

CANDIDATE
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BIOLOGY

9700/43

Paper 4 A Level Structured Questions

October/November 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.

This document consists of **21** printed pages and **3** lined pages.



Section A

Answer **all** the questions.

- 1 The Labrador retriever is a modern breed of dog that can have yellow, black or brown fur and pale, black or brown noses. The inheritance of fur and nose colour is the result of the interaction between genes at two different loci, the B locus and the E locus.

Fig. 1.1 shows a Labrador retriever.



Fig. 1.1

Table 1.1 shows how gene interaction results in different phenotypes.

Table 1.1

alleles at B locus	alleles at E locus	phenotype
B ₋	ee	yellow fur black nose
bb	ee	yellow fur pale nose
B ₋	E ₋	black fur black nose
bb	E ₋	brown fur brown nose

A male Labrador retriever, heterozygous at the B locus and homozygous recessive at the E locus, was mated with a female Labrador retriever heterozygous at both loci.

- (a) Explain the terms *locus* and *homozygous*.

locus

.....

homozygous

..... [2]

- (b) Use a genetic diagram to show the possible genotypes and phenotypes of the offspring from the mating between the two Labrador retrievers.

parental phenotypes

parental genotypes

gametes

offspring genotypes and phenotypes

[6]

[Total: 8]

- 2 Most plants are C3 plants and are so-called because their first photosynthetic product is a three carbon compound.

The enzyme ribulose biphosphate carboxylase/oxygenase (rubisco) catalyses the fixation of carbon dioxide in the Calvin cycle and is used by both C3 and C4 plants.

Each molecule is made up of eight large polypeptides and eight small polypeptides. Fig. 2.1 shows a side view of the molecule.

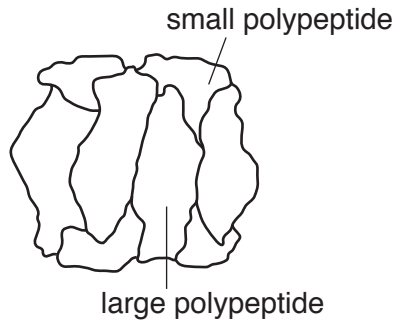


Fig. 2.1

- (a) (i) Outline how the biochemistry of C4 plants differs from that of C3 plants.

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.....
.....
..... [2]

- (ii) State why rubisco is said to have quaternary structure.

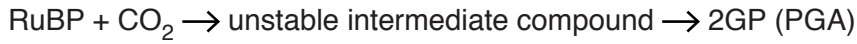
.....
..... [1]

- (iii) Explain what makes a molecule such as rubisco soluble.

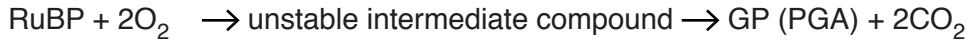
.....
.....
.....
..... [2]

(b) The active sites of rubisco accept ribulose biphosphate (RuBP) and **either** carbon dioxide **or** oxygen and can catalyse the two reactions shown below.

either



or



Explain the consequences to the plant of the reaction involving oxygen.

.....
.....
.....
.....
..... [2]

(c) In the absence of light, rubisco changes shape from an active form to an inactive form.

Explain why rubisco does **not** need to be in an active form in the absence of light.

.....
.....
.....
.....
..... [3]

[Total: 10]

- 3 Vitamin A deficiency is a major health problem in parts of the world where children have a limited diet. Rice enhanced with pro-vitamin A has been produced through genetic engineering. This new rice, called Golden Rice, contains large amounts of β -carotene, which is used in the human body to synthesise vitamin A. From this Golden Rice, newer varieties of Golden Rice have been developed by selective breeding.

Fig. 3.1 shows how Golden Rice was originally produced by genetic engineering.

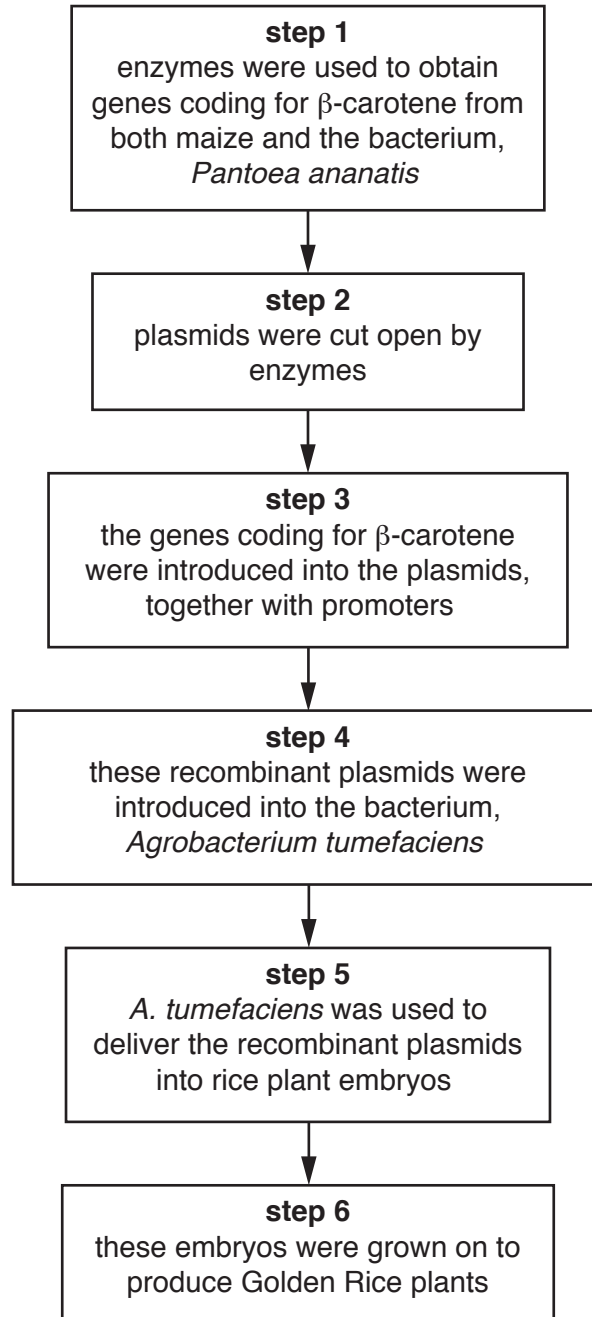


Fig. 3.1

(a) (i) Name the types of enzyme used in **step 1** and **step 2**.

.....[1]

(ii) Name the enzyme used in **step 3**.

.....[1]

(iii) Explain why promoters were introduced along with the genes for β -carotene in **step 3**.

.....
.....
.....
.....
.....
.....[2]

(iv) Describe the properties of plasmids that make them suitable for their roles in the production of Golden Rice.

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.....
.....[3]

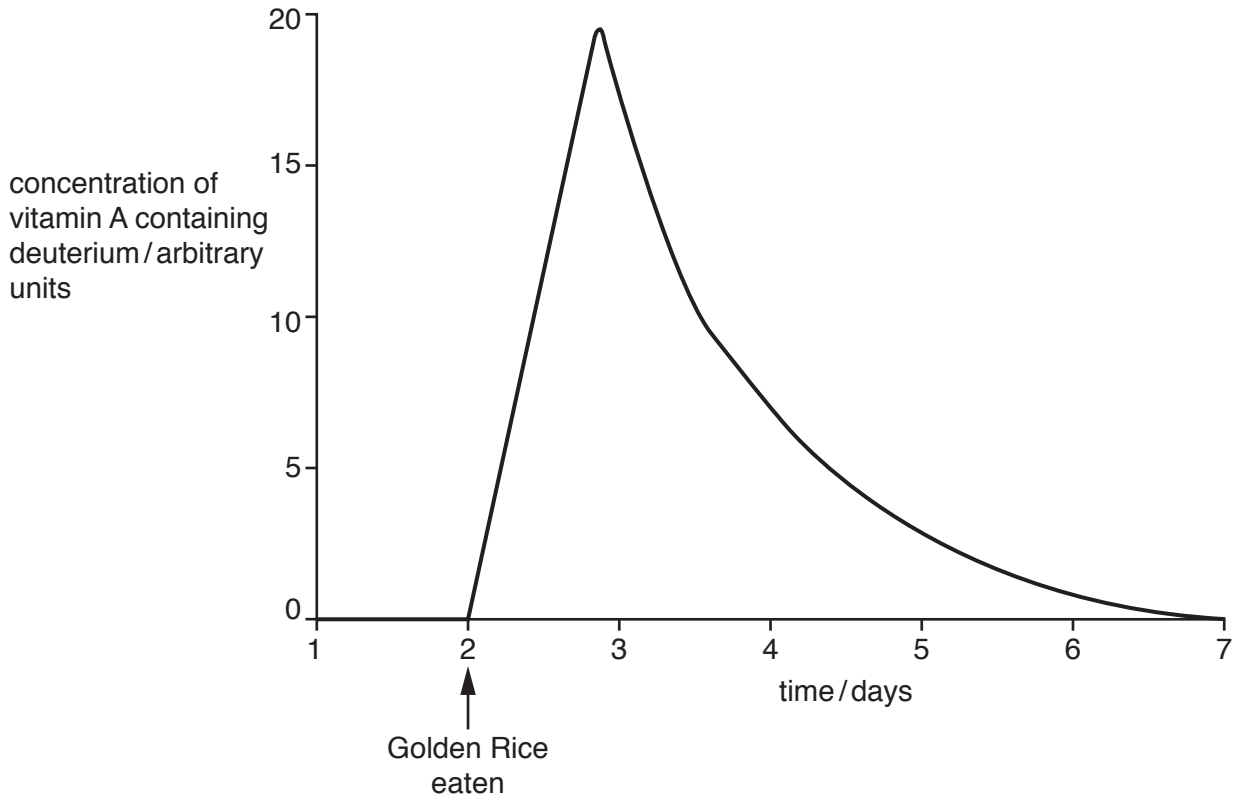


Fig. 3.2

(i) Explain why the Golden Rice was grown using water containing deuterium.

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.....

.....[2]

(ii) Suggest why it took several hours after the Golden Rice had been eaten for the maximum concentration of vitamin A containing deuterium to be reached.

.....

.....

.....[1]

[Total: 13]

Table 5.2

taxon	number of species	total number of individuals
Coleoptera (beetles)	113	2 197
Diptera (flies)	58	1 029
Formicidae (ants)	14	7 467
Hemiptera (bugs)	121	11 875

(i) Complete Table 5.1 by calculating the mean number of insect species for *Acacia tortilis*. [1]

(ii) Select, from Tables 5.1 and 5.2, a name to fit the following taxonomic groups:

a genus

a species

[2]

(iii) Comment on the effects of sample size on the quality and accuracy of the data in Table 5.1.

.....

 [2]

(c) This study was carried out in Mkomazi Game Reserve in Tanzania.

Suggest how research into insect diversity on *Acacia* trees is relevant to the conservation of bigger animals in the reserve, such as elephants.

.....

 [3]

[Total: 11]

[Turn over

- 6 (a) Fig. 6.1 shows the concentration of two hormones, oestrogen and progesterone, in a woman's blood during one menstrual cycle.

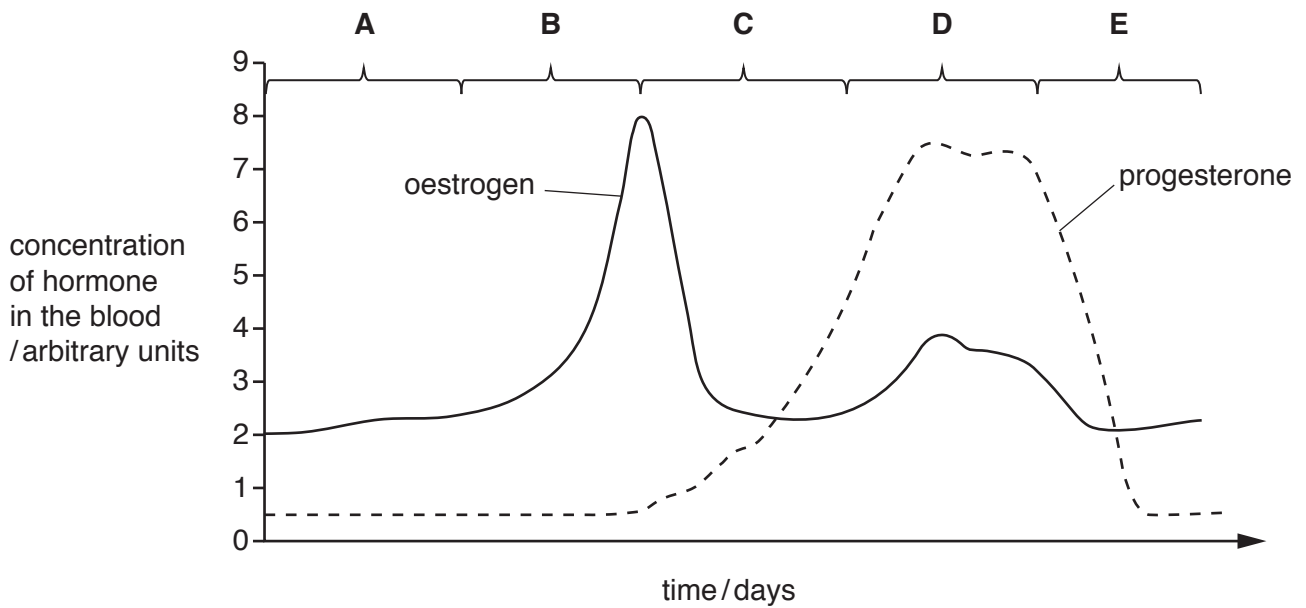


Fig. 6.1

- (i) With reference to Fig. 6.1, state the letter of the stage of the cycle during which ovulation occurs.

.....[1]

- (ii) State how Fig. 6.1 shows that the woman did not become pregnant during this cycle.

.....
[1]

- (iii) Name the ovarian structure that secretes progesterone after ovulation.

.....[1]

- (iv) State the role of progesterone during stage D.

.....

[1]

- 8 (a) A respirometer can be used to measure the respiration rate of small invertebrates such as the common woodlouse, *Oniscus asellus*.

Fig. 8.1 shows a common woodlouse.

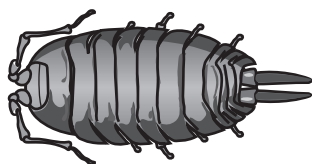


Fig. 8.1

Fig. 8.2 shows a respirometer.

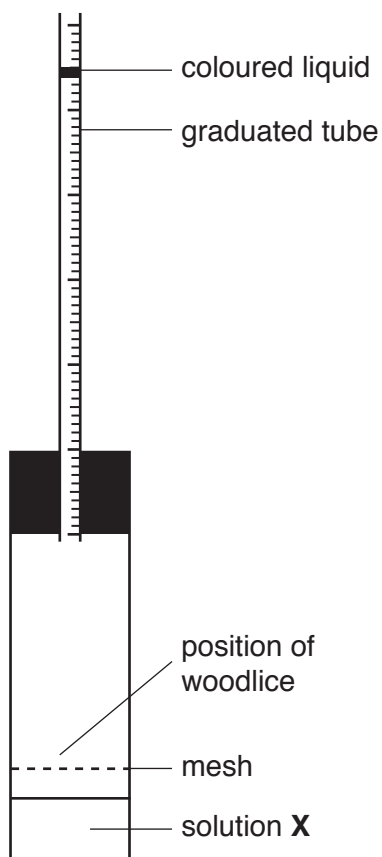


Fig. 8.2

- (i) Name solution X.
[1]
- (ii) The respirometer can be used to measure the effect of temperature on the rate of respiration of organisms.
 Suggest **one** factor that would need to be taken into account when using woodlice rather than germinating seeds.

[1]

- (iii) As respiration takes place, oxygen is used by the woodlice and the coloured liquid moves down the graduated tube.

Name the stage of aerobic respiration where oxygen is used.

.....[1]

- (b) A respirometer as shown in Fig. 8.2 was used to investigate the effect of temperature on the rate of respiration of woodlice.

- A student set up a respirometer containing 5 woodlice.
- The respirometer was placed in a water-bath maintained at 15 °C.
- The respirometer was left for 10 minutes to equilibrate.
- After a further 15 minutes the distance moved by the coloured liquid was measured.
- The volume of oxygen used by the woodlice was then calculated.
- The experiment was repeated, using the same woodlice and respirometer, at 25 °C.

- (i) The results are shown in Table 8.1.

Table 8.1

temperature /°C	volume of oxygen used /cm ³	rate of oxygen uptake /cm ³ min ⁻¹
15	0.18
25	0.42

Complete Table 8.1 by calculating the rates of oxygen uptake at 15 °C and 25 °C.

[2]

- (ii) Explain the difference in the rates of oxygen uptake at 15 °C and 25 °C.

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.....[3]

