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Wednesday 20th May 2020

Time: 50 minutes

Marks: 50

Name: _____

Teacher's initials: _____

Instructions:

- Check that you have 5 printed pages.
- Answer all questions on the question paper, in the spaces provided.

Question 1

Choose the best term in Column B to match the description in Column A. Write only the letter in the Answer Column. (7)

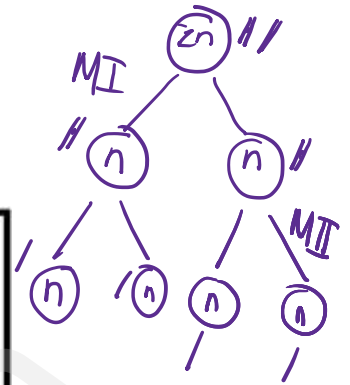
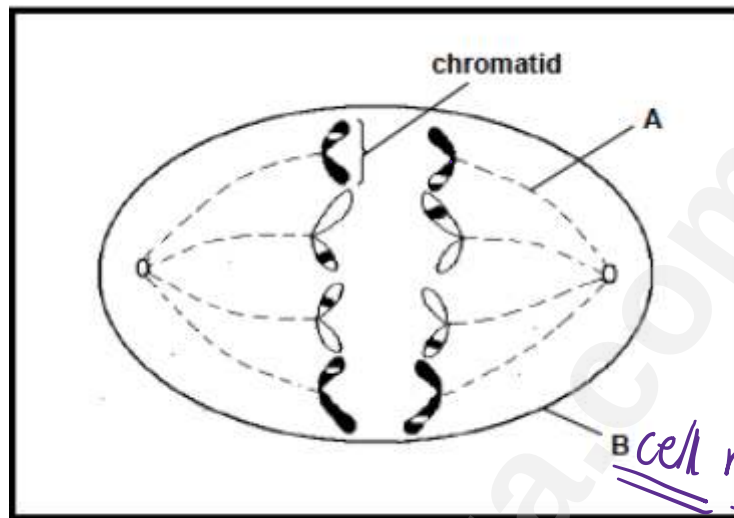
Answer	Column A Statement or Description	Column B Term
[C✓]	1.1 Phase of meiosis when <u>crossing over</u> occurs	A. Centromere
[E✓]	1.2 The proteins around which the double helix of the DNA coils	B. Variation
[A✓]	1.3 Central point of a chromosome	C. <u>Prophase I</u>
[G✓]	1.4 Organelles that shift to poles of cell during cell division	D. <u>Prophase II</u>
[I✓]	1.5 Phase during which <u>DNA replication</u> takes place	E. Histones
[F✓]	1.6 Phase of meiosis where homologous chromosomes line up at the equator	F. <u>Metaphase I</u>
[K✓]	1.7 Dividing of cytoplasm to make two separate cells	G. <u>Centrioles</u>
		H. Chloroplasts
		I. Interphase
		J. Replication
		K. <u>Cytokinesis</u>
		L. Metaphase II

[7]

Question 2

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

only plants
have a
cell wall
→



2.1 State which phase of meiosis is represented in the diagram above. (1)

Anaphase II ✓

2.2 Give a reason for your answer to QUESTION 2.1. (1)

Chromosomes are being split/divided/torn apart at their centromeres, this does not happen in Anaphase I. ✓

sister chromatids are separated

2.3 Identify parts A and B. (2)

A – spindle fibre ✓

B – cell membrane ✓

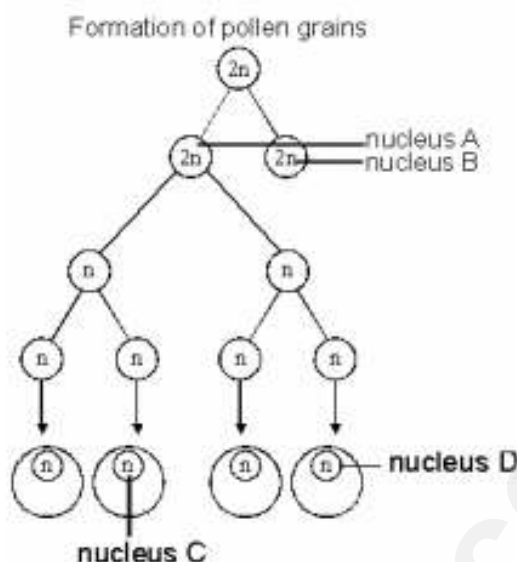
2.4 Could the cell represented in the diagram be that of a human? Explain. (2)

No, there are only four chromosomes. ✓✓

→ 46

Yes, it's diploid but only four chromosomes are shown. ✓✓

meiosis does occur in humans



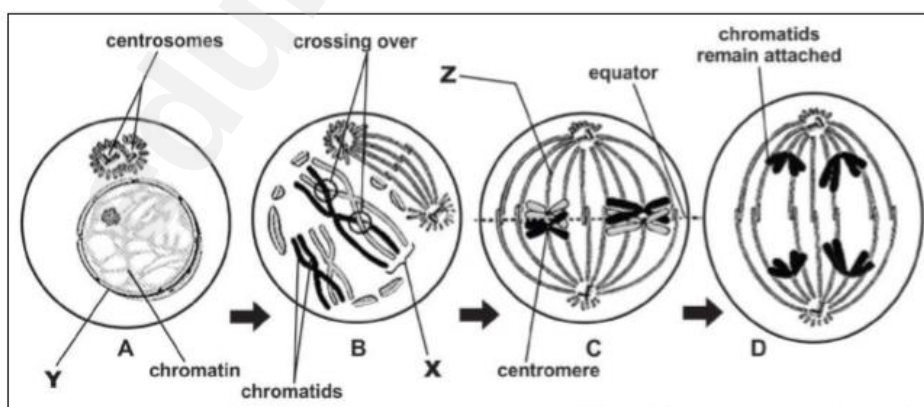
- 2.5 Using the diagram above, explain the processes of cell division that result in nuclei labelled A and B being genetically identical, while those labelled C and D are genetically different. (4)
- The processes are mitosis and meiosis. Mitosis✓ involved genetic duplication and then separation, resulting in genetically identical cells/clones, A & B✓. Cells/Nuclei C & D are the result of a meiotic division✓ which include independent assortment and/or crossing over/recombination which would result in gametes and thus nuclei C & D being unique✓.**

[10]

Question 3

Study the diagram below of a cell undergoing the reduction division phase of meiosis and answer the questions that follow.

Diagram showing the first stages of meiosis



[Adapted from: <www.course1.winona.edu>]

- 3.1 (a) Explain clearly the function of meiosis in the human body. (2)
- meiosis produces haploid gametes /halves chromosome no./ ✓ genotype complement /increases genetic variation ✓**

(b) How many cells would be formed from cell A by the end of the complete process of meiosis? (1)

4 ✓

(c) What term (based on chromosome number) describes the original cell at A? (1)

Diploid ✓

3.2 (a) Name the biological process by which a chromosome duplicates before meiosis takes place. (1)

DNA replication ✓

(b) Write a brief description of this process you named in Question 3.2 (a) to explain how the chromosomes make duplicate chromatids as seen in diagram B. (6)

process started by DNA polymerase ✓ which unwinds chromosome helix ✓ DNA molecule separates between nucleotide base pairs each single strand of DNA acts as template ✓ free nucleotides pair up with complementary bases ✓ thymine with adenine guanine with cytosine link by hydrogen bonds ✓ between nitrogen bases two new identical DNA strands are formed ✓ 6 good, relevant facts in correct order

3.3 The diagram below is from a micrograph of part of a cell in the testis of a human male. It illustrates a process known as 'crossing over' as seen in **cell B** in the diagram on the previous page.

Diagram showing crossing over of chromosomes during meiosis



[Adapted from: <bioinfo.org.cn>]

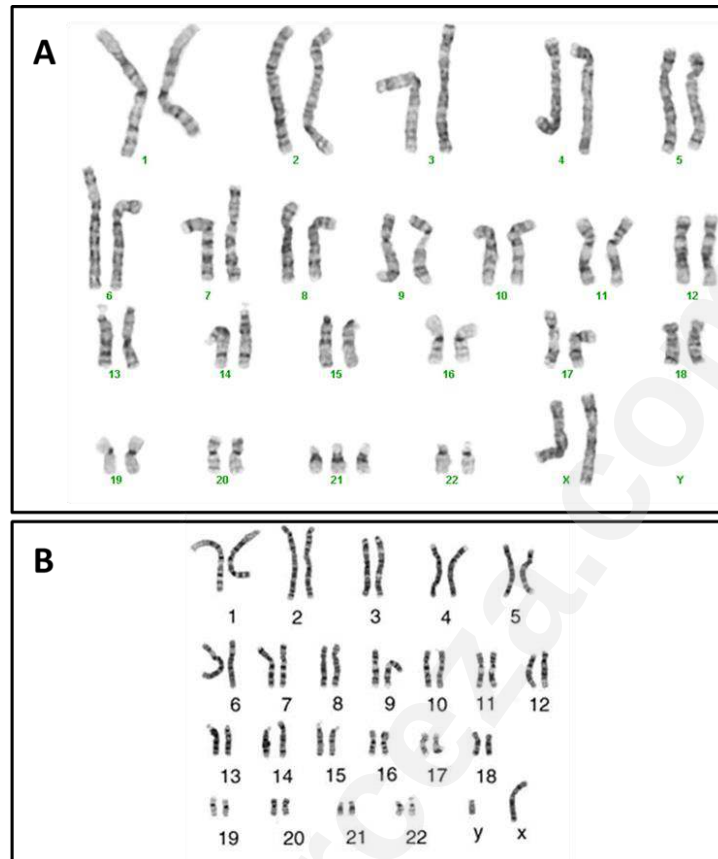
3.3.1 Give a brief description of what happens during crossing over of chromatids. (3)

two chromatids/any non-sister chromatids (other words describing this) of homologous chromosomes ✓ cross over at points of attachment called chiasmata ✓ chromatids break /pull apart and re-join with swapped sections ✓ of chromatids

3.3.2 What is the biological importance of the 'crossing over' of chromatids in the cells of the testis? (2)

crossing over results in mixing of maternal and paternal characteristics/genes ✓ results in greater variation ✓ in offspring/gametes

[16]



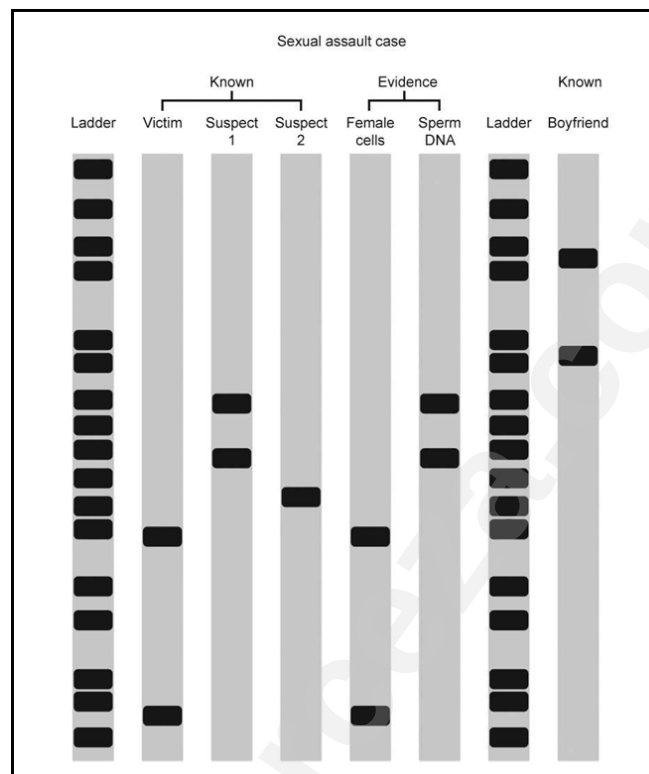
- 4.1 What is a karyotype? (2)
A set of chromosomes that have been photographed under a microscope and then stained, sorted and arranged in homologous pairs✓ from longest to shortest✓ is called a karyotype.
- 4.2 Mention TWO differences between karyotypes A and B. (2)
A is a female while B is a male✓; A has three chromosomes in chromosome pair 21 whereas B has two chromosomes in chromosome pair 21✓
- 4.3 (a) Name the genetic abnormality of individual A. (1)
Down Syndrome ✓
- (b) Explain what happened during meiosis to cause the abnormal chromosome number in A. (3)
During meiosis I (anaphase I)✓ in the female, the homologous pair (bivalent) 21✓ did not split ✓ and go to opposite poles. Instead 24 chromosomes went to one pole and 22 chromosomes went to the other pole✓. (After that meiosis proceeded as normal, but the eggs that formed each had either 22 or 24 chromosomes. The egg with 24 chromosomes would have been fertilised.)

[8]

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Question 5

The following DNA evidence was used to solve a sexual assault case. Look at it carefully and answer the questions that follow.



- 5.1 What is the difference between the source of the “known” DNA and the “evidence” DNA?(2)

The “known” DNA was collected from specific people✓, while the “evidence” DNA was collected at the scene of the crime✓. (2)

- 5.2 Who do the female cells belong to? (1)

Female cells belong to the victim✓

- 5.3 From the DNA fingerprints, identify the guilty person in this sexual assault case. (1)

Guilty person is Suspect 1✓

[4]

Question 6

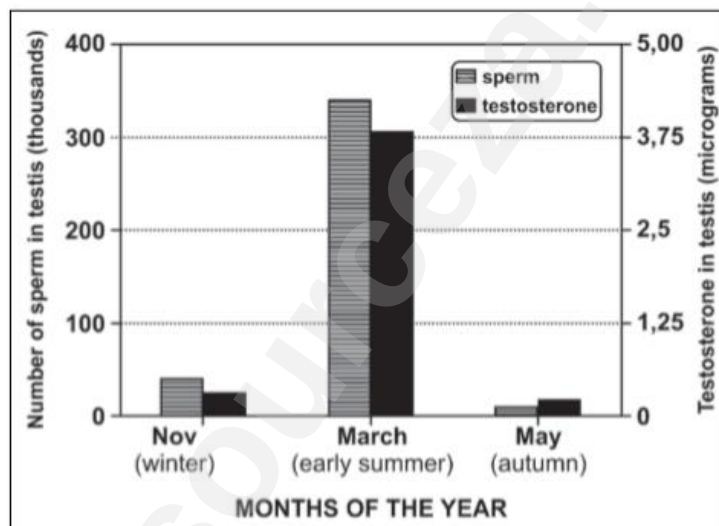
Read the information below and answer the questions that follow

Scientists investigated the sperm production of the 'mink', a small mammal living in the Northern Hemisphere. They discovered that sperm production in male minks decreases during the cold winter months and increases in the warm spring and summer months during their breeding season.

The graph below illustrates some of the scientific findings.



Graph showing the relationship between sperm and testosterone production in minks



[Note: variable units for sperm and testosterone]

[Adapted from: <www.sciencedirect.com>]

- 6.1 What evidence is provided by the graph to suggest that meiosis is affected by the changes in seasons? (2)

low sperm production in non-breeding seasons (May and Nov) ✓ high sperm production in early summer/breeding season ✓ amount of sperm produced changes in winter and early summer ✓
(any two facts)

- 6.3 Write a suitable hypothesis for this investigation. (3)

Sperm production ✓ in male Minks increases ✓ in the breeding season/summer ✓ and spring.

Statement (Sperm production in minks decreases during the winter/non-breeding season) or (other suitable statement)

[5]