

# SOLUTIONS

## Unit 5: The mitotic cell cycle

### 5.1: Replication and division of nuclei and cells

- D**  
In cell W, DNA replication is complete but the cell has not reached maximum size ( $G_2$  phase). In cell X, microtubule formation is nearly complete (late  $G_2$  phase), but chromosomes have not yet condensed, as condensation happens during prophase.
- D**  
After one cell cycle, the number of chromosomes remains the same. The volume of cytoplasm decreases due to cell division, and telomere length shortens with each replication cycle.
- B**  
Starting with 12 cells and given a rate of 1 division every 32 hours, 3 divisions occur in 4 days (96 hours). Each division doubles the number of cells:  $12 \rightarrow 24 \rightarrow 48 \rightarrow 96$  cells.
- A**  
Mitosis is involved in growth (diagram 1), repair (diagram 4), asexual reproduction (diagram 3), and replacement of cells (diagram 2). All diagrams show roles of mitosis.
- A**  
Interphase (preparation), anaphase (separation of chromatids), and cytokinesis (cell division) are all key phases of the mitotic cell cycle.
- D**  
Telophase (2) is the final stage of mitosis, while interphase (1) occurs before mitosis, and cytokinesis (3) happens after mitosis. Hence, only telophase is part of mitosis
- B**  
During the stages of the mitotic cell cycle, the DNA content changes. Here's how many copies of each DNA molecule will be found at the specified stages:  
G1 of interphase: At the start of interphase ( $G_1$ ), the cell is diploid ( $2n$ ), meaning it has two copies of each DNA molecule. So, it has 2 copies.  
Cytokinesis: Cytokinesis is the stage at the end of the cell cycle where the cell divides into two daughter cells. Each daughter cell will receive a complete set of DNA, so they will each have 1 copy.
- D**  
Mitosis involves the formation of genetically identical nuclei. Recognizing the characteristic of mitosis that results in equal-sized daughter cells with identical genetic material is fundamental to understanding cellular replication and growth.
- B**  
Able to divide by mitosis to produce more stem cells: True. One of the key characteristics of stem cells is their ability to self-renew through cell division. This allows them to maintain a pool of undifferentiated stem cells.  
Able to differentiate into specialized cells: True. Stem cells have the capacity to differentiate into various types of specialized cells, which is essential for tissue repair and regeneration. This process is called differentiation.