

60 points total

Name: ANSWER  
KEY

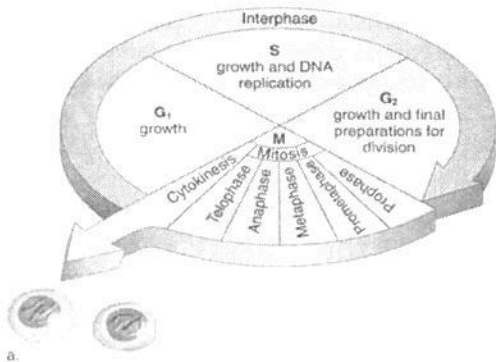
### Mitosis and Meiosis EOC Review

#### The Cell Cycle

Cell division is just one of several stages that a cell goes through during its lifetime. The **cell cycle** is a repeating series of events, including growth, DNA synthesis, and cell division. The cell cycle in prokaryotes is quite simple: the cell grows, its DNA replicates, and the cell divides. In eukaryotes, the cell cycle is more complicated.

#### Eukaryotic Cell Cycle

The diagram in the figure below represents the cell cycle of a eukaryotic cell. As you can see, the eukaryotic cell cycle has several phases. The mitosis phase (M) actually includes both mitosis and cytokinesis. This is when the nucleus and then the cytoplasm divide. The other three phases (G1, S, and G2) are generally grouped together as interphase. During interphase, the cell grows, performs routine life processes, and prepares to divide. These phases are discussed below.



This diagram represents the cell cycle in eukaryotes. The G1, S, and G2 phases make up interphase (I). The M phase includes mitosis and cytokinesis. After the M phase, two cells result.

#### Interphase

Interphase of the eukaryotic cell cycle can be subdivided into the following three phases, which are represented in the figure above:

- Growth Phase 1 (G1): During this phase, the cell grows rapidly, while performing routine metabolic processes. It also makes proteins needed for DNA replication and copies some of its organelles in preparation for cell division. A cell typically spends most of its life in this phase.
- Synthesis Phase (S): During this phase, the cell's DNA is copied in the process of DNA replication.
- Growth Phase 2 (G2): During this phase, the cell makes final preparations to divide. For example, it takes additional proteins and organelles.

#### Questions

1. What is the cell cycle?

2 Repeating series of events, including growth, DNA synthesis, and cell division, cell reproduces

2. What are the phases of the eukaryotic cell cycle?

3 G1 → S → G2 → M

3. In which phase does a cell spend most of its life? What happens during this phase?

2 Interphase

4. What is the S phase? What happens during this phase?

2 Growth and DNA replication

Write true if the statement is true or false if the statement is false.

5. F Cell division is basically the same in prokaryotic and eukaryotic cells.
6. T Cytokinesis is the division of the cytoplasm.
7. T Mitosis is the process in which the nucleus of the cell divides.
8. F A cell spends most of its life in growth phase 1 of the cell cycle.
9. T The correct order of phases of the cell cycle is G1 → S → G2 → M.
10. F Interphase consists of mitosis and cytokinesis.

1 point each

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## Mitosis

Mitosis is a continuous process that is divided into four phases: prophase, metaphase, anaphase, and telophase. **Prophase** is the first phase of mitosis. Prophase begins with the shortening and tight coiling of DNA into rod-shaped chromosomes that can be seen with a light microscope. During the S phase, each chromosome is copied. The two copies of each chromosome—called chromatids—stay connected to one another by the centromere. At this time, the nucleolus and the nuclear membrane break down and disappear. Two pairs of dark spots called *centrosomes* appear next to the disappearing nucleus. The centrosomes move toward opposite poles of the cell, and **spindle fibers** radiate from the centrosomes in preparation for mitosis.

**Metaphase** is the second phase of mitosis. During metaphase, kinetochore fibers move the chromosomes to the center of the dividing cell.

During **anaphase**, the chromatids of each chromosome separate at the centromere and slowly move toward opposite poles of the dividing cell. After the chromatids separate, they are considered to be individual chromosomes.

**Telophase** is the fourth phase of mitosis. After the chromosomes reach opposite ends of the cell, the spindle fibers disassemble and the chromosomes return to a less tightly coiled chromatin state. A nuclear envelope forms around each set of chromosomes, and a nucleolus forms in each of the newly forming cells.

**Cytokinesis** immediately follows Mitosis. In Cytokinesis, the cytoplasm from the original parent cell splits to form two new cells. Each new cell will contain one of the nuclei formed by mitosis.

Match each statement with the phase of mitosis it describes. Write the letter corresponding to the correct phase in the space provided.

### SKILL: Sequencing Information

In this exercise, matching the statement with the stage of mitosis will help you learn the sequence of events of mitosis.

1 point each

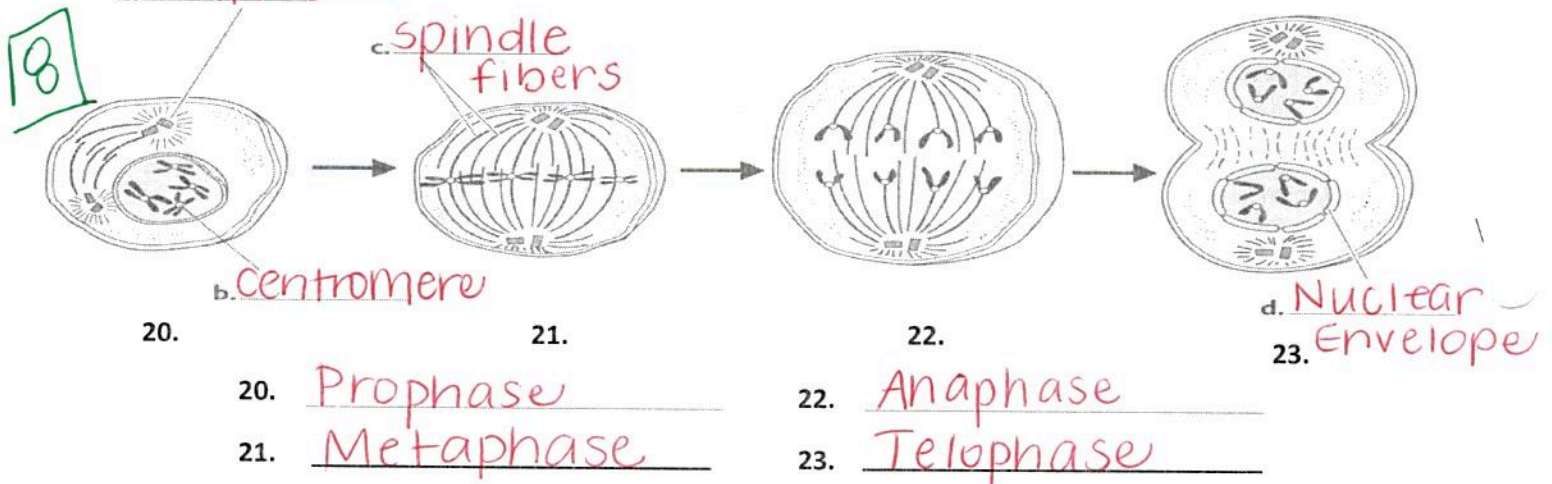
- |    |           |    |           |
|----|-----------|----|-----------|
| a. | prophase  | c. | anaphase  |
| b. | metaphase | d. | telophase |

11. C Chromatids of each chromosome separate at the centromere.
12. A Copied DNA coils into chromosomes.
13. D Spindle fibers disassemble.
14. B Kinetochore fibers move chromosomes to the cell's center.
15. A Centrosomes appear next to the disappearing nucleus.
16. D A nucleolus forms in each newly formed cell.
17. C Chromatids move toward opposite poles of the dividing cell.
18. A Spindle fibers radiate from the centrosomes.
19. D A nuclear envelope forms around each set of chromosomes.

### SKILL: Interpreting Graphics

The figure below shows the phases of mitosis. Using the information contained in the passage, write the name of the structure on each lettered line. On the numbered lines below the figure, name the stage of mitosis corresponding to the number on the figure. Use the following labels: "Anaphase," "Centromere," "Centrosomes," "Metaphase," "Nuclear envelope," "Prophase," "Spindle fibers," and "Telophase."

1 point each





## Meiosis

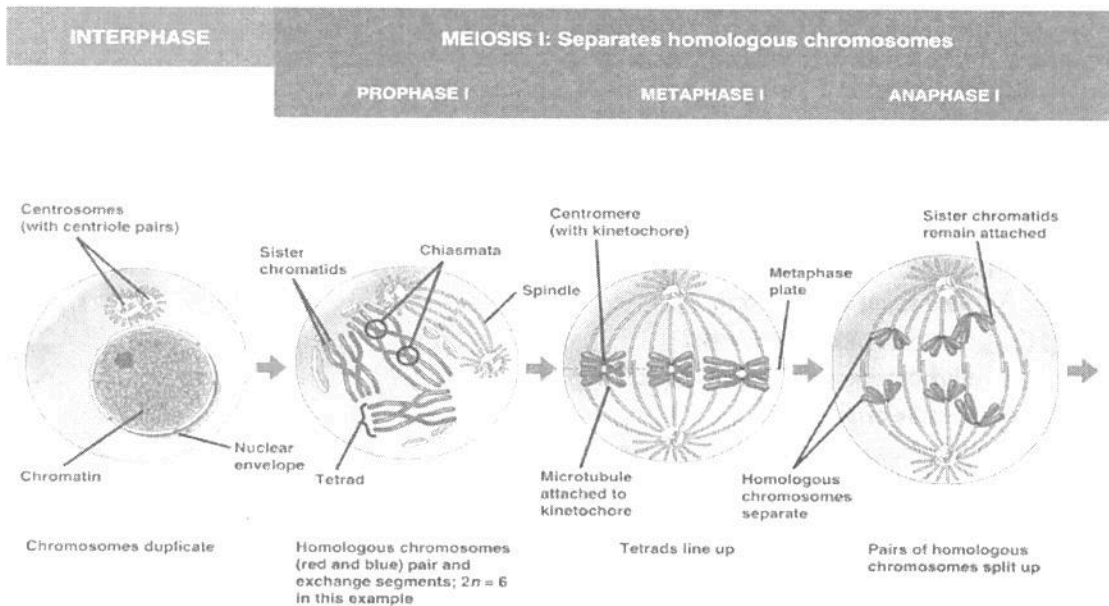
The process that produces haploid gametes is meiosis. **Meiosis** is a type of cell division in which the number of chromosomes is reduced by half. It occurs only in certain special cells of the organisms. During meiosis, homologous chromosomes separate, and the haploid cells that form have only one chromosome from each pair. Two cell divisions occur during meiosis, and a total of four haploid cells are produced. The two cell divisions are called meiosis I and meiosis II.

## Phases of Meiosis

Meiosis I begins after DNA replicates during interphase. In both meiosis I and meiosis II, cells go through the same four phases as mitosis. However, there are important differences between meiosis I and mitosis.

## Meiosis I

- Prophase I:** The nuclear envelope begins to break down, and the chromosomes condense. Centrioles start moving to opposite poles of the cell, and a spindle begins to form. Importantly, homologous chromosomes pair up, which is unique to prophase I. In prophase of mitosis and meiosis II, homologous chromosomes do not form pairs in this way.
- Metaphase I:** Spindle fibers attach to the paired homologous chromosomes. The paired chromosomes line up along the equator of the cell. This occurs only in metaphase I. In metaphase of mitosis and meiosis II, it is sister chromatids that line up along the equator of the cell.
- Anaphase I:** Spindle fibers shorten, and the chromosomes of each homologous pair start to separate from each other. One chromosome of each pair moves toward one pole of the cell, and the other chromosome moves toward the opposite pole.
- Telophase I and Cytokinesis:** The spindle breaks down, and the new nuclear membranes form. The cytoplasm of the cell divides, and two haploid daughter cells result. The daughter cells each have a random assortment of chromosomes, with one from each homologous pair. Both daughter cells go on to meiosis II.



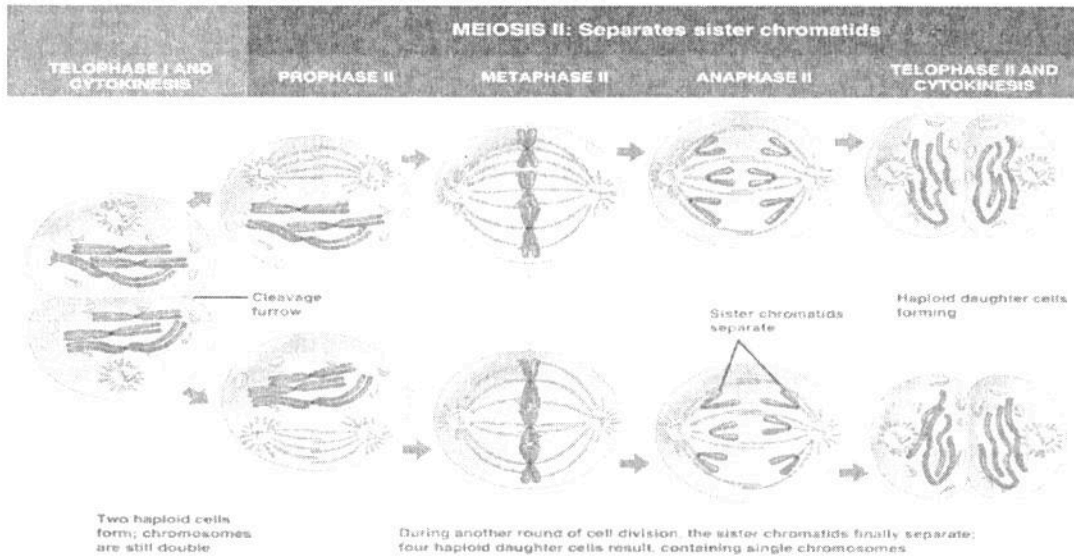
Match each statement with the stage of meiosis I it describes by writing in the spaces provided. The choices are: Prophase I, Metaphase I, Anaphase I, and Telophase I. *1 point each*

- Telophase I Cytoplasm divides
- Prophase I Nuclear envelope breaks down
- Anaphase I Homologous chromosomes separate
- Metaphase I Spindle moves homologous chromosomes to the cell's equator
- Prophase I Crossing-over occurs
- Telophase I Two new cells form
- Anaphase I Homologous chromosomes move to opposite poles of the cell
- Prophase I Chromosomes condense

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## Meiosis II

- Prophase II:** The nuclear envelope breaks down and the spindle begins to form in each haploid daughter cell from meiosis I. The centrioles also start to separate.
- Metaphase II:** Spindle fibers line up the sister chromatids of each chromosome along the equator of the cell.
- Anaphase II:** Sister Chromatids separate and move to opposite poles.
- Telophase II and Cytokinesis:** The spindle breaks down and the new nuclear membranes form. The cytoplasm of each cell divides, and four haploid cells result. Each cell has a unique combination of chromosomes.



Match each statement with the stage of meiosis II it describes by writing in the spaces provided. The choices are: Prophase II, Metaphase II, Anaphase II, and Telophase II. *1 point each*

- 7* Anaphase II Centromeres divide
- Prophase II New spindle fibers form
- Telophase II Cell undergoes cytokinesis
- Metaphase II Chromosomes line up at the equator
- Telophase II Spindle breaks down
- Anaphase II Chromosomes move to opposite poles of the cell
- Telophase II Four haploid cells form

Use both the readings from Meiosis I and Meiosis II to answer the questions.

39. Define meiosis.

*2* Process that produces haploid gametes (sex cells)

40. Is the DNA replicated after meiosis I? Why or why not?

*2* DNA replication happens before Meiosis I in interphase.

41. Describe the main difference between metaphase I and metaphase II.

*4* Metaphase I - paired chromosomes are in the middle  
Metaphase 2 - sister chromatids of each chromosome line along the equator of the cell

42. What is the final product of meiosis?

*3* 4 'Haploid' daughter' cells