



PAPER 2 QUESTIONS (LIVE)



Lesson Description

In this lesson we:

- Work through selected examination questions adapted from 2014 Exemplar Paper covering:
 - DNA
 - Genetics



Improve your Skills

Question 1

(Adapted from DBE 2014 Exemplar P2, Question 1.1)

Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A to D) next to the question number (1.1.1 to 1.1.10)

- 1.1 Which ONE of the following serves as evidence of cultural evolution in early Homo species?
- A Drawings and carvings on rocks
 - B Animal remains close to a Homo skeleton
 - C Male and female skeletons in the same area
 - D More than one Homo skeleton in an area
- 1.2 A father has blood type A. He has 4 children with the following blood types:
- Child 1 – A
 - Child 2 – O
 - Child 3 – AB
 - Child 4 – B
- What is the blood type of the mother of the above children?
- A A
 - B B
 - C O
 - D AB



- 1.3 New alleles arise in a sexually reproducing population through ...
- A mutations in DNA sequences prior to meiosis.
 - B random fertilisation of gametes during reproduction.
 - C random assortment of homologous chromosomes during meiosis.
 - D exchange of chromatid segments between homologous chromosomes during meiosis.
- 1.4 A tall pea plant was crossed repeatedly with a short pea plant. In each of these crosses, they produced only tall offspring. It is reasonable to conclude that the ...
- A tall pea plant involved in the cross is homozygous.
 - B tall pea plant involved in the cross is heterozygous.
 - C offspring are all heterozygous for height.
 - D short pea plant involved in the cross is heterozygous.
- 1.5 The table below shows a section of the mitochondrial DNA (mtDNA) sequence for a modern human, a chimpanzee and three hominid species. The letter 'X' in the chimpanzee and the hominid sequences means that the DNA base was the same as that found in the modern human sequence.

ORGANISM	SECTION OF mtDNA SEQUENCE
Modern human	AAT-TCC-CCG-ACT-GCA-ATT-CAC-CTT
Chimpanzee	XXX-XXX-TXA-TTX-XXX-XAC-TGA-AAA
Hominid species 1	GGX-CTT-TTA-TTC-XTC-TCC-GTA-TAG
Hominid species 2	GGX-XGX-XXA-TTC-XTC-CCC-TGT-AAG
Hominid species 3	XTA-XXX-XXA-TTX-ATC-CXC-TGT-TCC

From the data in the table above it is possible to conclude that ...

- A chimpanzees are more closely related to hominid species 3 than they are to modern humans.
- B hominid species 1 is probably the most recent common ancestor of chimpanzees and modern humans.
- C modern humans are more closely related to hominid species 2 than to hominid species 3.
- D modern humans are more closely related to hominid species 3 than to hominid species 2.



- 1.6 The following data represents a small section of a sequence of nucleic acid bases taken from an animal cell:

A G C U C G U U

From this data it is reasonable to conclude that ...

- A this portion of nucleic acid will code for a chain of eight amino acids.
 - B the sequence given will be complementary to the sequence
C T C G T G C T T.
 - C the nucleic acid shown contains the sugar ribose.
 - D the nucleic acid shown is DNA
- 1.7 The list below provides information relating to the replication of DNA:
1. Complementary nucleotides bind to each of the two strands.
 2. Sugar phosphate bonds form between the nucleotides.
 3. The newly formed DNA molecules are identical to each other.
 4. After unwinding, the DNA molecule forms two single strands.

The correct order of these events as they occur in DNA replication is ...

- A 1, 2, 3 and 4.
 - B 1, 2, 3 and 2.
 - C 4, 2, 1 and 3.
 - D 4, 1, 2 and 3.
- 1.8 Which ONE of the following accounts for gametes having a single allele only for a particular characteristic, instead of two?
- A The chromosome number is halved during Meiosis II
 - B Mendel's principle of segregation
 - C Mendel's principle of independent assortment
 - D The 'law' of dominance
- 1.9 In multiple alleles ...
- A more than one gene controls a trait or characteristic.
 - B there are more than two different alleles for the same gene.
 - C the different alleles for the same characteristic are at different positions.
 - D there are only two alleles for a particular gene.



- 1.10 In a situation where a characteristic is expressed more frequently in males than in females in humans, we can conclude that ...
- A one allele is dominant over the other.
 - B the alleles for the characteristic are located on the X chromosomes.
 - C the alleles for the characteristic are located on the autosomes.
 - D the alleles for the characteristic are located on the Y chromosomes.

Question 2

(Adapted from DBE 2014 Exemplar P2, Question 1.2)

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

- 2.1 An allele that does not influence the phenotype when found in the heterozygous condition
- 2.2 The position of a gene on a chromosome
- 2.3 The physical and functional expression of a gene
- 2.4 Chromosomes that are not responsible for sex determination
- 2.5 The process of finding a desirable gene, isolating it and then moving it into the cells of another organism

Question 3

(Adapted from DBE 2014 Exemplar P2, Question 1.3)

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

COLUMN I	COLUMN II
3.1 Discovered the double helical structure of DNA	A Francis Crick B James Watson
3.2 Describes evolution as consisting of long phases of little change alternating with short phases of rapid change	A punctuated equilibrium B Darwinism
3.3 Variation within a population in which there is a range of intermediate phenotypes	A discontinuous variation B continuous variation
3.4 Evidence for evolution	A mitochondrial DNA B cladogram
3.5 Two alleles of a gene that are equally dominant	A Co-dominance B complete dominance
3.6 Bonds that hold amino acids together in a protein molecule	A hydrogen bonds B peptide bonds



Question 4

(Adapted from DBE 2014 Exemplar P2, Question 1.4)

In pea plants the allele for round seeds (R) is dominant over the allele for wrinkled seeds (r). The allele for yellow seeds (Y) is dominant over the allele for green seeds (y).

Plant A, heterozygous for both seed shape and seed colour, was crossed with plant B, which had wrinkled, green seeds.

4.1 Write down the genotype of:

4.1.1 Plant A

4.1.2 Plant B

4.2 Write down ALL the possible genotypes of the gametes of plant A.

4.3 State the phenotype of an offspring having the genotype:

4.3.1 rrYy

4.3.2 RrYy

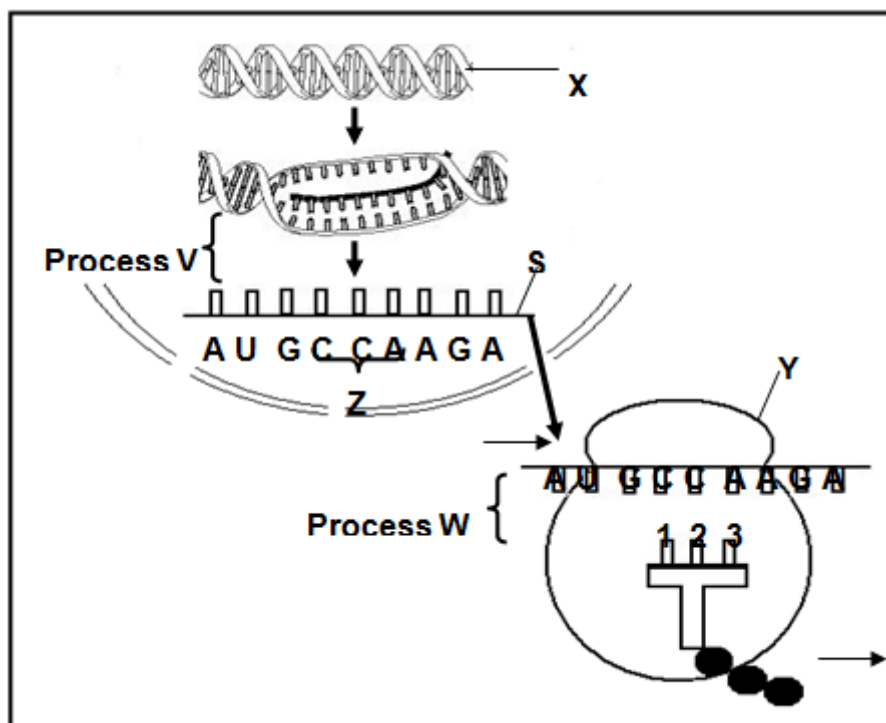
4.4 When plant B was crossed with plant C, all the offspring had round yellow seeds.

Use this information and write down the genotype of plant C.

Question 5

(Adapted from DBE 2014 Exemplar P2, Question 2.1)

The diagram below shows the process of protein synthesis.



5.1 Identify the following

5.1.1 Molecule X

5.1.2 Organelle Y



- 5.2 Identify the nitrogenous base labelled:
- 5.2.1 1
- 5.2.2 3
- 5.3 Describe the role of DNA during transcription.
- 5.4 Describe the part of protein synthesis shown as process W, which occurs at organelle Y.
- 5.5 The table below shows the amino acids that correspond with different DNA codes.

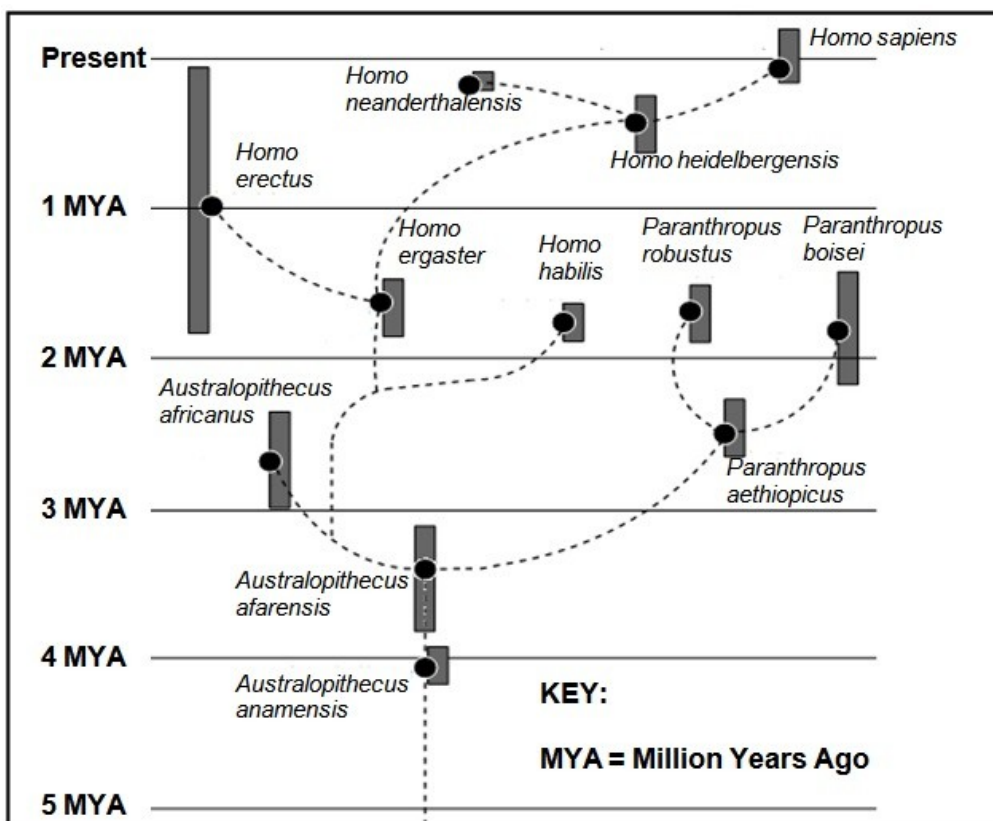
AMINO ACID	DNA CODE
Arginine	TCT
Methionine	TAC
Glycine	GGT

Write down the correct sequence of amino acids coded for by structure **S** in the diagram above.

Question 6

(Adapted from DBE 2014 Exemplar P2, Question 2.2)

The phylogenetic tree below shows one interpretation of the origin of humans. The dotted lines indicate the possible evolutionary relationships, and the vertical bars show the period during which the organisms are believed to have existed on earth.





- 6.1 Use the diagram to identify ONE organism that may have competed with *Homo heidelbergensis* for resources.
- 6.2 Identify the common ancestor that gave rise to both *Paranthropus* and *Homo*.
- 6.3 For what period of time did *A. africanus* exist on Earth? Show all working.
- 6.4 Name ONE piece of evidence that could be used to prove that *A. africanus* existed during the time period calculated in QUESTION 6.3.
- 6.5 Which organism, *H. ergaster* or *H. neanderthalensis*, is more closely related to modern-day humans?
- 6.6 Explain your answer to QUESTION 6.5 using information in the diagram.

Question 7

(Adapted from DBE 2014 Exemplar P2, Question 3.1)

Scientists investigated the resistance of mosquitos to DDT.

The following steps were followed:

- They captured a sample of mosquitos from the environment.
- The mosquitos were then exposed to a standard dose of DDT (4% DDT for 1 hour) in the laboratory.
- The number of mosquitos that died was counted.
- Those that survived were left to reproduce.
- A sample was taken from this population every two months and the same procedure was followed for a period of 16 months.

The results are shown in the table below.

TIME (IN MONTHS)	MORTALITY OF MOSQUITOES (%)
0	95
2	87
4	80
6	69
8	60
10	54
12	35
14	27
16	22

- 7.1 Identify the:
 - 7.1.1 Independent variable
 - 7.1.2 Dependent variable



- 7.2 Formulate a hypothesis for this investigation.
- 7.3 Draw a line graph to show how the mortality of mosquitoes changed over the period of the investigation due to the application of DDT.
- 7.4 State TWO factors, other than those mentioned, that should be controlled in this investigation.
- 7.5 State TWO ways in which the scientists could improve the reliability of their results.
- 7.6 Explain, in terms of natural selection, how mosquitoes may develop resistance to DDT.

Question 8

(Adapted from DBE 2014 Exemplar P2, Question 3.2)

Study the table below, which indicates some of the hominid fossils found in different parts of the world.

SPECIES	AREA WHERE IT WAS FOUND	PERIOD OF EXISTENCE
<i>Australopithecus afarensis</i>	Eastern Africa	3,4–2,8 mya
<i>Australopithecus africanus</i>	Southern Africa	2,1–2,8 mya
<i>Australopithecus sediba</i>	Southern Africa	2,0–1,9 mya
<i>Homo habilis</i>	Sub-Saharan (Africa)	2,3–1,4 mya
<i>Homo erectus</i>	Africa, Europe, Asia	1,5–0,2 mya
<i>Homo heidelbergensis</i>	Europe, China	0,6–0,35 mya
<i>Homo neanderthalensis</i>	Europe, Western Asia	0,35–0,03 mya
<i>Homo sapiens</i>	Worldwide	0,2 mya–present

[Adapted from *The Evolutionary Road*, Jamie Shreeve, *National Geographic*, July 2010]

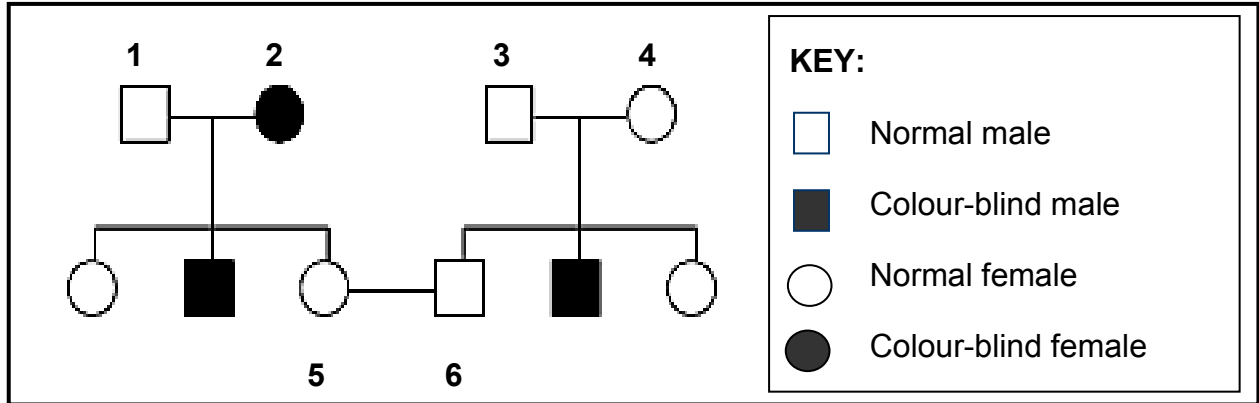
- 8.1 Explain why the information in the table supports the 'Out of Africa' hypothesis.
- 8.2 Describe how the analysis of mitochondrial DNA is used to support the 'Out of Africa' hypothesis.



Question 9

(Adapted from DBE 2014 Exemplar P2, Question 3.3)

The pedigree diagram below shows the inheritance of Daltonism in a family. Daltonism (red-green colour-blindness) is sex-linked. The allele for Daltonism is recessive to the allele for normal colour vision.



- 9.1 Use the symbols X^D , X^d and Y to state the genotype of the following:
- 9.1.1 Individual 2
 - 9.1.2 Individual 3
- 9.2 How many family members not affected by Daltonism are definitely carriers?
- 9.3 Use a genetic cross to determine the possible genotypes and phenotypes of the offspring that may be formed by individuals 5 and 6.

Question 10

(Adapted from DBE 2014 Exemplar P2, Question 4)

It is thought that modern humans evolved gradually from ape-like beings over millions of years through speciation.

Describe how a single species can form new species, and explain how the differences in the skulls and other parts of the skeleton of primitive ape-like beings and modern humans support the idea that the general trend in human evolution has been towards bipedalism and a change in diet from raw food to cooked food.



SOLUTIONS TO PAPER 2 QUESTIONS (LIVE)

Question 1

(Adapted from DBE 2014 Exemplar P2, Question 1.1)

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

Question 2

(Adapted from DBE 2014 Exemplar P2, Question 1.2)

- 2.1 Recessive
- 2.2 Locus
- 2.3 Phenotype
- 2.4 Autosomes
- 2.5 Genetic engineering/DNA manipulation/

Question 3

(Adapted from DBE 2014 Exemplar P2, Question 1.3)

- 3.1 Both A and B
- 3.2 A only
- 3.3 B only
- 3.4 A only
- 3.5 B only
- 3.6 A only

Question 4

(Adapted from DBE 2014 Exemplar P2, Question 1.4)

- 4.1.1 RrYy
- 4.1.2 rryy
- 4.2 RY, Ry, rY, ry
- 4.3.1 Wrinkled, yellow seeds



4.3.2 Round, yellow seeds

4.4 RRY Y

Question 5

(Adapted from DBE 2014 Exemplar P2, Question 2.1)

5.1.1 DNA

5.1.2 Ribosome

5.2.1 G

5.2.2 U

5.3 DNA codes for a particular protein but cannot leave nucleus

One strand of DNA is used as a template
to form mRNA

5.4 According to the codons on mRNA

tRNA molecules with matching anticodons
bring the required amino acids to the ribosome
This is called translation

The amino acids become attached by peptide bonds
to form the required protein

5.5 Methionine, Glycine, Arginine (in the correct order)

Question 6

(Adapted from DBE 2014 Exemplar P2, Question 2.2)

6.1 H. erectus

6.2 A. afarensis

6.3 $3 \text{ mya} - 2,4 \text{ mya} = 0,6 \text{ my}$

OR

$3 \text{ mya} - 2,3 \text{ mya} = 0,7 \text{ my}$

6.4 Fossils

6.5 H. neanderthalensis

6.6 H. neanderthalensis and H. sapiens share a common ancestor

OR

Both evolved from H heidelbergensis

Question 7

(Adapted from DBE 2014 Exemplar P2, Question 3.1)

7.1.1 Time

7.1.2 Mortality of mosquitoes



7.2 Mosquito Mortality due to DDT/Resistance of mosquitos to DDT will decrease over time

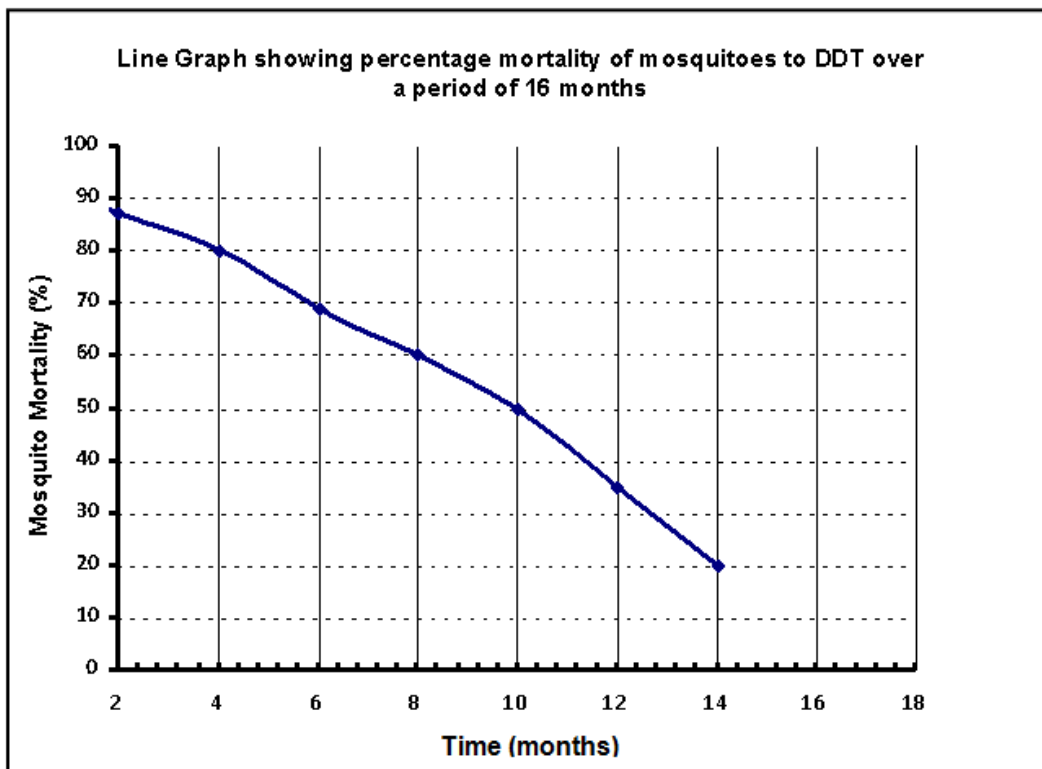
OR

Mosquito Mortality due to DDT✓/Resistance of mosquitos to DDT will increase over time

OR

Mosquito Mortality due to DDT/Resistance of mosquitos to DDT will remain the same over time

7.3



7.4 Same species of mosquito

Identical laboratory conditions for the full period of the investigation

The same scientist must be used for the full period of the investigation

Mosquitos should not be hurt for the full period of the investigation

7.5 Use a larger sample of mosquitoes

Repeat the investigation

Take many samples each time and calculate the average mortality

7.6 More mosquitoes are produced than can survive.

There is genetic variation amongst the mosquitoes.

Some mosquitoes may be naturally resistant to DDT.

When DDT is applied



those that are resistant survive
and they then reproduce,
passing the allele for resistance to the offspring.

Those that are not resistant, die
and their alleles are lost from the population.

The number of DDT-resistant mosquitoes therefore increases over the generations.

Question 8

(Adapted from DBE 2014 Exemplar P2, Question 3.2)

- 8.1 The oldest fossils of human ancestors were only found in Africa
- 8.2 Mitochondrial DNA is passed down from mother to child
mutations on the mitochondrial DNA
were traced to an ancestral female that existed in Africa

Question 9

(Adapted from DBE 2014 Exemplar P2, Question 3.3)

- 9.1.1 XdXd
- 9.1.2 XDY
- 9.2 3



9.3

P₁ phenotype Normal female x Normal male ✓
 genotype $X^D X^d$ x $X^D Y$ ✓
Meiosis
G₁ X^D, X^d x X^D, Y ✓
Fertilisation
 $X^D X^D, X^D X^d, X^D Y, X^d Y$ ✓
F₁ genotype 2 normal females 1 normal 1 colour-
 phenotype female male blind male ✓
 Parents and offspring ✓ / P₁ & F₁
 Meiosis and fertilisation ✓ (any 6)

OR

P₁/parent phenotype Grey bodied x grey bodied ✓
 genotype Gg x Gg ✓
Meiosis

gametes	X^D	X^d
X^D	$X^D X^D$	$X^D X^d$
Y	$X^D Y$	$X^d Y$

1 mark for correct gametes ✓
 1 mark for correct genotypes ✓

F₁ genotype 2 normal females 1 normal 1 colour-
 phenotype female male blind male
 Parents and offspring ✓ / P₁ & F₁
 Meiosis and fertilisation ✓ (any 6)

Question 10

(Adapted from DBE 2014 Exemplar P2, Question 4)

The development of a new species

- If a population splits into two populations ✓.
- There is now no gene flow between the two populations. ✓
- Since each population may be exposed to different environmental conditions ✓,
- Natural selection occurs independently in each of the two populations ✓
- such that the individuals of the two populations become very different from each other ✓
- genotypically and phenotypically ✓.





- Even if the two populations were to mix again✓,
- they will not be able to reproduce with each other✓, thus becoming different species

(any 5)

The development of bipedalism

- The backward position of the foramen magnum on the skull✓,
- the narrow pelvis✓
- and the less-curved spine✓
- indicates that the ape-like beings were quadripedal✓

(any 3)

- The forward position of the foramen magnum on the skull✓,
- the wider pelvis✓
- and the curved spine✓
- indicates that modern humans are bipedal✓

(any 3)

Change in the diet from raw food to cooked food

- The large teeth, especially the canines✓
- as well as the large and long jaws✓
- which makes the skull prognathous✓
- as well as cranial/brow ridges associated with large muscles that operate the jaws✓
- indicate that the ape-like beings ate raw food that required a great amount of processing✓/tearing, biting and chewing.

(any 3)

- The smaller teeth, including the canines✓
- as well as the smaller jaw size✓
- which makes the skull less prognathous✓
- as well as the absence of cranial/brow ridges due to the presence of smaller muscles for chewing✓
- indicate that modern humans rely on a diet of cooked food that does not require the same amount of processing✓/tearing, biting and chewing.

(any 3)

Content: (17)

Synthesis: (3)