OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

BIOLOGY 2804

Central Concepts

Monday **16 JUNE 2003** Morning 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator
Ruler (cm/mm)

Candidate Name	Centre Number	Candidate Number

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers, in black or blue ink, in the spaces on the question paper.
- Read each question carefully before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	9	
2	14	
3	18	
4	13	
5	20	
6	8	
7	8	
TOTAL	90	

This question paper consists of 16 printed pages.

Registered Charity Number: 1066969
[Turn over

Answer **all** the questions.

1 Fig. 1.1 is a diagram of a spinal reflex arc.

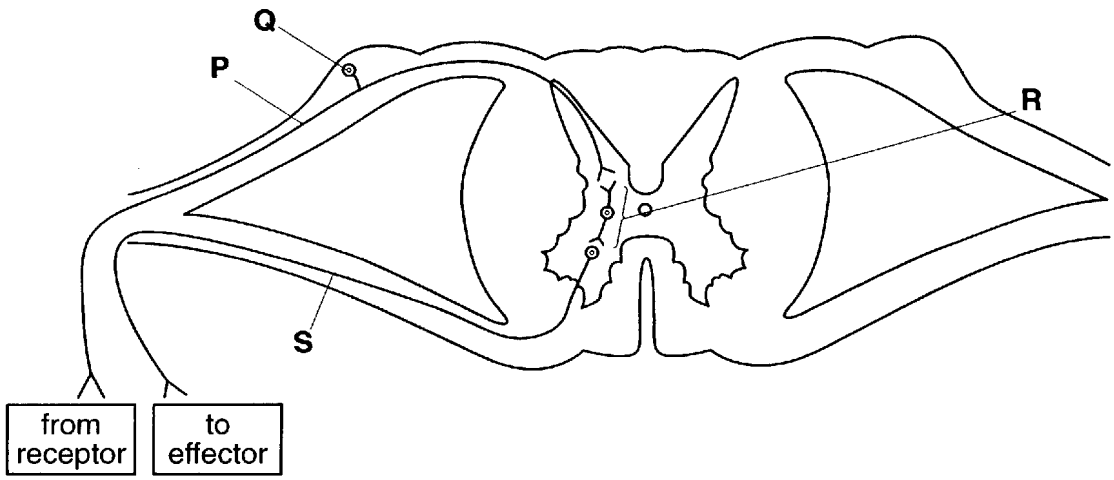

Fig. 1.1

(a) Identify the structures labelled **P** to **S**.

P .....

Q .....

R .....

S .....[4]

(b) Explain how synapses determine the direction of nerve impulse transmission in the reflex arc shown in Fig. 1.1.

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..... [2]

(c) Botulinum toxin stops nerve impulse transmission at synapses. Suggest how this may occur.

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..... [3]

[Total: 9]

2 Two pure breeding strains of snapdragon, a garden plant, were obtained. One strain had red flowers and the other had white flowers. The two strains were crossed yielding F_1 plants all with pink flowers. The F_1 plants were then interbred to produce F_2 plants with the following petal colours:

red 62

pink 131

white 67

The following hypothesis was proposed:

Flower colour is controlled by a single gene with two codominant alleles.

(a) Complete the genetic diagram to explain this cross. Use the following symbols to represent the alleles:

C^r = red, C^w = white.

Parental phenotypes: Red flowers x White flowers

Parental genotypes: ....

Gametes: ....

F_1 genotypes: .....

F_1 phenotypes: .....

Gametes: .....

F_2 genotypes: .....

F_2 phenotypes: .....

Expected F_2 phenotypic ratio: ..... [6]

(b) A chi-squared (χ^2) test is carried out on the experimental data to determine whether the hypothesis is supported.

(i) Complete Table 2.1 by calculating the expected numbers.

Table 2.1

F_2 phenotype	observed numbers	expected numbers
red	62	
pink	131	
white	67	
total	260	260

[3]

The χ^2 statistic is calculated in the following way:

$$\chi^2 = \Sigma \frac{(\text{observed} - \text{expected})^2}{\text{expected}} \qquad \Sigma = \text{"sum of ..."}$$

(ii) Calculate the χ^2 value for the above data. Show your working.

χ^2 value = ... [2]

(iii) The critical value of χ^2 for this type of investigation with two degrees of freedom is 5.991.

Explain whether your answer to **(b) (ii)** supports the hypothesis.

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..... [1]

(c) Phenotype is influenced by genetic and environmental factors. Describe **one** example of how the **environment** influences phenotype.

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..... [2]

[Total: 14]

3 **(a)** Aerobic respiration of glucose requires enzymes. The process is divided into four stages: glycolysis, the link reaction, Krebs cycle and oxidative phosphorylation.

Complete the table to indicate the **precise location** of the four stages.

respiratory stage	location in cell
glycolysis	
link reaction	
Krebs cycle	
oxidative phosphorylation	

[4]

Question 3 continues on page 6

(b) Liver cells are frequently used as a source of mitochondria. These cells are homogenised in a sucrose solution and the mitochondria isolated. The suspended mitochondria are then placed in an oxygen electrode where the oxygen uptake of these organelles can be measured over a given time period.

Fig. 3.1 shows a print-out from this apparatus. At point **A** the respiratory substrate glucose was added. At points **B**, **C** and **D** equal quantities of ADP were added.

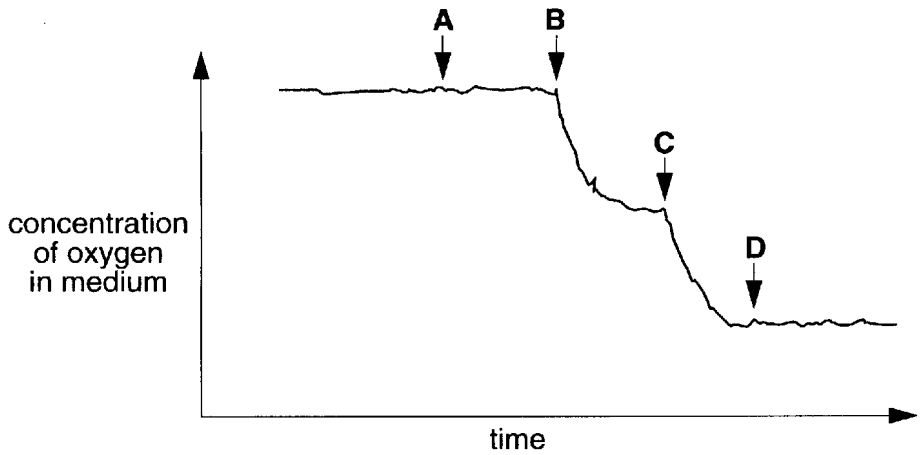

Fig. 3.1

Explain the results,

(i) between points **A** and **B**;

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..... [2]

(ii) between points **B** and **C**;

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..... [2]

(iii) after point **D.**

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..... [2]

(c) In this question, one mark is available for the quality of written communication.

Describe the main features of the Krebs cycle. **No credit will be given for a flow diagram of the cycle.**

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..... [7]

Quality of Written Communication [1]

[Total: 18]

[Turn over

4 In biological classification, there are seven principal taxonomic groups. For garlic, a flowering plant, they are listed below, but not in the correct sequence.

number	taxonomic group	classification of garlic
1	order	Liliales
2	kingdom	Plantae
3	genus	*Allium*
4	phylum	Spermatophyta
5	family	Liliaceae
6	species	*sativum*
7	class	Monocotyledoneae

(a) Using the numbers 1 – 7, place the taxonomic groups in the correct sequence starting with the highest group. The first one has been done for you.

2							

[1]

Garlic is a member of the kingdom Plantae, which are all eukaryotic organisms.

(b) List the other **three** kingdoms that contain eukaryotic organisms.

1 .....

2 .....

3 ..... [3]

(c) State **three** features of the kingdom Plantae, other than being eukaryotic.

1 .....

2 .....

3 .....[3]

(d) Cytochrome c is a protein that is found in all living organisms. Analysis of the amino acid sequences of proteins, such as cytochrome c, provides data that taxonomists use to produce more accurate classifications.

Explain how analysing the amino acid sequences of proteins provides useful data for taxonomists.

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..... [4]

(e) Since the late 19th century, taxonomists have been able to describe phylogenies.

Explain the term *phylogeny*.

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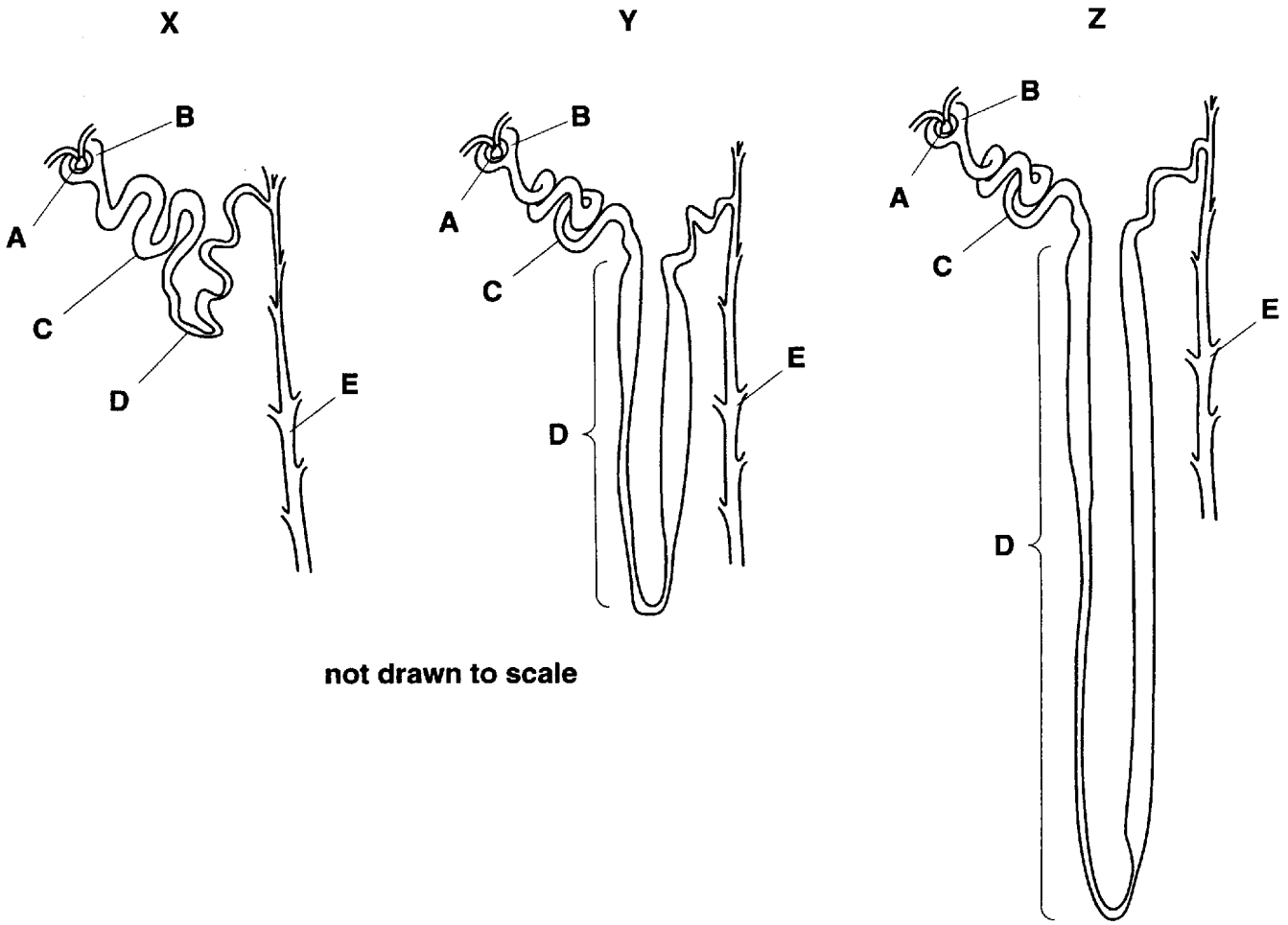
..... [2]

[Total: 13]

5 Fig. 5.1 shows diagrams of nephrons from the kidneys of three different mammals, **X**, **Y** and **Z**.



not drawn to scale

	X	Y	Z
name of mammal	beaver	house mouse	desert living gerbil
water potential of urine	high	low	very low

Fig. 5.1

(a) Name parts **A** to **E**.

A .....

B .....

C .....

D .....

E ..... [5]

(b) Explain the relationship between the length of part **D** and the water potential of the urine in the three mammals.

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..... [4]

Fig. 5.2 is a drawing of a cell from part **C** of the diagram of the nephrons shown in Fig. 5.1.

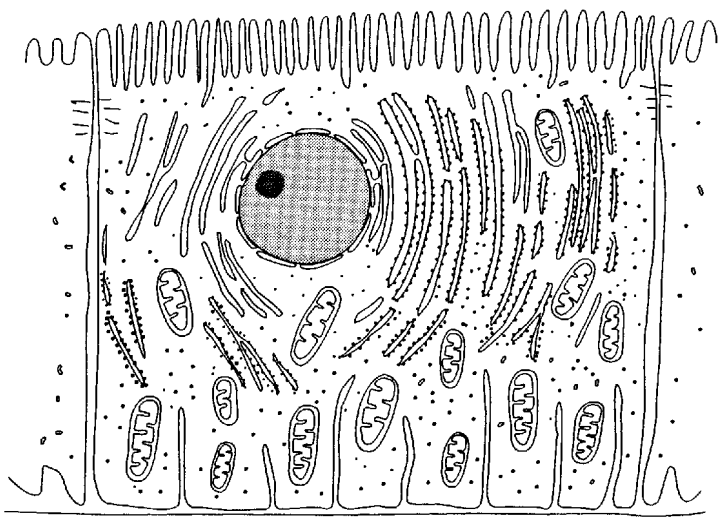

Fig. 5.2

(c) State **three** structural features **visible** in this cell which help in selective reabsorption from the glomerular filtrate.

1 .....

2 .....

3 ..... [3]

(d) In this question, one mark is available for the quality of written communication.

Explain how the composition of the fluid flowing through part **C** of the nephrons shown in Fig. 5.1 is altered by cells of the type shown in Fig. 5.2.

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Quality of Written Communication [1]

[Total: 20]

6 In the majority of photosynthetic organisms, fixation of carbon dioxide occurs using the Calvin cycle. Fig. 6.1 is an outline of this cycle.

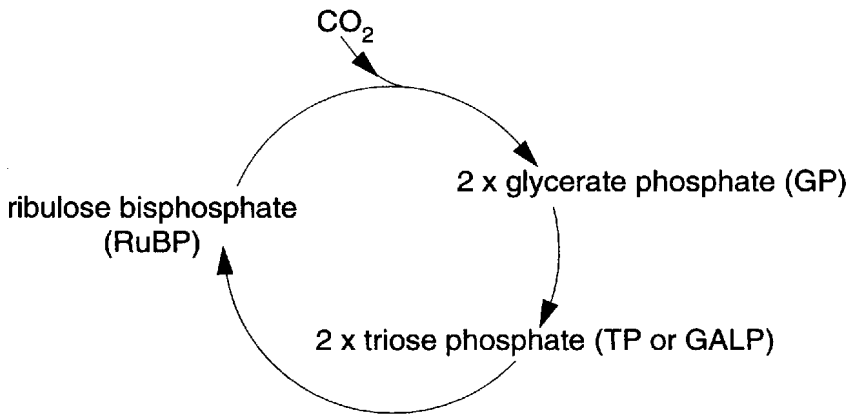

Fig. 6.1

(a) (i) Name the five carbon sugar in the cycle.

..... [1]

(ii) Name the enzyme that fixes the carbon dioxide.

..... [1]

(iii) Mark an **A** on Fig 6.1 to show where reduced NADP from the light dependent reaction is used. [1]

(iv) State where in the chloroplast the Calvin cycle occurs.

..... [1]

(v) Name another compound produced in the light dependent stage that is used in this cycle.

..... [1]

(b) Fig. 6.2 shows the changes in the relative amounts of RuBP and GP produced in the Calvin cycle before and after a light source is switched off. All other conditions are constant.

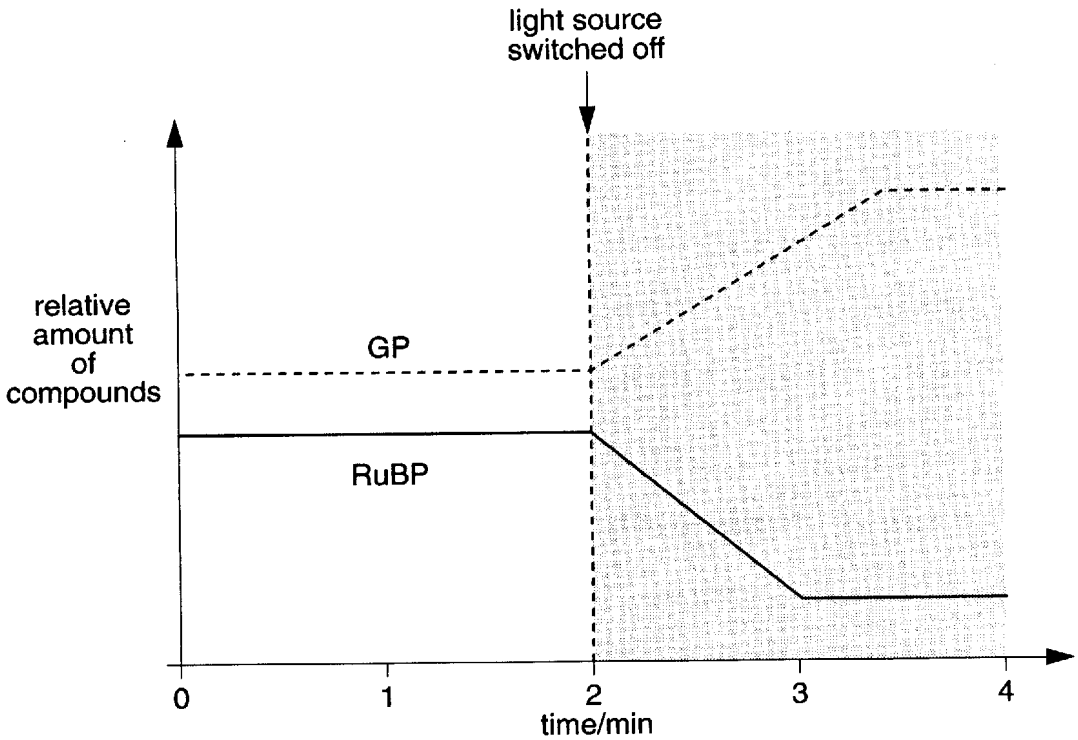

Fig. 6.2

Explain the changes in the relative amounts of GP and RuBP **after the light source is switched off.**

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..... [3]

[Total: 8]

7 Two species of mite were kept in a laboratory. One species, **X**, feeds on oranges, and the other, **Y**, is a predator on **X**.

Fig. 7.1 shows the changes in the populations of these two mites when species **Y** was introduced to a population of **X** feeding on a single orange. The introduction occurred on day 18.

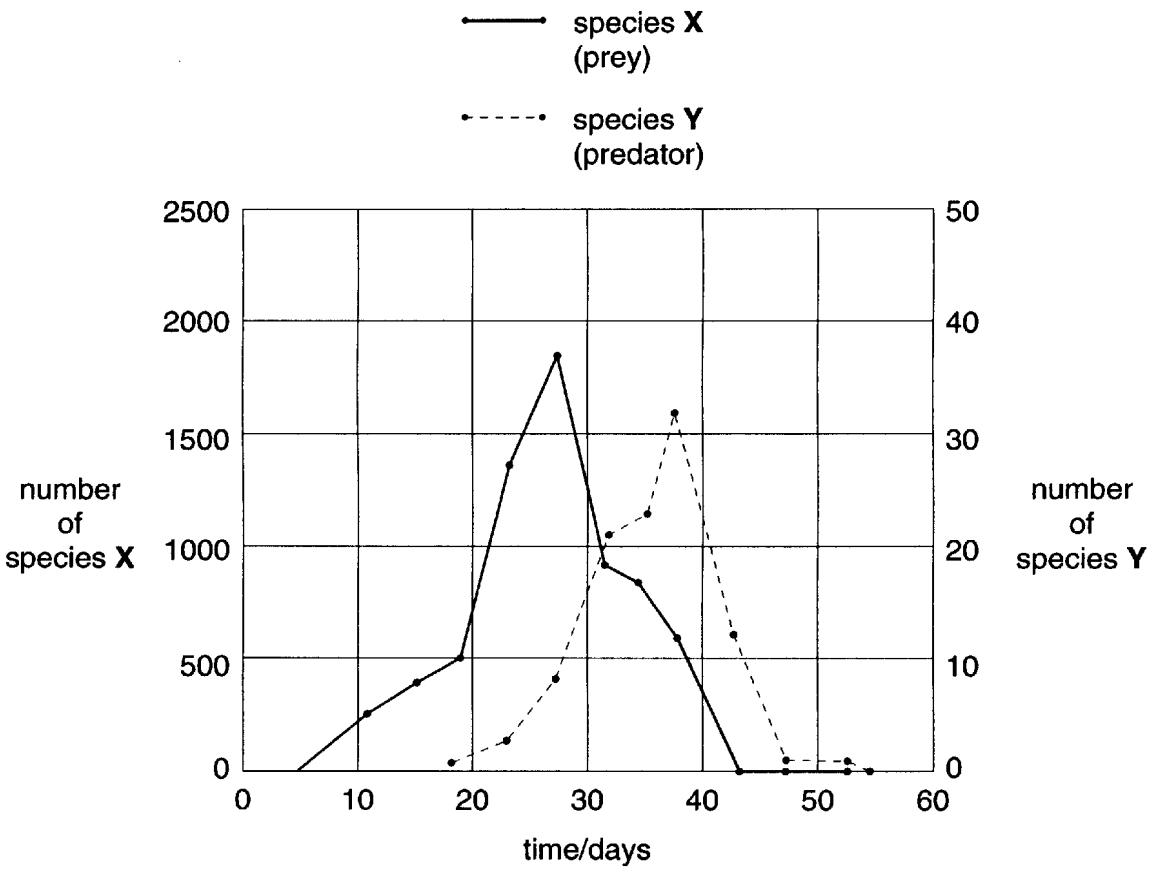

Fig. 7.1

(a) Complete the following table using data from Fig. 7.1.

	species	
	X	**Y**
maximum population size		
time when maximum population was recorded / days		

[2]

[Turn over

(b) Explain the changes in the population of species **Y** during the course of the experiment.

Credit will be given for reference to the data.

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[Total: 8]