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# GCSE BIOLOGY

Topic Paper: 6.1 Genetic Inheritance  
Part 2

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Time allowed: 30 minutes

## Materials

For this paper you must have:

- the Periodic Table/Data Sheet, provided as an insert (enclosed)
- a ruler with millimetre measurements
- a calculator, which you are expected to use where appropriate.

## Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

## Information

- The Periodic Table/Data Sheet is provided as in insert.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully meets the requirements of the question
  - shows that each separate point or step supports the overall answer.



**25 Marks**

**Q6.** The photographs show the flowers of two closely-related species of plant.

**Species A**



**Species B**



Images: © iStock/Thinkstock

The drawings show chromosomes from one cell in the root of each plant during cell division.

**Species A**



**One  
chromosome**

**Species B**



**One  
chromosome**

(a) The drawings show that each chromosome has two strands of genetic material.

(i) How does a chromosome become two strands?

.....  
.....

(1)

(ii) Explain why each chromosome must become two strands before the cell divides.

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.....  
.....  
.....

(2)

(b) For sexual reproduction, the plants produce gametes.

(i) Name the type of cell division that produces gametes.

.....

(1)



- (ii) How many chromosomes would there be in a gamete from each of these two plant species?

**Species A**  **Species B**

(1)

- (iii) It is possible for gametes from **Species A** to combine with gametes from **Species B** to produce healthy offspring plants.  
How many chromosomes would there be in each cell of one of the offspring

plants?

(1)

- (c) (i) Look back at the information at the start of the question and the information from part (b).

What evidence from these two pieces of information supports the belief that **Species A** and **Species B** evolved from a common ancestor?

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.....  
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(2)

**Questions continue on the next page**



- (ii) For successful gamete production to take place, chromosomes that contain the same genes must pair up.

The drawings showing the chromosomes of **Species A** and of **Species B** are repeated below.



The offspring plants cannot reproduce sexually.

Suggest an explanation for this.

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(2)  
(Total 10 marks)

**Q7.** People with cystic fibrosis make large amounts of thick, sticky mucus in their lungs. Cystic fibrosis is caused by the inheritance of recessive alleles.

(a) What do each of the following mean?

(i) Alleles

.....

.....

(1)

(ii) Recessive

.....

.....

(1)



- (b) Mr and Mrs Brown have a child with cystic fibrosis. They hope to have another child. They want to know the probability that their next child will have cystic fibrosis. They visit a genetic counsellor who explains, "You are both heterozygous for cystic fibrosis. There is a 1 in 4 (25%) chance that your next child will have cystic fibrosis."

Use the following symbols in answering the questions.

**N** = allele for being unaffected by cystic fibrosis

**n** = allele for cystic fibrosis

- (i) Mr and Mrs Brown both have the same genotype.

What is their genotype? .....

(1)

- (ii) There is a 1 in 4 chance that Mr and Mrs Brown's next child will have cystic fibrosis. Use a genetic diagram to explain why.

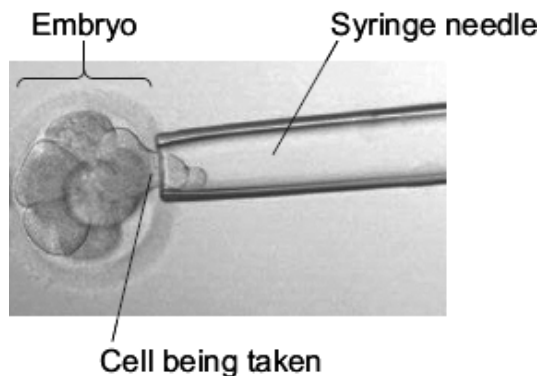
(3)

- (c) Mr and Mrs Brown do **not** want to have another child with cystic fibrosis. The genetic counsellor explains two different methods for finding out whether an embryo has cystic fibrosis. The methods are:

pre-implantation genetic diagnosis (**PGD**)

chorionic villus sampling (**CVS**).

In **PGD**, eggs are fertilised in dishes and allowed to grow into embryos. A cell is taken from each embryo when the embryo is 3 days old. The photograph shows how the cell is taken.

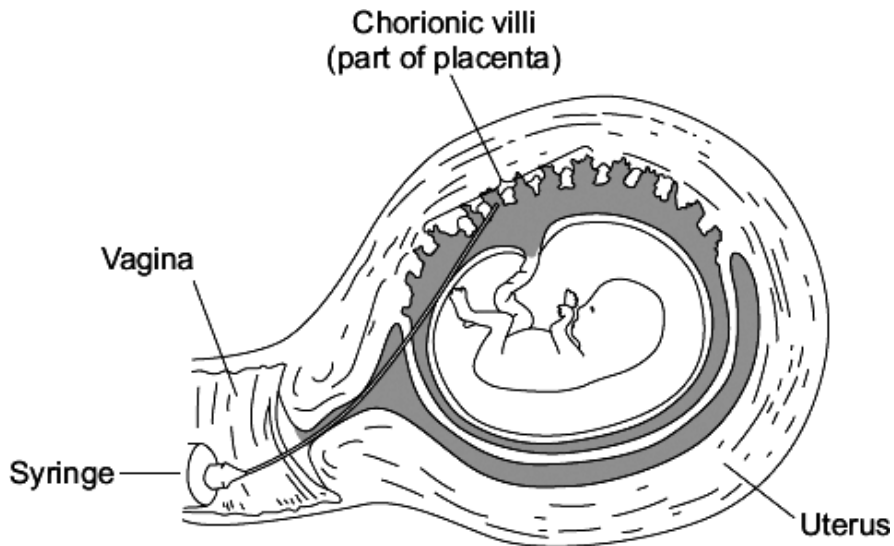


Photograph: © Pascal Goetgheluck/  
Science Photo Library



The DNA in the cell can then be tested. The possibility of a false positive result is about 1 in 6. An unaffected embryo can then be placed in the woman's uterus. The procedure costs about £6000.

**CVS** can only be done after 9 weeks of pregnancy. A tiny piece of the placenta is taken out using a tube attached to a syringe. This is grown in tissue culture for about 7 days. The diagram below shows how **CVS** is done.



Questions continue on the next page



The DNA in the cells can then be tested. About 2 in every 100 women have a miscarriage because of **CVS**. The possibility of a false positive result is about 1%. The procedure costs about £600. Following a positive result, the parents must then decide whether to terminate the pregnancy.

The genetic counsellor thinks that **PGD** is a better method than **CVS** for detecting cystic fibrosis in an embryo.

Evaluate this opinion.

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(4)  
(Total 10 marks)