Cambridge International **A Level**

Cambridge International Examinations
Cambridge International Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/43**

Paper 4 A2 Structured Questions **October/November 2015**

2 hours

Candidates answer on the Question Paper.

Additional Materials: Answer paper available on request.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces provided at the top of this page.
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.
Circle the number of the Section B question you have answered in the grid below.

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

Electronic calculators may be used.

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.

For Examiner's Use	
Section A	
1	
2	
3	
4	
5	
6	
7	
8	
Section B	
9 or 10	
Total	

This document consists of **21** printed pages, **2** blank pages and **1** lined page.

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CAMBRIDGE International Examinations

[Turn over

Section A

Answer **all** the questions.

1 **(a)** Yeast cells sometimes carry out anaerobic respiration.

Fig. 1.1 outlines the process of anaerobic respiration in yeast cells.

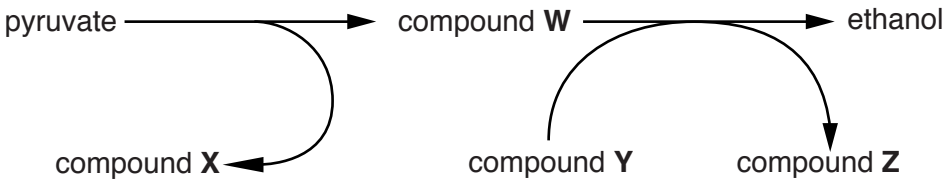

Fig. 1.1

(i) Identify compounds **W**, **X** and **Y**.

W .....

X .....

Y ..... [3]

(ii) State **two** differences between anaerobic respiration in yeast cells and anaerobic respiration in human muscle cells.

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(b) Dinitrophenol (DNP) is a compound used as a herbicide. DNP inhibits respiration by interfering with the formation of the proton gradient between mitochondrial membranes.

When DNP was added to isolated mitochondria the following observations were made:

- fewer ATP molecules were produced
- more heat energy was released
- the uptake of oxygen remained constant.

Suggest explanations for these observations.

fewer ATP molecules produced .....

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more heat energy released .....

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constant oxygen uptake.....

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[Total: 8]

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2 A vaccine, NicVAX, is being developed to help people stop smoking tobacco. Injection of NicVAX into the body causes production of antibody molecules that bind to nicotine.

(a) Outline the immune response that leads to the production of these anti-nicotine antibodies.

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(b) Mice injected with NicVAX produce B-lymphocytes that mature into cells responsible for the production of antibody (plasma cells).

Outline how these B-lymphocytes can be used to produce monoclonal antibody.

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(c) Tobacco smoking during pregnancy has adverse side-effects on the developing fetus.

An investigation was carried out to find out whether vaccinating pregnant women with NicVAX might offer some protection for the developing fetus.

Two different monoclonal antibodies, produced in response to NicVAX, were used in this investigation:

- Nic-IgG
- Nic311.

Nicotine, or nicotine plus one of the monoclonal antibodies, was injected into the maternal circulation. The concentrations of nicotine in the fetal circulation were measured at intervals.

The results of the investigation are shown in Fig 2.1.

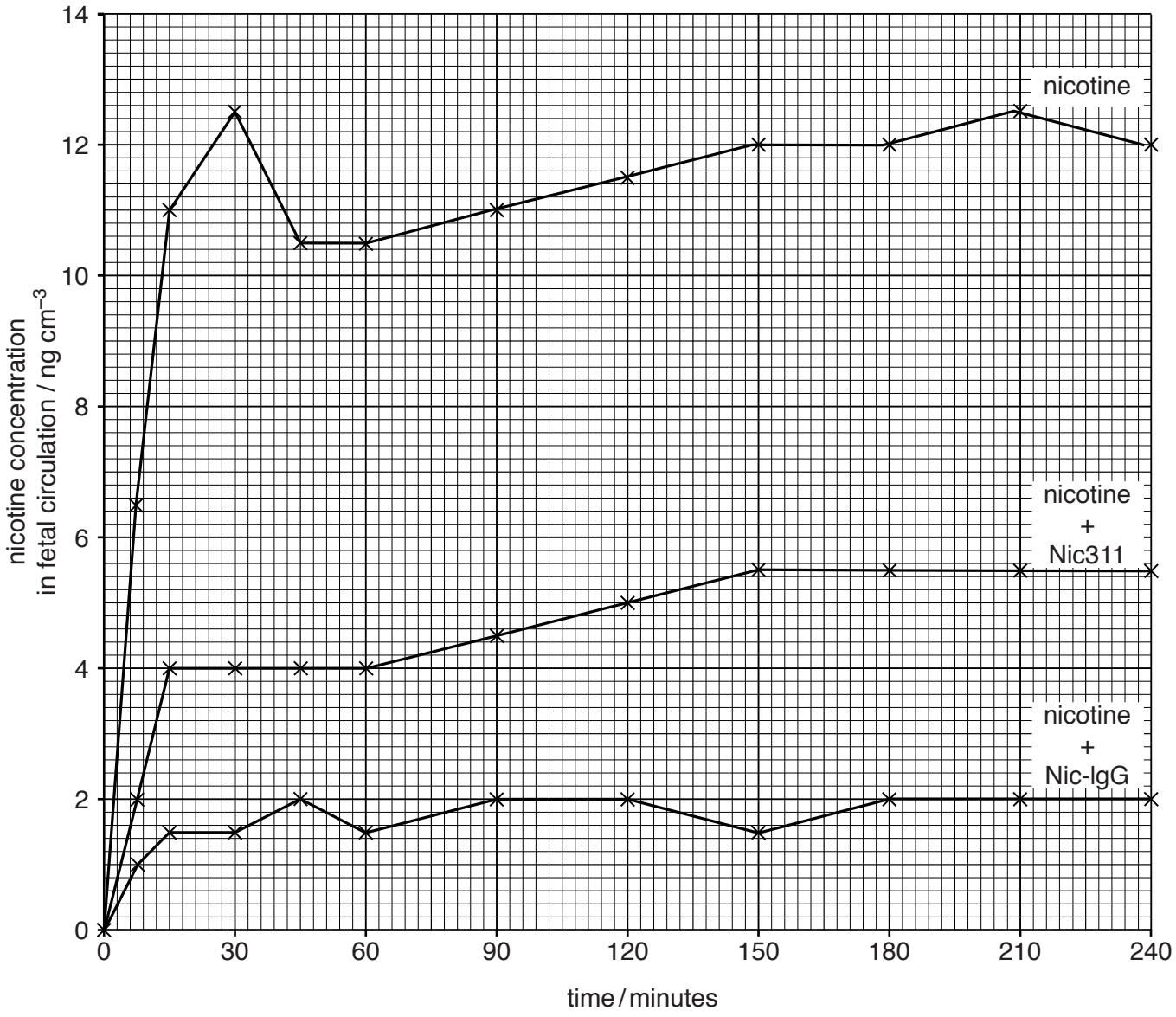

Fig. 2.1

(i) With reference to Fig. 2.1, describe the results obtained for nicotine only.

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(ii) Discuss the extent to which these results support the idea that vaccination with NicVAX could protect the developing fetus of a woman who smokes tobacco.

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(d) State **one** medical use of monoclonal antibodies, other than their use in producing vaccines.

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[Total: 15]

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3 Atlantic salmon, *Salmo salar*, is one of the most important fish species farmed for human consumption.

Fig. 3.1 shows an Atlantic salmon.

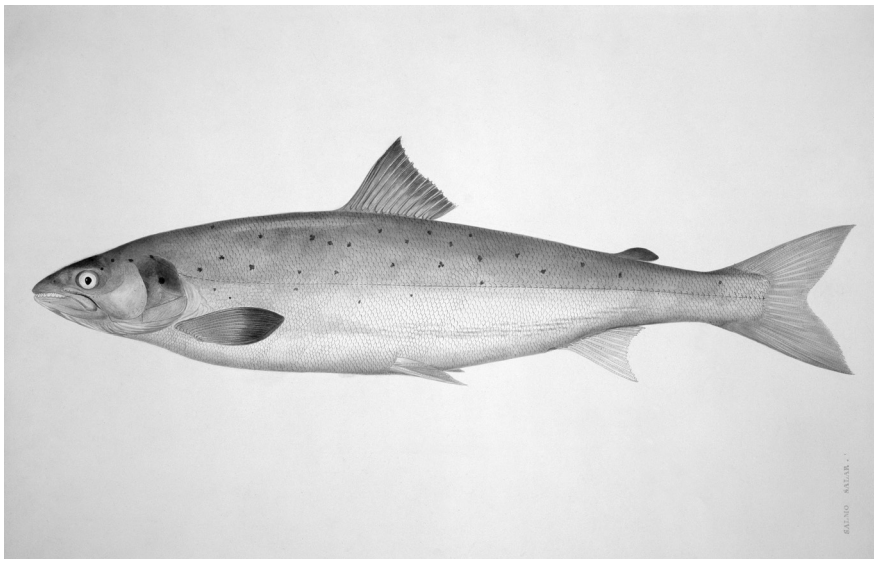

Fig. 3.1

Infectious pancreatic necrosis (IPN) is a serious viral disease currently affecting farmed salmon.

(a) (i) Describe how artificial selection could be used to produce a population of salmon that is resistant to IPN.

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(ii) Suggest problems that may arise from artificial selection.

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(b) A laboratory investigation was carried out to compare the artificially selected farmed Atlantic salmon with farmed salmon that had not been artificially selected.

Three groups of young fish were set up in carefully controlled conditions as follows:

- Group **A**: artificially selected salmon
- Group **B**: non-artificially selected salmon
- Group **C**: non-artificially selected salmon.

During this investigation, only groups **A** and **B** were exposed to IPN on day 0.

The percentages of salmon that died (percentage mortality) were calculated and are shown in Fig. 3.2.

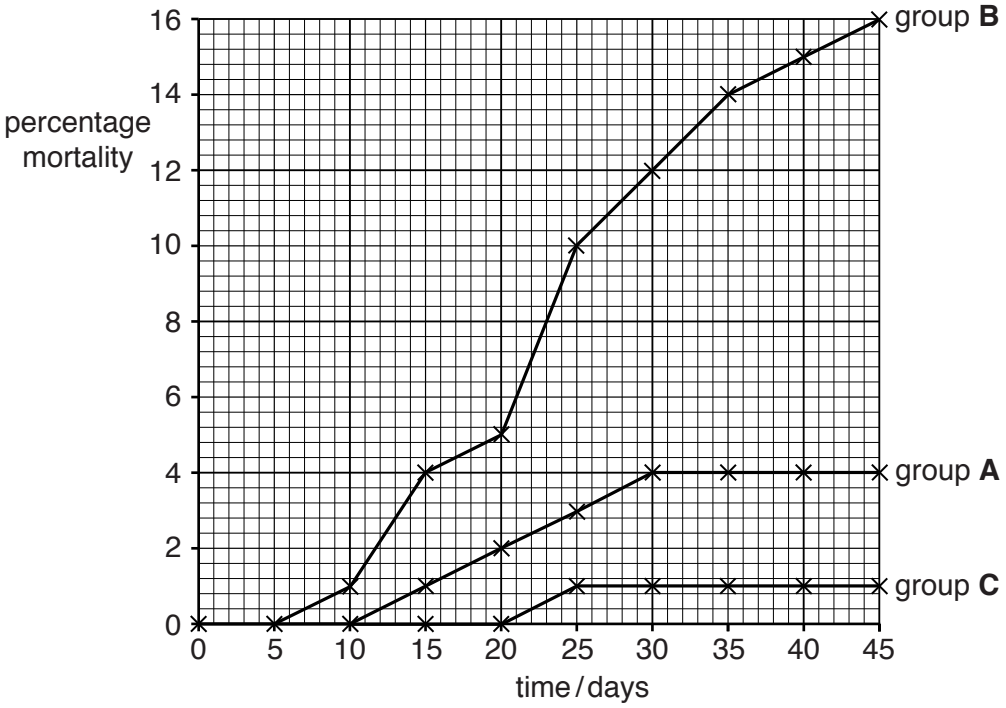

Fig. 3.2

(i) Describe **and** explain the differences in percentage mortality between groups **A** and **B**.

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(ii) Suggest a reason for the mortality in group **C**.

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[Total: 10]

[Turn over

4 Haemophilia A and haemophilia B are common hereditary disorders of blood clotting.

Haemophilia A is a sex-linked genetic disorder that affects approximately 1 in 20 000 males worldwide. It is caused by a recessive allele of a gene coding for a clotting factor and results in excessive bleeding.

There is currently no cure, but symptoms of haemophilia can be treated with a transfusion of a clotting factor to slow down the bleeding.

(a) State how genetic screening could reduce the number of cases of haemophilia.

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(b) **(i)** Some genetic disorders can be treated with gene therapy.

Outline the aims of gene therapy.

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(ii) Suggest why haemophilia A is a suitable disorder for treatment with gene therapy.

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(c) Haemophilia A and haemophilia B are caused by mutations in different blood clotting genes, *F8* and *F9* respectively. Both disorders have been treated with gene therapy involving the use of a vector.

(i) Table 4.1 shows the lengths, in kilobases (kb), of the *F8* and *F9* genes.

Table 4.1

haemophilia	gene	gene length / kb
A	*F8*	>8
B	*F9*	1.4

With reference to Table 4.1, suggest why gene therapy using the *F9* gene has been more successful than using the *F8* gene.

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(ii) Two frequently used vectors in gene therapy are compared in Table 4.2.

Table 4.2

feature	**vector**	
	adenovirus	**retrovirus**
genetic material of virus	double-stranded DNA	single-stranded RNA
expression of inserted gene	high gene expression	gene expression in dividing cells only
host immune response to virus	high	low

With reference to Table 4.2, explain the advantages and disadvantages of using adenovirus rather than retrovirus as a vector.

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[Total: 10]

5 (a) (i) Explain what is meant by the term *biodiversity*.

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(ii) Explain why it is important to ensure that biodiversity is maintained.

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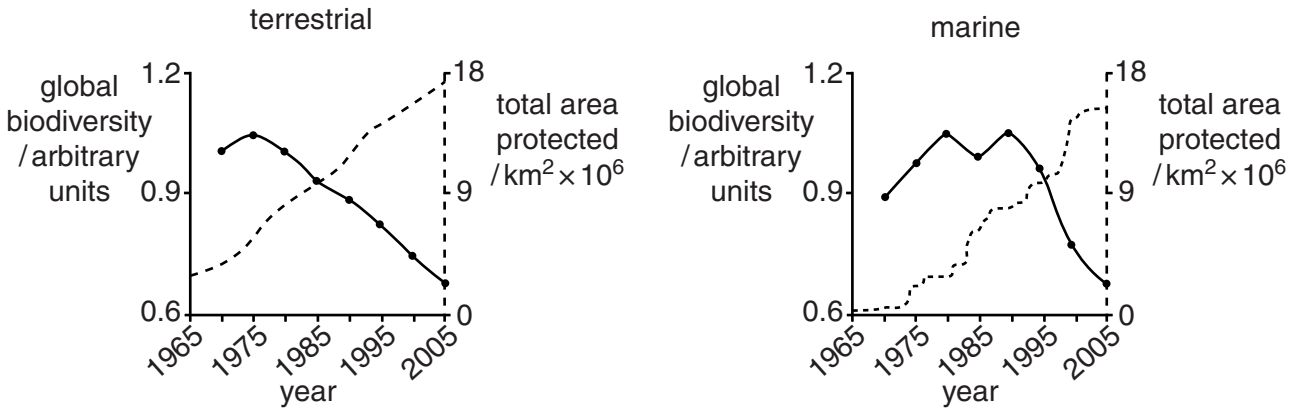
(b) To reduce the loss of global biodiversity, areas of habitat have been protected.

Fig 5.1 shows the changes in the total area protected and in global biodiversity from 1965 to 2005, in terrestrial and marine habitats.



key:

——— global biodiversity

- - - - - - total area protected

Fig. 5.1

(i) With reference to Fig. 5.1, compare the relationship between total area protected and global biodiversity in terrestrial and marine habitats:

- between 1970 and 1990
- between 1990 and 2005.

between 1970 and 1990 .....

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between 1990 and 2005 .....

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(ii) Suggest why a smaller area of marine habitats has been protected than of terrestrial habitats.

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[Total: 10]

6 (a) One important function of the kidney nephron is selective reabsorption. This involves the rapid transfer of water across cell surface membranes. The rapid transfer of water requires the presence of protein channels known as aquaporins.

Fig. 6.1 is a diagram of a nephron.

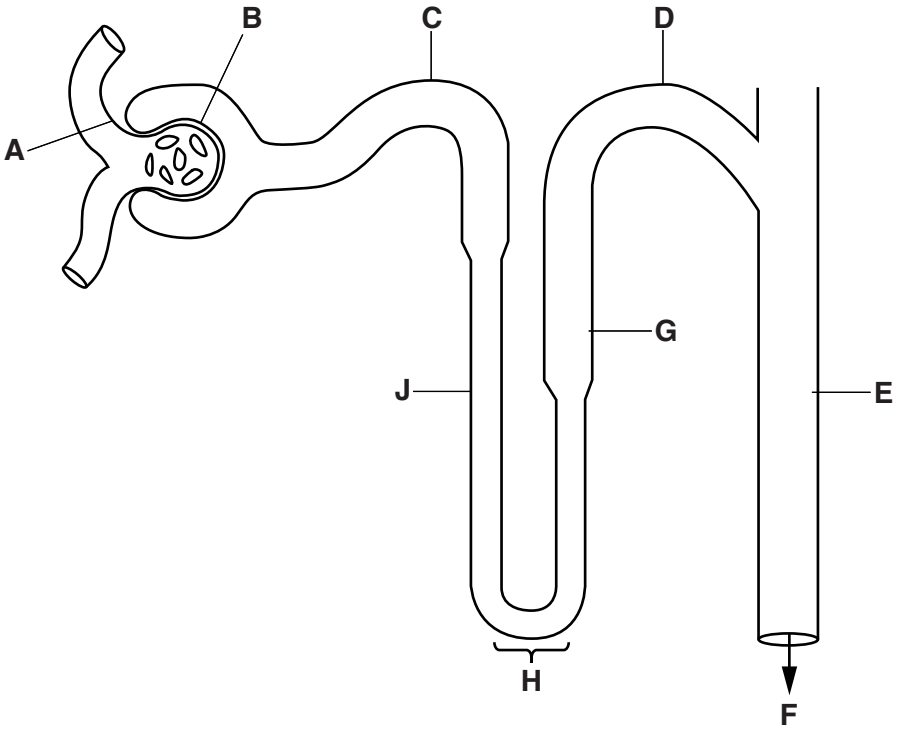

Fig. 6.1

With reference to Fig. 6.1, complete the table by inserting the correct letter for each description.

description of region of nephron	letter
region where no aquaporins are present in the tubule wall cells	
region where aquaporins and glucose transport proteins are present in tubule wall cells	
region where aquaporins are always present in the tubule wall cells but no glucose transport proteins are present	
region where tubule wall cells are modified to produce filtration slits	

[4]

(b) (i) The urine of people on different types of diet was analysed.

- people on a low protein diet had a mean urea concentration of 2.40 g dm^{-3}
- people on a high protein diet had a mean urea concentration of 14.76 g dm^{-3}.

Calculate the percentage increase in the concentration of urea between the low and high protein diets.

Show your working.

answer ..... % [2]

(ii) Explain why an increase in the quantity of protein in the diet leads to an increase in the concentration of urea in the urine.

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[Total: 8]

7 **(a)** Fig. 7.1 shows the absorption spectra of chlorophyll a and chlorophyll b and a corresponding action spectrum.

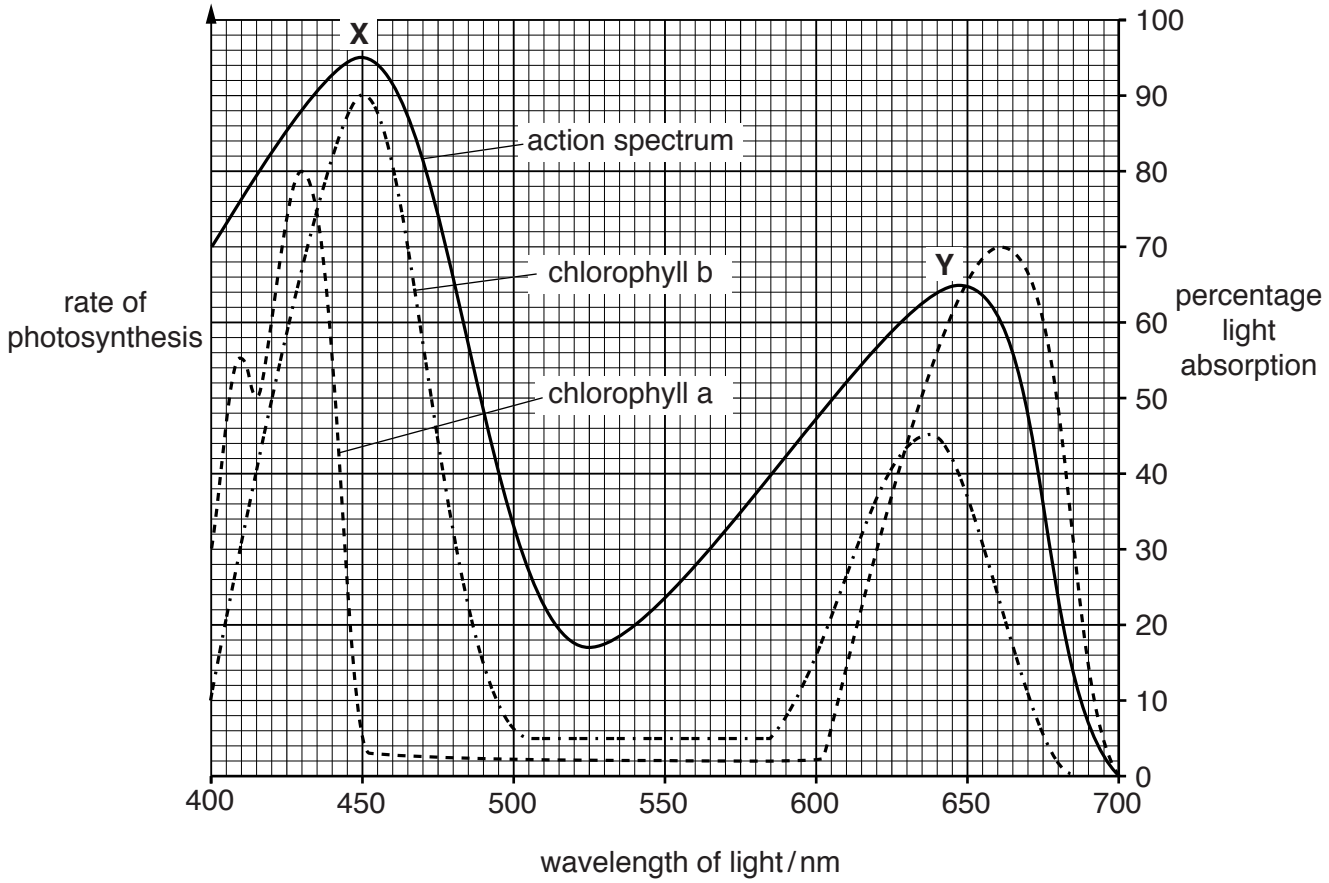

Fig. 7.1

(i) Explain why peak **X** of the **action** spectrum is higher than peak **Y**.

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(ii) Explain why most plants appear green.

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(iii) Chlorophyll b is an accessory pigment.

Outline the role played by accessory pigments in the light-dependent stage of photosynthesis.

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(b) Describe the effects on a plant if its environmental temperature rises well above the usual temperature range.

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(c) Complete the following paragraph by using the most suitable words to fill in the gaps.

A chloroplast is surrounded by two phospholipid membranes. It has an internal ground substance called the stroma which is the site of the Calvin cycle. The stroma contains enzymes such as ..... and also sugars, lipids and starch. A chloroplast has an internal membrane system of fluid-filled sacs called ..... which can be stacked to form grana. Grana membranes hold photosynthetic pigments so that the light-dependent stage of photosynthesis can take place. The stroma contains circular ..... which codes for some of the chloroplast proteins made by its own small .....

[4]

[Total: 15]

8 The fruit fly, *Drosophila melanogaster*, is widely used in genetic research. It has many phenotypic variants in features such as body colour, wing shape and eye colour.

Two variations from the normal-winged, grey-bodied phenotype are:

- vestigial (very short) wings, coded for by the recessive allele of the gene **N/n**
- ebony (black) body colour, coded for by the recessive allele of the gene **G/g**.

(a) Using the symbols given, state the possible genotypes of normal-winged, grey-bodied fruit flies.

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(b) Describe how you would determine the genotype of a normal-winged, grey-bodied fly.

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(c) One of the genes for eye colour is carried on the X chromosome. This gene has different alleles coding for:

- red eyes
- orange eyes
- white eyes.

The allele for red eyes (R) is dominant to the allele for orange eyes (o) and dominant to the allele for white eyes (w). The allele for orange eyes is dominant to that for white eyes.

Using these symbols, draw a genetic diagram to show how a cross between a white-eyed male fruit fly with a red-eyed female fruit fly will produce male and female offspring that are either red-eyed or orange-eyed.

[4]

[Total: 9]

Section B

Answer **one** question.

9 **(a)** Outline oogenesis in a human female. [9]

(b) Describe and explain the changes to the uterus during the menstrual cycle. [6]

[Total:15]

10 **(a)** Outline how hybridisation leads to polyploidy in wheat **and** how this benefits farmers. [8]

(b) Discuss the detrimental environmental and economic effects of growing genetically modified herbicide-resistant oil seed rape. [7]

[Total: 15]