1.7 Chromosomes, DNA and Mitosis: 30-minute Pack

EDEXCEL 4BI1 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 State whether mitosis produces genetically identical cells or genetically different cells, and state the chromosome number term used for normal human body cells produced by mitosis.

(Total for Question 1 is 1 mark)

2 Define the term 'allele' when describing variation between individuals of the same species. Give a short example.

(Total for Question 2 is 1 mark)

3 Define DNA in the context of chromosomes and state its overall shape as proposed by Watson and Crick.

(Total for Question 3 is 2 marks)

4 In a skin sample, 6 of 30 cells are observed in mitosis. In a second sample from the same tissue, 9 of 30 cells are observed in mitosis. Calculate the difference between the samples in the number of mitotic cells and state which sample has more.

(Total for Question 4 is 2 marks)

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5 A scientist counts cells in two tissue samples. In a root sample, 8 of 40 cells have visible chromosomes. In a mature leaf sample, 2 of 40 cells have visible chromosomes. Calculate the difference in the percentage of cells with visible chromosomes between the samples, in percentage points. Assume the same counting method was used for each sample.

(Total for Question 5 is 2 marks)

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6 Describe, in one sentence, Watson and Crick's model idea that explains how the two DNA strands are held together and name the complementary base pairs.

(Total for Question 6 is 2 marks)

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7 Give the four stages of mitosis that follow interphase, in their correct order, and name the final cell division process that follows in animal cells.

(Total for Question 7 is 2 marks)

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8 Describe two roles of mitosis in multicellular organisms, giving one short example for each role.

(Total for Question 8 is 2 marks)

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9 Explain how asexual reproduction by mitosis can produce genetically identical offspring, and give one advantage and one disadvantage of asexual reproduction for a species.

(Total for Question 9 is 3 marks)

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10 A scientist observes a tissue sample where cells are rapidly dividing by mitosis. Suggest two reasons why the rate of mitosis might be high in this tissue and give one method the scientist could use to identify cells in mitosis under a microscope.

(Total for Question 10 is 3 marks)

11 A diploid plant body cell has 8 chromosomes before DNA replication. The cell replicates its DNA and reaches metaphase of mitosis. State the number of chromosomes and the number of chromatids in this cell. Explain how the arrangement of sister chromatids determines the chromosome count at this stage.

(Total for Question 11 is 3 marks)

12 A sample of 24 cells from a growing plant root has 6 cells with chromosomes visible. A sample of 24 cells from a mature leaf has 1 cell with chromosomes visible. Calculate the difference in the number of cells with visible chromosomes and use the observations to compare mitotic activity in the two tissues. State one limit on this comparison. Assume each sample is counted once using the same method.

(Total for Question 12 is 3 marks)

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Mark scheme · 1.7 Chromosomes, DNA and Mitosis: 30-minute Pack

Question 1

produces genetically identical cells and the term is diploid **B1**

Answer: Genetically identical cells; diploid

Question 2

one of two or more alternative forms of a gene that cause variation in a characteristic **B1**

Answer: One of two or more alternative forms of a gene, e.g. an allele for brown eyes or an allele for blue eyes

Question 3

deoxyribonucleic acid, a molecule that stores genetic information in the sequence of nucleotides **B1**

exists as a double helix made of two strands twisted around each other, as described by Watson and Crick **B1**

Answer: Deoxyribonucleic acid, a molecule storing genetic information; a double helix of two twisted strands

Question 4

difference is 3 cells **B1**

second sample has more **B1**

Answer: 3 cells; the second sample has more

Question 5

root: 8 / 40 x 100 = 20%; leaf: 2 / 40 x 100 = 5% **M1**

difference is 15 percentage points **A1**

Answer: Root: 20%; leaf: 5%; difference: 15 percentage points.

Question 6

the two strands are held together by base pairing between specific complementary bases **B1**

adenine pairs with thymine and cytosine pairs with guanine **B1**

Answer: The two strands are held by specific base pairing: adenine with thymine and cytosine with guanine

Question 7

correct sequence of the four mitosis stages: prophase, metaphase, anaphase, telophase **B1**

names cytokinesis or states cell membrane pinches in or cleavage furrow forms as the final cell division process in animal cells **B1**

Answer: Prophase, metaphase, anaphase, telophase; the final division process is cytokinesis

Question 8

growth, with example such as increase in number of cells during organism development or child growth **B1**

repair, with example such as replacing skin cells after a cut or healing tissue **B1**

Answer: Growth, e.g. increasing cell number as an organism grows; repair, e.g. replacing skin cells after a cut

Question 9

states that asexual reproduction involves mitosis where the nucleus divides to make genetically identical daughter cells **B1**

advantage: rapid population increase or no need for a mate, giving quick colonisation **B1**

disadvantage: low genetic variation, making the population vulnerable to disease or environmental change **B1**

Answer: Asexual reproduction uses mitosis so daughter cells inherit identical DNA, producing genetically identical offspring. Advantage: fast reproduction without a mate, allowing rapid colonisation. Disadvantage: low genetic variation so vulnerability to disease or changing conditions.

Question 10

possible reason 1: tissue is growing, e.g. in a developing embryo or a growing child **B1**

possible reason 2: tissue is repairing damage or renewing cells, e.g. healing a wound or high turnover tissue like bone marrow **B1**

method: stain chromosomes (e.g. with a DNA stain) and look for condensed chromosomes or mitotic figures under a light microscope **B1**

Answer: Rate may be high because the tissue is growing (development) or repairing and renewing cells; identify mitotic cells by staining DNA and observing condensed chromosomes or mitotic figures under the microscope.

Question 11

8 chromosomes **B1**

16 chromatids **B1**

each chromosome consists of two sister chromatids joined at a centromere, so it is counted as one chromosome **B1**

Answer: 8 chromosomes and 16 chromatids; each chromosome has two sister chromatids joined at a centromere, so the chromosome count remains 8.

Question 12

difference is 5 cells **B1**

root sample shows more cells in mitosis / greater observed mitotic activity **B1**

a single sample/count may not represent the whole tissue or other times **B1**

Answer: There are 5 more cells with visible chromosomes in the root sample, indicating greater observed mitotic activity there; one count may not represent the whole tissue or other times.

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