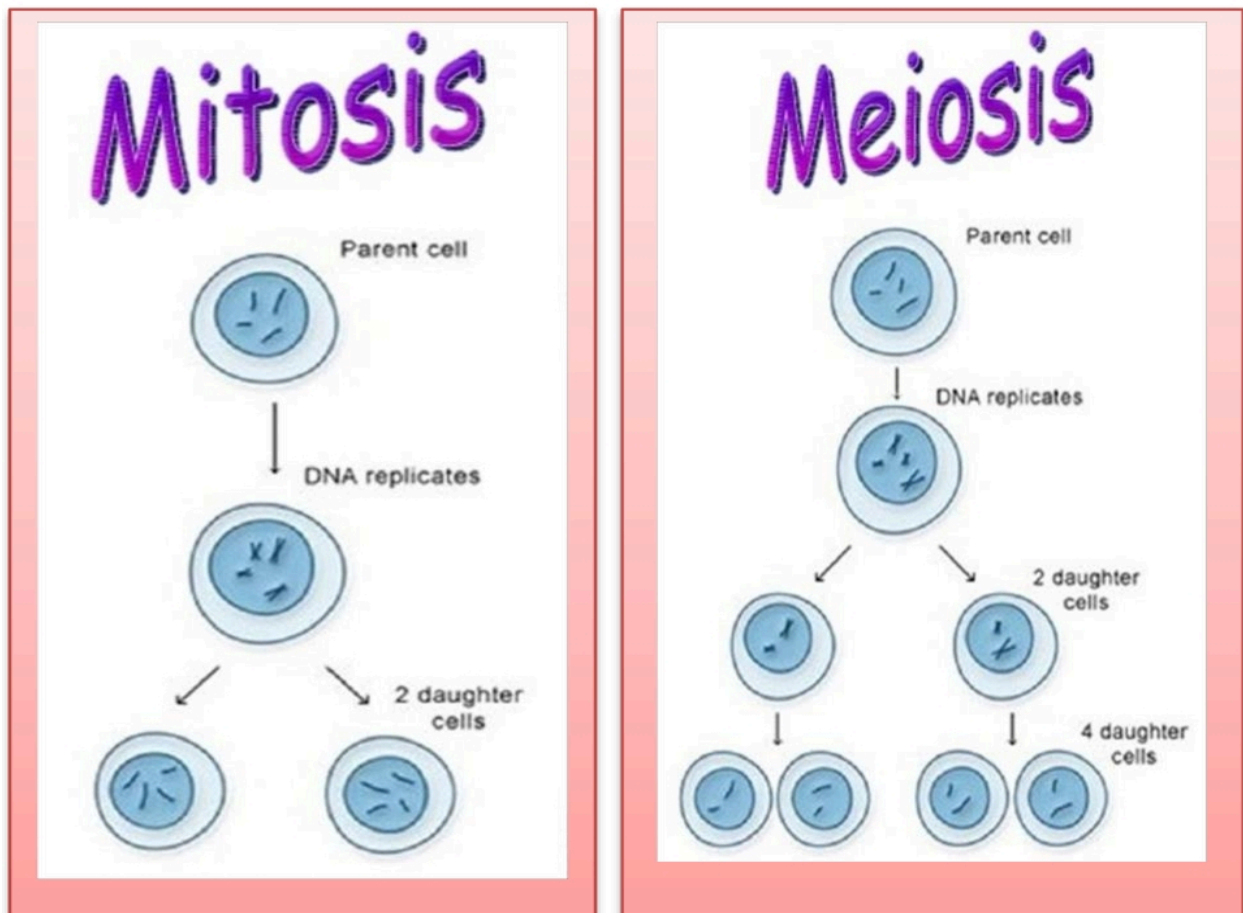


MEIOSIS



REVISION QUESTIONS

EXAM GUIDELINES:

MEIOSIS Paper 1: 11 marks & Paper 2: 12 marks		Term 1	2 weeks
CONTENT	ELABORATION		
Introduction	❑ Revision of the structure of a cell with an emphasis on the parts of the nucleus, the centrosome and the cytoplasm ❑ Structure of chromosomes: • Chromosomes consist of DNA (which makes up genes) and protein • The number of chromosomes in a cell is a characteristic of an organism (e.g. humans have 46 chromosomes) • Chromosomes which are single threads become double (two chromatids joined by a centromere) as a result of DNA replication ❑ Differentiate between: • Haploid (n) and diploid ($2n$) cells in terms of chromosome number • Sex cells (gametes) and somatic cells (body cells) • Sex chromosomes (gonosomes) and autosomes ❑ Revision of the process of mitosis		

CONTENT	ELABORATION
Meiosis – The process	❑ Definition of meiosis ❑ Site of meiosis in plants and in animals ❑ Meiosis is a continuous process, but the events are divided into different phases for convenience ❑ Events of interphase: • DNA replication takes place • Chromosomes which are single threads, become double • Each chromosome will now consist of two chromatids joined by a centromere • DNA replication helps to double the genetic material so that it can be shared by the new cells arising from cell division ❑ The events of the following phases of Meiosis I, using diagrams: • Prophase I - Including a description of crossing over • Metaphase I - Including the random arrangement of chromosomes • Anaphase I • Telophase I ❑ The events of each phase of Meiosis II, using diagrams: • Prophase II • Metaphase II - Including the random arrangement of chromosomes • Anaphase II • Telophase II
Importance of meiosis	❑ The importance of meiosis: • Production of haploid gametes • The halving effect of meiosis overcomes the doubling effect of fertilisation, thus maintaining a constant chromosome number from one generation to the next • Mechanism to introduce genetic variation through: - Crossing over - The random arrangement of chromosomes at the equator
Abnormal meiosis	❑ Non-disjunction and its consequences ❑ Non-disjunction of chromosome pair 21 during Anaphase I in humans to form abnormal gametes with an extra copy of chromosome 21 ❑ The fusion between an abnormal gamete (24 chromosomes) and a normal gamete (23 chromosomes) may lead to Down syndrome
Comparison of mitosis and meiosis	❑ Similarities of mitosis and meiosis ❑ Differences between mitosis and meiosis

BIOLOGICAL TERMS:

EXPLANATION	TERM
Structures found only in animal cells that form the spindle during cell division.	
The phase in the cell cycle when DNA replication occurs.	
The division of the cytoplasm through the constriction of the cell membrane at the end of cell division.	
The point where two chromatids overlap during prophase I	

The two parts of a chromosome held together by a centromere.	
The phase of meiosis during which homologous chromosomes separate and start moving towards opposite poles.	
The defect in cell division that leads to Down syndrome.	
The structure that is made up of two chromatids joined by a centromere	
The complete set of chromosomes in the cell of an organism.	
A representation of the number, shape and arrangement of all the chromosomes in the nucleus of a somatic cell.	
The structure responsible for pulling chromosomes to the poles of an animal cell during cell division.	
A phase in the cell cycle that occurs before cell division.	
A human disorder caused by a non-disjunction of chromosome pair 21.	
The name of the process when homologous chromosome pairs fail to separate during meiosis	

REVISION QUESTIONS: MULTIPLE CHOICE

QUESTION 1.1 & 1.2

- 1.1.9 In gamete formation in human females, each diploid cell forms ...
- A four diploid gametes.
 - B one diploid gamete.
 - C one haploid gamete.
 - D two haploid gametes.
- 1.1.10 Crossing-over and random arrangement of chromosomes occur respectively in ...
- A prophase II and metaphase II.
 - B prophase I and metaphase I.
 - C prophase II and anaphase II.
 - D prophase I and anaphase I.
- (10 x 2)

QUESTION 1.3

- 1.1.3 The number of chromosomes found in a human sperm cell is ...
- A 23.
 - B 22.
 - C 46.
 - D 47.

QUESTION 1.4

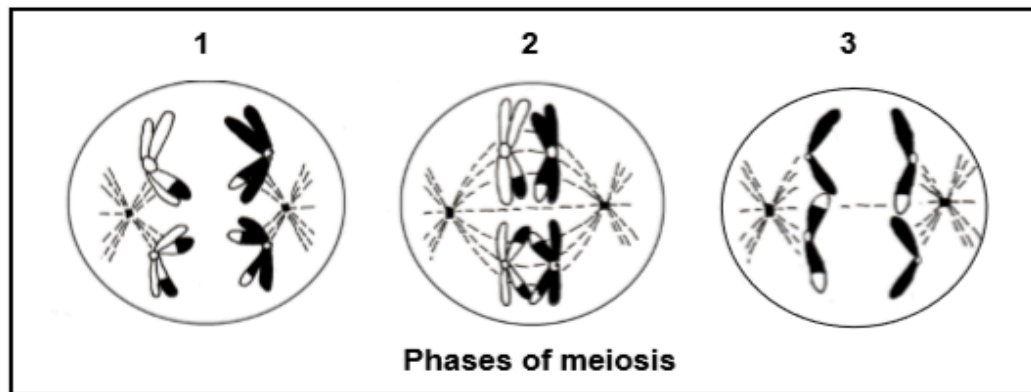
- 1.1.9 Homologous chromosomes are described as ...
- A being similar in structure and coding for the same characteristics.
 - B a product of the division of chromosomes.
 - C identical daughter chromatids formed through DNA replication.
 - D two chromosomes that code for different characteristics.

QUESTION 1.5

- 1.1.1 When a cell divides by meiosis it results in ...
- A four haploid gametes.
 - B two diploid gametes.
 - C four haploid somatic cells.
 - D two haploid somatic cells.

QUESTION 1.6

1.1.4 The diagrams below represent different phases of meiosis.

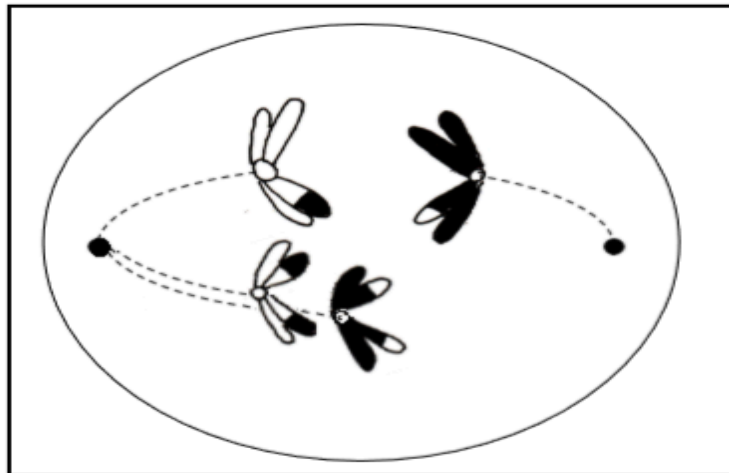


The correct order of the phases is ...

- A 1, 2 and 3.
- B 2, 3 and 1.
- C 3, 1 and 2.
- D 2, 1 and 3.

QUESTION 1.7

1.1.2 The diagram below shows a cell undergoing meiosis.



The diagram above shows ...

- A non-disjunction in metaphase II.
- B a chromosomal aberration that results in haemophilia.
- C a chromosomal aberration involving chromosome pair number 23, leading to Down syndrome.
- D non-disjunction in anaphase I.

QUESTION 1.8

1.1.6 The following relates to meiosis and reproduction:

- (i) Prophase I
- (ii) Metaphase I
- (iii) Prophase II
- (iv) Fertilisation

Which ONE of the following combinations is most likely to contribute to genetic variation amongst offspring?

- A (ii) and (iv) only
- B (i), (iii) and (iv) only
- C (ii) and (iii) only
- D (i), (ii) and (iv) only

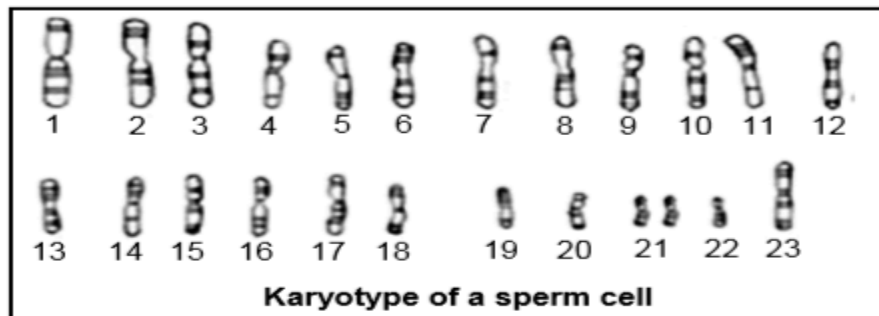
QUESTION 1.9

1.1.5 Which ONE of the following is most likely the chromosome complement of a person with Down syndrome?

- A 46 and XX
- B 46 and XY
- C 45 and XX
- D 44 and XY

QUESTION 1.10

- 1.1.7 The diagram below represents the chromosomes from a sperm cell.



According to the karyotype, how many autosomes are present in the sperm cell?

- A 21
- B 22
- C 23
- D 24

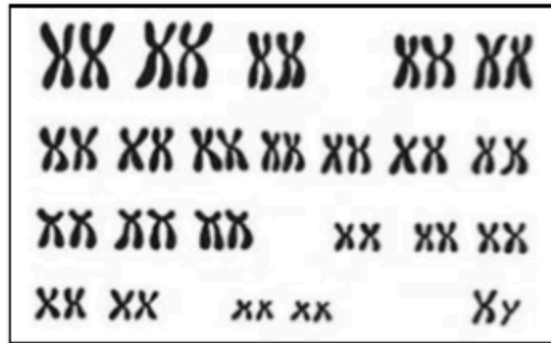
QUESTION 1.11

- 1.1.3 A human somatic cell has ...

- A 46 autosomes and 2 gonosomes.
- B 2 autosomes and 44 gonosomes.
- C 44 autosomes and 2 gonosomes.
- D 23 autosomes and 23 gonosomes.

QUESTION 1.12

1.1.7 The diagram below shows the karyotype of an organism.



Study the following descriptions:

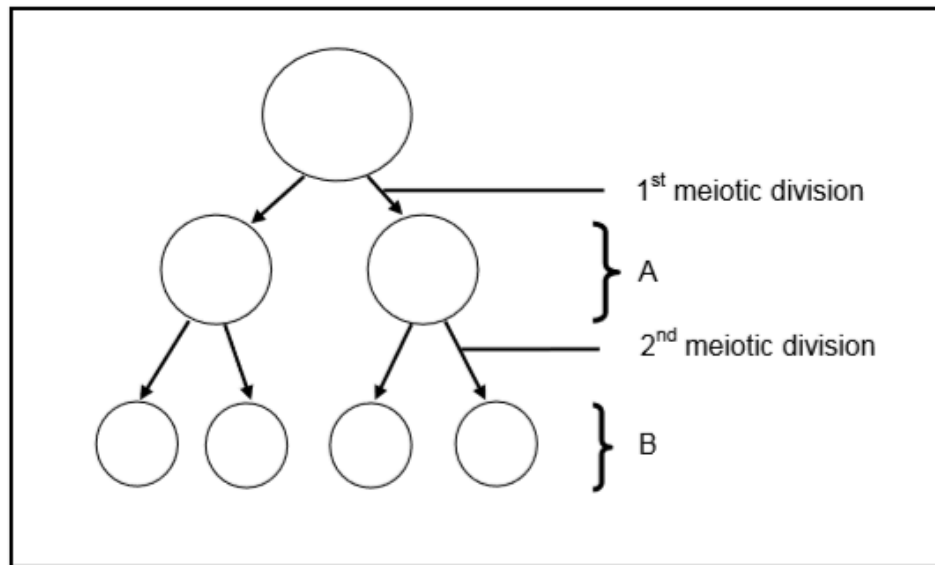
- (i) There are 46 chromosomes.
- (ii) There are 46 autosomes.
- (iii) The 2 gonosomes are different from each other.
- (iv) The 2 gonosomes are identical.

Which combination of descriptions can be used to identify this karyotype as belonging to a normal, human male?

- A (i), (iii) and (iv)
- B (i) and (ii) only
- C (ii) and (iii) only
- D (i) and (iii) only

QUESTION 1

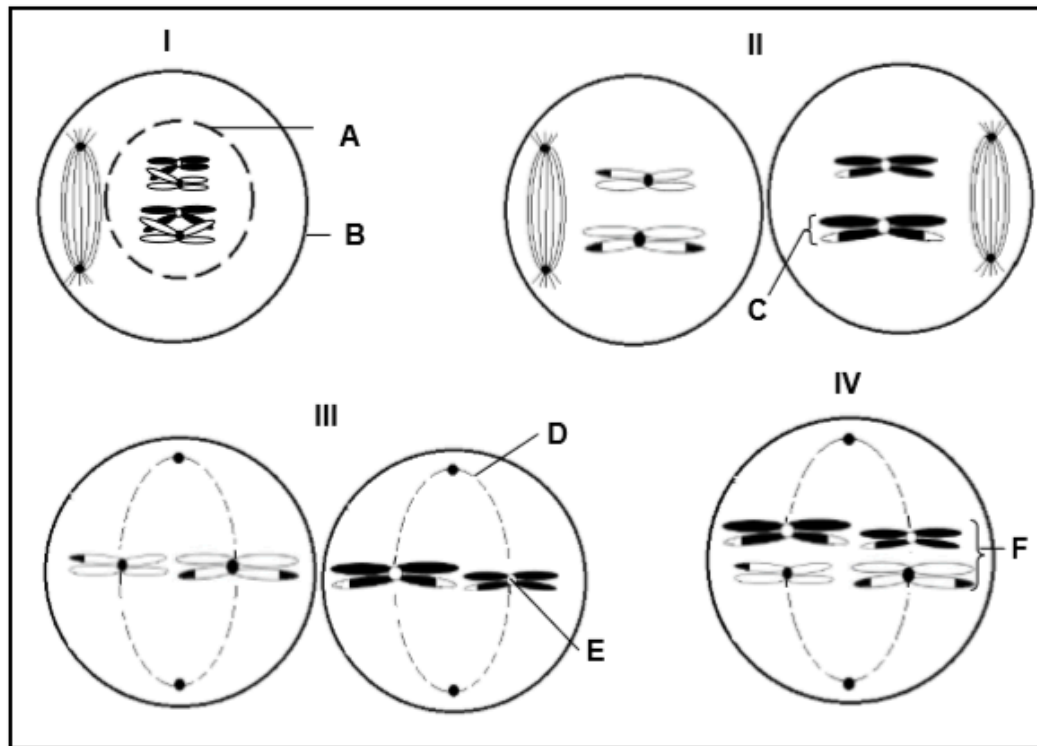
1.4 Study the diagram below, which shows a process occurring in a human male.



- 1.4.1 Name the process by which male gametes in humans are formed through meiosis. (1)
- 1.4.2 Name the organ in males where the process mentioned in QUESTION 1.4.1 takes place. (1)
- 1.4.3 How many chromosomes will be found in each cell at:
- (a) A (1)
- (b) B (1)
- 1.4.4 Name TWO processes occurring during the 1st meiotic division that contribute to the genetic variation of cells **A**. (2)
- 1.4.5 How many cells at **B** will carry the Y-chromosome? (1)
- 1.4.6 What are the mature cells at **B** called? (1)
- (8)**

QUESTION 2

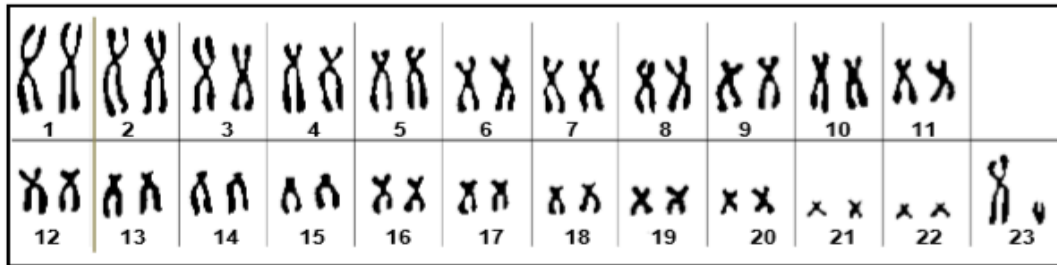
- 1.4 The diagrams below show an animal cell in the various stages of meiosis in the incorrect order.



- 1.4.1 Provide labels for structures **A**, **B**, **C** and **F**. (4)
- 1.4.2 Give the NUMBER of the diagram (I to IV) which represents cells:
- (a) Where crossing over occurs (1)
 - (b) That are haploid (1)
- 1.4.3 Give the LETTER and NAME of the structure that:
- (a) Is produced from the centrioles (2)
 - (b) Holds two chromatids together (2)
- (10)**

QUESTION 3

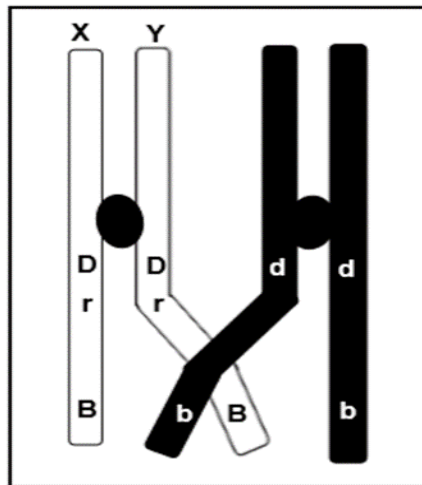
1.4 The diagram below shows a karyotype.



- 1.4.1 How many of the following are present in the karyotype:
- (a) Chromosomes (1)
 - (b) Autosomes (1)
 - (c) Gonosomes (1)
- 1.4.2 How many chromosomes would be present in the gametes produced by this individual? (1)
- 1.4.3 Is the karyotype in the diagram that of a male or a female? (1)
(5)

QUESTION 4

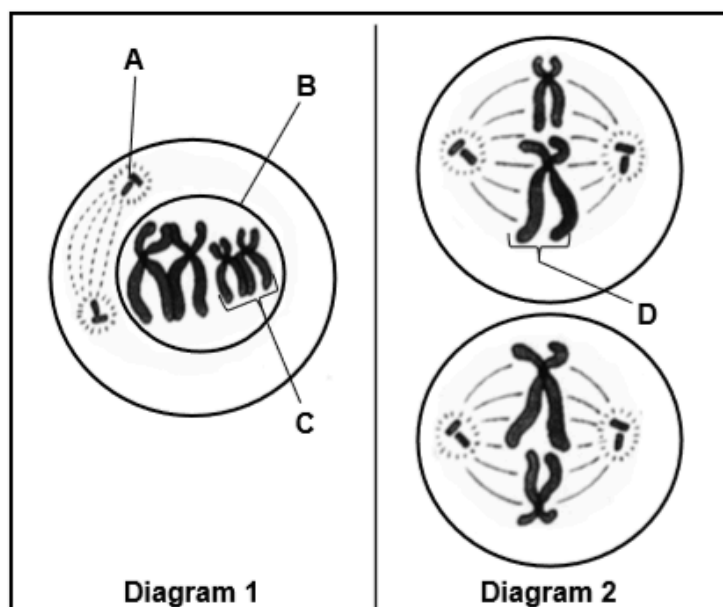
2.3 The diagram below shows crossing over during meiosis.



- 2.3.1 Name the phase of meiosis during which the process represented above takes place. (1)
- 2.3.2 Describe the process of *crossing over*. (3)
- 2.3.3 Explain the importance of crossing over. (2)
- 2.3.4 Draw a diagram, giving the position of the alleles, to show the structure of chromatid Y after crossing over. (2)
- (8)**

QUESTION 5

1.5 The diagrams below represent a cell in two different phases of meiosis.



1.5.1 Which phase is represented in:

(a) Diagram 1 (1)

(b) Diagram 2 (1)

1.5.2 Provide labels for:

(a) A (1)

(b) B (1)

(c) C (1)

1.5.3 Give the functions of the parts labelled:

(a) A (2)

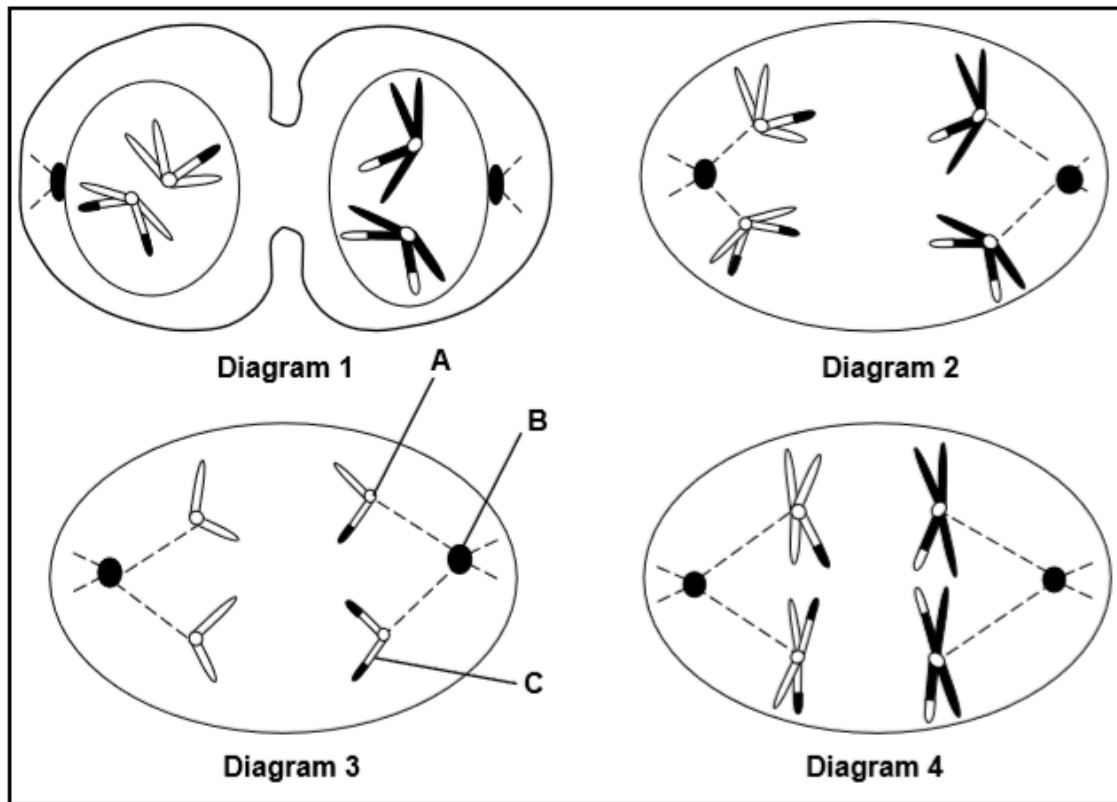
(b) D (1)

1.5.4 Are the cells in Diagram 2 haploid or diploid? (1)

1.5.5 Name the process that would have caused variation in structure D. (1)
(10)

QUESTION 6

1.4 The diagrams below represent some phases of meiosis in an animal cell.



1.4.1 Identify the following parts in Diagram 3:

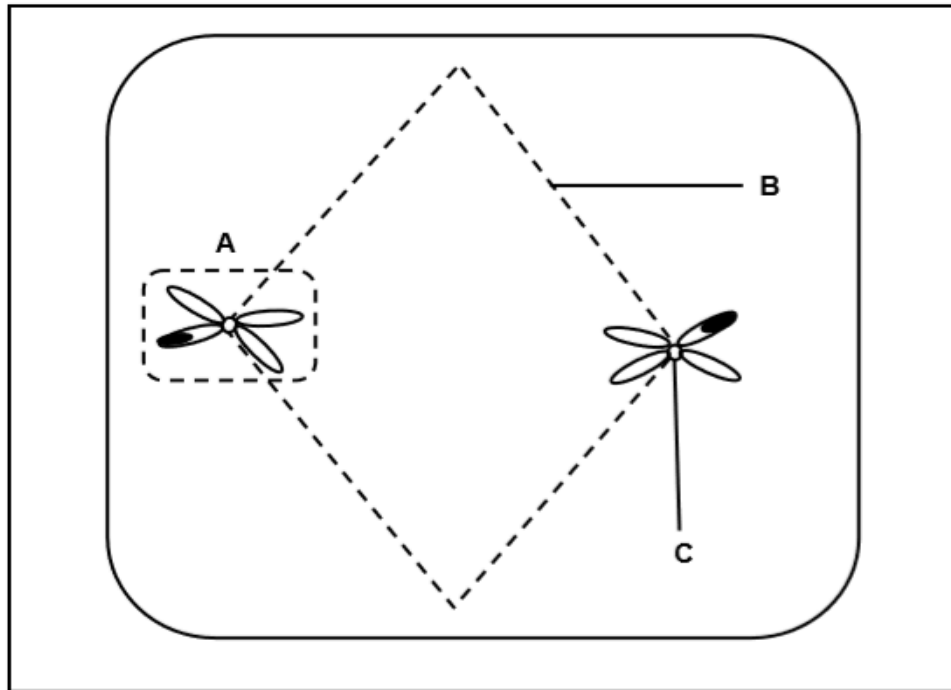
- (a) **A** (1)
- (b) **B** (1)
- (c) **C** (1)

1.4.2 Using the diagram NUMBERS (1, 2, 3, 4) showing some of the phases, arrange the diagrams above in the sequence as they occur during meiosis. (2)

1.4.3 How many chromosomes were in the cell before meiosis began? (1)
(6)

QUESTION 7

2.2 The diagram below illustrates a phase in meiosis.



2.2.1 Identify part:

- (a) **A** (1)
- (b) **B** (1)
- (c) **C** (1)

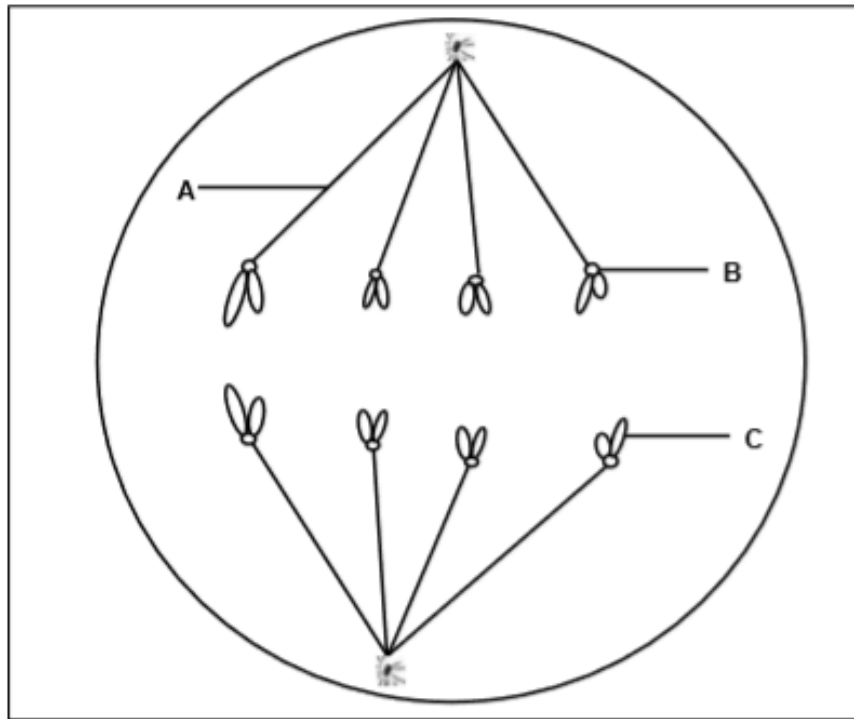
2.2.2 Identify the phase illustrated above. (1)

2.2.3 Give a reason for your answer to QUESTION 2.2.2. (2)

2.2.4 Draw a diagram of the cell above as it would appear during **anaphase I**. (4)
(10)

QUESTION 8

1.5 The diagram below shows a phase during meiosis.



1.5.1 Identify part:

- (a) A (1)
- (b) B (1)
- (c) C (1)

1.5.2 Name the phase illustrated in the diagram above. (1)

1.5.3 How many chromosomes were present in the phase before the one shown in the diagram above? (1)

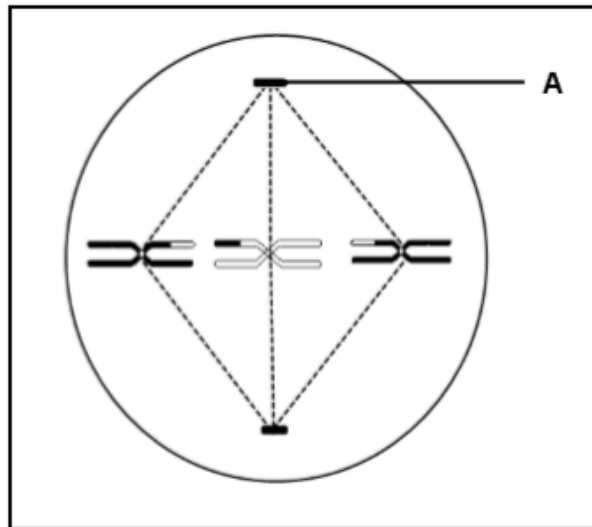
1.5.4 How many chromosomes would be found in each gamete at the end of this division? (1)

1.5.5 Explain why the diagram above is NOT representative of a cell from a human being. (2)

1.5.6 State ONE place where meiosis takes place in the human male. (1)
(9)

QUESTION 9

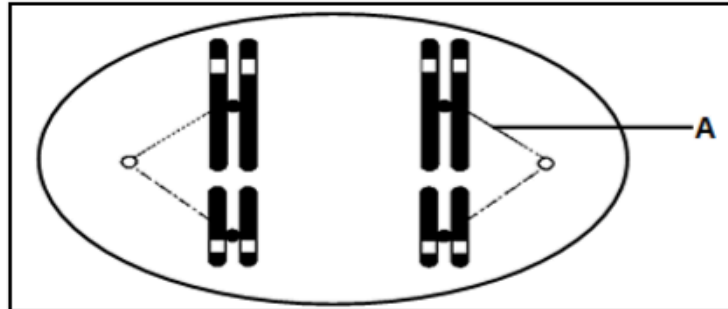
2.5 Study the diagram of a phase during meiosis below.



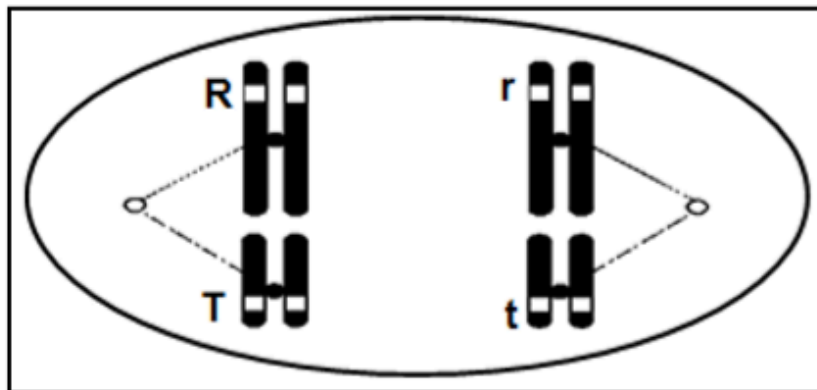
- 2.5.1 Identify part **A**. (1)
- 2.5.2 Identify the phase represented in the diagram. (1)
- 2.5.3 Explain your answer to QUESTION 2.5.2. (2)
- 2.5.4 Explain how the phase identified in QUESTION 2.5.2 contributes to variation in the gametes. (2)
- 2.5.5 How many chromosomes:
- (a) Were present in the original cell at interphase (1)
 - (b) Will be present in each gamete that forms at the end of meiosis (1)
- 2.5.6 Which process resulted in the two chromatids in each chromosome being different from each other? (1)
- (9)**

QUESTION 10

- 3.1 The diagram below shows the arrangement of two pairs of homologous chromosomes in a cell undergoing meiosis.



- 3.1.1 State TWO characteristics of homologous chromosomes. (2)
- 3.1.2 Identify structure A. (1)
- 3.1.3 How many of EACH of the following is present in the diagram?
- (a) Chromatids (1)
 - (b) Centromeres (1)
- 3.1.4 Draw a labelled diagram to show ONE of the cells that would be formed at the end of telophase I. (6)
- 3.1.5 The diagram below shows some of the alleles during the formation of gametes.

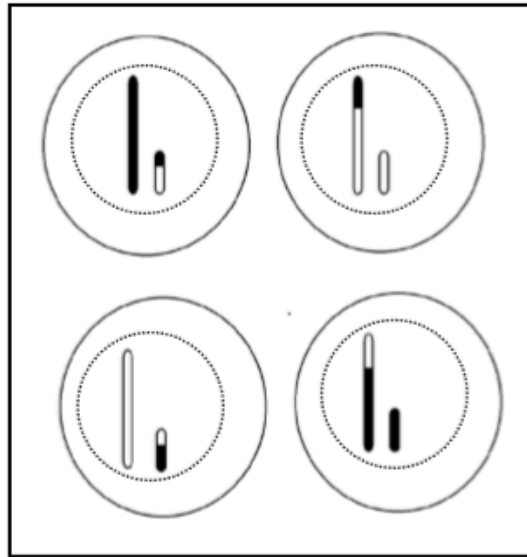


Give the genotype of the:

- (a) Individual represented in the diagram (1)
 - (b) Possible gametes resulting from the arrangement of alleles represented in the diagram (2)
- (14)**

QUESTION 11

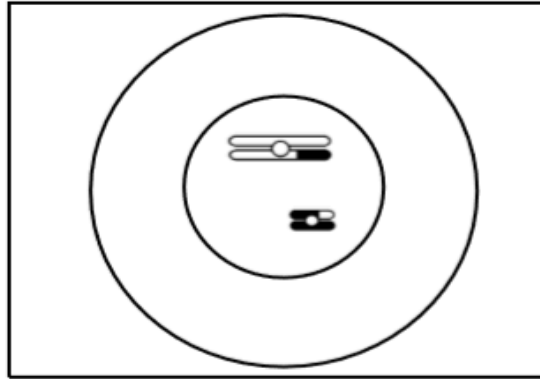
2.3 Study the diagram of a phase during meiosis below.



- 2.3.1 Identify the phase in the diagram above. (1)
- 2.3.2 Give TWO visible reasons for your answer to QUESTION 2.3.1. (2)
- 2.3.3 How many chromosomes:
- (a) Are present in EACH cell in the diagram (1)
 - (b) Were present in the original cell at the start of meiosis (1)
- 2.3.4 The cells in the diagram are NOT identical.
- (a) Name TWO processes during meiosis that lead to the cells being different from one another. (2)
 - (b) Explain the significance to a species of the cells being different from one another. (3)
- (10)**

QUESTION 12

- 3.3 The diagram below represents one of the two cells that formed during Telophase I of meiosis in an organism.

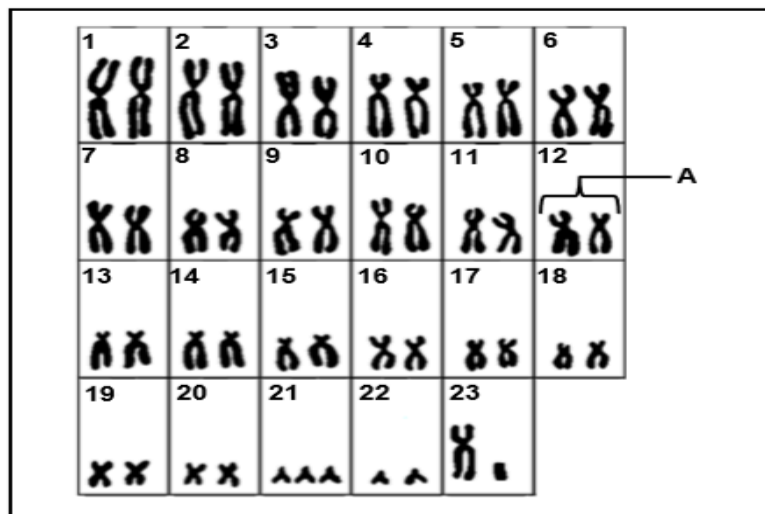


Draw a labelled diagram to show the cell during Anaphase II of meiosis.

(5)

QUESTION 13

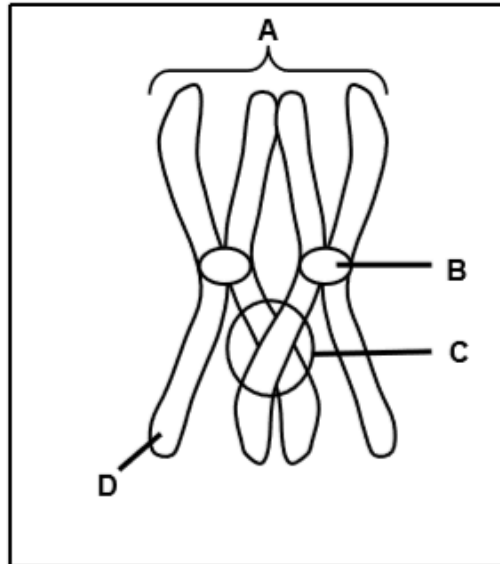
- 2.1 The karyotype below shows the chromosomes of a person with Down syndrome.



- 2.1.1 Give the label for A. (1)
- 2.1.2 How many autosomes are there in a nucleus of this cell? (1)
- 2.1.3 Name the type of chromosomes at position 23. (1)
- 2.1.4 What evidence suggests that this is a karyotype of a male? (1)
- 2.1.5 Name the type of mutation represented in the diagram. (1)
- 2.1.6 Describe the events that led to Down syndrome. (6)
- (11)

QUESTION 14

1.5 The diagram below represents a process that occurs during meiosis.



1.5.1 Provide labels for:

- (a) **A** (1)
- (b) **B** (1)
- (c) **D** (1)

1.5.2 Give the function of the structure labelled **B**. (1)

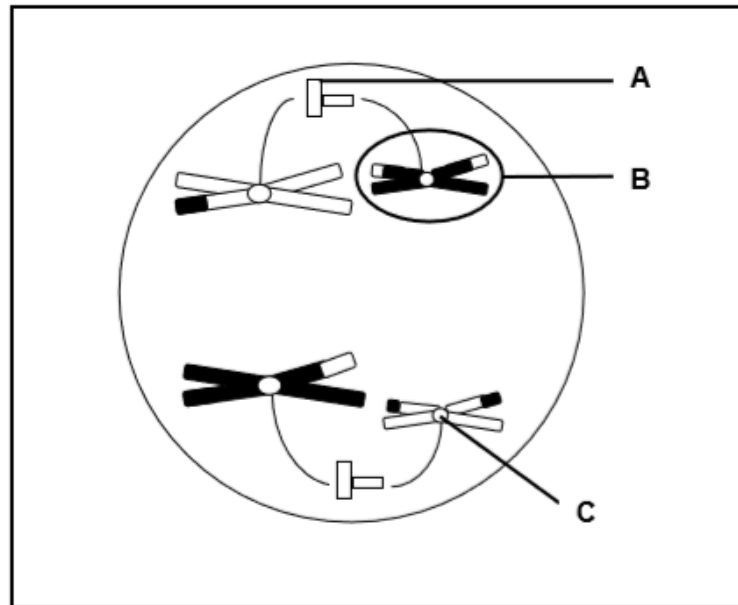
1.5.3 Name:

- (a) The process occurring at **C** (1)
- (b) The phase in meiosis during which the process at **C** occurs (1)

1.5.4 State ONE reason why process **C** is significant. (1)
(7)

QUESTION 15

1.4 The diagram below shows a phase of meiosis in an animal cell.

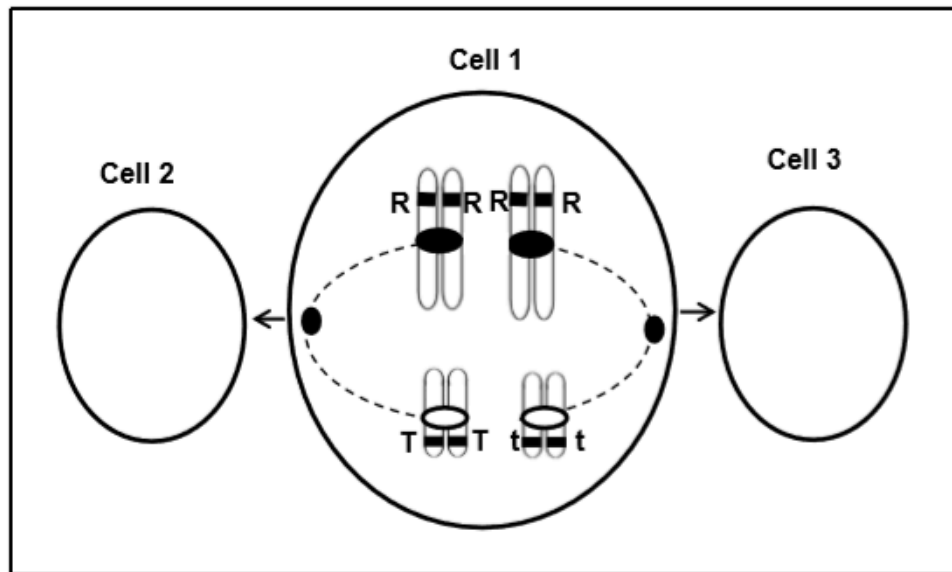


- 1.4.1 Identify: (1)
- (a) **A** (1)
 - (b) **B** (1)
 - (c) **C** (1)
- 1.4.2 Which phase of meiosis is illustrated in the diagram above? (1)
- 1.4.3 Name the phase that follows the one represented in the diagram above. (1)
- 1.4.4 How many chromosomes were there in the cell above before the process of meiosis began? (1)
- 1.4.5 What is the specific name given to meiosis when it takes place in a human female? (1)
- (7)**

QUESTION 16

2.2 The diagram below represents a phase in meiosis.

Cell 1 undergoes division to give rise to cells 2 and 3. Some alleles are indicated by letters.



2.2.1 Explain why cell 1 does NOT belong to a human. (2)

2.2.2 How many chromosomes would be present in:

(a) Cell 2 at the end of telophase I (1)

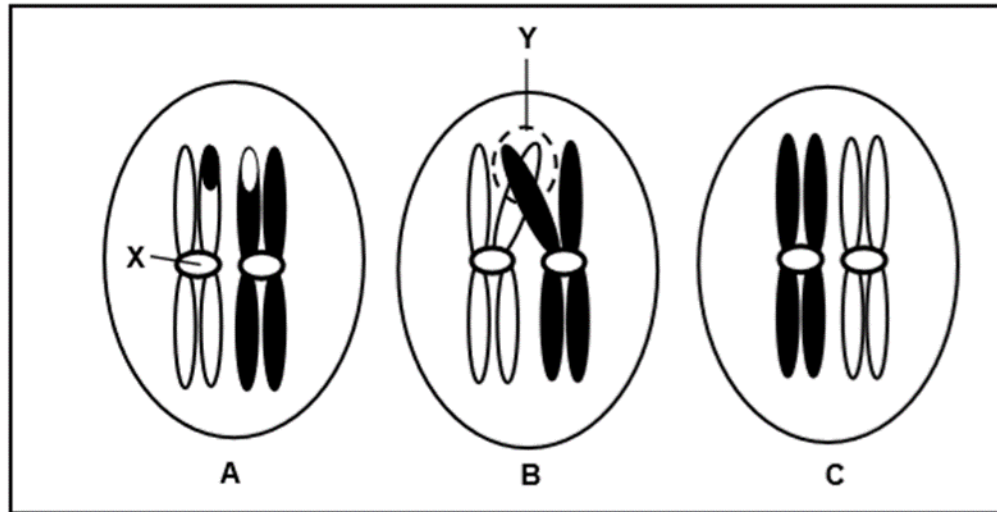
(b) The daughter cells produced by cell 3 after meiosis II (1)

2.2.3 Draw a labelled diagram of a gamete that will result from cell 2. (5)
(9)

2.3 State Mendel's law of segregation. (3)

QUESTION 17

- 1.5 The diagrams below represent a chromosome pair in a female human cell. The cells (**A**, **B** and **C**) show different events in a phase of meiosis, which are not necessarily in the correct sequence.



- 1.5.1 How many pairs of chromosomes occur in a normal human cell? (1)
- 1.5.2 Give labels for:
- (a) Structure **X** (1)
 - (b) Area **Y** (1)
- 1.5.3 Name the organ in the human female where meiosis occurs. (1)
- 1.5.4 Name the:
- (a) Process occurring in diagram **B** (1)
 - (b) Phase represented by the diagrams above (1)
 - (c) Type of cells that would result from meiosis of this cell (1)
- 1.5.5 Arrange the letters **A**, **B** and **C** to show the correct sequence of the events. (1)
- (8)**

ESSAY QUESTIONS:

QUESTION 4

Describe the structure and arrangement of chromosomes making up the normal human karyotype. Also describe the behaviour of the chromosomes during the different phases of meiosis I.

Content: (17)
Synthesis: (3)

QUESTION 4

Describe how genetic variation is brought about in gametes through cell division and name and describe the specific process that takes place in the formation of an ovum.

Content: (17)
Synthesis: (3)
(20)