1.10 Cell Division and Stem Cells: Test Pack

AQA 8464 · Calculator allowed · about 40 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 The cell cycle has several stages including interphase and mitosis. Name two events that occur during interphase.

(a) Name an event that occurs during interphase (first event). **(1)**

(b) Name another event that occurs during interphase (second event). **(2)**

(Total for Question 1 is 3 marks)

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2 Mitosis is a type of cell division that produces new cells.

(a) State two purposes of mitosis in the human body. **(2)**

(b) Describe what happens to the chromosomes during mitosis, and state the type of cell produced as a result. **(3)**

(Total for Question 2 is 5 marks)

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3 Embryonic stem cells can be grown in a laboratory culture. In one such culture, every cell divides by mitosis into two new cells once every 18 hours.

(a) A culture starts with 500 stem cells. Calculate the number of stem cells present in the culture after 72 hours, assuming every cell continues to divide at this rate. **(3)**

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(b) State one assumption made in this calculation. **(1)**

(Total for Question 3 is 4 marks)

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4 Explain why the new plant produced from a runner is genetically identical to the parent plant.

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(Total for Question 4 is 2 marks)

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5 Error analysis: In a mitotic index experiment, Callum stains cells and counts phases but forgets to use the same magnification for all slides. State one likely effect of this error on the mitotic index results and explain why.

(a) State one likely effect of using different magnifications on different slides. **(1)**

(b) Explain why different magnifications cause this effect. **(2)**

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(Total for Question 5 is 3 marks)

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6 A population of stem cells divides every 12 hours. Starting with 250 stem cells, calculate how many cells there will be after 48 hours, assuming each division doubles the number of cells and no cells die.

(a) Calculate the number of cells after 48 hours. **(3)**

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(Total for Question 6 is 3 marks)

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7 The number of cells in a culture was measured each day for five days: Day 0: 1.0×10^4 cells, Day 1: 1.8×10^4, Day 2: 3.2×10^4, Day 3: 5.6×10^4, Day 4: 10.0×10^4. Use the data to answer the following.

(a) Calculate the fold increase in cell number between Day 0 and Day 4. Give your answer to two significant figures. **(2)**

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(b) Comment briefly why growth appears approximately exponential over these days. **(2)**

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(Total for Question 7 is 4 marks)

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8 Stretch question: A tumour suppressor gene normally prevents uncontrolled cell division. A mutation causes a loss of function in the suppressor gene. Explain how this mutation can lead to cancer. Include reference to cell cycle control and genetic changes.

(a) Explain how loss of function mutation in a tumour suppressor gene may lead to cancer. **(5)**

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(Total for Question 8 is 5 marks)

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Mark scheme · 1.10 Cell Division and Stem Cells: Test Pack

Question 1

(a) DNA replication (duplication of chromosomes) cao **B1**

(a) Answer: DNA replication.

(b) cell growth or increased organelle number or protein synthesis, oe **B1**

(b) metabolic activity such as respiration increased, oe **B1**

(b) Answer: Cell growth and increased organelle number.

Question 2

(a) growth (production of new cells so the body/an organ can grow), oe **B1**

(a) repair of damaged tissue (allow: replacement of dead or worn-out cells), oe **B1**

(a) Answer: Growth (producing new cells for the body to grow), and repair of damaged tissue.

(b) before mitosis begins, each chromosome is copied/duplicated (so it consists of two identical strands), oe **B1**

(b) during mitosis, one copy of each chromosome is pulled to each end (pole) of the cell, and the cell then divides into two, oe **B1**

(b) producing two genetically identical (diploid) daughter cells, each with the same number of chromosomes as the parent cell, oe **B1**

(b) Answer: Each chromosome is copied before mitosis. During mitosis, one copy of each chromosome moves to each end of the cell, which then divides, producing two genetically identical diploid daughter cells with the same number of chromosomes as the parent cell.

Question 3

(a) number of divisions in 72 hours = 72 / 18 = 4, oe **M1**

(a) 500 * 2^4, oe **M1**

(a) 8000 cao **A1**

(a) Answer: 8000 cells

(b) e.g. assumes no cells die during the 72 hours / assumes every cell divides at exactly the same rate / assumes nutrients, oxygen and space do not become limiting, oe **B1**

(b) Answer: Assumes that no cells die and that every cell continues to divide at exactly the same, constant rate (e.g. nutrients and space do not become limiting).

Question 4

the new plant's cells are produced by mitosis from the parent plant's cells, oe **B1**

mitosis produces cells that are genetically identical (exact copies) to the parent cell, oe **B1**

Answer: The new plant's cells are produced by mitosis from the parent plant's cells, and mitosis produces cells that are genetically identical to the parent cell.

Question 5

(a) counts would be inconsistent or mitotic index could be over or under estimated, oe **B1**

(a) Answer: The mitotic index results would be inconsistent, possibly over or under estimated between slides.

(b) states that different magnifications change the field of view and apparent cell size or number **M1**

(b) explains that more or fewer cells will be visible at once leading to inconsistent counts and hence wrong mitotic index, oe **A1**

(b) Answer: Different magnifications change the field of view and apparent cell size so more or fewer cells are visible, causing inconsistent counts and incorrect mitotic index values.

Question 6

(a) correct method: number after n divisions = initial x 2^n with n = 48/12 = 4 **M1**

(a) substitutes: 250 x 2^4 **M1**

(a) 4000 cells cao **A1**

(a) Answer: 4000 cells

Question 7

(a) correct method: fold increase = Day4 / Day0 **M1**

(a) 10.0 x 10^4 / 1.0 x 10^4 = 10 or 1.0 x 10^1 -> 10 to two sig fig cao **A1**

(a) Answer: 10

(b) states that each cell divides to produce two daughter cells so population doubles repeatedly **M1**

(b) links repeated doubling to exponential increase in cell numbers, oe **A1**

(b) Answer: Because cells divide repeatedly and each division increases the number of cells so the population doubles repeatedly, producing exponential growth.

Question 8

(a) states that tumour suppressor proteins normally inhibit cell cycle progression or promote DNA repair/apoptosis **M1**

(a) states that loss of function removes this inhibition so cells can divide unchecked **M1**

(a) mentions accumulation of additional mutations or genomic instability as a consequence **M1**

(a) explains that uncontrolled cell division leads to tumour formation and spread, oe **A1**

(a) may include reference to failure of apoptosis or failure to repair DNA increasing cancer risk, oe **A1**

(a) Answer: Loss of tumour suppressor removes inhibition of the cell cycle or reduces DNA repair/apoptosis, allowing cells with DNA damage to divide unchecked and accumulate further mutations, leading to tumour formation.

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