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Mitosis

Exam — Cell Division

Challenging Pre-med style questions on mitosis, spindle mechanics, and cytokinesis in plant and animal cells

28 items — Printable Exam

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1 **In a typical eukaryotic cell cycle, which statement correctly describes the relationship between DNA replication and mitosis?**

A DNA replication and separation of sister chromatids both occur during mitosis (M phase).

B DNA replication occurs during S phase before mitosis; mitosis distributes the replicated chromosomes into two nuclei.

C DNA replication occurs only in G1, whereas mitosis occurs only in S phase.

D DNA replication takes place only during cytokinesis.

E DNA replication and mitosis occur continuously and simultaneously throughout interphase.

2 **Which event marks the transition from prophase to prometaphase in a typical animal cell?**

A Replication of DNA is completed.

B The nuclear envelope breaks down, allowing spindle microtubules to access chromosomes.

C Chromosomes first begin to condense and become visible.

D Chromosomes align at the metaphase plate.

E The contractile ring of actin and myosin begins to constrict.

3 **Which description corresponds specifically to metaphase of mitosis in an animal cell?**

A Chromosomes begin to condense, but the nucleolus is still visible and the nuclear envelope intact.

B All chromosomes are maximally condensed and aligned at the cell equator, with sister chromatids attached to microtubules from opposite spindle poles.

C Sister chromatids separate and move toward opposite poles of the cell.

D Nuclear envelopes re-form around each set of chromosomes and the chromosomes begin to decondense.

E A cell plate begins to form between two groups of chromosomes.

4 **A diploid cell in a species with 2n = 4 chromosomes has just completed S phase and is in metaphase of mitosis. How many chromosomes and chromatids are present in this cell at metaphase?**

A 2 chromosomes and 2 chromatids

B 4 chromosomes and 8 chromatids

C 4 chromosomes and 4 chromatids

D 8 chromosomes and 8 chromatids

E 8 chromosomes and 16 chromatids

5 **A diploid cell in a species with 2n = 4 chromosomes completes S phase and enters mitosis. During anaphase, after sister chromatids separate, how many chromosomes are present in total within the single cell?**

A 2

B 4

C 8

D 16

E 0

6 **A diploid cell with $2n = 6$ chromosomes is in G1. After DNA replication and one complete mitotic division (including cytokinesis), what is the number of chromosomes and double-stranded DNA molecules in each daughter nucleus immediately after mitosis?**

A 3 chromosomes and 3 DNA molecules

B 3 chromosomes and 6 DNA molecules

C 6 chromosomes and 6 DNA molecules

D 6 chromosomes and 12 DNA molecules

E 12 chromosomes and 12 DNA molecules

7 **Which statement correctly describes the roles of different spindle microtubule populations during mitosis?**

A Kinetochore microtubules overlap at the cell equator to push spindle poles apart, whereas polar microtubules attach to kinetochores and pull chromatids apart.

B Astral microtubules attach directly to chromosome arms and pull them to the poles.

C Kinetochore microtubules attach to centromeric kinetochores and typically shorten during anaphase, whereas non-kinetochore (polar) microtubules overlap and help push the poles apart.

D All spindle microtubules have identical functions and none attach directly to chromosomes.

E Only astral microtubules are required for chromosome segregation; kinetochore microtubules are dispensable.

8 **Which statement correctly compares mitosis in typical animal cells with mitosis in most higher plant cells?**

A Animal cells typically lack centrosomes and do not form astral microtubules, whereas plant cells possess centrioles that nucleate the spindle.

B Animal cells often form a cleavage furrow using a contractile ring of actin and myosin, whereas plant cells assemble a cell plate from vesicles that fuse between the daughter nuclei.

C Only plant cells undergo mitosis; animal cells rely solely on binary fission.

D Plant and animal cells use identical mechanisms for cytokinesis, both relying on a contractile ring anchored to the cell wall.

E Mitosis in plant cells reduces the chromosome number by half, whereas mitosis in animal cells maintains it.

9 **Which statement best distinguishes mitosis from cytokinesis in eukaryotic cells?**

A Mitosis divides the nucleus, whereas cytokinesis divides the cytoplasm.

B Mitosis occurs only in plant cells, whereas cytokinesis occurs only in animal cells.

C Mitosis doubles the chromosome number, whereas cytokinesis halves it.

D Mitosis always precedes DNA replication, whereas cytokinesis follows it.

E Mitosis occurs only in somatic cells, whereas cytokinesis occurs only in germ cells.

10 **In an animal cell, the cleavage furrow that appears during cytokinesis is produced primarily by:**

A Depolymerization of microtubules at the metaphase plate.

B A contractile ring of actin microfilaments and myosin just beneath the plasma membrane.

C Fusion of Golgi-derived vesicles forming a new cell wall.

D Condensation of chromatin along the equator of the cell.

E Constriction of intermediate filaments attached to desmosomes.

11 **During cytokinesis in a typical plant cell, which process directly leads to the formation of the new cell wall between daughter cells?**

A Inward constriction of the plasma membrane by a contractile ring.

B Outward growth of the old cell wall from the cell periphery toward the center.

C Fusion of Golgi-derived vesicles at the center of the cell to form a cell plate that develops into a new wall.

D Sliding of intermediate filaments that pinches the cytoplasm in two.

E Fragmentation of the old cell wall to create two separate cells.

12 **The anaphase-promoting complex/cyclosome (APC/C) is not activated in a metaphase cell. Which immediate consequence is most likely?**

A The nuclear envelope re-forms prematurely around condensed chromosomes.

B Sister chromatids fail to separate because cohesin is not cleaved.

C DNA replication continues during metaphase.

D The cell skips anaphase and proceeds directly to cytokinesis.

E The cleavage furrow forms earlier than normal.

13 **The spindle-assembly (metaphase) checkpoint delays the onset of anaphase until:**

A All sister chromatids are fully decondensed.

B DNA replication has started in S phase.

C Cyclin-dependent kinase (CDK) activity has dropped to zero.

D All kinetochores are properly attached to microtubules from opposite poles.

E The cleavage furrow has begun to form.

14 **Which statement best explains why mitosis is essential for growth and tissue repair in multicellular animals?**

A Mitosis produces genetically diverse cells that increase the adaptability of tissues.

B Mitosis produces haploid cells that can fuse to form diploid zygotes.

C Mitosis produces daughter cells with the same chromosome number and, barring mutation, the same genetic information as the parent cell.

D Mitosis reduces the cell size and removes excess cytoplasm without affecting chromosome number.

E Mitosis selectively eliminates mutated chromosomes from somatic cells.

15 **In a healthy adult human, which of the following cell types is most likely to remain permanently in G0 and rarely, if ever, re-enter the cell cycle to undergo mitosis?**

A Basal epithelial cells of the skin

B Cells lining the intestinal crypts

C Hematopoietic stem cells in bone marrow

D Neurons in the cerebral cortex

E Fibroblasts in a healing wound

16 **Which feature is characteristic of mitosis in eukaryotic cells but not of binary fission in most prokaryotes?**

A DNA replication before cell division

B Use of a microtubule-based mitotic spindle to segregate chromosomes

C Attachment of DNA to the plasma membrane

D Cytokinesis that divides one cell into two

E Use of DNA polymerases to copy DNA

17 Which statement correctly describes the behaviour of homologous chromosomes and sister chromatids during mitosis in a diploid cell?

A Homologous chromosomes pair along their lengths and separate at anaphase, while sister chromatids remain together.

B Homologous chromosomes and sister chromatids both pair and separate together at anaphase.

C Homologous chromosomes behave independently; it is sister chromatids of each chromosome that separate at anaphase.

D Homologous chromosomes pair only at telophase, after sister chromatids separate.

E Neither homologous chromosomes nor sister chromatids separate during mitosis.

18 During which stage of mitosis are chromosomes typically at their maximum level of condensation and most easily visible as distinct units under the light microscope?

A Early prophase

B Metaphase

C Anaphase

D Telophase

E Late G1

19 **Which combination of events correctly matches a mitotic stage in a typical animal cell?**

A Prophase: nuclear envelopes re-form, nucleoli reappear, chromosomes decondense.

B Telophase: nuclear envelopes re-form around each set of chromosomes, nucleoli reappear, and chromosomes begin to decondense.

C Metaphase: nuclear envelope intact, nucleoli prominent, chromosomes decondensed.

D Anaphase: nuclear envelopes re-form and cytokinesis begins before chromatids separate.

E Prometaphase: cleavage furrow forms and a cell plate appears.

20 **A drug that specifically prevents actin polymerization is applied to a culture of dividing animal cells. Microtubules and DNA replication are unaffected. Which outcome is most likely?**

A Chromosomes cannot condense, so the cells arrest in prophase.

B Mitotic spindle cannot form, so chromosomes fail to attach to microtubules.

C Mitosis proceeds normally, but cytokinesis fails, producing multinucleate cells.

D DNA replication stops and cells remain permanently in G1.

E Golgi-derived vesicles cannot fuse, so a cell plate fails to form in animal cells.

21 **Colchicine is added to a culture of dividing animal cells. It binds tubulin and prevents spindle microtubule formation. Which observation best describes the effect on mitosis?**

A Cells complete mitosis but fail cytokinesis, becoming multinucleate.

B Chromosomes fail to condense and remain in an interphase-like state.

C Cells show condensed chromosomes with a broken-down nuclear envelope but no organized spindle, and they do not progress to anaphase.

D Sister chromatids separate earlier than normal, producing extra daughter cells.

E DNA replication continues throughout mitosis.

22 **A cell is observed with the following features: the nuclear envelope has disintegrated, chromosomes are condensed but not yet arranged on a single plane, and spindle microtubules are attaching to kinetochores. Which stage of mitosis is this cell most likely in?**

A Prophase

B Prometaphase

C Metaphase

D Anaphase

E Telophase

23 **In the context of the eukaryotic cell cycle, the term M phase refers to:**

A Mitosis only (nuclear division), excluding cytokinesis.

B The entire interval from the end of G1 to the start of G2.

C Both mitosis (nuclear division) and cytokinesis (cytoplasmic division).

D Only meiosis in germ cells.

E Only the period of DNA replication.

24 **Entry into mitosis in many eukaryotic cells is triggered by high activity of M-phase cyclin–CDK complexes (MPF). Which event is essential for a cell to exit mitosis and return to interphase?**

A Complete replication of DNA in S phase.

B Phosphorylation of nuclear lamins to break down the nuclear envelope.

C Ubiquitin-mediated degradation of mitotic cyclins, leading to inactivation of CDK.

D Synthesis of new centrioles.

E Random loss of chromosomes during anaphase.

25 In many higher plant cells, which structure appears before mitosis and predicts the future plane of cell division and position of the cell plate?

A Cleavage furrow

B Preprophase band of microtubules just beneath the plasma membrane

C Contractile ring of actin and myosin

D Anaphase spindle midzone

E Nucleolus

26 A pathologist calculates the mitotic index (fraction of cells in mitosis at a given time) in a tissue sample and finds it to be much higher than in normal tissue from the same organ. Which is the most reasonable conclusion?

A Cells in the sample have a much higher mutation rate than normal.

B Cells in the sample are dividing more rapidly than normal, consistent with a tumour.

C Cells in the sample have stopped dividing and are arrested in G0.

D Cells in the sample are undergoing extensive apoptosis.

E Cells in the sample are mostly undergoing meiosis.

27 **Which mechanism contributes most directly to the movement of sister chromatids toward opposite poles during anaphase?**

A Polymerization of kinetochore microtubules at their plus ends pushing chromatids outward.

B Depolymerization (shortening) of kinetochore microtubules and activity of motor proteins at kinetochores and spindle poles.

C Random diffusion of chromatids in the cytoplasm until they reach the poles.

D Contraction of intermediate filaments attached to centromeres.

E Fusion of Golgi vesicles at the metaphase plate.

28 **Cohesin proteins hold sister chromatids together from S phase until anaphase. In a mutant cell line, cohesin does not load properly onto chromosomes during S phase, so sister chromatids are not stably paired. Which consequence is most likely during mitosis?**

A Chromosomes cannot condense, so the cell arrests in prophase.

B Sister chromatids behave as independent chromosomes and may attach to spindle poles randomly, increasing the risk of aneuploid daughter cells.

C Anaphase occurs earlier than normal but still produces genetically identical daughters.

D DNA replication does not occur in S phase.

E The nuclear envelope cannot break down at the start of mitosis.

Answer Key

#	Ans	Answer Text
1	B	DNA replication occurs during S phase before mitosis; mitosis distribute...
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12	B	Sister chromatids fail to separate because cohesin is not cleaved.
13	D	All kinetochores are properly attached to microtubules from opposite pol...
14	C	Mitosis produces daughter cells with the same chromosome number and, bar...
15	D	Neurons in the cerebral cortex
16	B	Use of a microtubule-based mitotic spindle to segregate chromosomes
17	C	Homologous chromosomes behave independently; it is sister chromatids of ...
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