Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

BIOLOGY **9700/42**

Paper 4 A Level Structured Questions **May/June 2016**

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.

Section B
Answer **one** question.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Section A

Answer **all** the questions.

1 **(a)** ATP and coenzyme A both play important roles in respiration.

Fig. 1.1 represents the molecular structure of coenzyme A.

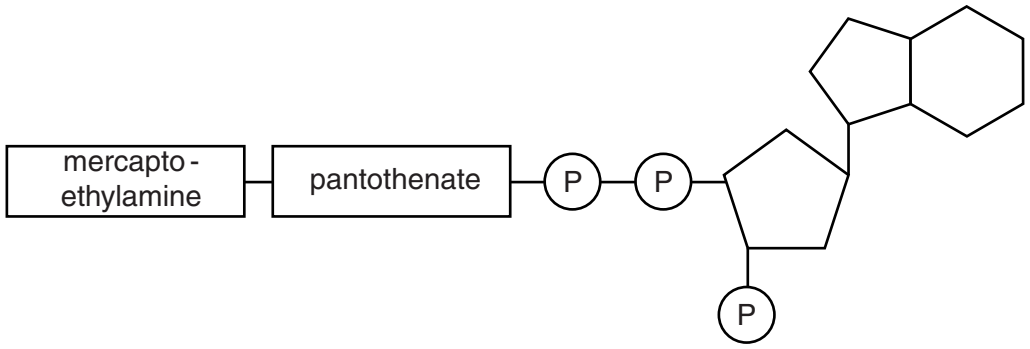

Fig. 1.1

(i) With reference to Fig. 1.1, state two structural **similarities** between coenzyme A and ATP.

1 .....

2 ..... [2]

(ii) Describe the role of coenzyme A in respiration.

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..... [3]

(b) Fig. 1.2 summarises the reactions that take place after glucose has entered a certain type of cell.

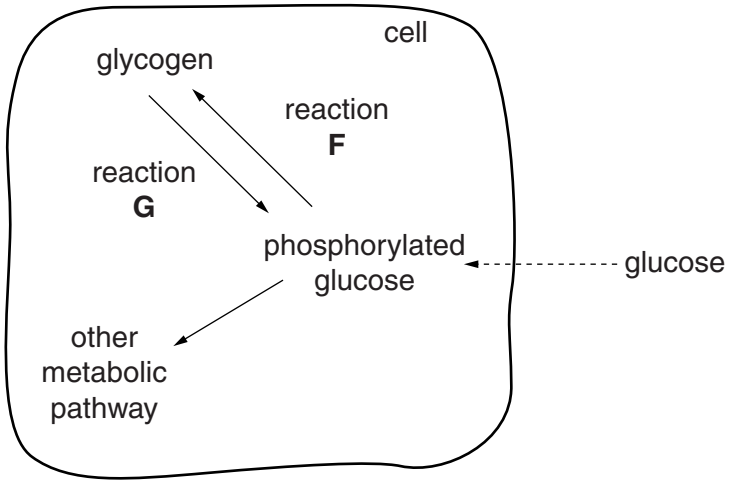

Fig. 1.2

(i) Suggest **one** type of cell in which the reactions shown in Fig. 1.2 could occur.

..... [1]

(ii) State the mechanism by which glucose enters the cell.

..... [1]

(iii) Name the type of reaction occurring at **F** and the type of reaction occurring at **G**.

F .....

G ..... [2]

(iv) With reference to Fig. 1.2, suggest **one** example of an 'other metabolic pathway' for phosphorylated glucose.

..... [1]

[Total: 10]

2 **(a)** Fig. 2.1 shows the effect of temperature on the rate of photosynthesis of a plant at low light intensity and at high light intensity.

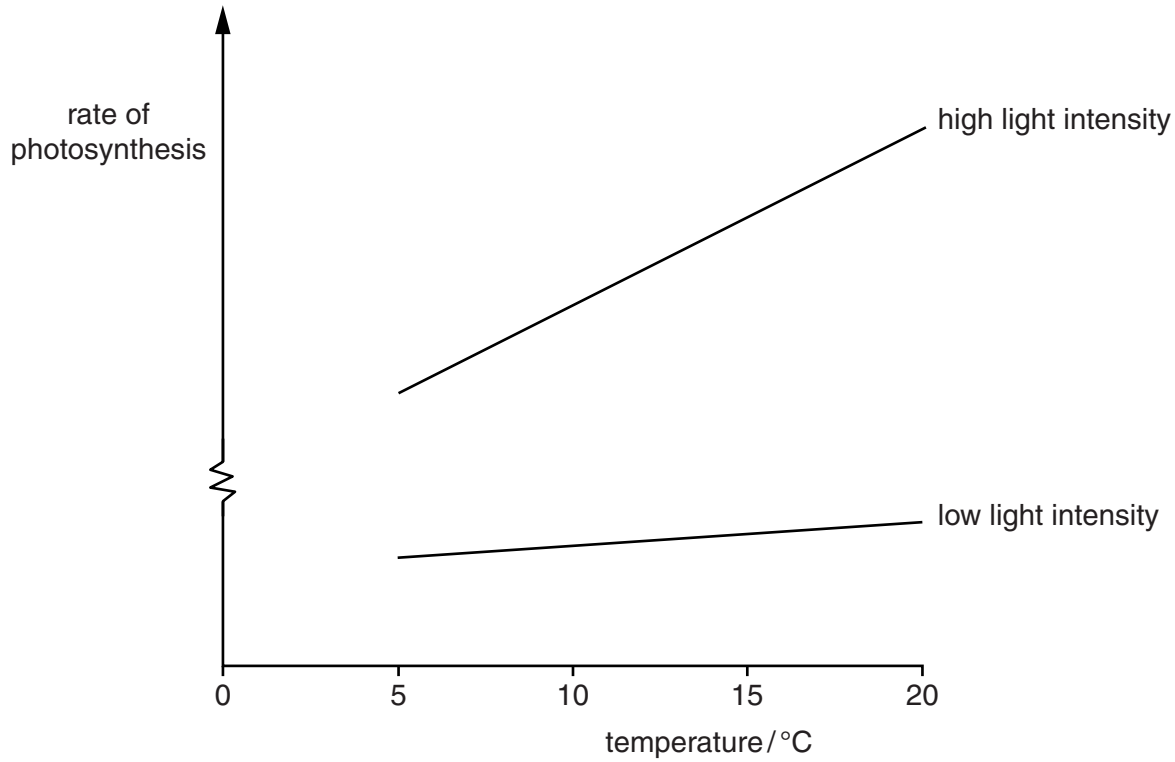

Fig. 2.1

With reference to Fig. 2.1, describe **and** explain the effect of temperature on the rate of photosynthesis.

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..... [4]

(b) Fig. 2.2 shows an absorption spectrum for chloroplast pigments and a photosynthetic action spectrum for the same plant.

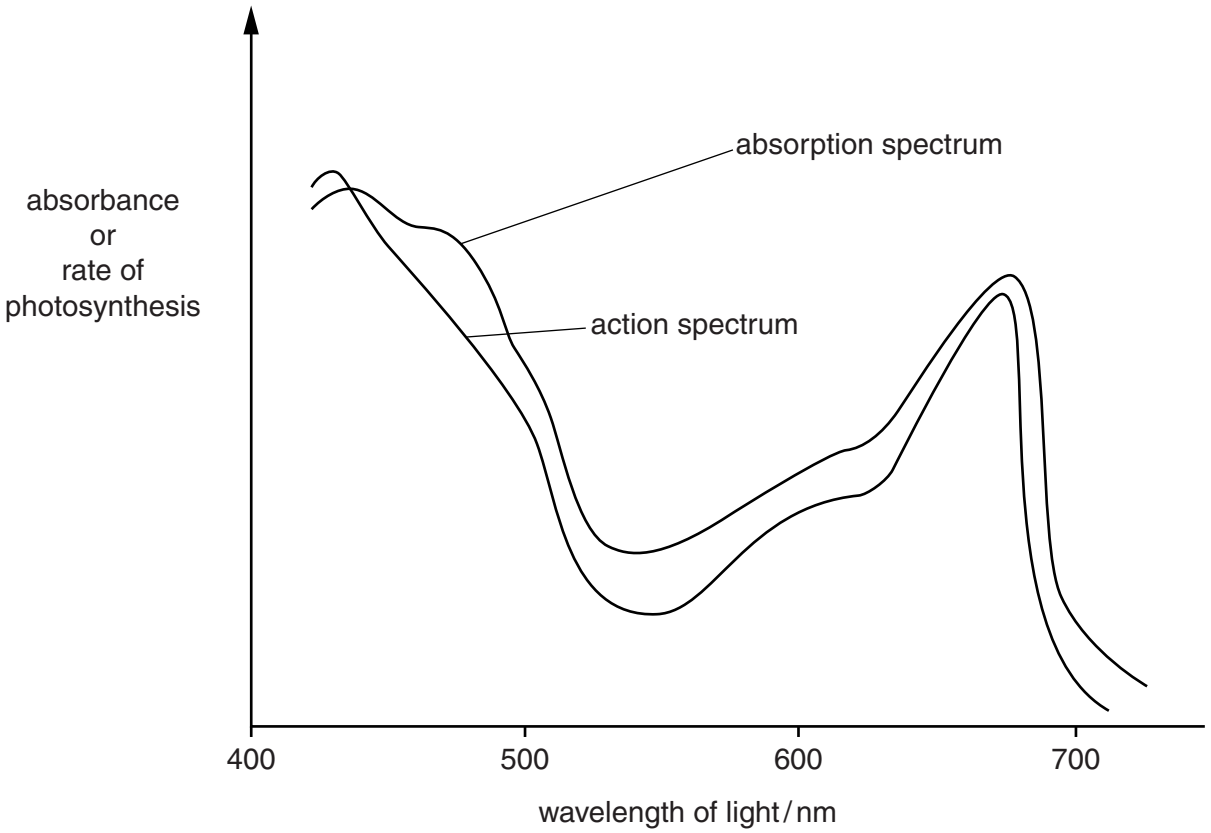

Fig. 2.2

(i) Distinguish between an absorption spectrum and an action spectrum.

absorption spectrum .....

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action spectrum .....

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..... [2]

(ii) Explain why the two curves shown in Fig. 2.2 have similar shapes.

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..... [2]

(c) Describe the role in photosynthesis of an accessory pigment, such as carotene.

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..... [2]

[Total: 10]

3 Malaria is a serious and often fatal disease that is transmitted by the mosquito *Anopheles gambiae*. One method of reducing the incidence of malaria is to control the numbers of these mosquitoes.

In mosquitoes, as in humans, males have an X chromosome and a Y chromosome, while females have two X chromosomes. Researchers investigated the possibility of producing genetically modified (GM), fertile male mosquitoes in which most of the sperm contained a Y chromosome and not an X chromosome.

They predicted that introducing these males into a population of *A. gambiae* could greatly reduce the number of females in each generation and therefore reduce the numbers of eggs laid.

(a) In order to produce the GM males, the researchers inserted the gene coding for a restriction endonuclease called I-PpoI. This restriction endonuclease was known to destroy the X chromosome of *A. gambiae*.

Explain the meaning of the term *restriction endonuclease* **and** suggest why I-PpoI destroys the X chromosome, but not the Y chromosome.

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..... [4]

(b) The researchers introduced the gene for I-PpoI and also a gene for green fluorescent protein (GFP) into one of the autosomes (a chromosome other than X or Y) of male mosquitoes.

Explain why the researchers introduced the gene for GFP, as well as the gene for I-PpoI.

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..... [2]

(c) The researchers found that I-PpoI destroyed the X chromosome during meiosis in the GM male mosquitoes. This prevented these males from producing sperm containing an X chromosome.

However, I-PpoI was still active in zygotes produced by the fusion of female gametes with sperm containing a Y chromosome.

Explain why this meant that the GM males produced no offspring at all.

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..... [2]

(d) The researchers modified the gene for I-PpoI, so that it produced a version of I-PpoI that was active **only** during meiosis in the males, and was **not** active in the zygote. They then tested the effect of introducing these GM males into a mosquito population.

- Several cages were set up. 50 adult male mosquitoes and 50 adult female mosquitoes without the I-PpoI gene were placed in each cage.
- 150 adult GM males were introduced into each cage. In half of the cages (**A**), these GM males had the normal gene for I-PpoI. In the rest of the cages (**B**), the GM males had the modified gene for I-PpoI.
- The mean number of adult female offspring per cage was determined over the next six generations.

Fig. 3.1 shows the results.

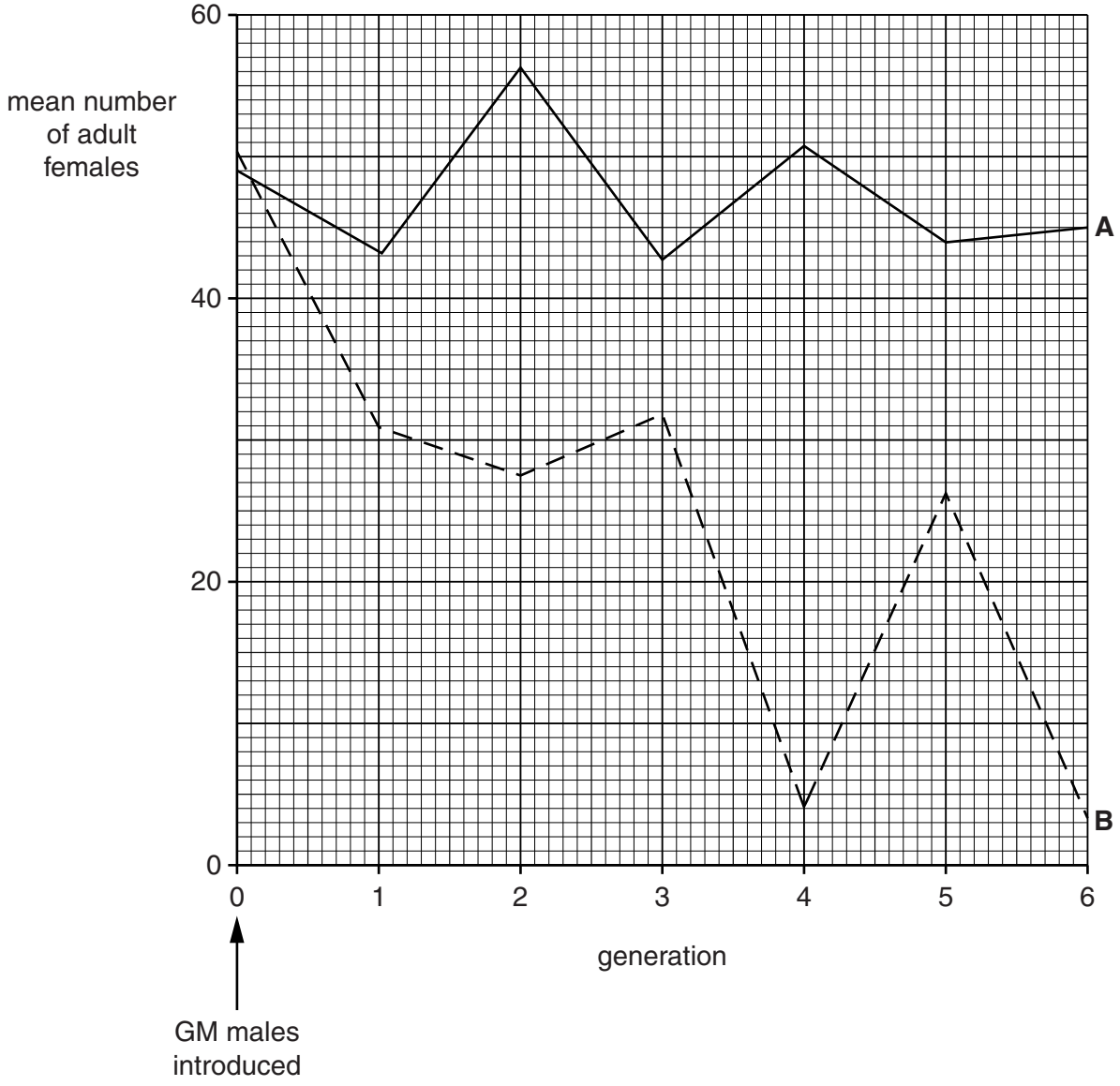

Fig. 3.1

(i) Describe **and** suggest explanations for the differences between the mean numbers of adult females in the two sets of cages during the experiment.

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..... [3]

(ii) Suggest possible difficulties that might arise if the technique of releasing GM male mosquitoes with the modified I-PpoI gene were used to try to control populations of *A. gambiae* that occur naturally in the wild.

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..... [2]

[Total: 13]

4 Food crops like wheat may be improved by selective breeding and genetic modification.

(a) Outline how wheat crops have been improved by selective breeding.

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..... [4]

(b) Variation in height of a strain of wheat plants in a field shows a continuous pattern of variation.

Explain what is meant by continuous variation **and** explain why this type of variation occurs in a population.

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..... [3]

(c) Wheat and other crops have been genetically modified to be resistant to the herbicide glyphosate since 1996.

Fig. 4.1 shows the area of glyphosate-resistant crops grown as a percentage of the total planted hectares (plotted points) and the number of weed species with resistance to glyphosate (bars).

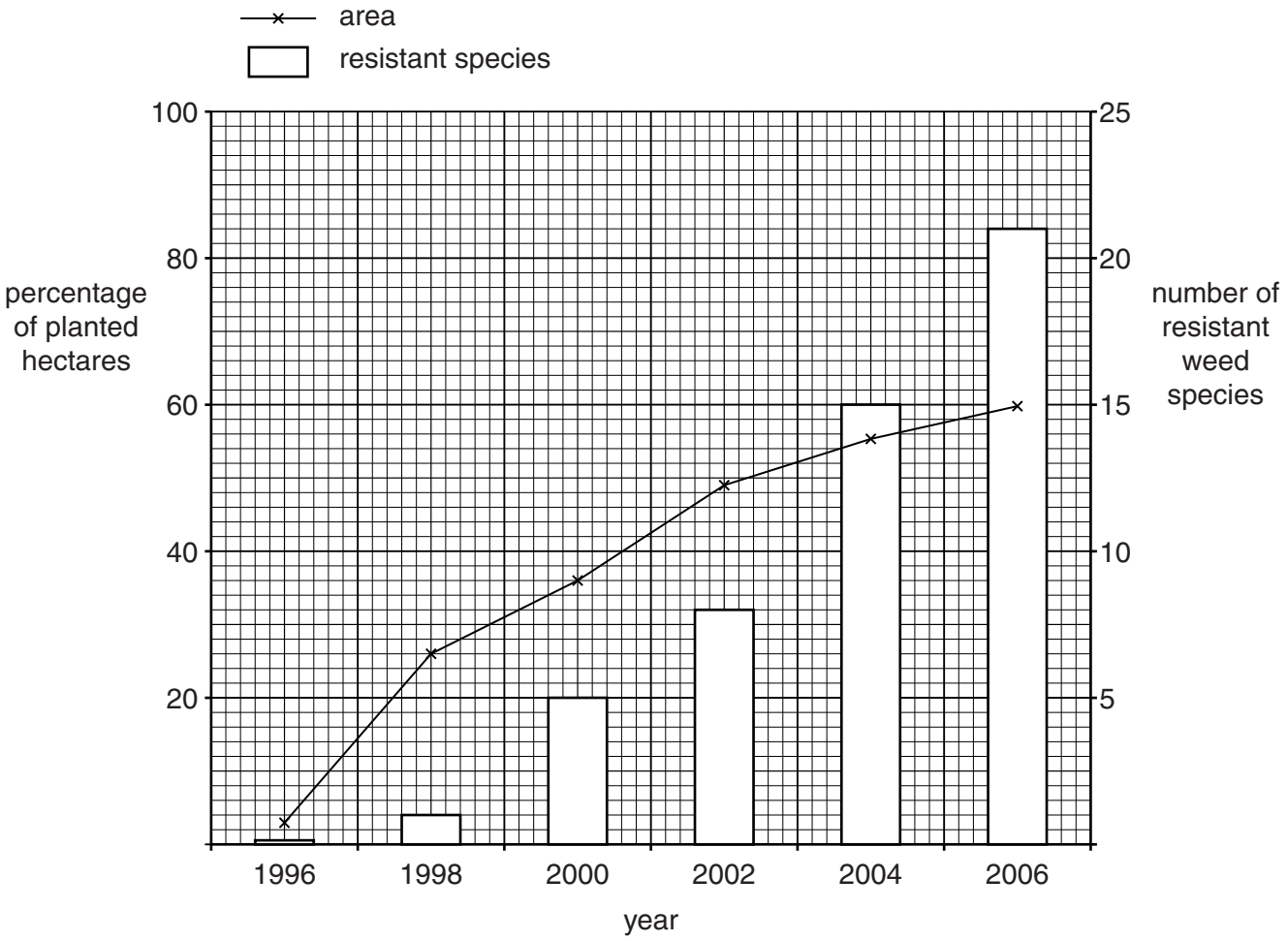

Fig. 4.1

Describe and explain the relationship between the area of glyphosate-resistant crops grown and the number of resistant weed species.

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..... [4]

(d) Suggest **one** social advantage and **one** environmental advantage of growing glyphosate-resistant wheat.

social advantage .....

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environmental advantage .....

..... [2]

[Total: 13]

5 Fig. 5.1 shows a raccoon, *Procyon lotor*. This species is native to North America. Four individuals were released in Germany in 1934. There are now thought to be more than a million raccoons in Germany.

Fig. 5.1

(a) Urban raccoons live in towns. Although they are nocturnal their large size means they may be noticed by humans. They may be found raiding bins containing food waste, or entering buildings.

Describe a method for estimating the size of a raccoon population in a town.

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..... [3]

(b) **(i)** Raccoons are classified in the phylum Chordata of the kingdom Animalia.

Name the domain to which raccoons belong.

..... [1]

(ii) Outline three characteristic features of members of this domain.

1 .....

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2 .....

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3 .....

..... [3]

(c) It has been suggested that raccoons may threaten biodiversity and pose a risk to human health in Germany.

Explain how raccoons could cause problems for local biodiversity **and** for human health.

local biodiversity .....

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human health .....

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..... [3]

[Total: 10]

6 The sex chromosomes of domestic chickens are known as **W** and **Z**.

- Male chickens have two **Z** chromosomes.
- Female chickens have one **W** and one **Z** chromosome.

A gene for feather colour in chickens is located on an autosome.

This gene (**C**) has two alleles
- black ($\mathbf{C^B}$)
- splashed-white ($\mathbf{C^S}$).

When a chicken with black feathers is mated with a chicken with splashed-white feathers, all the offspring will have blue feathers.

A gene for feather pattern is located on the **Z** chromosome but not on the **W** chromosome. This gene has two alleles
- barred (striped) feathers (**A**)
- non-barred feathers (**a**).

(a) State the type of inheritance for feather colour and for feather pattern.

feather colour .....

feather pattern ..... [2]

(b) A male chicken with black, non-barred feathers was crossed with a female chicken with splashed-white, barred feathers.
All the offspring had blue feathers, but the males were barred and the females were non-barred.

Using the symbols given, draw a genetic diagram to show this cross.

parents phenotype	male, black, non-barred feathers	female, splashed-white, barred feathers
parents genotype		
gametes		
offspring genotypes		
offspring phenotypes	male, blue, barred feathers	female, blue, non-barred feathers

[5]

(c) Explain how the genotype of a male chicken with blue, barred feathers could be determined.

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..... [3]

[Total: 10]

7 **(a)** In mammals, excess amino acids cannot be stored in the body.

Outline the formation of urea from excess amino acids by liver cells.

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..... [3]

(b) The mammalian kidney is composed of many nephrons.

Describe the process of ultrafiltration in the nephron.

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(c) Fig. 7.1 is a diagram of a nephron.

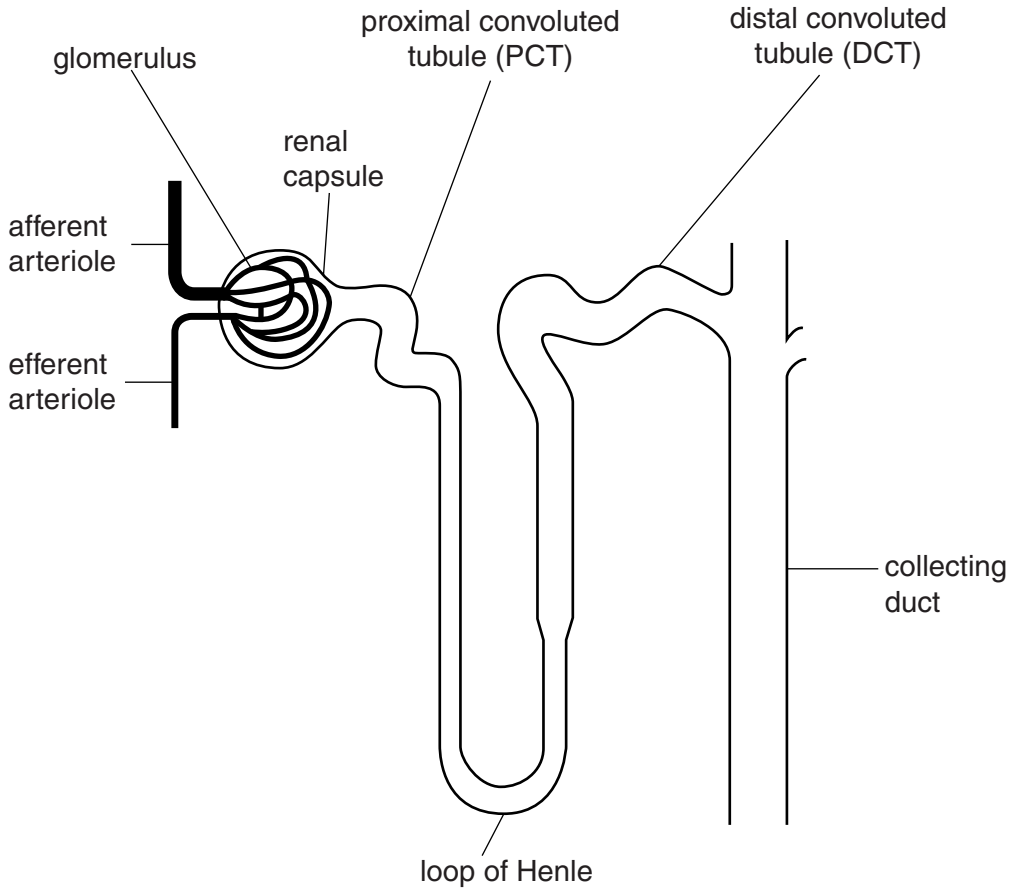

Fig. 7.1

Complete Table 7.1 by naming a part of the nephron that corresponds to each of the statements.

Table 7.1

statement	part of nephron
passes through the medulla	.....
glucose is reabsorbed into the blood	.....
ADH acts on its walls	.....
most of the water is reabsorbed into the blood	.....

[4]

[Total: 11]

8 **(a)** Fig. 8.1 is an electron micrograph of part of a cholinergic synapse.

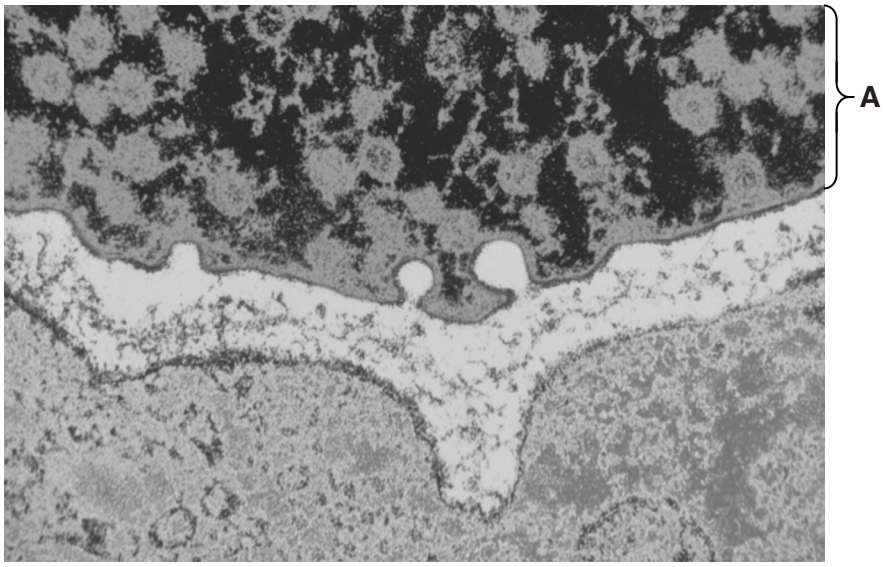

Fig. 8.1

On Fig. 8.1, use label lines and letters to label each of the following:

X – a structure that indicates that **A** is a pre-synaptic neurone

Y – an area that contains many voltage-gated Na^+ channels

Z – an area that contains both acetylcholine **and** acetylcholinesterase.

[3]

(b) Some insecticides have a similar structure to acetylcholine. Suggest how these insecticides may affect the functioning of acetylcholinesterase.

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..... [3]

(c) Outline the roles of synapses in the nervous system.

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..... [2]

[Total: 8]

Section B

Answer **one** question.

9 **(a)** Outline the process of glycolysis. [6]

(b) Describe the series of reactions that make up the Krebs cycle. [9]

[Total: 15]

10 **(a)** Explain how meiosis and fertilisation can result in genetic variation amongst offspring. [8]

(b) Describe the genetic control of protein production in a prokaryote using the *lac* operon. [7]

[Total: 15]

[Turn over