



Biology
Standard and Higher level
D2.1 Cell and nuclear division Paper 1A

11 May 2026

Zone A afternoon | **Zone B** morning | **Zone C** afternoon

1 hour [Paper 1A]

Instructions to candidates

- Answer all questions.
- For each question, choose the answer you consider to be the best.
- A calculator is required for this paper.
- This paper generally presents questions in the same order the concepts are presented in the syllabus guide. The earlier questions are usually but not always easier than the later questions. Although most questions focus on this topic only, some are linked to other topics.
- This paper contains challenging IB-style problems. It is meant to enrich your learning and improve your mastery of the concepts presented in this topic after you have studied it.
- All but a few referenced questions are original and written by me.
- **None of the questions are from past papers.**
- The maximum mark for paper 1A is **[40 marks]**.

1. Why is cell division important for living organisms?
 - A. It provides a mechanism for survival and reproduction
 - B. It provides a mechanism for heredity and variation
 - C. It provides a mechanism for unity and change
 - D. It provides a mechanism for continuity and homeostasis

2. What are mother cells?
 - A. Cells in the fetus that originate from the mother
 - B. Antibodies in the fetus produced by the mother during pregnancy
 - C. Cells that produce two daughter cells by nuclear and cytoplasmic divisions
 - D. Cells that produce identical daughter cells when they undergo division

3. Why does cytokinesis occur after nuclear division?
 - A. To ensure each daughter cell receives the same DNA
 - B. To ensure each daughter cell contains genetic material
 - C. To ensure each daughter cell does not receive two nuclei
 - D. To ensure each daughter cell contains enough organelles

4. What is a consequence of actin and myosin filament contraction during animal cytokinesis?
 - A. Formation of a cleavage furrow
 - B. Shortening of the mother cell
 - C. Pushing of the plasma membrane near the contractile ring
 - D. Movement of organelles towards opposite poles

5. What is a shared feature of cytokinesis between animals and plants?
 - A. Polysaccharide-containing vesicles
 - B. Cleavage furrow
 - C. Barrier between the two daughter cells
 - D. Cytoskeleton involvement

6. What happens to the plasma membrane during cytokinesis in animal cells?
- A. It is pulled outwards as the contractile ring shrinks
 - B. It is pulled outwards as the contractile ring expands
 - C. It is pulled inwards as the contractile ring expands
 - D. It is pulled inwards as the contractile ring shrinks
7. How do mother cells split during cell division in plant cells?
- A. The cell plate forms and contracts to pull the plasma membrane
 - B. Vesicles fuse at the center of the mother cell until a cell wall forms
 - C. The cell wall forms from each end of the mother cell by vesicle fusion
 - D. The plasma membrane pinches inwards and fuses with vesicles
8. What is the consequence of a mutation in myosin proteins?
- A. The alignment of chromosomes at the equator will be disrupted
 - B. The cleavage furrow would form normally but the mother cell cannot split
 - C. The contractile ring will shrink but no daughter cells will be produced
 - D. The cell will be unable to form a cleavage furrow and fail to split
9. What is the difference between equal and unequal cytokinesis?
- A. Unequal cytokinesis distributes organelles to one daughter cell
 - B. Equal cytokinesis distributes organelles to both daughter cells
 - C. Unequal cytokinesis results in different amounts of genetic material in each daughter cell
 - D. Equal cytokinesis results in similar amounts of cytoplasm in each daughter cell

- 10.** What happens before daughter cells split from parent cells during yeast budding?
- A. Genetic material must be inherited
 - B. Essential organelles and genetic material must be inherited
 - C. All organelles and genetic material must be inherited
 - D. A small amount of cytosol must be inherited
- 11.** Why do both daughter cells inherit mitochondria during equal or unequal cytokinesis?
- A. Cells only come from pre-existing cells
 - B. Mitochondria only come from pre-existing mitochondria
 - C. Organelles only come from pre-existing organelles
 - D. Mitochondrial DNA only comes from pre-existing mitochondrial DNA
- 12.** What is a consequence of DNA replication?
- A. Doubling of DNA molecules but not chromosomes
 - B. Doubling of chromatids but not chromosomes
 - C. Doubling of chromosomes but not chromatids
 - D. Doubling of DNA molecules but not chiasmata
- 13.** What process is part of both meiosis and mitosis?
- I. Condensation of DNA molecules
 - II. Alignment of homologous chromosomes at the equator
 - III. Division of the cytoplasm
- A. I only
 - B. II only
 - C. I and II only
 - D. I, II and III

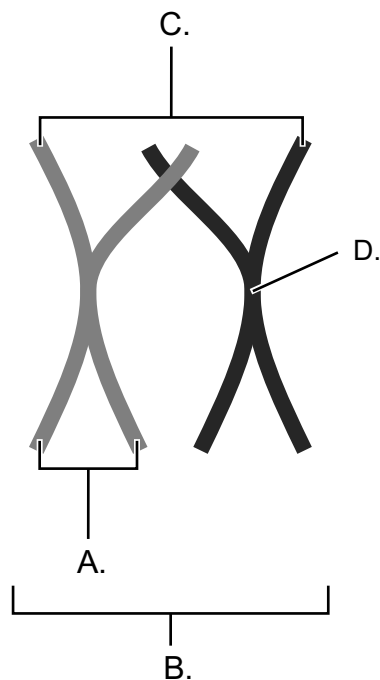
- 14.** What is the role of histones in mitosis and meiosis?
- A. Condense chromosomes into compact genetic material
 - B. Supercoil DNA molecules to form condensed genetic material
 - C. Attach spindle fiber microtubules to centromeres
 - D. Form kinetochore proteins at the centromere
- 15.** When are DNA molecules referred to as chromatids during mitotic division?
- I. Before DNA replication
 - II. Prophase
 - III. Anaphase
- A. I only
 - B. II only
 - C. II and III only
 - D. I and III only
- 16.** When does the number of DNA molecules equal the number of chromosomes?
- I. Telophase
 - II. Telophase I
 - III. Telophase II
- A. I only
 - B. II only
 - C. I and III only
 - D. I, II and III
- 17.** How many chromosomes are present before and after meiosis II in humans?
- A. 23 before, 46 after
 - B. 46 before, 23 after
 - C. 23 before and after
 - D. 46 before and after

- 18.** How many chromatids are in each daughter cell after meiosis I in humans?
- A. 23
 - B. 46
 - C. 92
 - D. 62
- 19.** Where are chromatids attached to each other?
- A. At the bivalent
 - B. At the kinetochore
 - C. At the centromere
 - D. At the DNA equator
- 20.** In which of the following nuclear divisions do the number of chromosomes and chromatids remain the same until cytokinesis is completed?
- I. Meiosis I
 - II. Meiosis II
 - III. Mitosis
- A. I only
 - B. II only
 - C. I and II only
 - D. I and III only
- 21.** Diploid cells in fruit flies (*Drosophila melanogaster*) have 8 chromosomes. How many DNA molecules are present in the mother cell during metaphase?
- A. 4
 - B. 8
 - C. 16
 - D. 32

22. Spinach (*Spinacia oleracea*) cells have a haploid number of 5 chromosomes. After cytokinesis following telophase II, how many DNA molecules are in each daughter cell?
- A. 5
 - B. 10
 - C. 15
 - D. 20
23. What happens during anaphase I of meiosis?
- A. Paternal and maternal chromosomes are equally separated
 - B. Paternal and maternal chromosomes are randomly separated
 - C. Sister chromatids are equally separated
 - D. Sister chromatids are randomly separated
24. Why is meiosis a reduction division?
- A. The number of chromosomes in each daughter cell decreases after meiosis I
 - B. The number of chromosomes in each daughter cell decreases after meiosis II
 - C. The number of chromatids in each daughter cell decreases after meiosis I
 - D. The number of chromatids in each daughter cell decreases after meiosis II
25. What **correctly** compares microtubules and spindle fibers?
- A. Spindle fibers are a network of microtubules
 - B. Microtubules are a network of spindle fibers
 - C. Spindle fibers are a type of microtubule in nuclear division
 - D. Microtubules are a type of spindle fiber in nuclear division

26. What is the role of centrioles in nuclear division?
- A. Synthesis of spindle fibers
 - B. Organization of spindle fibers
 - C. Binding kinetochore proteins to pull apart sister chromatids
 - D. Binding centromeres to pull apart homologous chromosomes
27. What is **correct** about homologous chromosomes?
- A. They are a pair of sister chromatids formed during meiosis
 - B. They are a pair of sister chromatids formed during mitosis
 - C. They are a pair of chromosomes connected at the centromere
 - D. They are a pair of chromosomes from different parental origins
28. How is meiosis II similar to mitosis?
- A. Meiosis II is not a reduction division
 - B. DNA replication does not occur before meiosis II
 - C. Chromosomes align at the metaphase plate
 - D. Crossing over occurs in prophase
29. What is the change in chromosome number between meiosis I and meiosis II?
- A. $2n \rightarrow n$
 - B. $n \rightarrow n$
 - C. $\frac{1}{2} n \rightarrow \frac{1}{2} n$
 - D. $2n \rightarrow \frac{1}{2} n$

30. Which option **correctly** labels a bivalent?



31. **[AHL]** What part of the cell cycle does a cell enter after cytokinesis?

- A. Interphase
- B. Telophase
- C. Anaphase
- D. Prophase

32. **[AHL]** Which of these processes is not a part of the cell cycle?

- A. Duplication of genome
- B. Division into daughter cells
- C. Synthesis of cell organelles
- D. Alignment homologous chromosomes at the equator

33. **[AHL]** What is the period between two M phases?

- A. Interphase
- B. Prophase
- C. Metaphase
- D. Telophase

34. **[AHL]** What is the main prerequisite for clearance at the G2 checkpoint?
- A. The cell has reached a sufficient size
 - B. An adequate supply of nucleotides
 - C. Complete and accurate DNA replication
 - D. Proper attachment of spindle fibers to kinetochores
35. **[AHL]** What stage of mitosis will be blocked if the M checkpoint is not cleared?
- A. Metaphase
 - B. Prophase
 - C. Interphase
 - D. Anaphase
36. **[AHL]** What is the role of cyclin-dependent kinases?
- A. They phosphorylate cyclins to reach threshold levels
 - B. They phosphorylate target proteins in the cell cycle
 - C. Their phosphorylation activates cell cycle proteins
 - D. Their phosphorylation causes fluctuations in cyclin levels
37. **[AHL]** What **correctly** describes a group of cancer cells that developed in the skin and spread to the lungs?
- A. Primary tumours
 - B. Secondary tumours
 - C. Benign tumours
 - D. Malignant tumours

38. [AHL] What are proto-oncogenes?

- A. Mutated oncogenes that promote excess cell proliferation
- B. Mutated oncogenes that promote normal cell proliferation
- C. Oncogene precursors that promote normal cell proliferation
- D. Oncogene precursors that promote excess cell proliferation

39. [AHL] What does a high mitotic index indicate?

- A. High cell proliferation
- B. Low cell proliferation
- C. High genetic diversity
- D. Low genetic diversity

40. [AHL] Scientists investigated the effect of reducing cyclin D1 levels on human cartilage cells and observed the results shown in the table.

Treatment	Cells in G ₁ phase	Cells in S phase
Normal cyclin D1 levels	54.7%	35.9%
Reduced cyclin D1 levels	78.3%	10.6%

What is a **correct** conclusion?

- A. Cyclin D1 is required for DNA replication completion
 - B. Cyclin D1 determines how long cells remain in the S phase
 - C. Cyclin D1 promotes progression from the G₁ phase into S phase
 - D. Cyclin D1 prevents cells from spending a long time in the G₁ phase
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References:

<https://www.sanfoundry.com/biology-questions-answers-cell-cycle/>

40. Beier, F et al. "TGFbeta and PTHrP control chondrocyte proliferation by activating cyclin D1 expression." Molecular biology of the cell vol. 12,12 (2001): 3852-63. doi:10.1091/mbc.12.12.3852

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