10.1 Meiosis

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Course	DP IB Biology
Section	10. Genetics & Evolution (HL Only)
Topic	10.1 Meiosis
Difficulty	Medium

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

1

The correct answer is **D**

- Statement **I is correct** because the gamete-producing cell is diploid, whereas meiosis produces 4 haploid gametes each with ½ the amount of DNA of the original diploid cell. Whilst the amount of DNA halves **in each cell**, the overall amount has doubled (thanks to DNA replication before meiosis)
- Statement **II is incorrect** because crossing over requires chromosomes to be in homologous pairs (bivalents) to be close enough to exchange DNA
- Statement **III is incorrect** because it is meiosis I that is the reduction division (the number of chromosomes is divided by two)
- Statement **IV is incorrect** because sister chromatids remain together in meiosis I but separate in meiosis II

2

The correct answer is **A**

Autosomes are the non-sex chromosomes, so the koala's diploid cells will have 7 pairs of autosomes plus one pair of sex chromosomes to make a total of 16 chromosomes. During meiosis and oogenesis, the female koala will produce eggs with 7 autosomes and one sex chromosome.

3

The correct answer is **C**

Recombination involves breaking and rejoining strands of DNA, which can often give new traits as alleles move wholly from one DNA strand to another. Statement **A is incorrect** because DNA does not exchange just by virtue of chromosomes orienting themselves. Statement **B is incorrect** because mutation does not involve breaking and rejoining, nor does Statement **D** because telomere loss just involves non-coding DNA that does not always get replicated, so there is no recombination involved.

4

The correct answer is **C**

In meiosis I, homologous chromosomes separate as full chromosomes; only in meiosis II do the separate chromatids assort and segregate; this eliminates Statements **A** and **B**.

Whilst it may be tempting to think that chiasmata form in metaphase, when chromosomes align along the equator of the cell, the pairing of pairs of homologous chromosomes actually occurs in prophase I, so this eliminates Statement **D**.

5

The correct answer is **B**

A chiasma can only form at the equivalent place in two chromatids because that's where the same base sequences exist. Breaks occur so that **an equal length of DNA** is exchanged from one non-sister chromatid to the other. A chiasma can form between adjacent chromatids, or between non-adjacent ones, so drawings **A**, **C** and **D** are all possible. Drawing **C** is possible as it shows two chiasmata forming, which is entirely possible; in fact, many chiasmata can form simultaneously along two separate chromatids in meiosis I.

6

The correct answer is **D**

Statement I is correct in both cases.

Statement II is a difference. In meiosis II, the cells entering the process are haploid, whereas they are diploid in mitosis.

Statement III applies to mitosis and meiosis I, but not to meiosis II

Statement IV is correct in both cases. The differences are **II and III**.

7

The correct answer is **A.** A chiasma is the position where DNA strands intertwine and then break and rejoin to exchange alleles between non-sister chromatids.

- Staement **B is incorrect** because assortment follows the formation of chiasmata, although it is only just after it chronologically
- Statement **C is incorrect** because the gametes's makeup of alleles is already prearranged by events in meiosis I
- Statement **D is incorrect** because linkage is not an event, it's just a feature of gene loci that refers to two genes being located on the same chromosome

8

The correct answer is **B**.

Answer **A** is just the number of chromosomes. Answer **C** is $2^{14} = 16\,384$ which uses the diploid number, so is the wrong power to raise 2 to. Answer **D** is far too high, and could take into account a degree of crossing over, although the question is about independent assortment alone.

Question 8

For a eukaryotic organism with a diploid number of 14, how many combinations of chromosomes can occur through independent assortment in meiosis?

The number of combinations of chromosomes during independent assortment is 2 raised to the power of the haploid no. of chromosomes.

If the diploid number is 14, the haploid number = $\frac{14}{2} = 7$

No. of combinations = 2^7

= 128

Answer B [1 mark]

9

The correct answer is **A**

A bivalent is another name for a tetrad, so they are identical in size; each contains two chromosomes and four chromatids. This eliminates rows **B** and **C**. Row **D** is incorrect because a bivalent contains two chromosomes.

10

The correct answer is **A**.

The only diploid cell is I. a primary spermatocyte, which is the diploid cell whose differentiation allows it to begin spermatogenesis to produce haploid gametes. An oocyte is an immature ovum (so haploid), and a spermatid is an immature sperm cell (also haploid). A mature sperm cell is otherwise known as a spermatozoon (plural: spermatozoa).