centromere ✓
 C – Spindle fibre ✓ / thread (3)
- 3.2 (a) Metaphase 2 ✓ (1)
 (b) Prophase I ✓ (1)
- 3.3 Diagram 2, Diagram 3, Diagram 1, Diagram 4 (Sequence must be correct) (2)
- 3.4

| Meiosis I | Meiosis II |
|---|--|
| - Crossing over takes place ✓ | - No crossing over takes place ✓ |
| - In metaphase the chromosomes align on the equator in homologous pairs ✓ | - In metaphase chromosomes align singly ✓ on the equator |
| - Reduction division ✓ | - No reduction division ✓ |
| - During anaphase whole chromosomes ✓ move towards the poles | - During anaphase chromatids ✓ move towards the pole |

(Mark first THREE only) any 3 x 2 + 1 table (7)

- 3.5 **Crossing over** ✓
 Pieces of chromatids / groups of genes are exchanged ✓ between homologous chromosomes
- Random independent assortment of chromosomes** ✓
 Maternal and paternal chromosomes assort themselves randomly / independently on either side of the equator during metaphase ✓ (4)

[18]

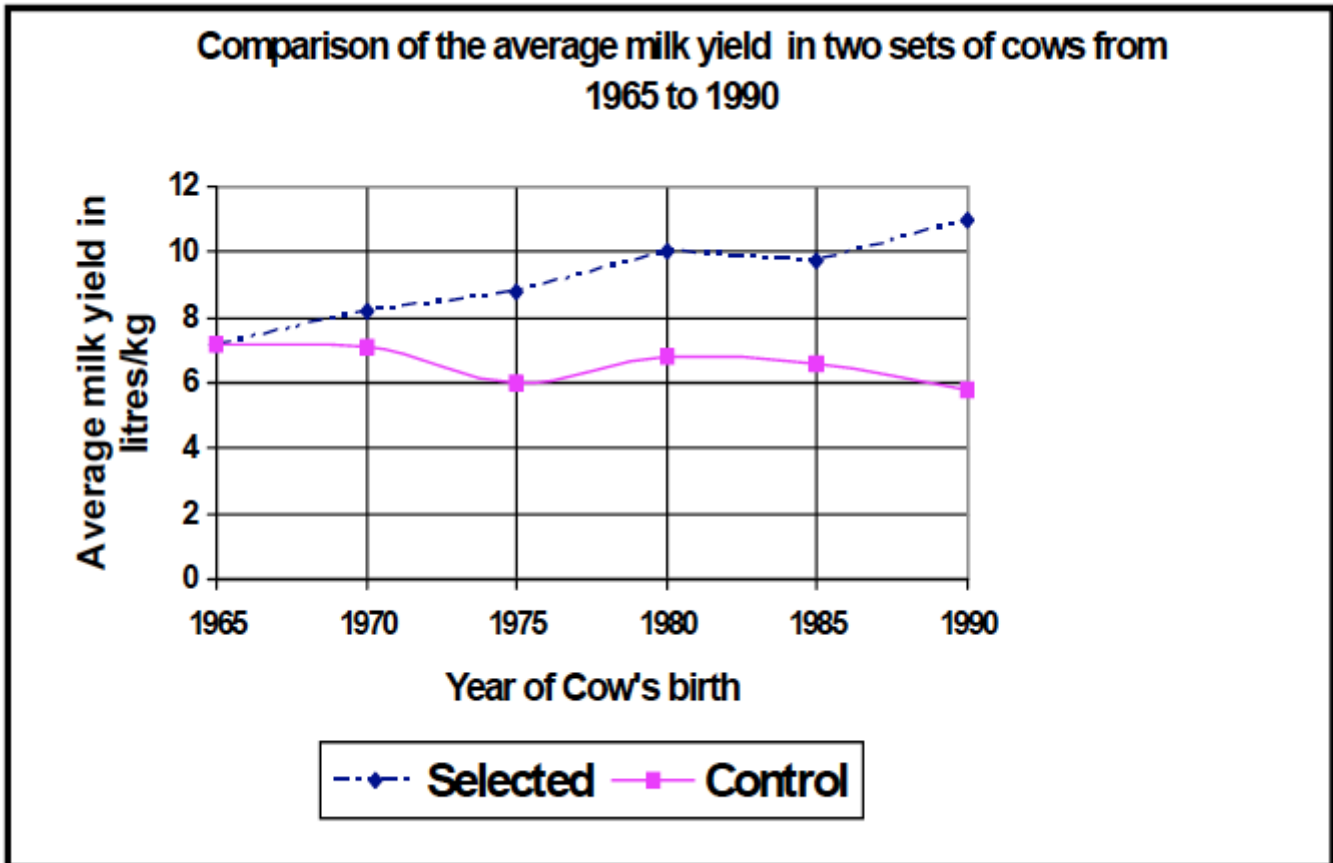
QUESTION 4

- 4.1. A only
 4.2. Both A and B
 4.3. B only
 4.4. B only
 4.5. Both A and B
 4.6. B only

(6 x 1) [6]

QUESTION 5

- 5.1 - There is a large degree of variation in the bacteria population ✓
 - When chloramphenicol was first used, it killed off a large number of bacteria ✓
 - But some bacteria were resistant to chloramphenicol ✓ and survived ✓
 - Those that survived were able to reproduce ✓
 - Increasing the population of resistant bacteria ✓
 - Continued use of chloramphenicol had little effect on the resistant bacteria ✓
 - Hence the disease reappeared ✓ **max (5)**
- 5.2.1.

**NOTE:**

- If the wrong type of graph is drawn, marks will be lost for 'correct type of graph'
- If graphs are not drawn on the same system of axes, mark the first graph only using the given criteria.

Rubric for the mark allocation of the graph

(12)

| | |
|---|--|
| Correct type of graph | 1 |
| Caption for graph | 1 |
| Correct label for X-axis | 1 |
| Graphs labelled/key provided for 2 graphs | 1 |
| Correct label for Y-axis | 1 |
| Appropriate scale for X-axis | 1 |
| Appropriate scale for Y-axis | 1 |
| Drawing of graphs | 1 – 1 to 2 points plotted correctly 2 – 3 to 4 points plotted correctly 3 – 5 to 7 points plotted correctly 4 – 8 to 10 points plotted correctly 5 – 11 to 12 points plotted correctly |

5.2.2. 11, 0 – 7,2 ✓ = 3,8 ✓ litres/kg ✓

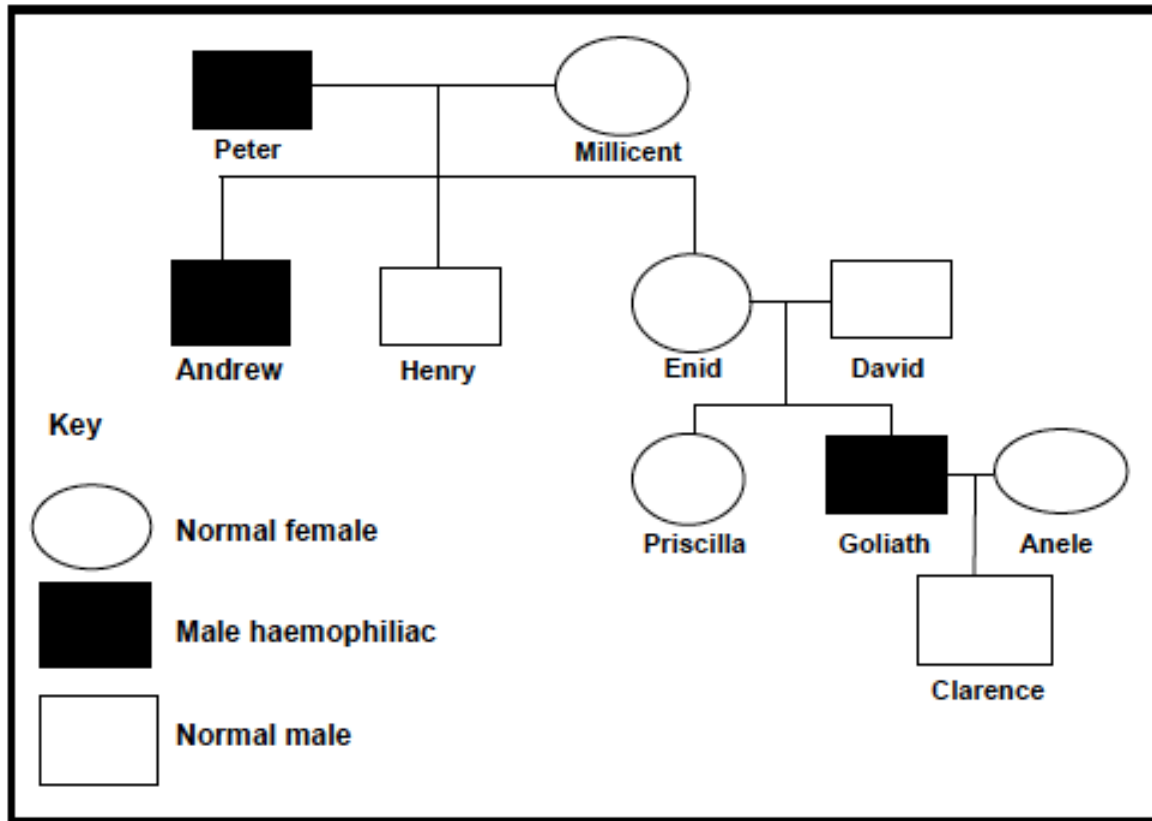
(3)

[20]**SECTION C: HOMEWORK****QUESTION 1:** 20 minutes (Taken from DoE Exemplar 2011 Paper 1)

Describe how proteins are formed in a cell and explain the impact of the two types of gene mutations on the formation of proteins. Content: (17) Synthesis: (3) [20]

QUESTION 2: 8 minutes (Taken from DoE Feb/Mar 2011 Paper 1)

Study the pedigree diagram of a family where some individuals have haemophilia. Haemophilia is a sex-linked disorder. Use H for normal blood clotting and h for the haemophilic trait.



- 2.1. From the pedigree diagram above, state the relationship between gender and haemophilia. (2)
- 2.2. Write down all the possible genotypes of individuals: (6)
- (a) Peter
 - (b) Enid
 - (c) Clarence
- [8]

QUESTION 3: 16 minutes (Taken from DoE Exemplar 2011 Paper 1)

Read the passage on the following page about the evolution of wheat and answer the questions that follow.

Thousands of years ago, wheat was one of many wild grasses producing few, small seeds. The wild wheat which has a diploid number of 14, crossed in a 'genetic accident' with a natural goat grass which also had a diploid number of 14 chromosomes. A new fertile hybrid species called Emmer, which had 28 chromosomes, was produced.

Emmer had many more seeds which were also larger than the wild wheat, and the seeds were attached to the husk in such a way that they could easily be dispersed by wind.

There was a second 'genetic accident' in which Emmer crossed with another species of goat grass which had a diploid number of 14, to produce a hybrid with 42 chromosomes.

This hybrid is the present-day bread wheat with seeds that are larger in size and number than any of the species from which it was formed. This wheat can only be propagated by humans, since the seeds are attached to the husk in such a way that they cannot easily be dispersed by wind.

[Adapted from *The Ascent of Man* by J Bronowski]

- 3.1. How many chromosomes are normally found in the gametes of the wild wheat plant? (1)
 - 3.2. How many chromosomes are normally found in the offspring grown from the seed of the wild wheat plant? (1)
 - 3.3. Name and explain the mechanism that accounts for Emmer having a chromosome number that was twice that of each of the two species from which it was formed. (5)
 - 3.4. The term 'diploid' refers to the presence of two sets of chromosomes in a cell, whereby each chromosome is present with its homologous partner.
 - (a) Name the general term used to describe the presence of many sets of chromosomes in cells of the present-day bread wheat. (1)
 - (b) Using the information in the passage above, name TWO advantages of the concept named in QUESTION 3.4 (a). (2)
 - 3.5. Explain why bread wheat cannot grow in the wild and must, therefore, be cultivated by humans. (2)
 - 3.6. What type of speciation occurred in the production of the hybrid wheat? (1)
 - 3.7. Name the other type of speciation that you have studied. (1)
 - 3.8. State ONE difference between the two types of speciation. (2)
- [16]

| |
|---|
| SECTION D: SOLUTIONS TO HOMEWORK |
|---|

QUESTION 1: max 20 marks

The process of protein synthesis occurs in two steps, namely transcription and translation.

Transcription

- Double stranded DNA unzips
- When the hydrogen bonds break
- One strand is used as a template
- To form mRNA
- Using free RNA nucleotides from the nucleoplasm
- The coded message for protein synthesis is thus copied onto mRNA
- mRNA moves from the nucleus to the cytoplasm and attaches to the ribosome **Max (6)**

Translation

- tRNA collects amino acids
- tRNAs, with amino acids attached, become arranged on the mRNA
- The anticodons on the tRNAs match complementary bases on the codons of mRNA
- Amino acids become attached by peptide bonds to form the required protein
- Each tRNA is released to pick up more amino acids **Max (6)**

Impact of gene mutations on protein synthesis

- Errors/mistakes/changes may occur during DNA replication
- Point mutation: replacing one base of a codon with another
- Small change that may possibly result in one amino acid changing in a protein
- Frameshift mutation: addition/deletion of one or more bases of a codon
- Resulting in changing the order/sequence of all the bases of the codons
- Resulting in forming a different protein with different functions **Max (5)**

ASSESSING THE PRESENTATION OF THE ESSAY

| Marks | Description |
|--------------|--|
| 3 | Explained all three of transcription, translation or mutation fully without irrelevant information |
| 2 | Explained 2 of transcription, translation or mutation fully with little/no irrelevant information |
| 1 | Explained 1 of transcription, translation or mutation fully with little/no irrelevant information |
| 0 | Not attempted/nothing written other than question number/no correct information |

Synthesis (3)**[20]**

QUESTION 2

- 2.1 Haemophilia occurred in males ✓ only ✓ (2)
- 2.2 (a) X^hY ✓✓ (2)
- (b) X^HX^h ✓✓ (2)
- (c) X^HY ✓✓ (2)
- [8]**

QUESTION 3

- 3.1 7 ✓ (1)
- 3.2 14 ✓ (1)
- 3.3 Non-disjunction ✓
 During meiosis in the wild wheat plant the 7 homologous pairs ✓ did not separate ✓
 The gamete was $2n$ ✓ / had 14 chromosomes
 The same process happened with the natural goat grass ✓
 Fusion of the two diploid gametes formed a polyploidy ✓ / tetraploid Emmer **(max 5)** (5)
- 3.4 (a) Polyploidy ✓ (1)
- (b) The size ✓ of the seeds increased and the number ✓ of seeds increased from
 the wild wheat plant to Emmer to the present day wheat (2)
- 3.5 Wind cannot disperse the seeds ✓ since the seeds are firmly attached to the husk ✓ (2)
- 3.6 Sympatric ✓ speciation (1)
- 3.7 Allopatric ✓ speciation (1)
- 3.8 Allopatric speciation: geographical barrier present ✓
 Sympatric speciation: no geographical barriers present ✓ (2)
- [16]**

SESSION 8: TOPIC 1: CONSOLIDATION – EXAMINATION PAPER 2

Teacher Note: Please ensure that the learners adhere to the time limits for each question. This is so that they learn to work quickly and efficiently. Please remind the learners of the **NEW** exam format:

Paper 1:

- DNA – code of life and RNA
- Cell division – Meiosis
- Genetics and genetic engineering
- Biodiversity - theories of the origin of plants and animals
- Biodiversity – theories of human evolution and alternative explanations.

Paper 2:

- Population ecology, community structure and ecological succession
- Plant responses to the environment (plant hormones and tropisms)
- Animal responses to the environment – nervous system, endocrine system, thermoregulation, the human eye and ear
- General reproduction and flowers as reproductive structures
- Human reproduction

LESSON OVERVIEW

1. Typical exam questions: 58 minutes
2. Review/solutions/memo: 32 minutes

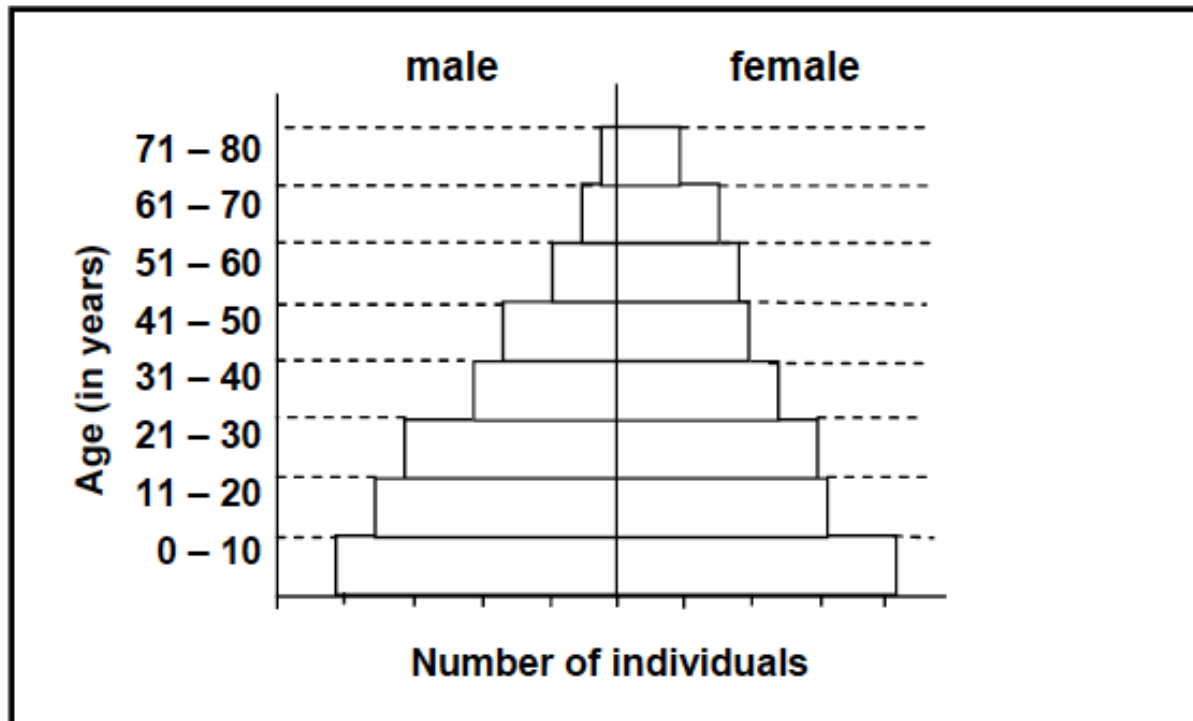
SECTION A: TYPICAL EXAM QUESTIONS

QUESTION 1: **7 minutes** *(Taken from DoE Exemplar 2011 Paper 2)*

Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A–D) next to the question number.

- 1.1 Which of the following is an exocrine gland?
 - A Thyroid
 - B Pancreas
 - C Adrenal
 - D Pituitary
- 1.2 The ability of the lens to change its curvature is known as ...
 - A astigmatism.
 - B binocular vision.
 - C accommodation.
 - D pupillary mechanism.

- 1.3 Diabetes is caused by an ...
- A oversecretion of adrenalin.
 - B undersecretion of insulin.
 - C oversecretion of aldosterone.
 - D undersecretion of glucagon.
- 1.4 The net increase of a population can be determined by ...
- A adding births and deaths and subtracting emigrations and immigrations.
 - B adding births and emigrations and subtracting deaths and immigrations.
 - C adding births and immigrations and subtracting deaths and emigrations.
 - D adding deaths and immigrations and subtracting births and emigrations.
- 1.5. Study the pyramid below:



- A Rapidly growing population; characteristic of a developing country
 - B Declining population; characteristic of a developing country
 - C Stable population; characteristic of a developed country
 - D Declining population; characteristic of a developed country
- 1.6 Complete metamorphosis is characterised by the following stages in the life cycle of an organism:
- A Egg, pupa and adult
 - B Egg, larva and adult
 - C Egg, larva, pupa and adult
 - D Egg and adult

1.7 The hatching of fertilised eggs in the body of the female, such that the young are born alive, is called ...

- A external fertilisation.
- B ovipary.
- C vivipary.
- D ovovivipary.

(7 x 1) [7]

QUESTION 2: 5 minutes (Taken from DoE Exemplar 2011 Paper 2)

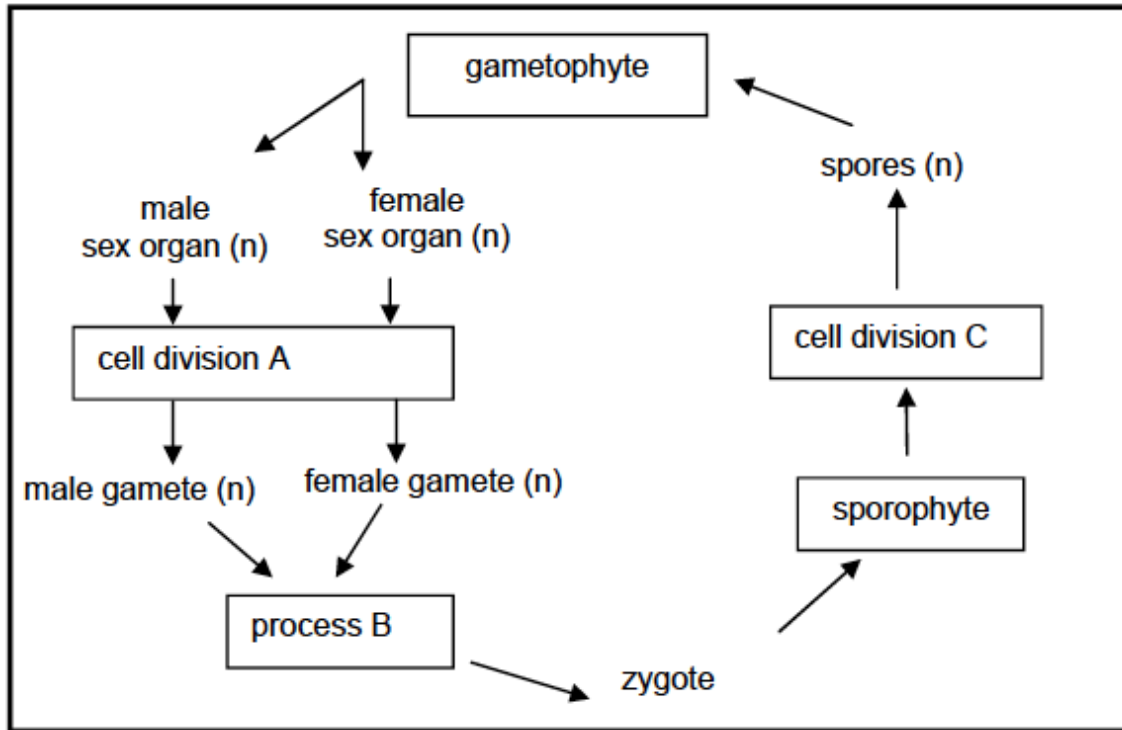
Indicate whether each of the statements in COLUMN 1 applies to A only, B only, both A and B or none of the items in COLUMN 2. Write A only, B only, Both A and B or None next to the question number.

| COLUMN 1 | COLUMN 2 |
|--|--|
| 2.1. No photoreceptors | A: Blind spot B: Yellow spot |
| 2.2. Process that reduces the chances of fertilisation | A: Contraception B: Conception |
| 2.3. Lens of the eye is too convex | A: Hypermetropia B: Astigmatism |
| 2.4. Used by plants as protection from being eaten by animals | A: Chemicals B: Thorns |
| 2.5. Example of social organisation that increases the chances of survival | A: Division of labour in bees B: A herd of zebras |

(5 x 1) (5)

QUESTION 3: 5 minutes (Taken from DoE Exemplar 2011 Paper 2)

Study the diagram of the life cycle of a plant in which the gametophyte generation is dominant, on the following page.



- 3.1. Is the life cycle represented that of moss or a flowering plant? (1)
- 3.2. Name the following: (1)
- (a) Cell division A (1)
- (b) Process B (1)
- (c) Cell division C (1)
- 3.3. Is the gametophyte haploid or diploid? (1)
- 3.4. Are seeds produced during the life cycle of this plant? (1)
- [6]

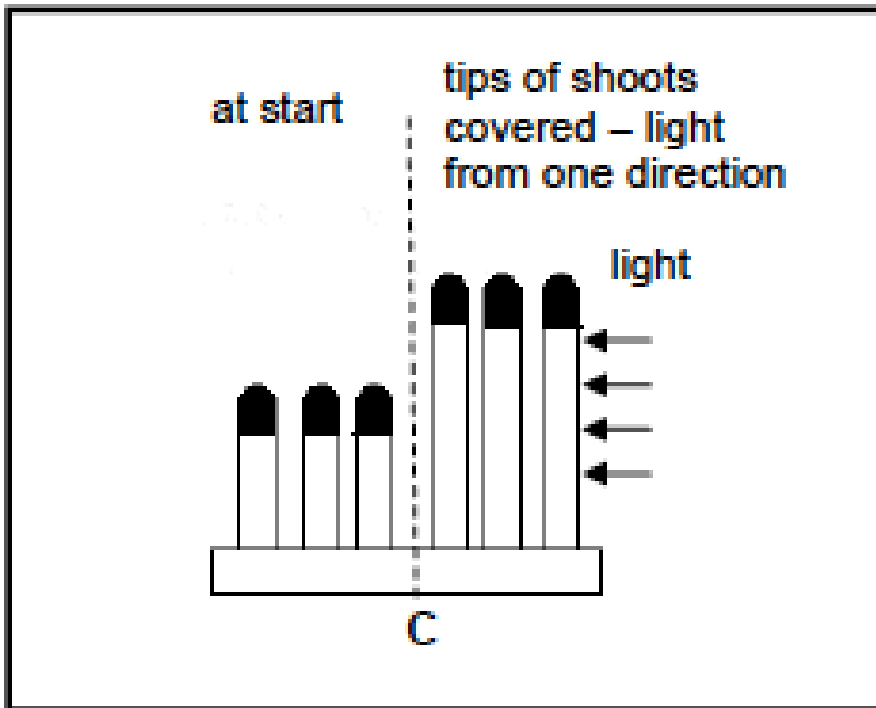
QUESTION 4: 10 minutes (Taken from DoE Exemplar 2011 Paper 2)

A group of grade 12 learners wanted to investigate the effect of light coming from one direction on the growth of shoots. They planted some wheat seeds in two seed trays and allowed them to germinate. When young shoots appeared above the soil level, the shoots were exposed to light from all directions for three days. After three days, the trays received different treatments as follows:

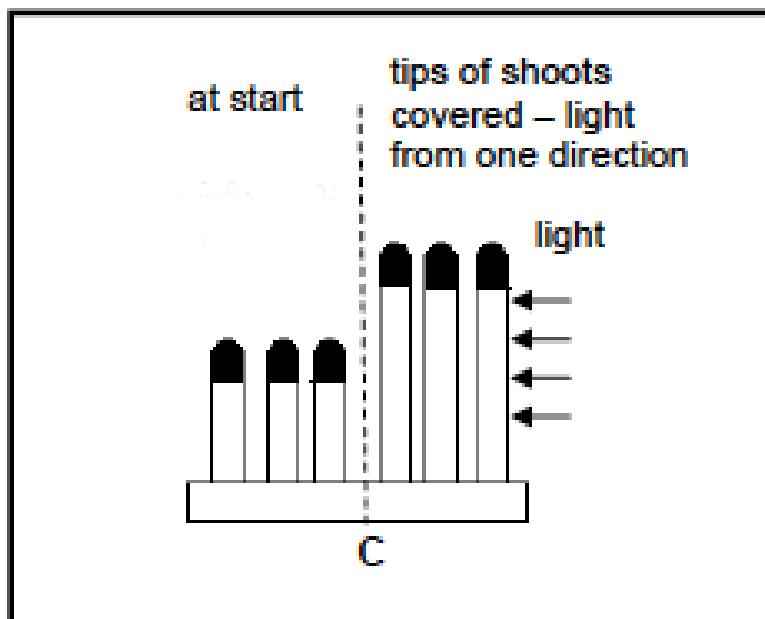
Tray A: The shoots were exposed to light from all directions.

Tray B: The shoots were exposed to light from one direction only.

The diagrams on the following page show the effects of these treatments. Study them and answer the questions that follow.



- 4.1. Formulate a hypothesis for the investigation above. (2)
- 4.2. Explain why it was important to include tray A as part of this investigation. (2)
- 4.3. State ONE conclusion that may be drawn from this investigation. (2)
- 4.4. A third tray (C) was set up in a similar way to tray A and tray B. The tips of the shoots were covered with aluminium foil. The diagram below shows the appearance of the shoots at the start, and after being exposed to light from one direction only.



What conclusion can you draw from the results obtained in tray C? (2)

4.5. Name ONE use in agriculture of the following:

(a) Auxins

(1)

(b) Gibberellins

(1)

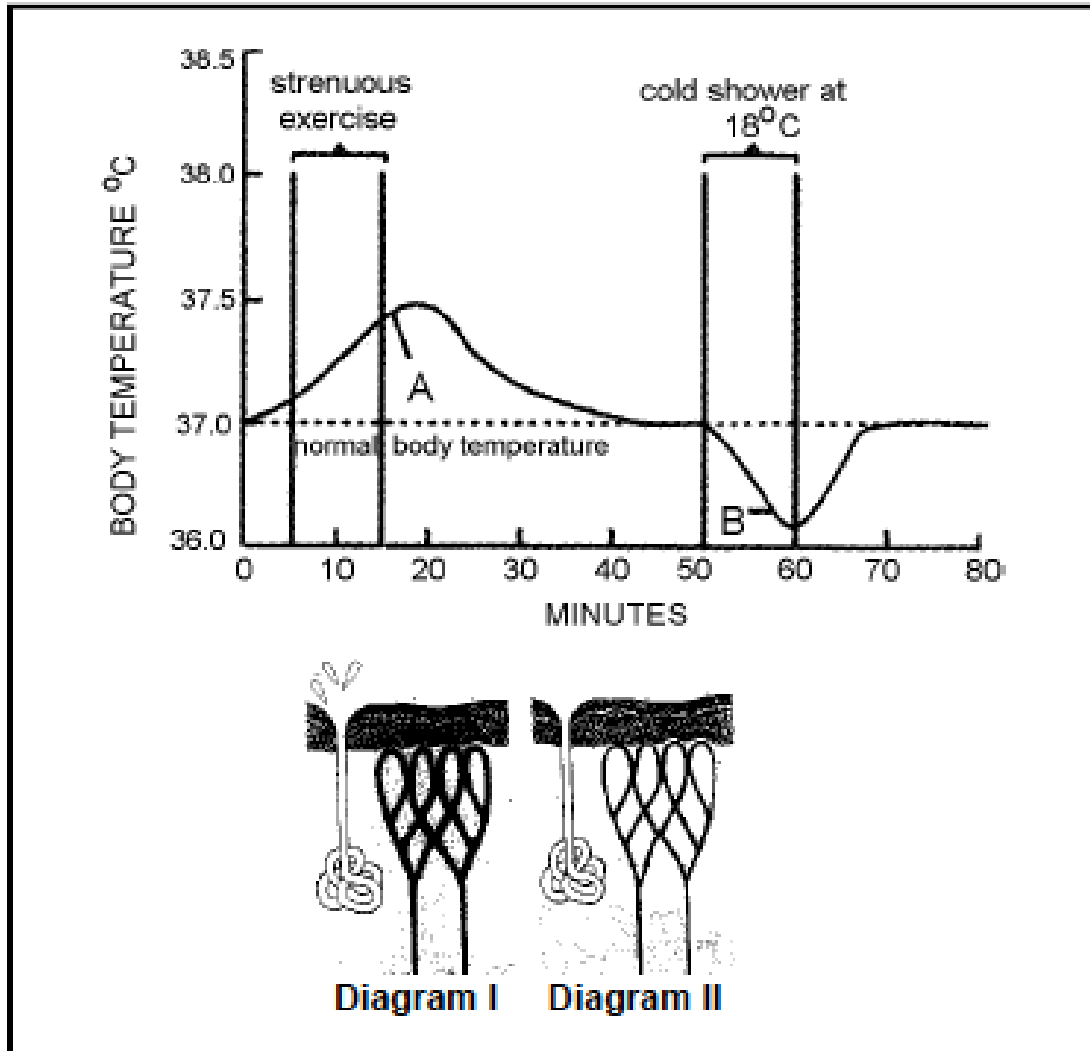
[10]

QUESTION 5:

7 minutes

(Taken from DoE Exemplar 2011 Paper 2)

The graph below shows the effect of strenuous exercise, followed by a cold shower, on the body temperature of an athlete.



5.1. Which part of the brain responds to the temperature changes that occur at A and B on the graph? (1)

5.2. What was the maximum temperature reached? (1)

5.3. For what period of time did the person engage in strenuous exercise? (1)

5.4. Why should body temperature not be allowed to fluctuate too much? (2)

5.5. Which diagram (I or II) would represent the condition of the skin after 15 minutes? (1)

5.6. Explain your answer to QUESTION 5.5. (2)

[8]

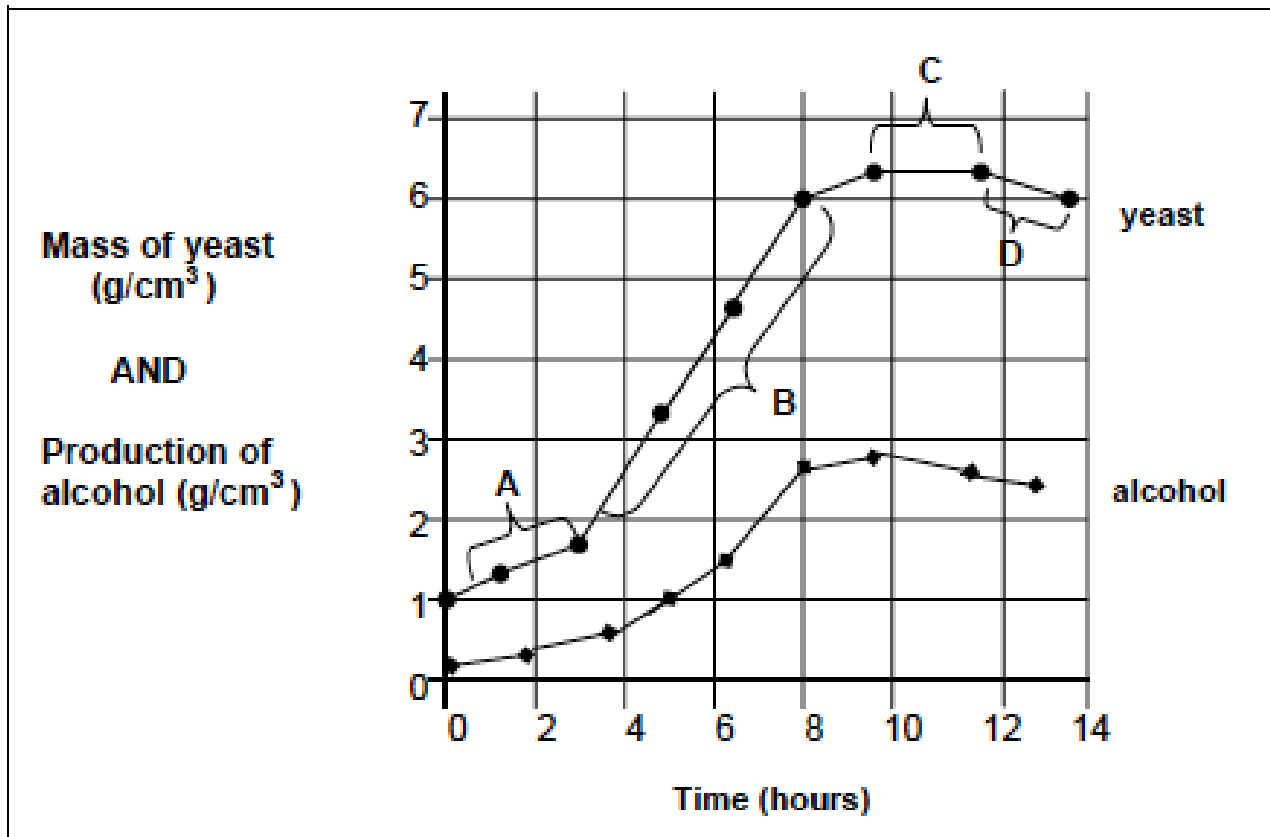
QUESTION 6: 8 minutes (Taken from DoE Exemplar 2011 Paper 2)

In an investigation to find the number of African potato plants in a field of area 6 000 m², three plots were selected, each with an area of 10 m². Plot 1 contained three, and the other plots contained seven, and two African potato plants, respectively.

- 6.1. What indirect method was used to estimate the population size? (1)
 - 6.2. How should the plots be selected to obtain a reliable estimate? (1)
 - 6.3. Estimate the total number of African potato plants in the field. Show all your workings. (3)
 - 6.4. Name ONE other indirect method that will be more appropriate to estimate the number of buck in a game reserve. (1)
 - 6.5. Name TWO advantages of projecting the future size of the human population. (2)
- [8]

QUESTION 7: 11 minutes (Taken from DoE Exemplar 2011 Paper 2)

The graph below illustrates the growth of yeast (*Saccharomyces sp.*) and the amount of alcohol it produces. The quantity of yeast was not measured by the number of yeast cells present, but by the mass of the yeast cells (g) per cm³.



- 7.1 Identify the phase of growth at C. (1)
- 7.2 Explain the shape of the graph at:
 - (a) A (2)
 - (b) B (2)
- 7.3 Using the graph, state the carrying capacity for yeast in this environment. (2)

- 7.4 State the general relationship between the growth of yeast and the production of alcohol. (2)
- 7.5 Explain the decrease in the yeast population in the last two hours. Give TWO reasons. (2)
- [11]

SECTION B: SOLUTIONS AND HINTS TO SECTION A

QUESTION 1

- 1.1. B
- 1.2. C
- 1.3. B
- 1.4. C
- 1.5. A
- 1.6. C
- 1.7. D
- (7 x 1) [7]

QUESTION 2

- 2.1. A only ✓
- 2.2. A only ✓
- 2.3. None ✓
- 2.4. Both ✓ / A and B ✓
- 2.5. Both ✓ / A and B ✓
- (5 x 1) [5]

QUESTION 3

- 3.1. Moss (1)
- 3.2. (a) Mitosis (1)
- (b) Fertilisation (1)
- (c) Meiosis (1)
- 3.3. Haploid (1)
- 3.4. No (1)
- [6]

QUESTION 4

- 4.1 Shoots ✓ will grow towards ✓ the light
OR
 Shoots ✓ will grow away ✓ from the light
OR
 Light has no ✓ influence ✓ on the shoot (2)
- 4.2 It is the control ✓ - To verify the results of the experiment ✓ To allow for one variable only. (2)
- 4.3 Shoots grow ✓ towards the source of light ✓. (2)
- 4.4 The auxins ✓ that make the shoot to grow towards the light is in the tips of the shoots ✓. (2)
- 4.5 (a) Apical dominance ✓ (2)
- (b) Tall growth of a plant/stimulate seed germination ✓ (2)
- [10]

QUESTION 5

- 5.1 Hypothalamus ✓ (1)
- 5.2 37,5 °C ✓ (1)
- 5.3 10 (1) minutes
- 5.4 Most human activities is controlled by enzymes ✓ and enzymes require optimum temperatures to function ✓ (2)
- 5.5 Diagram I ✓ (1)
- 5.6 Blood vessels dilated ✓ to bring more blood to the surface and more heat will be lost ✓ (2).
- OR**
- Increased sweat production ✓ which will cool down the body ✓ (1)
- [8]**

QUESTION 6

- 6.1 Simple sampling ✓ (1)
- 6.2 Randomly ✓ (1)
- 6.3 Average number per plot $3+7+2 \checkmark = 12 / 3 \checkmark = 4 \checkmark$ (3)
- 6.4 Mark recapture ✓ (1)
- 6.5 Planning for schools ✓
Housing needs ✓
Provision of resources ✓
Creating employment ✓
Medical service ✓
- (Mark first TWO only) (Any 2 options)** (2)
- [8]**

QUESTION 7

- 7.1 equilibrium ✓ / stationary ✓ (1)
- 7.2 (a) Slow growth ✓ due to:
time necessary for the population to acclimatise ✓ /
the time needed for individuals to locate mating partners/
or time to produce offspring (2)
- (b) Increasing growth ✓ due to very few limiting factors ✓ (2)
- 7.3 6,3 ✓ g/cm³ ✓ mass of yeast at phase C (2)
- 7.4 As the yeast population grows ✓ the production of alcohol increases ✓ (2)
- 7.5 - Population reached carrying capacity ✓ / environment cannot support any further increase due to a shortage of resources ✓
- OR**
- Increased concentration of alcohol created toxic conditions ✓ which started to kill of the yeast cells ✓ (2)
- [11]**

SECTION C: HOMEWORK

QUESTION 1: 8 minutes (Taken from Study and Master Grade 12 – old syllabus)

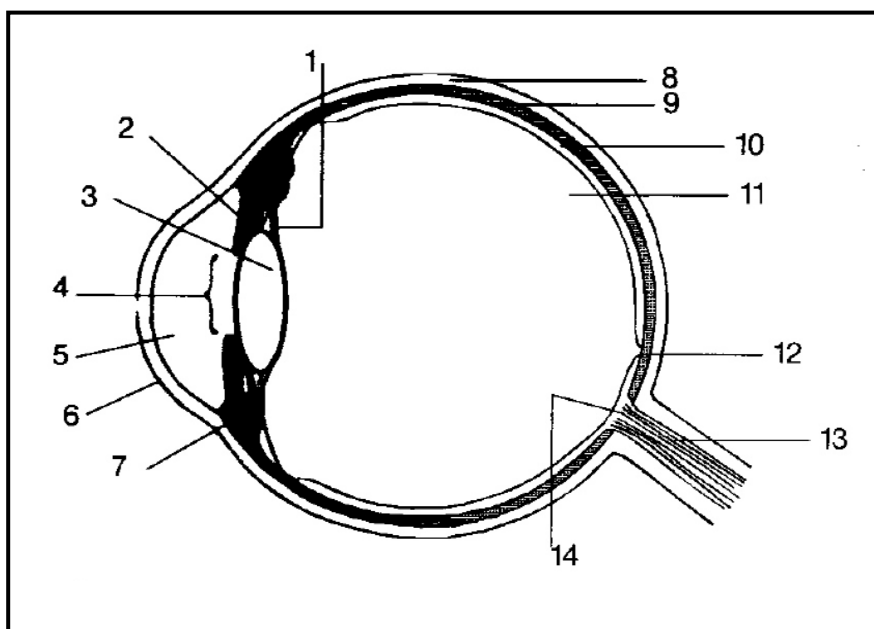
For each of the phrases in Column 1, state whether it applies to A only, B only, both A and B or none in Column 2. Write down A only, B only, A and B or None.

| Column 1 | Column 2 |
|--|--|
| 1. Site of olfactory receptors in the human body | A Ear B Eye |
| 2. Conducts impulses to the auditory centre of the brain | A Organs of Corti B Cochlea |
| 3. Refracting medium of the eyeball | A Cornea B Lens |
| 4. Fluid present in the middle canal of the inner ear | A Perilymph B Endolymph |
| 5. Play a role in the perception of gravitational pull | A Ampullae B Maculae |
| 6. Play a role in the perception of gravitational pull | A Semi-circular canals B Proprioceptors |
| 7. Assist in concentrating light rays on the fovea centralis | A Ciliary muscles B Cornea |
| 8. In dim light the radial muscles contract | A Pupillary mechanism B Eye accommodation |

(8 x 1) [8]

QUESTION 2: 30 minutes (Modified from Study and Master Grade 12 –old syllabus)

Study the diagram of the human eye and answer the questions that follow:



- 2.1. Write down the number and the name of the layer:
- a) giving colour to the eye (2)
 - b) that prevents the reflection of light rays in the eye (2)
 - c) which contains rod and cones (2)
- 2.2. Write down the number and name of the structure:
- a) mainly responsible for the refraction of light rays. (2)
 - b) where the clearest image of the object is formed. (2)
- 2.3. Write down the numbers and names of FOUR parts which refract light rays in order, as they pass through the eye. (4)
- 2.4. Write down the number and name of the layer which changes light energy into nerve impulses. (2)
- 2.5. Write down the number and name of the layer of the structure which controls the amount of light entering the eye. (2)
- 2.6. Explain the process and functioning of the structure named in QUESTION 2.5 when there is bright light. (4)
- 2.7. Explain the process that takes place in the eye when we focus on an object that is closer than 6m. (8)
- [30]

SECTION D: SOLUTIONS TO HOMEWORK

QUESTION 1

- 1.1. None
- 1.2. None
- 1.3. A and B
- 1.4. B only
- 1.5. B only
- 1.6. None
- 1.7. A and B
- 1.8. A only (8 x 1) [8]

QUESTION 2

- 2.1. a) 2 ✓ – iris ✓ (2)
- b) 9 ✓ – choroid ✓ (2)
- c) 10 ✓ – retina ✓ (structure and function must BOTH be correct for 2 marks) (2)
- 2.2. a) 6 ✓ – cornea ✓ (2)
- b) 12 ✓ – yellow spot / fovea centralis ✓ (2)
- 2.3. 6 – cornea
5 – aqueous humour
3 – lens
7 – vitreous humour
(Answer must be in the **correct order** with correct number AND structure) (4)
- 2.4. 10 ✓ – retina ✓ (2)
- 2.5. 2 ✓ – iris ✓ (2)

2.6. Bright light:

- circular muscles contract ✓
- causing pupil to constrict (get smaller) ✓
- radial muscles relax ✓
- less light is allowed into the eye ✓ (4)

2.7. Near vision:

- ciliary muscles **contract** ✓ causing the ciliary body to move closer to the lens ✓
- suspensory ligaments **slacken** ✓
- tension on the lens is released ✓
- lens becomes more convex and **rounded** ✓ increasing the **refractive power** of the lens ✓
- focal length **decreases**, ✓ bringing the object into focus onto the yellow spot of the retina ✓ (8)

[30]

SESSION 8: TOPIC 2: CONSOLIDATION – EXAMINATION PAPER 2

Teacher Note: Please ensure that the learners adhere to the time limits for each question. This is so that they learn to work quickly and efficiently. Please remind the learners of the **NEW** exam format:

Paper 1:

- DNA – code of life and RNA
- Cell division – Meiosis
- Genetics and genetic engineering
- Biodiversity - theories of the origin of plants and animals
- Biodiversity – theories of human evolution and alternative explanations.

Paper 2:

- Population ecology, community structure and ecological succession
- Plant responses to the environment (plant hormones and tropisms)
- Animal responses to the environment – nervous system, endocrine system, thermoregulation, the human eye and ear
- General reproduction and flowers as reproductive structures
- Human reproduction

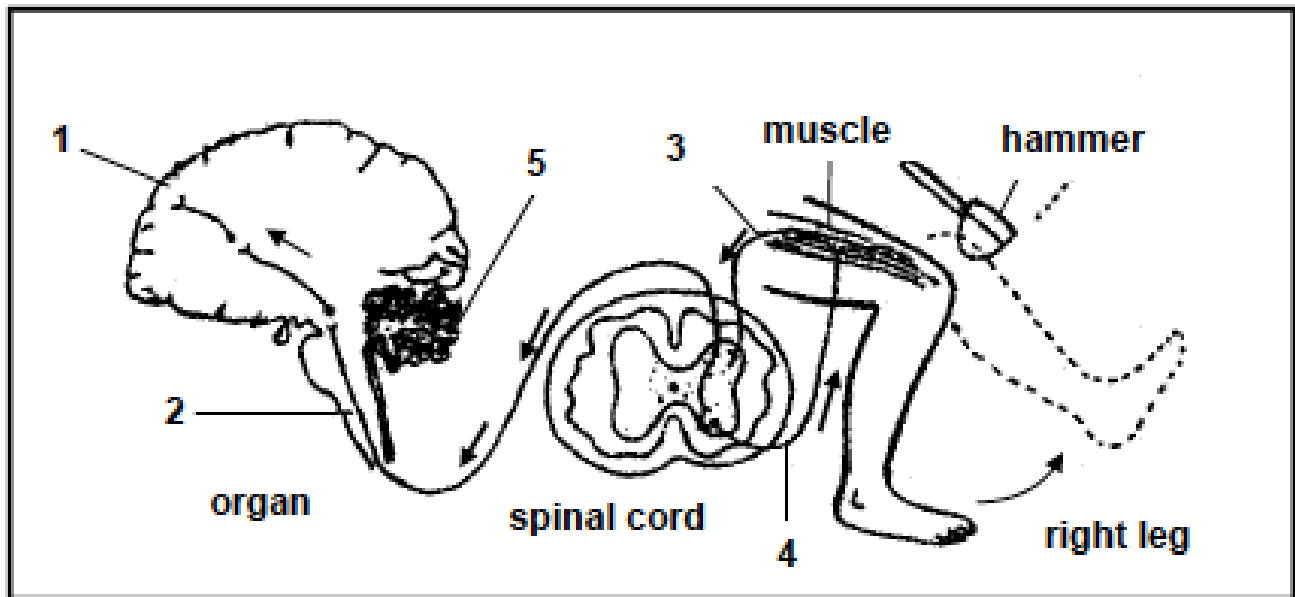
LESSON OVERVIEW

1. Typical exam questions: 60 minutes
2. Review/solutions/memo: 30 minutes

SECTION A: TYPICAL EXAM QUESTIONS**QUESTION 1: 5 minutes**

(Taken from DoE Exemplar 2011 Paper 2)

The diagram on the following page shows the human brain (longitudinal section), spinal cord (transverse section) and the right leg.



Four options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number.

- 1.1 Which part of the brain is indicated by 1?
 A Cerebrum
 B Medulla
 C Cerebellum
 D Hypothalamus
- 1.2 Which ONE of the following is a function of the part of the brain numbered 2?
 A Perception of sensations
 B Centre for control of breathing
 C Maintenance of equilibrium and balance
 D Centre for regulation of body temperature
- 1.3 Under normal circumstances, which numbered part coordinates the movements of the legs?
 A 2
 B 3
 C 4
 D 5
- 1.4 Which ONE of the following comparisons between 3 and 4 is FALSE?
 A 3 is a sensory neuron, while 4 is a motor neuron.
 B 3 leads from the receptor, while 4 leads to the effector.
 C 3 enters the dorsal root, while 4 leaves through the ventral root.
 D The cell body of 3 is located in the spinal cord, while that of 4 is found outside the spinal cord.

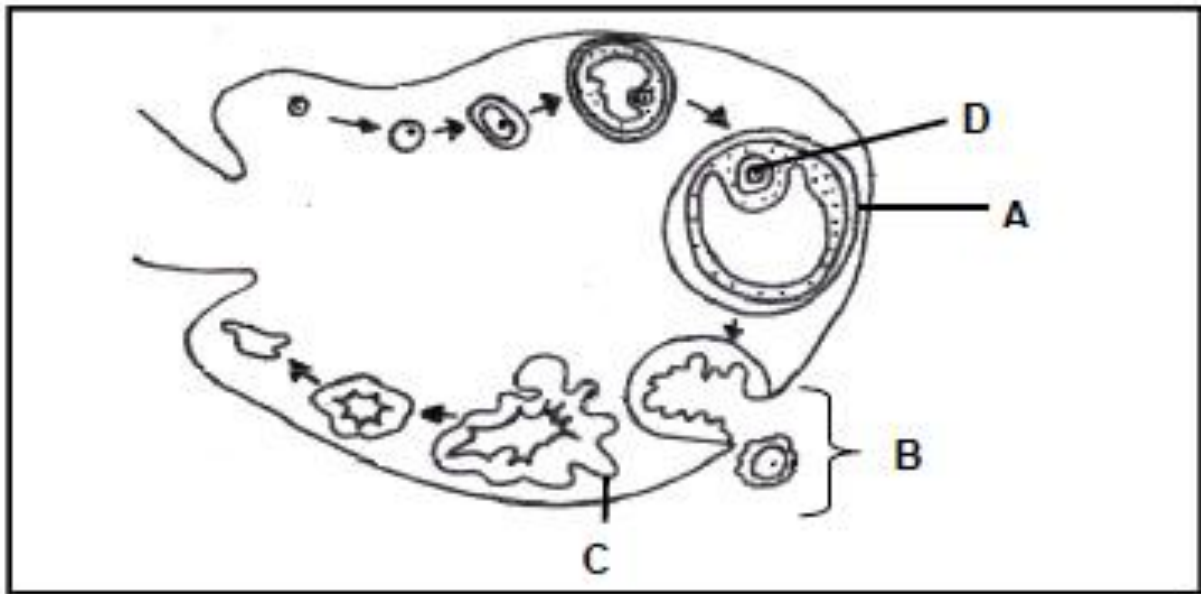
1.5 Which ONE of the following is FALSE about the role of the brain and spinal cord involved in the action in the diagram?

- A The brain is aware of the tap on the knee with the hammer.
- B An effector is stimulated to bring about a response.
- C The spinal cord receives sensory impulses from the knee.
- D The brain receives sensory impulses from the spinal cord and sends motor impulses to the leg muscles.

(5 x 1) [5]

QUESTION 2: 14 minutes (Taken from DoE Exemplar 2011 Paper 2)

Study the diagram below showing the sequence of events of the development of an ovum in a 28-day cycle and answer the questions that follow.



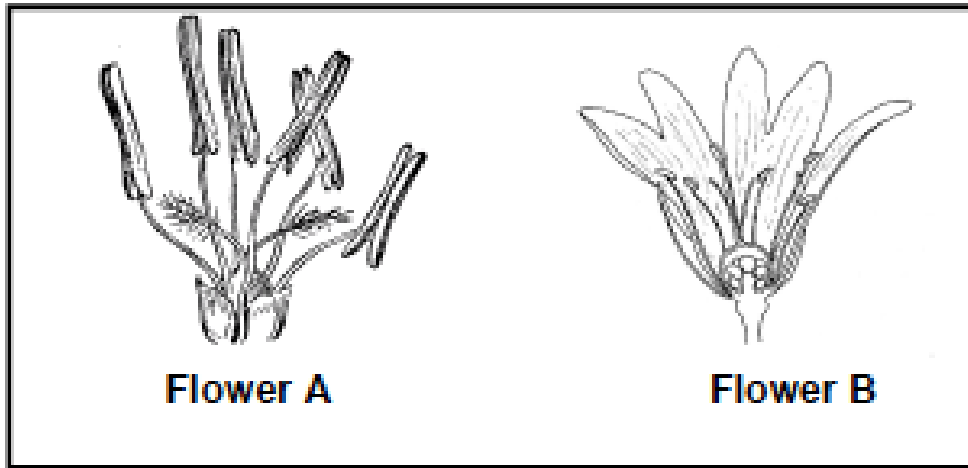
- 2.1. Identify the following:
- (a) Follicle labelled A (1)
 - (b) Structure labelled C (1)
 - (c) Process shown at B (1)
 - (d) Hormone responsible for the formation of part A (1)
 - (e) Hormone responsible for the formation of part C (1)
- 2.2. What type of cell division resulted in the formation of part D? (1)
- 2.3. If the events shown above took place in a 28-day cycle, state whether fertilisation took place during this period. (1)
- 2.4. Explain your answer to QUESTION 2.3. (3)
- 2.5. Explain HOW and WHY the production of FSH is inhibited when fertilisation takes place. (4)

[14]

QUESTION 3: 6 minutes

(Taken from DoE Exemplar 2011 Paper 2)

Study the diagrams below showing the structure of two flowers and answer the questions that follow.

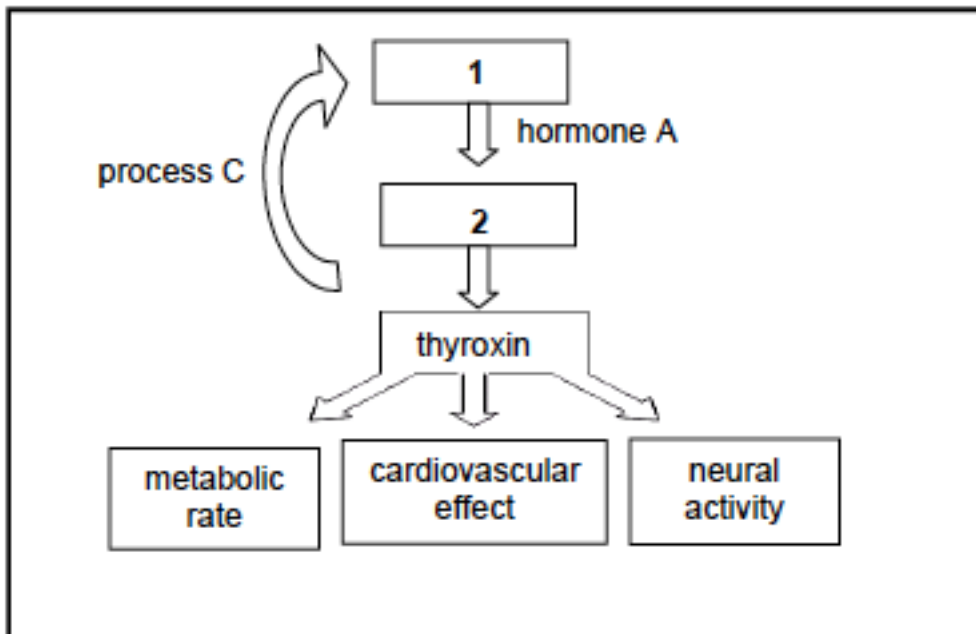


- 3.1. Define pollination. (2)
 - 3.2. Which flower (A or B) is wind-pollinated? (2)
 - 3.3. Provide TWO visible reasons for your answer to QUESTION 3.2. (2)
- [6]

QUESTION 4: 7 minutes

(Taken from DoE Exemplar 2011 Paper 2)

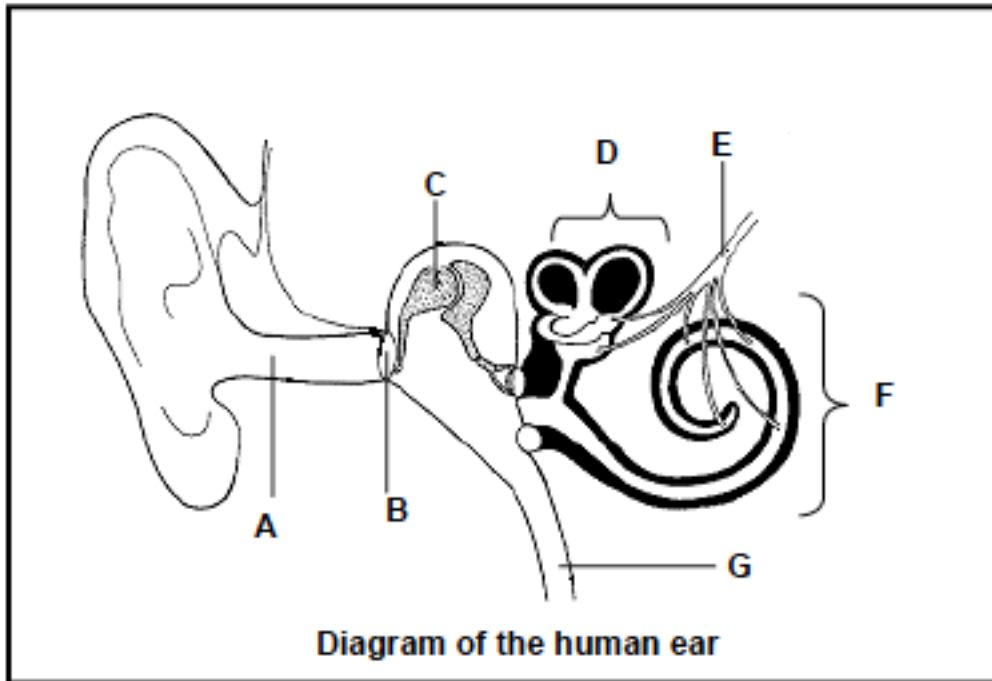
Study the diagram below and answer the questions that follow.



- 4.1. Give labels for the glands numbered 1 and 2. (2)
 - 4.2. Name hormone A. (1)
 - 4.3. Describe the negative feedback mechanism that operates when the thyroxin level in the blood is too high, as indicated by process C. (4)
- [7]

QUESTION 5:**13 minutes***(Modified from DoE Exemplar 2011 Paper 2)*

Study the diagram below and answer the questions that follow.



- 5.1. Identify the parts labelled B, C and F and name ONE function of each. (6)
- 5.2. Explain how the pinna of the ear is suited for its function. (2)
- 5.3. Name TWO functions of G. (2)
- 5.4. Write the letter of the part which:
- (a) contains receptors for balance (1)
 - (b) channels sound waves (1)
 - (b) transmits impulses to the brain (1)
- [13]

QUESTION 6:**20 minutes***(Taken from DoE Exemplar 2011 Paper 2)*

Using examples, describe predation, competition and symbiosis, explaining how each interaction influences the population size of the organisms involved.

Content: (17)

Synthesis: (3)

[20]

SECTION B: SOLUTIONS AND HINTS TO SECTION A
QUESTION 1

- 1.1. A
- 1.2. B
- 1.3. D
- 1.4. D
- 1.5. D

(5 x 1) [5]

QUESTION 2

- 2.1. (a) Graafian follicle ✓ (1)
 - (b) Corpus luteum ✓ (1)
 - (c) Ovulation ✓ (1)
 - (d) FSH ✓ (1)
 - (e) LH ✓ (1)
 - 2.2. Meiosis ✓ (1)
 - 2.3. No ✓ (1)
 - 2.4. If fertilisation occurred ✓ the corpus luteum ✓ would stay intact ✓ and not be destroyed (3)
 - 2.5. If fertilisation occurs high levels of progesterone enters the blood ✓
The high levels of progesterone inhibits the production of FSH ✓
Low levels of FSH stop the development of an ovum inside a Graafian follicle ✓
No ovulation occurs when the individual is pregnant ✓ (4)
- [14]**

QUESTION 3

- 3.1. Pollination is the transfer of pollen ✓ from the anther to the stigma ✓ of the flower
 - 3.2. Flower A ✓ (1)
 - 3.3. Large anthers ✓ (1)
 - No petals ✓ (1)
 - Large feathery stigma ✓ (2)
- (Mark first TWO only) (Any 2)**
[5]

QUESTION 4

- 4.1 1 – pituitary gland ✓
2 – thyroid gland ✓ (2)
 - 4.2 Thyroid stimulating hormone ✓ / TSH (1)
 - 4.3 High thyroxin concentration in the blood will stimulate the pituitary gland ✓ to secrete less TSH. ✓
The lower level of TSH will make the thyroid gland ✓ secrete less thyroxin ✓ which will decrease the level of thyroxin in the blood ✓ (Any 4) (4)
- [7]**

QUESTION 5

- 5.1 B - tympanic membrane ✓ to vibrate and transfer the sound wave to the ossicles / hammer ✓
 C - malleus/hammer ✓ to vibrate and transfer the sound to the anvil ✓ / amplify sound ✓
 F – cochlea ✓ to convert the stimulus of the sound waves into an impulse ✓ (6)
- 5.2 Pinna has many ridges ✓ to direct the sound waves along the auditory canal ✓
 Extends outside the head / large flaps / funnel shaped ✓ to trap sound waves ✓
(Mark first TWO answers only) (Any 2) (2)
- 5.3 Maintain air pressure on both sides of the eardrum ✓
 To drain fluid from the middle ear into the throat ✓ (2)
- 5.4 (a) D ✓ (1)
 (b) G ✓ (1)
 (c) E ✓ (1)

[13]**QUESTION 6****Predation**

A predator captures and kills other animals (prey) for its food (1)

Example: Lions that capture and feed on antelopes (1)

Prey population will decrease and the predator population will increase (1)

Competition**Interspecific competition**

Happens when large numbers of organisms of different species depend on same resources. (1)

Example: Flour beetles (1)

One species will decrease in population size while the other will increase (1)

OR**Intraspecific competition**

Happens between organisms of same species that share the same available resource. (1)

Example: Owls competing for same resources. Stronger owls will survive (1)

The owl population will decrease (1)

Symbiosis is the close association between two organisms so that one or both benefit (1)

Parasitism (1)

One organism benefit (parasite) while the other is harmed (host) (1)

Example: Tapeworm and humans (1)

The host organism's population size will decrease and the parasite population increase (1)

Mutualism (1)

Symbiotic relationship between two organisms in which both benefit (1)

Example: Bacteria and roots of leguminous plants (1)

Both populations will increase (1)

Commensalism (1)

Symbiotic relationship between two organisms in which one benefits without harming the other. (1)

Example: Sharks and sucker fish/Remora (benefit) (1)

The population size of the organism that benefits will increase in size (1)

Content: (Any 17)

ASSESSING THE PRESENTATION OF THE ESSAY

| Marks | Description |
|-------|--|
| 3 | All three interactions discussed with no irrelevant information |
| 2 | Two interactions discussed with no irrelevant information OR two interactions discussed with little irrelevant information |
| 1 | One interaction discussed with little or no irrelevant information OR two interactions discussed with little irrelevant information |
| 0 | Not attempted/nothing written other than question number/no correct information |

Synthesis: (3)

[20]

| |
|----------------------------|
| SECTION C: HOMEWORK |
|----------------------------|

QUESTION 1: 9 minutes (Taken from DoE Exemplar 2011 Paper 2)

Read the article below on elephant culling.

TOO HUNGRY, TOO DESTRUCTIVE, TOO MANY: SOUTH AFRICA TO BEGIN ELEPHANT CULLING

An elephant herd at the Kruger National Park has 20 000 elephants, 5 000 more than is sustainable. Ecologists say the animals' huge appetites and fondness for „habitat re-engineering“ – reducing forests to flatland by uprooting trees and trampling plants – is the main problem.

Culling of the excess elephants is seen as an advantage in that it generates revenue for the communities from the sale of ivory and other elephant products. It will also provide meat to the local communities. Alternatives to culling include contraception and relocation of entire elephant families. The removal of fences between the Kruger National Park and parks in neighbouring Mozambique will eventually help with migration into less congested areas.

The 1998 figure of 8 000 elephant increased to 10 000 in 2008 and it is expected to reach 34 000 by 2020

Adapted from *The Guardian* February 2008

- 1.1. Give the main reason mentioned above in support of the culling of elephants. (1)
- 1.2. Name TWO alternatives to culling proposed above. (2)

- 1.3. Draw a bar graph to show the change in the elephant population from 1998 to 2020.

(6)
[9]

QUESTION 2: **10 minutes** *(Taken from DoE Exemplar 2011 Paper 2)*

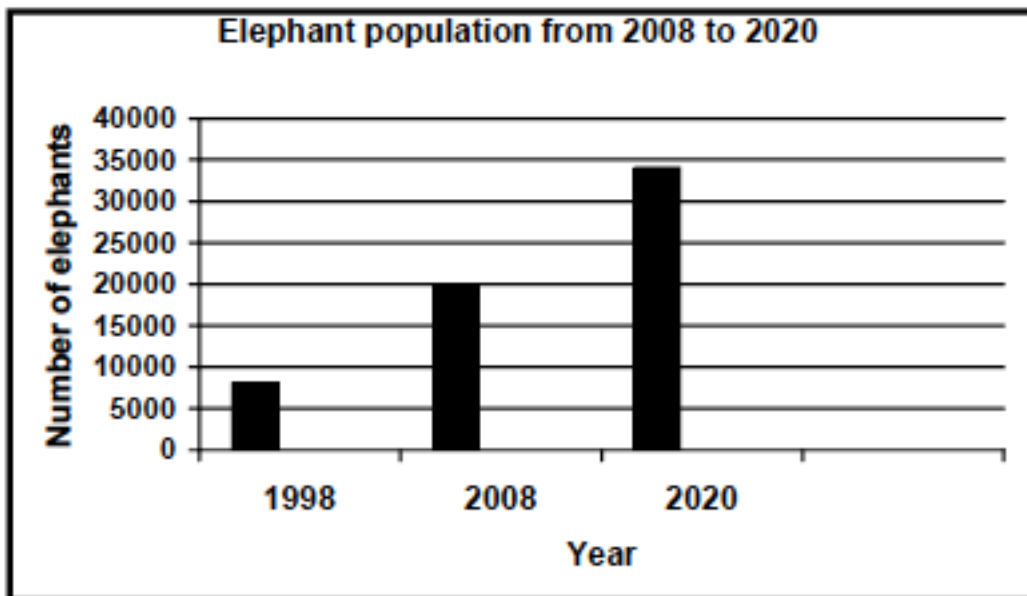
Give the correct biological term for each of the following descriptions. Write only the term next to the question number.

- 2.1. Type of vision made possible by two eyes with different, but overlapping, visual fields.
- 2.2. The permanent movement of individuals of a population out of a defined area.
- 2.3. The layer of the eyeball which is pigmented and which prevents internal reflection.
- 2.4. Development of a community over time where species in one stage are replaced by other species.
- 2.5. The total count of all individuals in a population.
- 2.6. The role of a species within the structure and functioning of an ecosystem.
- 2.7. Fluid that protects the embryo against injury and temperature changes.
- 2.8. The tube leading from the testis to the urethra in males.
- 2.9. Part of the nervous system consisting of a sympathetic and parasympathetic section.
- 2.10. The type of development whereby offspring are incapable of moving around soon after hatching. (10 x 1) [10]

SECTION D: SOLUTIONS TO HOMEWORK

QUESTION 1: **10 minutes**

- 1.1 Damage to the environment ✓ (1)
- 1.2 Contraception ✓
Relocation of elephant families ✓
Removing fences to allow migration ✓ **(Mark first TWO only)** (Any 2) (2)
- 1.3



Mark allocation for the graph:

| | |
|------------------------------|--|
| Caption for graph | 1 |
| Correct label for X-axis | 1 |
| Correct label for Y-axis | 1 |
| Appropriate scale for Y-axis | 1 |
| Drawing of bars (D) | 1 mark if 1 to 2 bars are drawn correctly 2 marks if all 3 bars are drawn correctly |

(6)
[9]

QUESTION 2

- 1.1 Binocular vision /stereoscopic vision
- 1.2 Emigration
- 1.3 Choroid
- 1.4 Ecological succession
- 1.5 Census
- 1.6 Niche
- 1.7 Amniotic
- 1.8 Vas deferens
- 1.9 Autonomic nervous system
- 1.10 Altricial development

(10 x 1) [10]