Control and co-ordination in mammals

Question Paper 1

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Control and co-ordination
Sub Topic	Control and co-ordination in mammals
Booklet	Theory
Paper Type	Question Paper 1

Time Allowed : **58 minutes**

Score : **/ 48**

Percentage : **/100**

Grade Boundaries:

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

1 Intracytoplasmic sperm injection (ICSI) is a modification of the procedure for in-vitro fertilisation (IVF). A single sperm is injected into an oocyte rather than allowing one of many sperm to fertilise the oocyte.

(a) Suggest **one** problem that may arise from the use of ICSI.

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(b) In preparation for ICSI, infertile women are injected at daily intervals with human follicle stimulating hormone (hFSH) to stimulate the growth and maturation of a number of ovarian follicles. Women may be treated with hFSH extracted from urine (u-hFSH) or with recombinant hFSH (r-hFSH) produced by genetically modified mammalian cells.

Each molecule of hFSH consists of two different polypeptide chains, α and β.
The genes for the α and β chains of hFSH, together with their promoters, have been inserted into mammalian ovary cells.

Explain why promoters need to be transferred with desired genes when producing a genetically modified cell.

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(c) After treatment with hFSH, oocytes are collected from mature ovarian follicles and examined to check that they have reached metaphase II of meiosis.

Describe how an oocyte in metaphase I of meiosis can be distinguished from one in metaphase II of meiosis. You may use labelled diagrams to illustrate your answer.

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(d) Two groups of women who were being prepared for ICSI were injected at daily intervals with either r-hFSH or with u-hFSH. The results of their treatment are shown in Table 2.1.

Table 2.1

	group of women receiving r-hFSH	group of women receiving u-hFSH
number of women	63	63
total number of oocytes collected	763	407
number of oocytes in metaphase II of meiosis	634	323

With reference to Table 2.1, compare the effects of treatment with r-hFSH and u-hFSH and suggest an explanation for any differences.

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(e) Whilst the two groups of women described in **(d)** were being injected at daily intervals with FSH, the concentrations of oestrogen in their blood were measured.

The results are shown in Fig. 2.1.

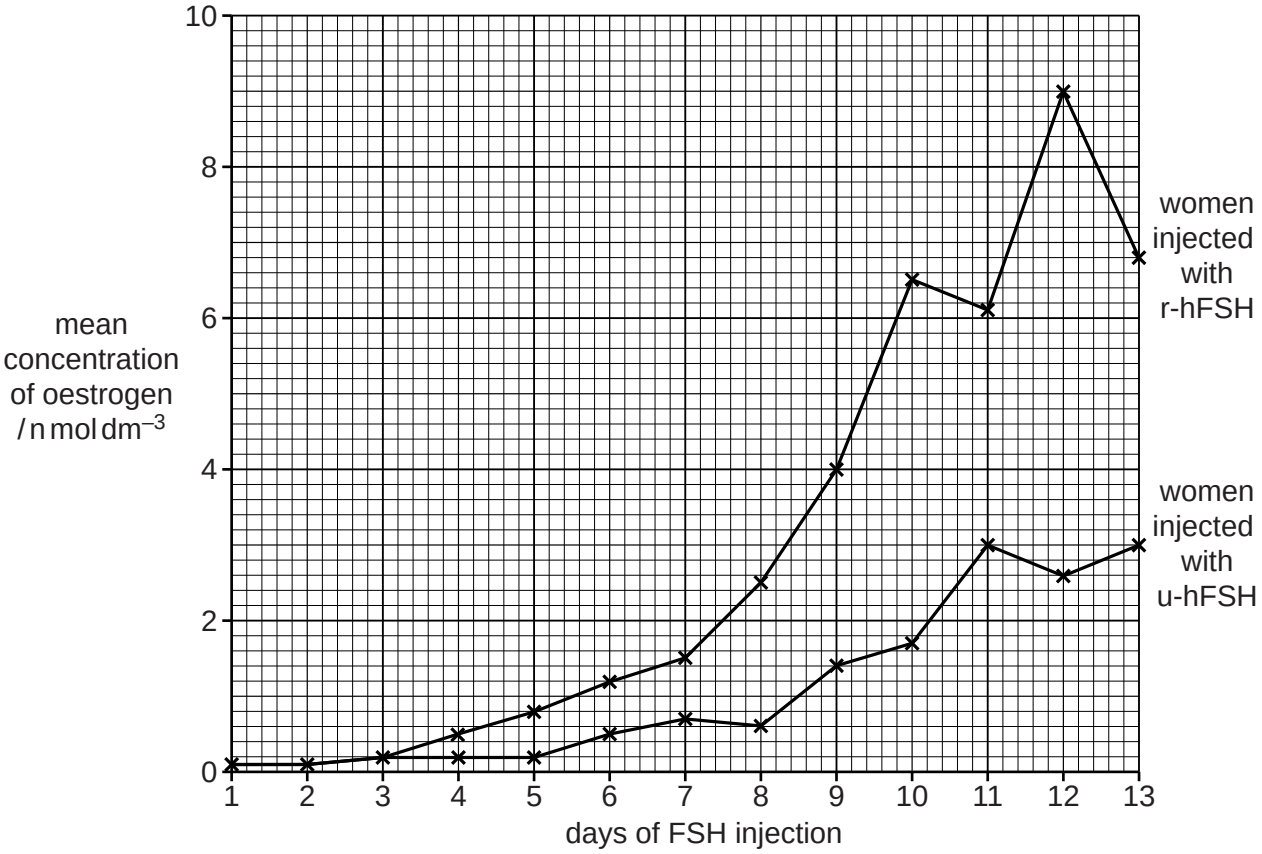

Fig. 2.1

(i) With reference to Fig. 2.1, compare the results for the two groups of women.

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(ii) Describe the role of oestrogen in the preparation of these women to receive an embryo.

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[Total: 14]

2 **(a)** Fig. 5.1 shows a type of neurone found in the brain, called a pyramidal cell.

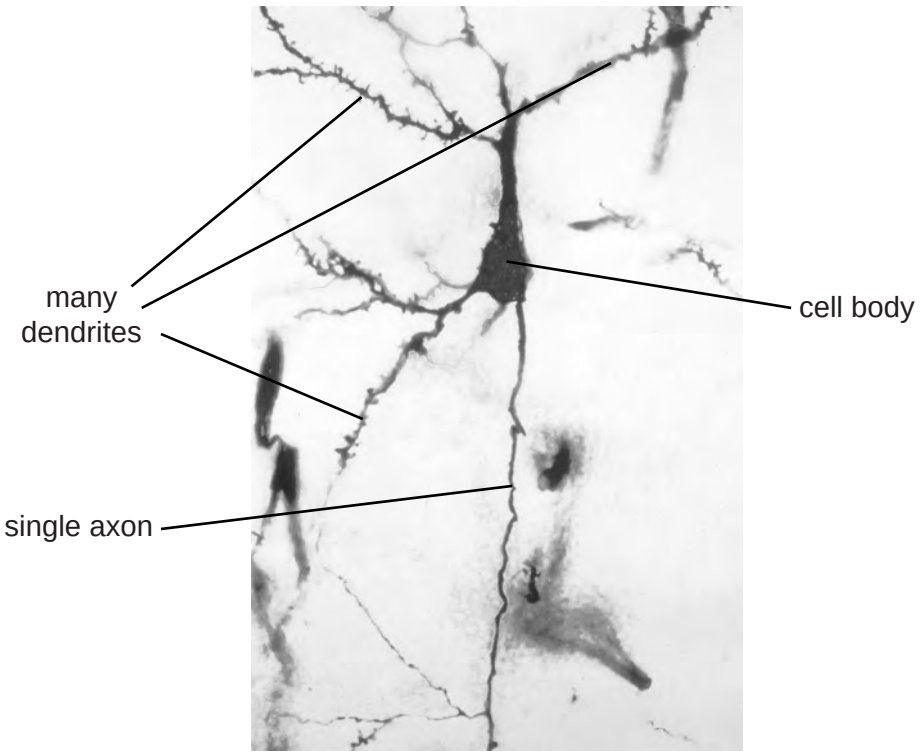

Fig. 5.1

On Fig. 5.1, draw **one** arrow to indicate the direction in which a nerve impulse will travel, as it leaves the cell body of the pyramidal cell. [1]

(b) Fig. 5.2 shows the percentage of energy used for various processes involved in the maintenance of resting potentials and in the reception and transmission of action potentials by a pyramidal cell.

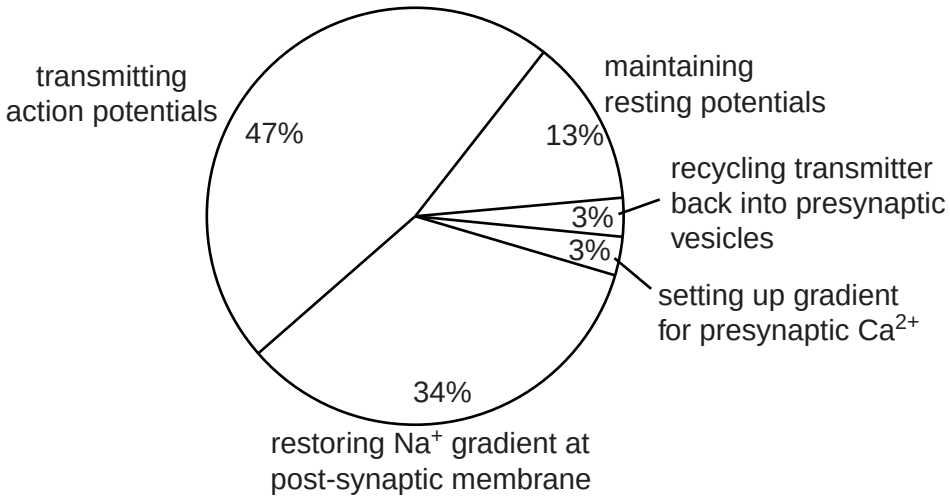

Fig. 5.2

(i) Explain why maintaining a resting potential requires energy.

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(ii) Outline the role of calcium ions in passing on an impulse from the pyramidal cell to another neurone.

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(iii) Pyramidal cells contain large numbers of mitochondria. There are more mitochondria in each dendrite than in the axon.

With reference to Fig. 5.2, suggest reasons for this distribution of mitochondria.

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[Total: 9]

3 **(a)** Wheat, *Triticum aestivum*, owes its origin to hybridisation involving three different, but related, species of grass, **A**, **B** and **C**.

Each of these species had seven pairs of chromosomes (2n = 14).

The hybridisation process is shown in Fig. 3.1.

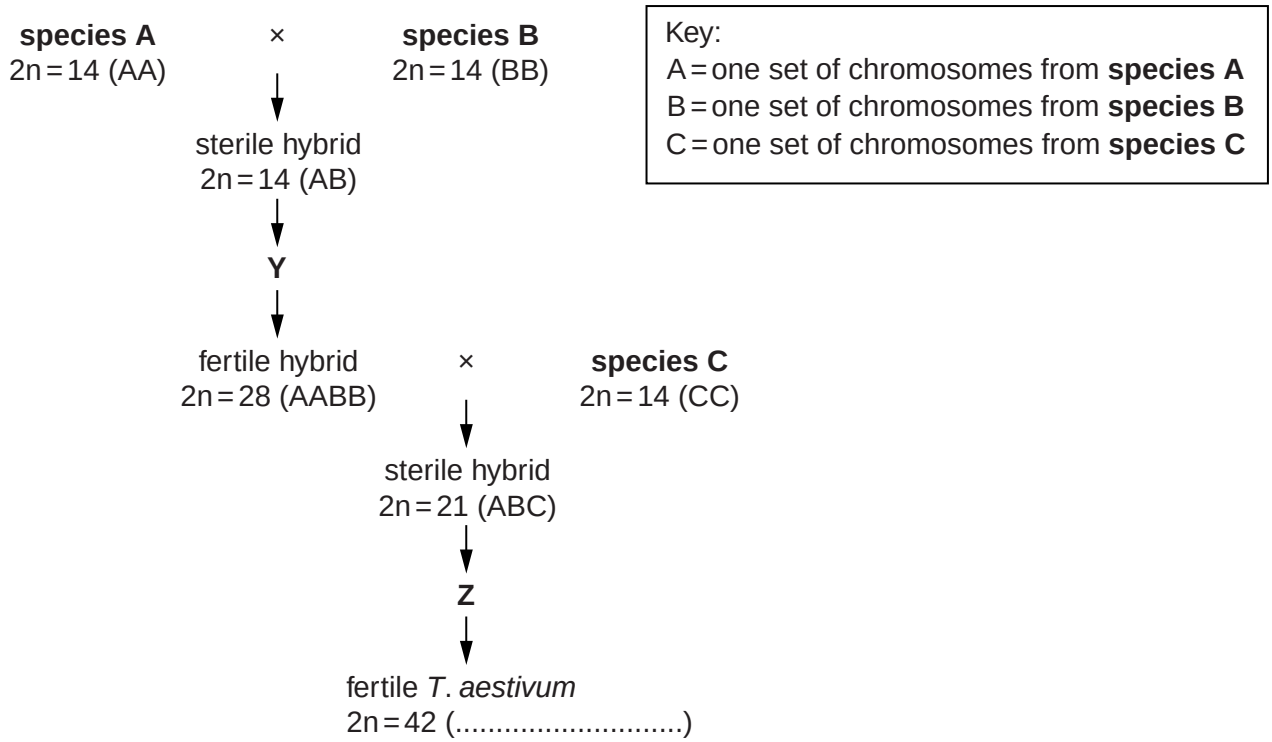

Fig. 3.1

(i) Using the symbols in the key, complete Fig. 3.1 by writing in the chromosome sets of *T. aestivum*. [1]

(ii) At the points labelled **Y** and **Z** in the hybridisation process, a fertile hybrid was produced from a sterile hybrid.

Explain why the hybrid (AB) is sterile **and** what occurred at the point labelled **Y** in Fig. 3.1.

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(b) In 2012, permission was granted for a field trial in the UK of genetically modified *T. aestivum*. The wheat carries a gene, taken from peppermint plants, that results in the wheat leaves releasing a volatile, non-toxic chemical, (E)-β-farnesene (Eβf), into the atmosphere.

Eβf is not only produced by various species of plants. It is also secreted by aphids when they are disturbed by a predator.

Two experiments have been performed into the effect of Eβf on the behaviour of aphids feeding on leaves in closed containers.

Experiment 1
Either 10 cm^3 of air from a syringe that contained plant leaves that secrete Eβf
or 10 cm^3 of air from a syringe with no such leaves
was added to the containers of feeding aphids.

Experiment 2
Either 20 cm^3 of air containing 50ng of Eβf
or 20 cm^3 of air containing no Eβf
was added to the containers of feeding aphids.

In both experiments, the number of aphids that stopped feeding and moved away from the food leaves was counted. The results are shown in Table 3.1.

Table 3.1

	Experiment 1		**Experiment 2**	
air added to containers of feeding aphids	10 cm^3 air that had been in contact with leaves secreting Eβf	10 cm^3 air that had not been in contact with leaves secreting Eβf	20 cm^3 air containing 50ng Eβf	20 cm^3 air containing no Eβf
number of aphids in containers	99	113	132	106
number of aphids that stopped feeding and moved away from the food leaves	54	1	111	0

(i) Discuss the extent to which the results of these experiments support the idea that Eβf is an alarm signal for aphids.

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(ii) Other experiments show that Eβf attracts predators of aphids, such as ladybirds.

Explain how growing genetically modified wheat secreting Eβf could increase the yield of wheat.

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(iii) Suggest why growing this genetically modified wheat might be acceptable to people who object to the growth of genetically modified insect-resistant maize or cotton.

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[Total: 15]

4 **(a)** The passage below outlines how sensory receptors work.

Complete the passage by using the most appropriate scientific term(s).

A sensory receptor cell responds to a stimulus by opening ion ..... in its cell surface membrane. Sodium ions flood into the cell causing the membrane to become ..... . This is called the ..... potential. If this potential is large enough to reach a ..... then an action potential is transmitted to the central nervous system. An increase in the strength of the stimulus will result in an increase in the ..... of action potentials transmitted. [5]

(b) Describe how an action potential is **transmitted** along a sensory neurone in a mammal.

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[Total: 10]