Full name: _____

School name: _____

Enhance Education

2026 Mock Examination

B I O L O G Y

Mock Exam | Questions

General Instructions

- Write using black pen
- Draw diagrams using pencil
- Calculators approved by NESA may be used
- Write your Full Name and School Name at the top of this page

Total marks: 100

Section I: 20 marks
- Attempt Questions 1-20
- Allow about 35 minutes for this section

Section II: 80 marks
- Attempt Questions 21-33
- Allow about 2 hours and 25 minutes for this section

Section I

20 marks
Attempt Questions 1-20
Allow about 35 minutes for this section

Use the multiple-choice answer sheet for Questions 1-20.

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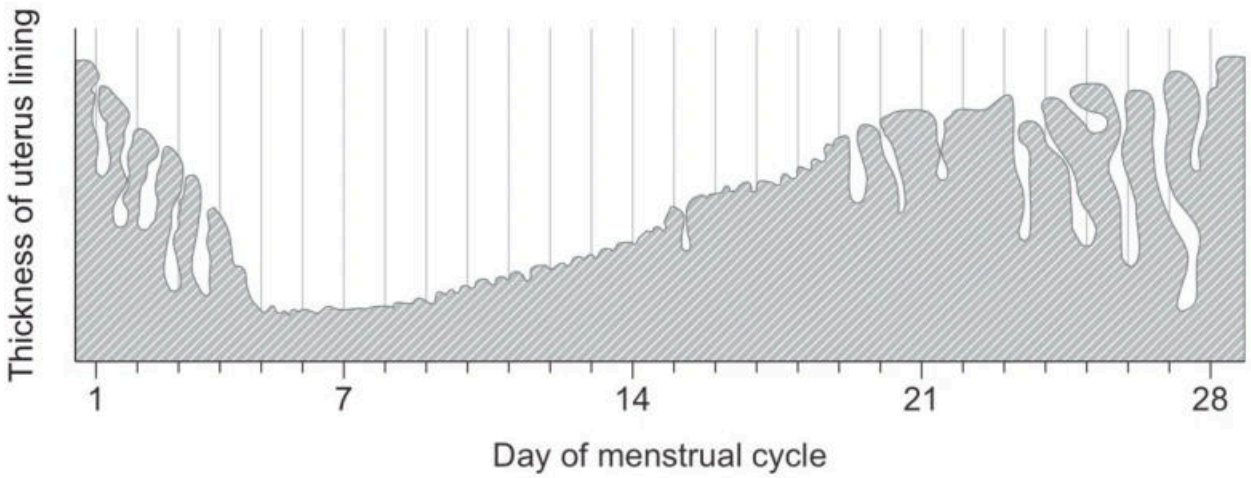
1 The image shows a pair of homologous chromosomes from a human cell.



What is always found at the same loci of homologous chromosomes?

(A) Alleles with the same function
(B) Alleles with identical base sequences
(C) Genes with identical base pairs
(D) Genes with the same mutations

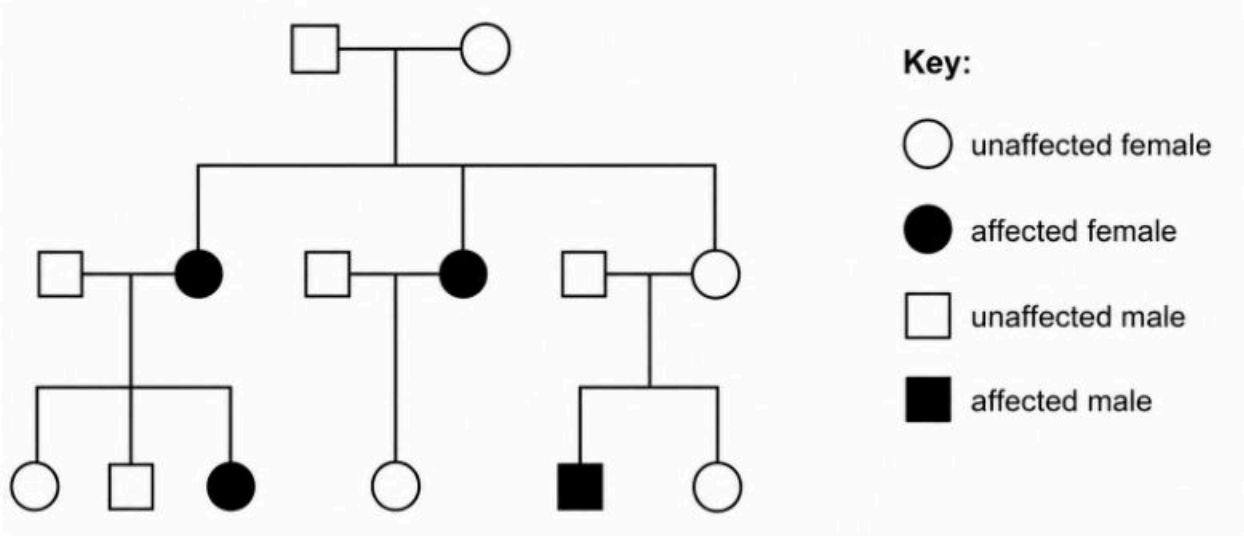
2 The diagram shows changes in the uterus lining of a woman throughout her menstrual cycle.



Between which days is she likely to be fertile?

(A) 1-6
(B) 7-10
(C) 11-16
(D) 17-21

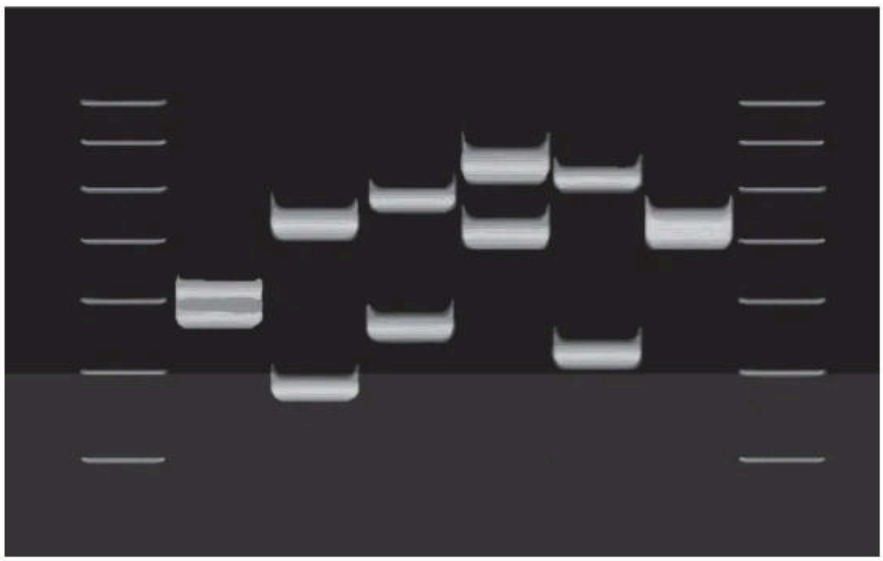
3 Nonsyndromic Hearing Loss and Deafness (DFNB1) is an inherited cause of deafness in humans. The pedigree chart shows the inheritance of DFNB1 in a family.



Where is the DFNB1 allele found in family members with this condition?

(A) On the Y chromosome
(B) On the X chromosome
(C) On one autosome only
(D) On a pair of autosomes

4 The image shows a DNA profile obtained by gel electrophoresis.



What could be found in each band?

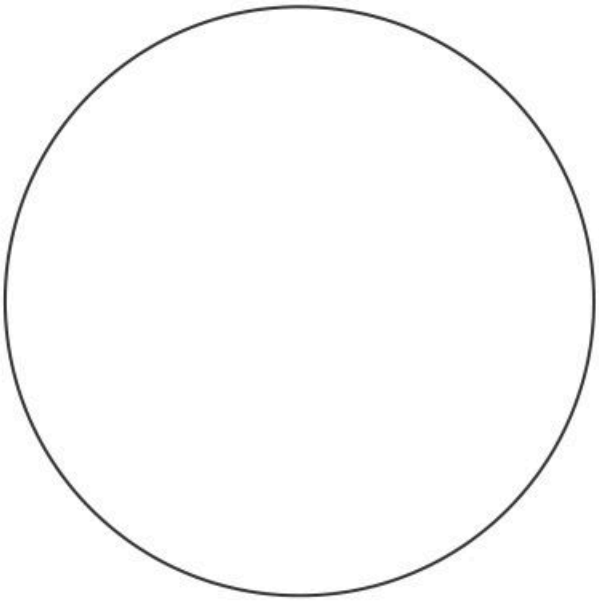
(A) DNA fragment with the same number of base pairs
(B) Several DNA molecules of similar length
(C) A complete DNA molecule with a specific charge
(D) One DNA strand with a particular base sequence

Question 21 (6 marks)

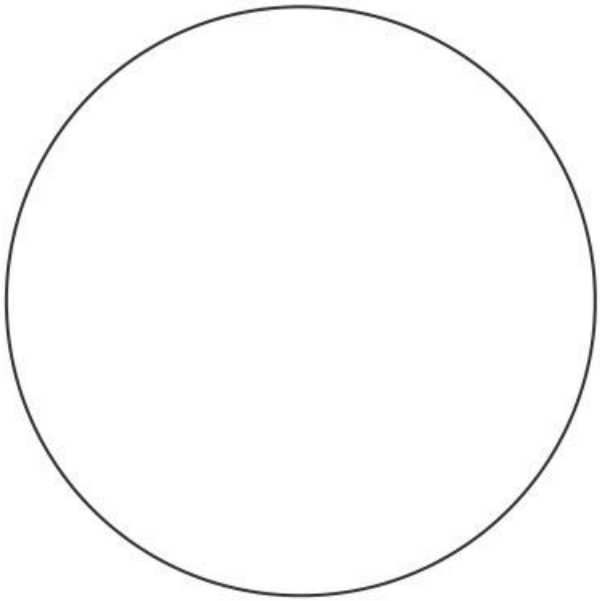
(a) The fruit fly, *Drosophila melanogaster*, has a chromosome number of 8.

In the circles below, draw a germ cell of a fruit fly undergoing metaphase I and metaphase II of meiosis. Ensure to include all necessary labelling. **2**

Metaphase I



Metaphase II



(b) Clownfish, *Amphiprion ocellaris*, have 24 pairs of chromosomes and reproduce via external fertilisation, with gametes initially created through meiosis. Females lay up to 1500 eggs and then males swim over the eggs and fertilise them.

Explain how independent assortment and random fertilisation ensure the continuity of the clownfish species. Ensure to include chromosome numbers in your answer. **4**

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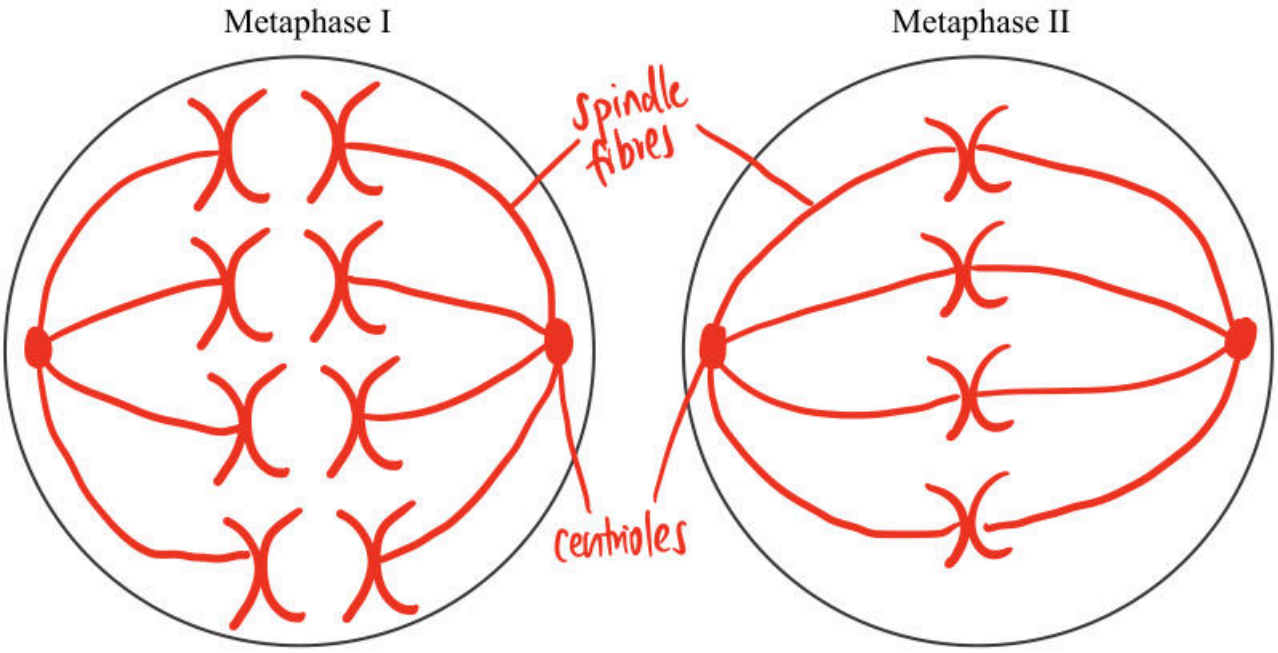
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Question 21 (6 marks)

2n = 8
n = 4

(a) The fruit fly, *Drosophila melanogaster*, has a chromosome number of 8.

In the circles below, draw a germ cell of a fruit fly undergoing metaphase I and metaphase II of meiosis. Ensure to include all necessary labelling. **2**



Marking criteria:

- 1 mark: Metaphase I drawn correctly - 4 homologous pairs (8 chromosomes total) aligned at the equator with spindle fibres, correctly labelled
- 1 mark: Metaphase II drawn correctly - 4 single chromosomes (haploid, sister chromatids still attached) aligned individually at the equator with spindle fibres, correctly labelled

Explanation: Metaphase I: the cell should show 4 pairs of homologous chromosomes (bivalents/tetrads), each consisting of two sister chromatids joined at a centromere, aligned as pairs along the equator/metaphase plate, with spindle fibres from opposite poles attached to each homologue. Metaphase II: the cell should show 4 individual chromosomes (haploid number, n=4), each still made of two sister chromatids, aligned singly (not in homologous pairs) along the equator, with spindle fibres attached to the centromere of each chromosome from opposite poles.

(b) Clownfish, *Amphiprion ocellaris*, have 24 pairs of chromosomes and reproduce via external fertilisation, with gametes initially created through meiosis. Females lay up to 1500 eggs and then males swim over the eggs and fertilise them.

Explain how independent assortment and random fertilisation ensure the continuity of the clownfish species. Ensure to include chromosome numbers in your answer. **4**

Marking criteria:

- ◯ Describe the process of independent assortment + how does it increase genetic variation

Random orientation/alignment of homologous pairs at the metaphase plate, generating genetically varied haploid (n=24) gametes during meiosis (metphase I)

- ◯ Describe the process of random fertilisation + how does it increase genetic variation

Random fusion of any sperm with any egg, restoring the diploid number (2n=48) and further increasing genetic variation by increasing the recombination of paternal and maternal alleles in the offspring.

- ◯ Explain the effect of high genetic variation on the continuity of the clownfish species: Increased survivability and adaptability in a changing environment

The continual generation of genetic variation provides the raw material for natural selection, increasing the likelihood that some offspring will have combinations of alleles suited to survive changing environmental conditions (e.g. disease, predators, changing reef conditions), allowing increased survival, reproductive success and adaptation over time.

- ◯ Correctly includes chromosome numbers - during independent assortment, there are 24 pairs of chromosomes that align in their pair independent of each other. This produces 2^24 allele combinations = 16, 777, 216. Gametes have a haploid chromosome number of 24 chromosomes that randomly fuse to produce a zygote with 48 chromosomes.

Sample answer:

During meiosis I, the 24 pairs of homologous chromosomes align randomly and independently at the metaphase plate (independent assortment). Because each pair can orient in either direction independently of the others, this generates 2^24 possible chromosome combinations in the resulting haploid (n=24) gametes, producing genetically varied sperm and eggs. During fertilisation, any one of the ~2^24 possible sperm can randomly fuse with any one of the ~2^24 possible eggs (from up to 1500 eggs laid), restoring the diploid number (2n=48) and multiplying the genetic variation further (up to 2^24 x 2^24 combinations). This continual generation of genetic variation provides the raw material for natural selection, increasing the likelihood that some offspring will have combinations of alleles suited to survive changing environmental conditions (e.g. disease, predators, changing reef conditions), allowing the population/species to adapt and persist over time. Maintaining the correct diploid chromosome number (48) each generation also ensures offspring are viable and fertile, allowing the species to continue reproducing successfully.

Question 24 (6 marks)

Domestic cats, *Felis catus*, have a diploid chromosome number of 38. The karyotypes below were prepared from two gametes from different domestic cats.

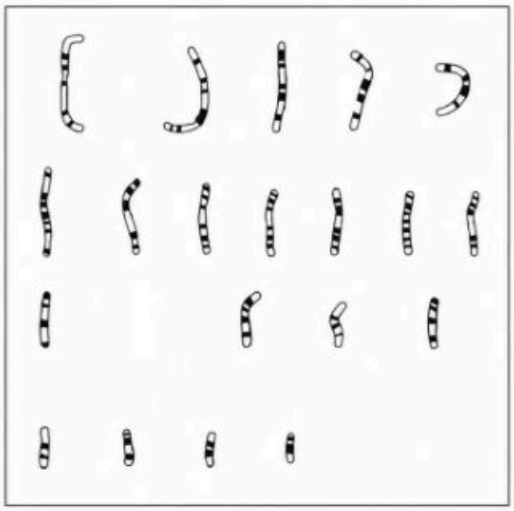


Figure 1: Karyotype A (sperm cell)

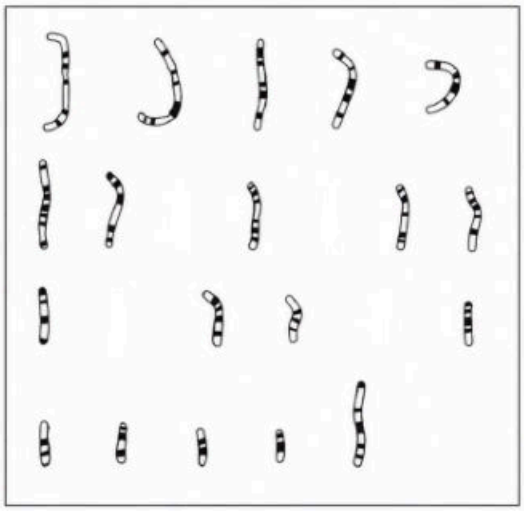


Figure 2: Karyotype B (egg cell)

(a) Justify which cell exhibits aneuploidy. Refer to evidence from the karyotype. **2**

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Question continues on the next page

Question 24 (continued)

(b) Explain how this chromosome abnormality may have occurred. **4**

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End of Question

Question 24 (6 marks)

Domestic cats, *Felis catus*, have a diploid chromosome number of 38. The karyotypes below were prepared from two gametes from different domestic cats.

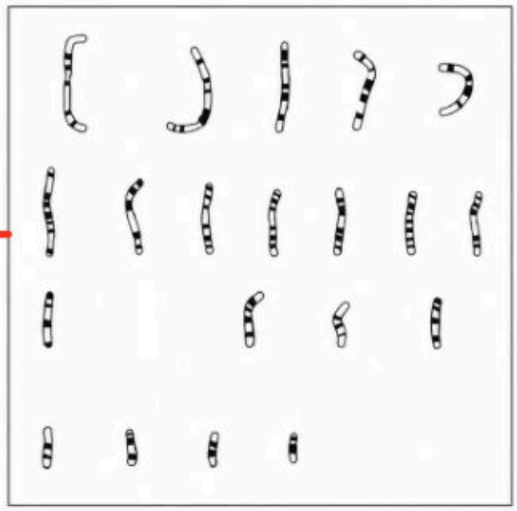


Figure 1: Karyotype A (sperm cell)

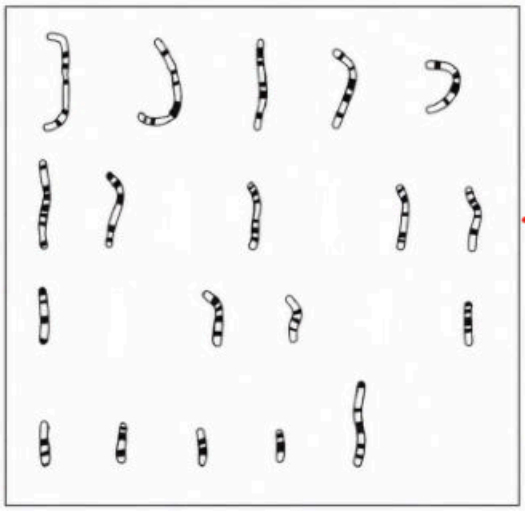


Figure 2: Karyotype B (egg cell)

(a) Justify which cell exhibits aneuploidy. Refer to evidence from the karyotype. **2**

Marking criteria:

- 1 mark: States the expected/normal haploid chromosome number for a cat gamete (19), correctly derived from the diploid number given (38)
- 1 mark: Identifies the aneuploid karyotype with justification via a chromosome count discrepancy compared to 19 (e.g. 18 or 20 chromosomes present, one missing/extra)

Domestic cats have a diploid number of 38, so a normal gamete (sperm or egg) should contain the haploid number of 19 chromosomes. Counting the chromosomes present in each karyotype and comparing this to the expected haploid number of 19 shows that one gamete has an incorrect chromosome count (one too many or one too few chromosomes), demonstrating aneuploidy in that gamete, while the other karyotype contains the expected 19 chromosomes.

(b) Explain how this chromosome abnormality may have occurred. **4**

Marking criteria:

○ 1 mark: Defines non-disjunction:

Non-disjunction is the failure of homologous chromosomes or sister chromatids to separate correctly during anaphase of meiosis

○ 1 mark: Correctly explain the effect of non-disjunction in anaphase I:

Homologous chromosomes in their pair fail to separate…two gametes with an extra chromosome (n+1 = 20) and two gametes with a missing chromosome (n-1 = 18)

○ 1 mark: Correctly explain the effect of non-disjunction in anaphase II:

Sister chromatids fail to separate…one gamete with an extra chromosome (n+1 = 20) and one gamete with a missing chromosome (n-1 = 18) and two normal gametes (n=19)

○ 1 mark: Incorporates the stimulus - specifies chromosome number including 18, 19, 20.

Sample answer:
This aneuploidy is most likely caused by non-disjunction - the failure of chromosomes to separate correctly during anaphase of meiosis. Non-disjunction can occur during anaphase I, when a pair of homologous chromosomes fails to separate and both move to the same pole, or during anaphase II, when sister chromatids of one chromosome fail to separate and move to the same pole. As a result of non-disjunction, two of the four resulting gametes are abnormal: one gamete receives one extra chromosome (n+1 = 20 chromosomes) and one gamete is missing a chromosome (n-1 = 18 chromosomes), while the remaining gametes have the normal haploid number. This error occurred during meiosis (gametogenesis) in the parent that produced the aneuploid gamete shown in the karyotype, resulting in the abnormal chromosome number observed.

