

Passage of information from parent to offspring

Question Paper 5

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Inherited change
Sub Topic	Passage of information from parent to offspring
Booklet	Theory
Paper Type	Question Paper 5

Time Allowed : 48 minutes

Score : / 40

Percentage : /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

- 1 Modern varieties of wheat have developed from numerous hybridisation events between different species of wild grasses. Fig. 4.1 shows some of the possible steps that are believed to have been involved in the development of bread wheat, *Triticum aestivum*.

The letters **A**, **B** and **C** represent three different sets of seven chromosomes.

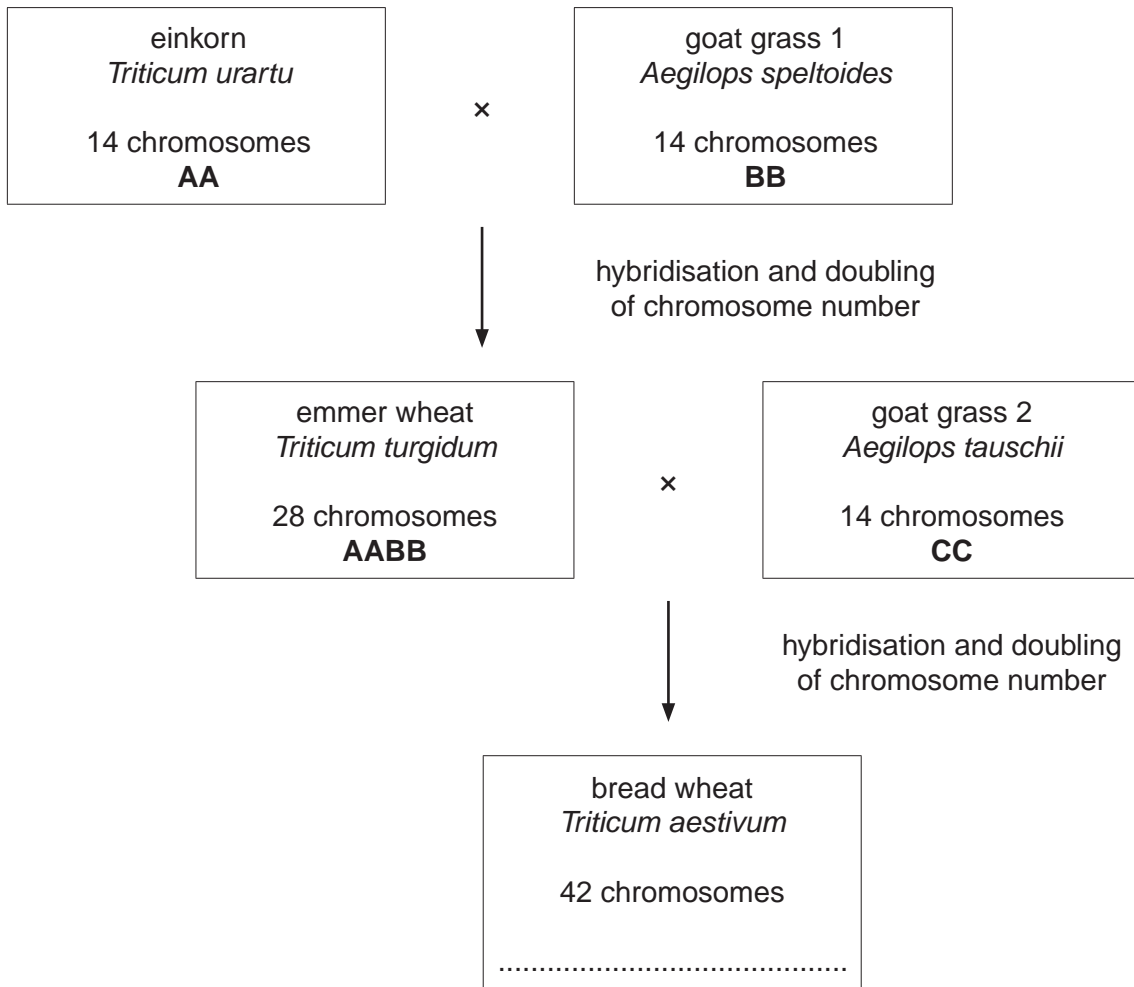


Fig. 4.1

- (a) Complete Fig. 4.1 by writing letters to represent the sets of chromosomes in bread wheat.

Write your answer on Fig. 4.1. [1]

- (b) Explain why hybridisation between emmer wheat and goat grass 2 would have produced a sterile hybrid, if doubling of chromosome number had **not** occurred.

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..... [3]

- (c) With reference to Fig. 4.1, suggest why *Triticum urartu* and *Triticum turgidum* are classified as different species.

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..... [2]

- (d) *Triticum turgidum* emerged as a new species without being geographically isolated from *Triticum urartu*.

Outline how geographical isolation may result in speciation.

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..... [3]

[Total: 9]

- 2 Fig. 2.1 shows the CFTR (cystic fibrosis transmembrane conductance regulator) protein in a plasma (cell surface) membrane.

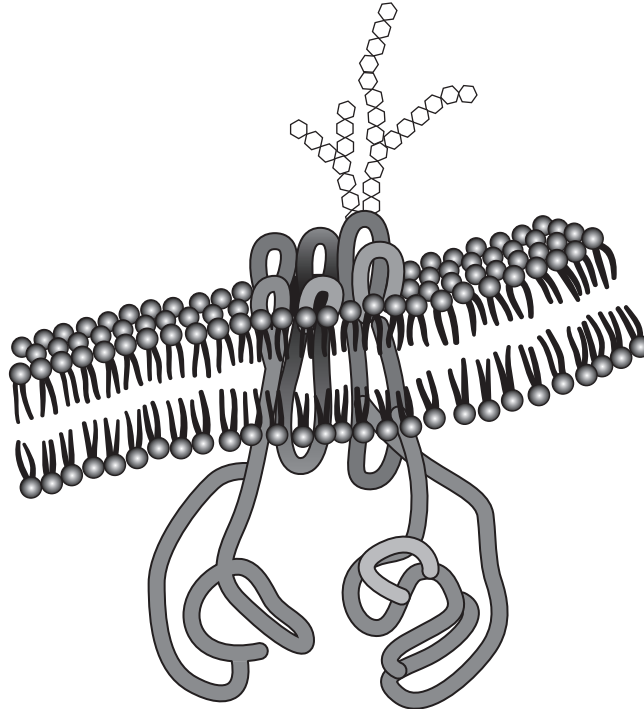


Fig. 2.1

- (a) (Describe the normal function of the CFTR protein.

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..... [2]

- (ii) On Fig. 2.1, use the letter **E** to indicate the external face of the membrane. State how you identified this face.

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..... [1]

- (b) Cystic fibrosis is caused by a recessive allele of the *CFTR* gene.

- (i) Explain the meaning of the term *recessive allele*.

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..... [2]

(ii) Explain how cystic fibrosis affects the function of the lungs.

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(c) As cystic fibrosis is caused by a recessive allele of a single gene, it is a good candidate for gene therapy. Trials were undertaken in the 1990s, attempting to deliver the normal allele of the *CFTR* gene into cells of the respiratory tract, using viruses or liposomes as vectors.

Explain how viruses deliver the allele into cells.

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..... [2]

(d) In some people with cystic fibrosis, the allele has a single-base mutation which produces a 'nonsense' (stop) codon within the gene.

(i) Explain how this mutation would prevent normal CFTR protein being produced.

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..... [2]

(ii) A new type of drug, PTC124, enables translation to continue through the nonsense codon. Trials in mice homozygous for a *CFTR* allele containing the nonsense codon have found that animals treated with PTC124 produce normal CFTR protein in their cells. The drug is taken orally, and is readily taken up into cells all over the body.

Using your knowledge of the progress towards successful gene therapy for cystic fibrosis, suggest why PTC124 could be a simpler and more reliable treatment for this disease.

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..... [3]

[Total: 15]

- 3** In mice there are several alleles of the gene that controls the intensity of pigmentation of the fur.

The alleles are listed below in order of dominance with **C** as the most dominant.

C = full colour
C^{ch} = chinchilla
C^h = himalayan
C^p = platinum
C^a = albino

The gene for eye colour has two alleles. The allele for black eyes, **B**, is dominant, while the allele for red eyes, **b**, is recessive.

A mouse with full colour and black eyes was crossed with a himalayan mouse with black eyes. One of the offspring was albino with red eyes.

Using the symbols above, draw a genetic diagram to show the genotypes and phenotypes of the offspring of this cross.

- 4 The colour of the tips of the hair in Australian Shepherd dogs is controlled by a gene at the **A** locus. There are three alleles at this locus which are:

A^s Black hair tips

A^y Red hair tips

A^t Copper hair tips

A cross between two dogs with copper hair tips will always produce offspring with copper hair tips. A cross between two dogs with black hair tips may produce some offspring with red hair tips and some with copper hair tips.

- (a) State the ratio of **offspring** phenotypes from the following crosses:

(i) **A^sA^t** × **A^yA^y**

offspring phenotypes

ratio

(ii) **A^sA^t** × **A^tA^y**

offspring phenotypes

ratio

(iii) **A^yA^t** × **A^yA^t**

offspring phenotypes

ratio

[6]

(b) A dog breeder wishes to know whether a dog with red hair tips is either homozygous or heterozygous for this characteristic.

(i) State the cross needed to determine the dog's genotype.

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..... [1]

(ii) Explain why the offspring of this cross will reveal the genotype of the dog.

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..... [3]

[Total: 10]