1.4 Cells: Division

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Course	DP IB Biology
Section	1. Cell Biology
Topic	1.4 Cells: Division
Difficulty	Medium

To be used by all students preparing for DP IB Biology SL
Students of other boards may also find this useful

1

The correct answer is **B** because:

- Cell 4 shows **metaphase**: chromosomes align at the equator which is where the mitotic spindle will bind to the centromere.
- Cell 1 shows **anaphase**: the chromosomes begin to separate into chromatids, which get pulled to the poles of the cell by the contracting mitotic spindle.
- Cell 2 shows **telophase**: the chromatids are at the poles ready for the nuclear envelope to reform.
- Cell 3 shows **late telophase**: the uncoiled chromosomes form two nuclei but cytokinesis (division of cytoplasm) has not occurred yet.
- Cell 5 shows a single cell with a nucleus and no distinct chromosomes and therefore it is in **interphase**.

2

The correct answer is **A** because a **cell plate** forms between the two new nuclei during **cytokinesis** in **plant cells** but not in animal cells.

B is incorrect because DNA is transcribed and translated in animal cells during interphase (G_1 phase), when proteins are synthesised.

C is incorrect because the spindle is formed from microtubules in metaphase in animal cells, to allow the sister chromatids to be separated.

D is incorrect because animal daughter cells are formed during cytokinesis by the process of cleavage furrowing.

3

The correct answer is **C** because cancer cells result from rapid, uncontrolled cell division and therefore have a shorter interphase (when the cell carries out protein synthesis and grows). Mitosis takes a specific length of time, whereas the length of interphase varies depending on when the cell receives a signal to divide.

A is incorrect because although mutations are rare, they can occur in any cell.

B is incorrect because new cells, including cancer cells, are created when the cytoplasm divides during cytokinesis.

D is incorrect because cancer cells undergo the same phases of mitosis (as normal cells) to produce new cancer cells.

4

The correct answer is **D** because **D** is located towards the end of interphase, which suggests the cell is in **G_2 phase** and has therefore already gone through **S phase** (during which DNA synthesis occurs), where nucleotides would be incorporated.

A & **B** are incorrect because both are located where the cell is undergoing mitosis, which is when the replicated chromosomes (sister chromatids) are being separated.

C is incorrect because immediately after mitosis and cytokinesis the cell enters the **G_1 phase**, where the cell grows and organelles are synthesised.

5

The correct answer is **B** because:

- The **nuclear membrane** breaks down during prophase.
- The **spindle** only starts to form during **metaphase**.
- During the **S phase** of **interphase**, DNA is **replicated** so there are 46 chromosomes, each of which is made up of two sister chromatids, resulting in 92 chromatids overall.

A is incorrect because the **nuclear envelope** does not break down until prophase and the **spindle fibres** do not form until metaphase.

C is incorrect because the **spindle fibres** do not form until metaphase and when the **46** chromatids are separated during **anaphase** this would result in only **23** chromosomes in the daughter cells.

D is incorrect because when the **46** chromatids are separated during **anaphase** this would result in only **23** chromosomes in the daughter cells.

6

The correct answer is **C** because the solid line on the graph indicates that the longer people smoke, the lower their survival probability becomes (i.e. their life expectancy decreases). Although this decrease in survival probability could be due to other factors not related to smoking, there is a control group (the dashed line, representing non-smokers), which shows that smoking is the factor that is reducing life expectancy.

A is incorrect because this graph does not provide any information on cancer rates in smokers or non-smokers.

B is incorrect for the same reason.

Although **D** is a scientifically correct statement, it cannot be concluded from the information provided in this graph alone.

7

The correct answer is **D** because the order of the mitosis stages are: **prophase** (two chromatids are joined by a centromere), **metaphase** (chromosomes line up along the equator of the spindle), **anaphase** (centromere divide, chromatids move to opposite poles of the cell) and **telophase** (chromosomes uncoil).

Answers **A**, **B** and **C** have the first stage as telophase, anaphase and metaphase respectively, which does not follow the correct order (PMAT).

8

The correct answer is **A** because the mitotic index is the proportion of cells (in a group of cells or a sample of tissue) that are undergoing mitosis. The mitotic index is normally given to 2 decimal places.

Step ①: Calculate number of cells undergoing mitosis (i.e. prophase + metaphase + anaphase + telophase)

= 11 + 2 + 4 + 3

= 20

Step ②: Calculate total number of cells (ie. including those in interphase)

= 20 + 80

= 100

Step ③: Calculate the mitotic index

$$\text{mitotic index} = \frac{\text{number of cells undergoing mitosis}}{\text{total number of cells}}$$

$$= \frac{20}{100}$$

$$= 0.20$$

9

The correct answer is **A** because ultraviolet light (specifically short-wave), viruses and X-rays are all examples of **carcinogens** (chemicals and agents that directly increase the incidence of cancer). These are also referred to as **mutagens**, as mutagens are agents that cause gene mutations. If the mutated gene is one that **causes cancer** it is referred to as an **oncogene**.

B is incorrect because viruses also can be mutagenic.

C and **D** are incorrect because they both include carbon monoxide, which is **not** a carcinogen.

10

The correct answer is **B** because:

- It is only possible to see that chromosomes consist of two chromatids held together at the centromere at the **end of prophase**. It is clear that the cell has **not yet entered metaphase** as the aligning of the chromosomes at the equator has not yet occurred. It has **not yet entered anaphase** as the centromeres have not yet divided (which allows the pairs of sister chromatids to separate).
- This diagram is of a cell undergoing mitosis, which will produce two **diploid** daughter cells (each with the same number of chromosomes)
- There are 10 chromosomes (that have been replicated, so each chromosome is made of two chromatids). This means 10 is the **diploid chromosome number** (2n).
- The **haploid number** (n) is where only **one set of chromosomes** is present. So the haploid chromosome number is 5.