# 3.2 Meiosis

## Question Paper

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|---|---|
| Course | DP IB Biology |
| Section | 3. Genetics |
| Topic | 3.2 Meiosis |
| Difficulty | Medium |

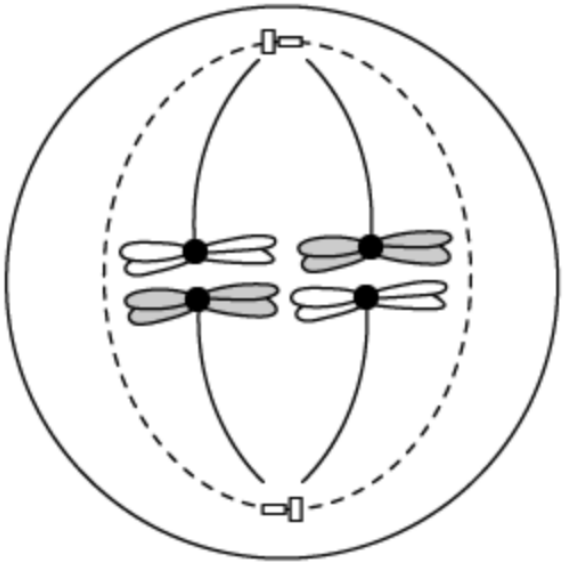
**Time allowed:** 60

**Score:** /45

**Percentage:** /100

## Question 1a

a) Identify, with a reason, the type of cell division shown in the diagram



[2 marks]

## Question 1b

b) *Pisum sativum* (garden pea) has a diploid chromosome number of 14.

Calculate how many different chromosomal combinations can result during meiosis, assuming no crossing over occurs.

[1 mark]

## Question 1c

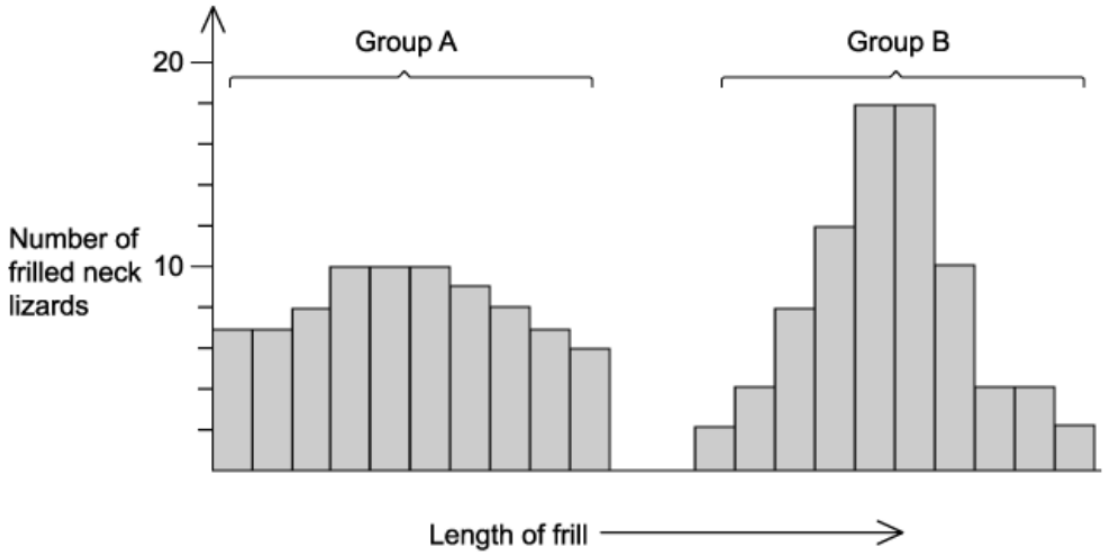
c) Discuss the significance of meiosis in the life cycle of *Pisum sativum* (garden pea).

[2 marks]

## Question 1d

d) *Chlamydosaurus kingii* (Australian Frillneck lizard) is a diurnal (active during the day) lizard whose distribution extends across northern Australia and into Papua New Guinea. If the lizard is startled it opens its mouth and flexes the muscles in its frill (a large fold of skin surrounding its throat) causing it to be raised. Scientists believe that the frill is used to deter predators and to attract females.

The graphs below show the variation in the frill length of 164 male lizards from two different sites 150 km apart.




Explain how meiosis may have caused the variation shown in these graphs.

**[2 marks]**

## Question 2a

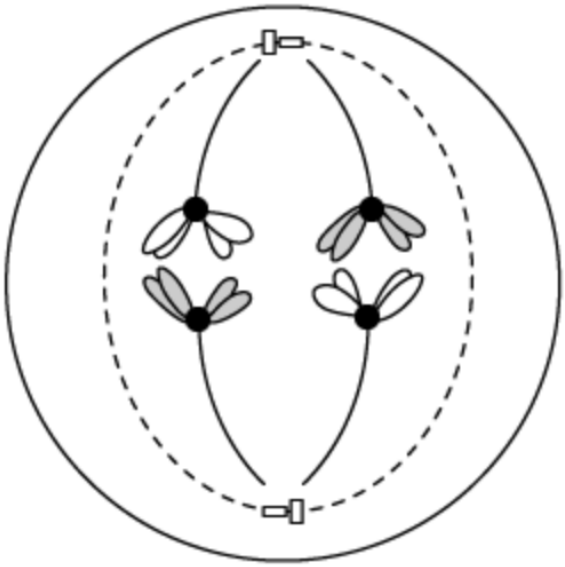
a) Complete the table using **'yes' / 'no'** or **numbers** to compare mitosis and meiosis.

| Feature | Meiosis | Mitosis |
|---|---|---|
| Number of nuclear divisions | | |
| Number of daughter cells produced | | |
| Genetically different daughter cells are produced | | |
| Crossing over occurs | | |
| Homologous chromosomes pair up | | |

**[2 marks]**

## Question 2b

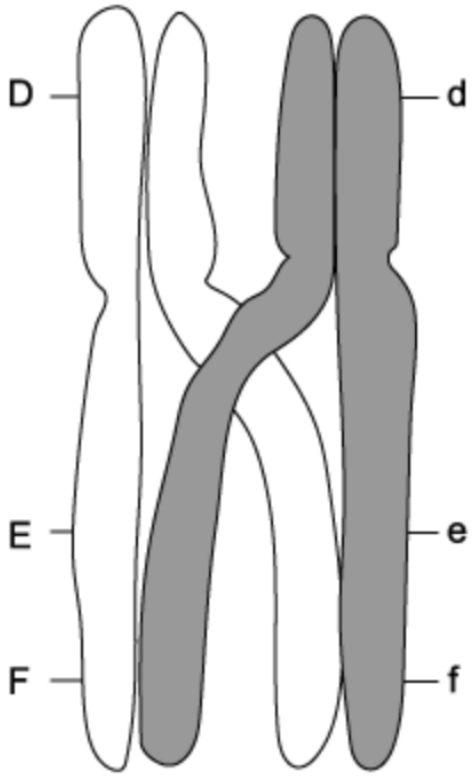
b) Explain how the diagram below illustrates that the resulting daughter cells will be genetically different. Give evidence from the diagram to support your answer.



**[2 marks]**

## Question 2c

c) The diagram below shows a pair of chromosomes during meiosis in a cell in a *Drosophila melanogaster* (fruit fly) testis. The position of the alleles of some genes is indicated.

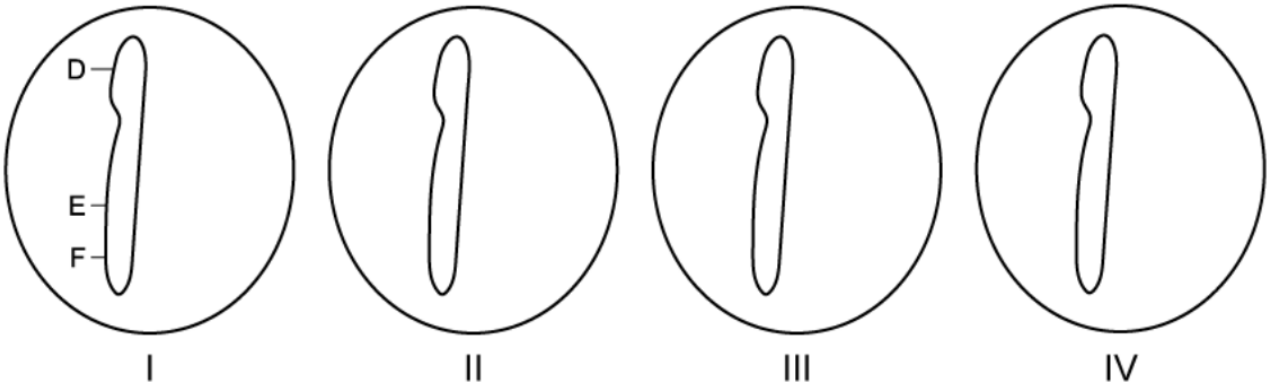



Explain whether the chromosomes are homologous or non-homologous.

**[2 marks]**

## Question 2d

d) At the end of meiosis, each of the chromosomes shown in the diagram from part (c) will be in a different haploid cell.

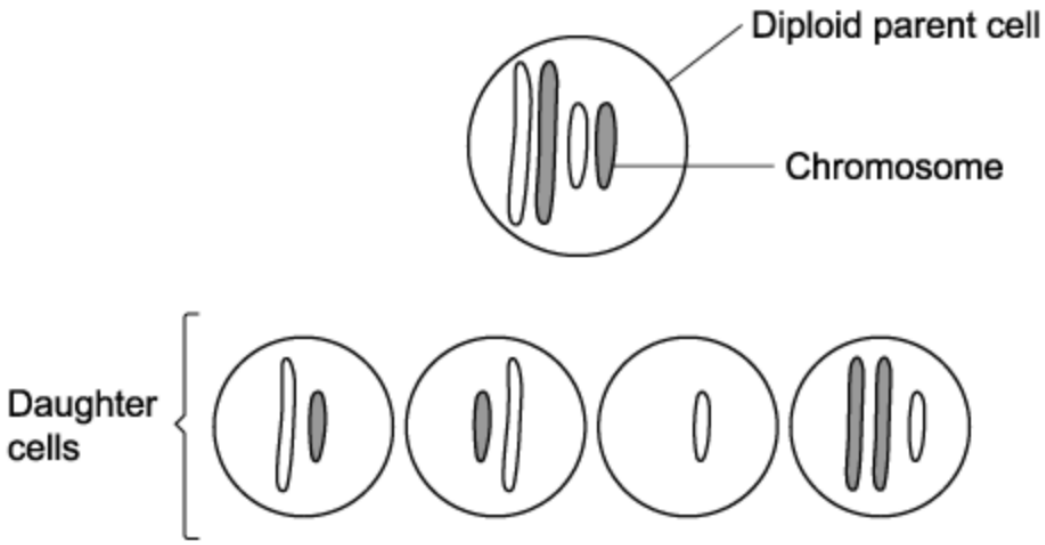



Label the diagram above to show the combinations of alleles that would be present on each chromosome inside the haploid daughter cells.

**[3 marks]**

## Question 3a

a) The diagram shows the chromosomes found in a parent cell and the daughter cells produced after meiosis.




Identify the daughter cell(s) that contain a chromosome mutation by circling the cell(s).

**[1 mark]**

## Question 3b

b) Explain how the spontaneous chromosome mutation shown in part (a) arose in the daughter cells during meiosis.

**[2 marks]**

## Question 3c

c) The risk of a non-disjunction mutation increases with age. The table shows how the Down syndrome risk increases with age.

| Mothers Age (Years) | Chance of conceiving a baby with Down syndrome |
|---|---|
| 25-29 | 1 in 1250 |
| 30-34 | 1 in 1000 |
| 35-39 | 1 in 400 |
| 40-44 | 1 in 100 |
| 45+ | 1 in 30 |

Calculate how much more likely it is that a child is conceived with Down Syndrome for a mother who is 41 compared to a mother who is 26.

**[1 mark]**

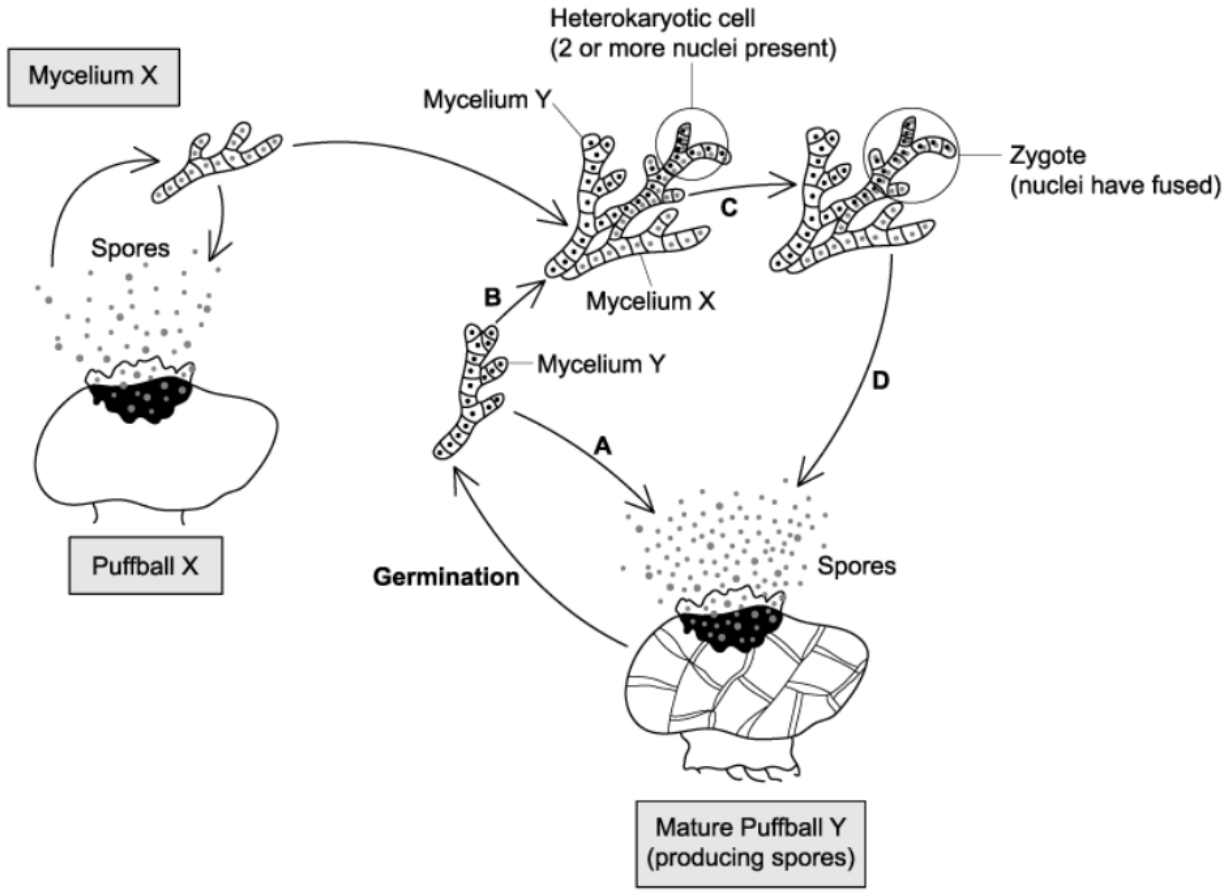
## Question 3d

d) Describe how the process of amniocentesis can be used to obtain cells which can be used for chromosome analysis.

**[3 marks]**

## Question 4a

a) The diagram below shows the life cycle of *Calvatia gigantea* (giant puffball). In this life cycle, only the zygote and mature puffball are diploid. All the cells in all the other stages of the life cycle of the puffball are haploid, including the spores.

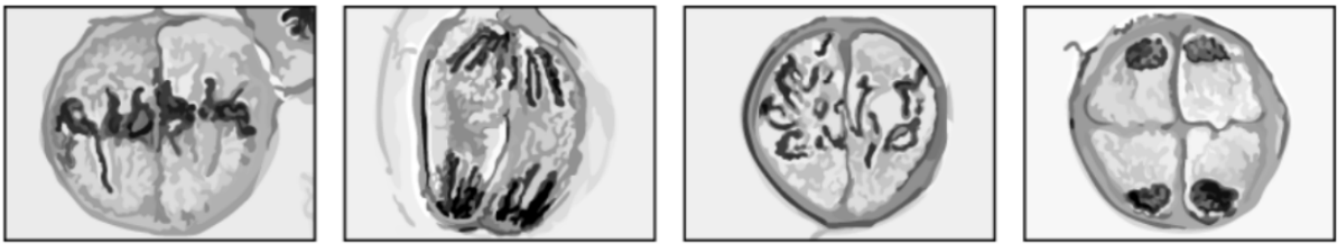



Identify which letter in the diagram shows where meiosis occurs in the life cycle of *Calvatia gigantea*.

**[1 mark]**

## Question 4b

b) The micrographs below show cells undergoing meiosis.

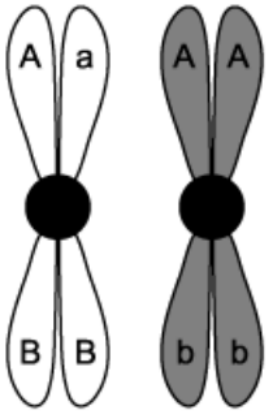


Identify, with a reason, the stages of meiosis shown in each micrograph.

**[4 marks]**

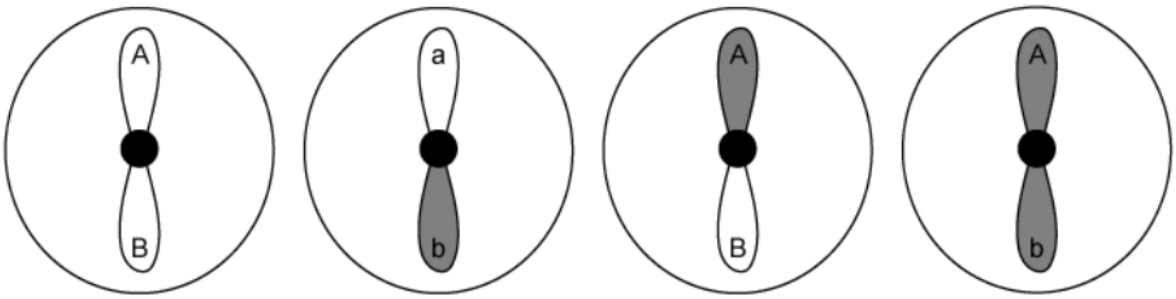
## Question 4c

c) A *Pisum sativum* (garden pea) pollen cell is undergoing meiosis. During the initial phase of meiosis a pair of homologous chromosomes located in these cells can be represented by the chromosomes shown below. The two different letters represent two different genes.




At the end of meiosis the chromosomes were distributed to the four pollen grains as shown in the gametes below.

**Figure 2**




Describe how the new allele combinations seen in these gametes were formed during meiosis.

**[2 marks]**

## Question 5a

*One mark is available for clarity of communication throughout this question.*

a) Draw a labelled diagram to show a cell in the following stages of meiosis:

- Metaphase I
- Prophase I

**[4 marks]**

## Question 5b

b) Outline how developments in scientific methods facilitated the discovery of meiosis.

**[4 marks]**

## Question 5c

c) Explain how genetic variation may be introduced into a population.

**[7 marks]**