

Model Answers: Hard

1

The correct answer is **C** because:

- Graph 1 shows that the distance between **sister chromatids** will not change until the **spindle microtubules** contract, causing the **centromeres** to divide and separate therefore pulling the sister chromatids away from each other towards opposite poles
- Graph 2 shows that initially the distance between the **centromeres** (the middle section of chromatids) and poles will not alter but when the spindle microtubules contract then the distance between centromeres and poles will decrease
- Graph 3 shows that the distance between the poles of spindle does not alter significantly

A & B are incorrect as the distance between the **poles** of spindle does **not** change whilst the chromosomes are being separated in **anaphase**

D is incorrect as the sister chromatids are initially joined by the centromere in **metaphase** so there will be no distance between them until the spindle microtubules contract and the centromeres are separated and pulled to the poles during **anaphase**

2

The correct answer is **D**

- As prophase is the first stage of mitosis and therefore the nuclear envelope is still present
- During the S phase of interphase DNA was replicated producing a copy of the 46 chromosomes

A is incorrect as during prophase the nuclear envelope gets broken down and the spindle fibres form. When the nucleus divides there would only be 23 chromosomes in the daughter cells

C is incorrect as there are no spindle fibres before prophase and when the 46 chromatids were separated during anaphase this would result in only 23 chromosomes in the daughter cells.

B is incorrect as there are too few molecules of DNA to produce two diploid cells that were genetically identical to the parent cell.

3

The correct answer is **D** because during **telophase**, the nuclear envelope reforms separating the chromatids at each pole into 2 nuclei. This occurs immediately prior to cytokinesis.

A is incorrect as during S phase of **interphase** DNA is **replicating** therefore the DNA content is increasing, at **X** the graph shows a decrease in DNA content.

B & C are incorrect as this is when the cell is undergoing mitosis and although the sister chromatids (replicated DNA molecules) are being separated they are still located in the one cell

4

The correct answer is **C** because

- Prophase is the initial phase of mitosis
- The presence of MPF initiates prophase and therefore the cell will begin to divide again too soon (before it is ready)
- This could lead to uncontrolled cell division as if prophase is being encouraged to start then the cell may divide even when it shouldn't

A is incorrect as although the cells produced may be smaller than normal as they have less time to grow, this is an effect and not a consequence.

B is incorrect as cytokinesis would occur at the right stage (not early) as MPF affects prophase starting but not subsequent events.

D is incorrect as the production of four cells from one parent cell is the result of meiosis, MPF wouldn't cause this.

5

The correct answer is **D** as during **interphase**, the cell either carries out its normal function or prepares to divide by mitosis with DNA being replicated during the S phase of interphase.

The DNA double helix uncoils and separates during **semi-conservative DNA replication**, so if chemotherapy treatments affect this process then they are acting during interphase.

Answers **A**, **B** and **C** are all stages of mitosis; during these phases the DNA has already been replicated. During metaphase the chromatids are separated but this does not involve the DNA double helix uncoiling and separating.

6

The correct answer is **A** because the stage after metaphase is **anaphase** where the sister chromatids are separated as the centromeres are pulled towards opposite poles by the spindle contracting

B is incorrect as centrioles become present during **prophase**

C & D are incorrect as chromatin condenses during **prophase**

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The correct answer is **D** because during interphase (**G1 phase**) the cell is producing most of the proteins it needs to function normally or to prepare to divide; this is the stage where loss of control occurs that can lead to cells proceeding to mitosis when they shouldn't and hence being different sizes.

A & B are incorrect as these stages occur during mitosis; at this point a cell is already dividing but this is dependent upon previous events in the cell cycle.

C is incorrect as cytokinesis is the division of the cytoplasm following nuclear division to form the two daughter cells.

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The correct answer is **B** because:

- Chromosomes become visible when they condense in prophase and the cell undergoes mitosis (prophase, metaphase, anaphase & telophase)
- Chromosomes only have paired chromatids (sister chromatids) joined together in prophase **and** metaphase
- Therefore the number of cells recorded at these stages were 64 (prophase) and 21 (metaphase) out of 892
 - $64 + 21 = 85$
 - $85 \text{ divided } 892 = 0.095$
 - $0.095 \times 100 = \mathbf{9.5\%}$

A is incorrect as this is the percentage the cell spent in **prophase** only

C is incorrect as this is the percentage the cell spent in **prophase**, **metaphase** and **anaphase**, however during anaphase the sister chromatids are no longer joined together

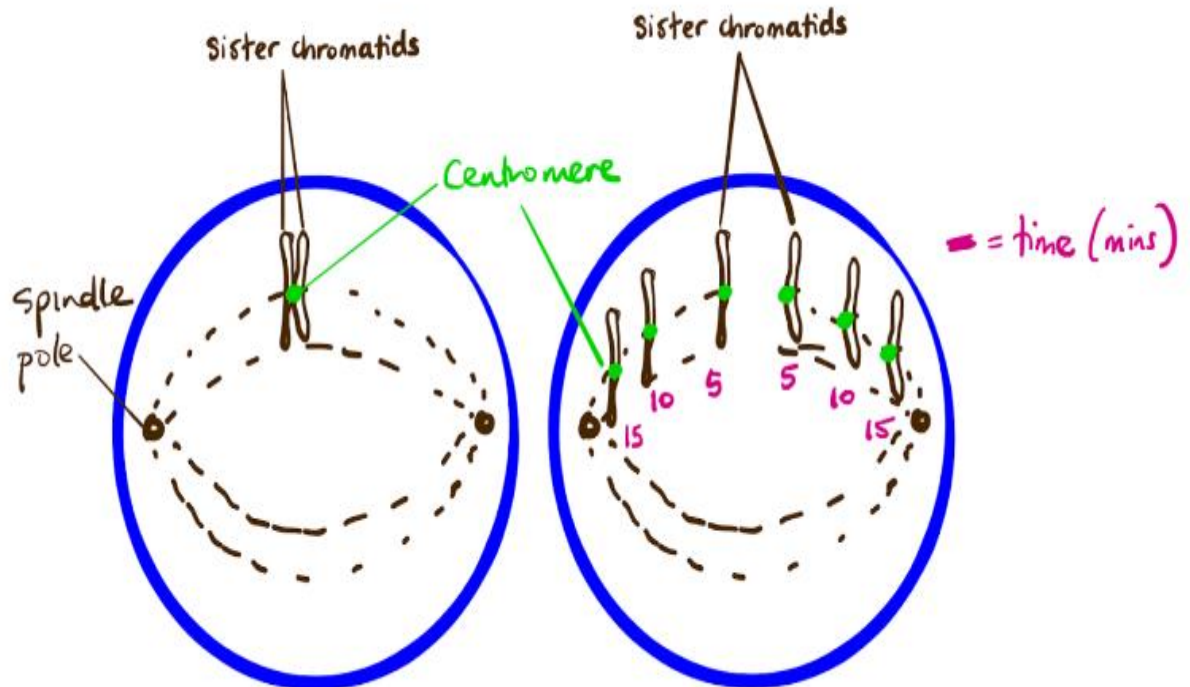
D is incorrect as this is the percentage the cell spent in **prophase**, **metaphase** and **interphase** (where the chromosomes are not visible or have sister chromatids joined together)

9

The correct answer is **A** because:

- Initially the distance between the centromeres and poles will not alter much, but when the spindle microtubules contract then the distance between centromeres and poles will decrease
- The distance between centromeres of sister chromatids will not change until the spindle microtubules contract causing the centromeres to divide and separate thus the sister chromatids will move away from each other towards the poles

- The distance between the poles of spindle should not alter significantly as the poles do not change location



B & C are incorrect as the distance must decrease between the poles and the centromeres if the chromosomes are to be separated

D is incorrect as when the sister chromatids separate the centromeres divide and thus as the spindle microtubules contract moving the chromatids apart the distance increases

10

The correct answer is **B** because:

- Metaphase** is when the chromosomes line up on the cell **equator**
- Therefore if there are 18 out of a total 335 cells in this stage in the 24 hrs (1,440 minutes) then
 - 18 divided by 335 = 0.054
 - 0.054 x 1,440 = **77.76 minutes**

A is incorrect as this is the number of minutes the cell spent in **anaphase** where the centromeres are dividing and the chromosomes are being pulled apart as the spindle microtubules contract

C is incorrect as this is the number of minutes the cell spent in **telophase** where the DNA uncoils and the nuclear envelope reforms

D is incorrect as this is the number of minutes the cell spent in **prophase** where the chromosomes are condense and the nuclear envelope breaks down