

AP[®] BIOLOGY
2015 SCORING GUIDELINES

Question 4

Both mitosis and meiosis are forms of cell division that produce daughter cells containing genetic information from the parent cell.

- (a) **Describe** TWO events that are common to both mitosis and meiosis that ensure the resulting daughter cells inherit the appropriate number of chromosomes.

Description (1 point each; 2 points maximum)

- Spindle elements (microtubules) form/attach to chromosomes
- Chromatin condenses
- Alignment of chromosomes across center of cell prior to chromosome separation
- Separation of chromatids/centromeres to daughter cells
- G2/M checkpoint occurs in both processes
- Replication or synthesis of DNA precedes mitosis/meiosis
- Cytokinesis separates daughter cells after mitosis/meiosis

- (b) The genetic composition of daughter cells produced by mitosis differs from that of the daughter cells produced by meiosis. **Describe** TWO features of the cell division processes that lead to these differences.

Feature	Description (1 point each row; 2 points maximum)	
	Mitosis	Meiosis
Number of divisions/ number of resulting cells	1 division/ 2 cells result	2 divisions/ 4 cells result
Ploidy of daughter cells	<ul style="list-style-type: none"> • Same as parent cell • Diploid • ($2n \rightarrow 2n$ or $n \rightarrow n$) 	<ul style="list-style-type: none"> • Half of parent cell • Haploid • ($4n \rightarrow 2n$; $2n \rightarrow n$)
Chromatids separate	Occurs	Not in meiosis I/only in meiosis II
Crossing over	Does not occur	Occurs
Homologous chromosomes separate/independently assort	Does not occur	Occurs

4. Both mitosis and meiosis are forms of cell division that produce daughter cells containing genetic information from the parent cell.
- (a) Describe TWO events that are common to both mitosis and meiosis that ensure the resulting daughter cells inherit the appropriate number of chromosomes.
- (b) The genetic composition of daughter cells produced by mitosis differs from that of the daughter cells produced by meiosis. Describe TWO features of the cell division processes that lead to these differences.

recombination

PAGE FOR ANSWERING QUESTION 4

(4a) The separation of sister chromatids in both mitosis and meiosis II ensure that each daughter cell receives the appropriate number of chromosomes. Also, the lining up of the chromosomes along the middle of the cell ensures that the chromosomes will separate properly.

(4b) Unlike mitosis, meiosis results in 4 haploid cells rather than 2 diploid cells because cell division occurs twice to produce gametes. Also, the chromosomes in ^{the cells that have undergone} meiosis are recombinants of each other because of the synapsing that occurs in prophase I.
 ↳ unlike those in mitosis.

4. Both mitosis and meiosis are forms of cell division that produce daughter cells containing genetic information from the parent cell.
- (a) **Describe** TWO events that are common to both mitosis and meiosis that ensure the resulting daughter cells inherit the appropriate number of chromosomes.
- (b) The genetic composition of daughter cells produced by mitosis differs from that of the daughter cells produced by meiosis. **Describe** TWO features of the cell division processes that lead to these differences.

PAGE FOR ANSWERING QUESTION 4

~~The~~ Both mitosis and meiosis are forms of cell ~~divid~~ division ~~in the eukaryotic cell~~ that produce daughter cells containing genetic information. In both processes, chromosomes line up in the middle of the cell and they ~~become~~ ^{split} apart. This ensures that the daughter cells have the appropriate amount of chromosomes. Cells also have checkpoints during the cell cycle in which they make sure they have the right amount of chromosomes in order to function properly and if the cell does not have everything it needs, it flags itself and apoptosis, or better known as cell suicide, occurs.

Mitosis is a process of cell division where two identical copies of the parent cell are created. The cell only splits once after the chromosomes are copied and it results in two diploid cells. Meiosis is ~~this~~ ^a process of cell division where gametes (eggs or sperm) are created. This differs from mitosis because the parent cell splits twice resulting in four haploid cells, each with different

IPMAT

4. Both mitosis and meiosis are forms of cell division that produce daughter cells containing genetic information from the parent cell.
- (a) Describe TWO events that are common to both mitosis and meiosis that ensure the resulting daughter cells inherit the appropriate number of chromosomes. **Anaphase**
- (b) The genetic composition of daughter cells produced by mitosis differs from that of the daughter cells produced by meiosis. Describe TWO features of the cell division processes that lead to these differences.

PAGE FOR ANSWERING QUESTION 4

a. In prophase the cells duplicate their entire sets of DNA.

In Anaphase ~~the~~ the chromosomes are lined up at the equator so that there is one ~~or~~ sister chromatid on each side.

b. In mitosis, cells undergo only one division leaving them with a diploid ($2n$) set of chromosomes.

In meiosis, cells undergo two divisions leaving each cell a haploid ($1n$) set of chromosomes.

AP[®] BIOLOGY

2015 SCORING COMMENTARY

Question 4

Question 4 was written to the following Learning Objectives in the AP[®] Biology Curriculum Framework: 3.3, 3.8.

Overview

This questions was based on a comparison of cell division processes. Students were asked to describe two events common to both mitosis and meiosis that ensure the proper allocation of chromosomes to daughter cells. Students were then asked to describe two features of mitosis and meiosis that result in the contrasting genetic composition of daughter cells after both cell division processes.

Sample: 4A

Score: 4

The response earned 1 point in part (a) for describing the separation of chromatids as an event common to mitosis and meiosis. The response earned 1 point for describing the lining up of chromosomes along the middle of the cell as an event common to mitosis and meiosis.

The response earned 1 point in part (b) for describing that meiosis results in four cells and mitosis results in two cells. The response earned 1 point for describing that meiosis produces haploid cells and mitosis produces diploid cells.

Sample: 4B

Score: 3

The response earned 1 point in part (a) for describing that chromosomes line up in the middle of the cell as an event common to mitosis and meiosis.

The response earned 1 point in part (b) for describing that meiosis results in four cells and mitosis results in two cells. The response earned 1 point for describing that meiosis produces haploid cells and mitosis produces diploid cells.

Sample: 4C

Score: 2

The response earned 1 point in part (b) for describing that in mitosis cells undergo only one division and in meiosis cells undergo two divisions. The response earned 1 point for describing that mitosis produces diploid cells and meiosis produces haploid cells.