Cambridge Assessment International Education

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CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

BIOLOGY **0610/43**

Paper 4 Theory (Extended) **May/June 2021**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

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1 **(a)** **(i)** The main component of milk is a liquid that is an important solvent in the body.

State the name of this solvent.

..... [1]

(ii) Table 1.1 shows some of the nutrients found in human milk, the elements that make up the nutrients, the enzymes that digest them and the products of digestion.

Complete Table 1.1.

Table 1.1

nutrient	elements	enzyme	products of digestion
protein			
fat			
lactose (milk sugar)	C, H, O		galactose and glucose (simple sugars)

[4]

(b) Milk also contains vitamins and mineral salts.

(i) Explain why vitamin D is important for the nutrition of children.

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(ii) Explain why iron is important in the diet.

View solution

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(c) Rubella and kwashiorkor are two diseases that affect children.

View solution

Rubella is a transmissible disease and kwashiorkor is a non-transmissible disease.

(i) Define the term transmissible disease.

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(ii) Explain why women should be vaccinated against rubella before they reach reproductive age.

View solution

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(iii) Outline the causes of kwashiorkor.

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[Total: 18]

2 Insulin is a protein made by cells in the pancreas.

Fig. 2.1 shows how insulin is made in a pancreatic cell.

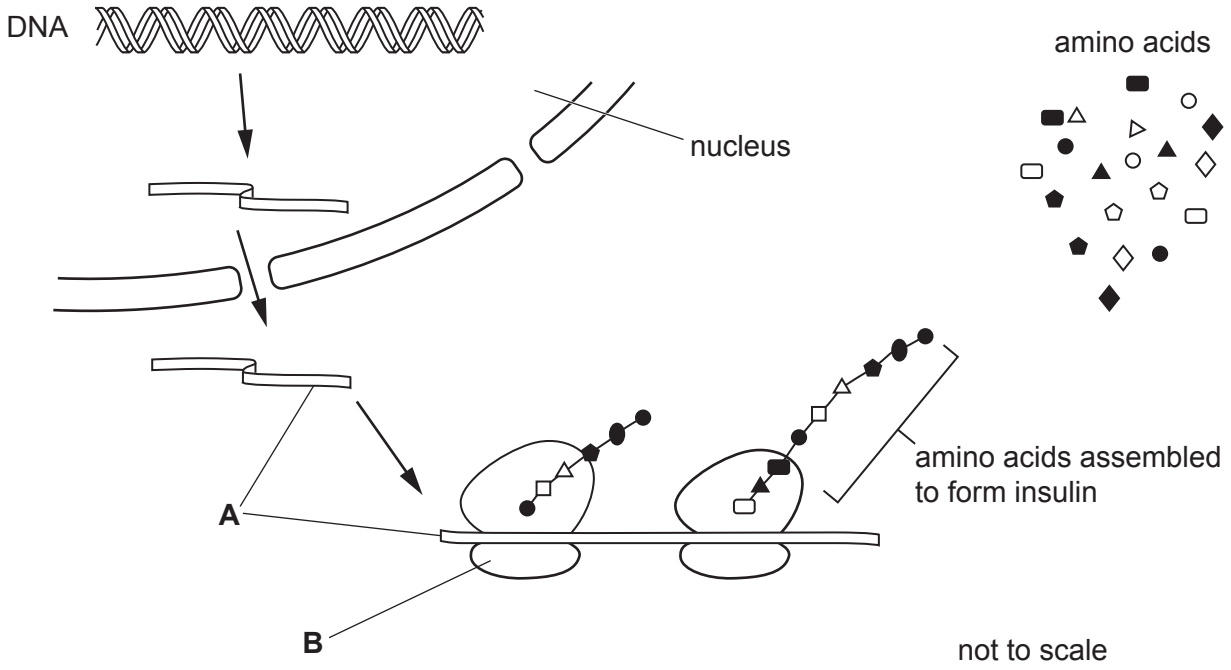

Fig. 2.1

(a) (i) State the name of molecule **A** in Fig. 2.1.

View solution

..... [1]

(ii) State the name of structure **B** in Fig. 2.1.

View solution

..... [1]

(iii) Explain the role of molecule **A** in protein synthesis, as shown in Fig. 2.1.

View solution

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(b) Insulin is secreted from cells in the pancreas when the concentration of glucose in the blood increases.

View solution

Outline the role of insulin.

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(c) State the names of **two** substances, **other than** insulin, that are secreted by the pancreas.

View solution

1 .....

2 .....

[2]

[Total: 11]

3 Scientists measured the rate of photosynthesis in the leaves of a sunflower plant, *Helianthus annuus*.

The scientists used the apparatus shown in Fig. 3.1 to measure the rate of photosynthesis.

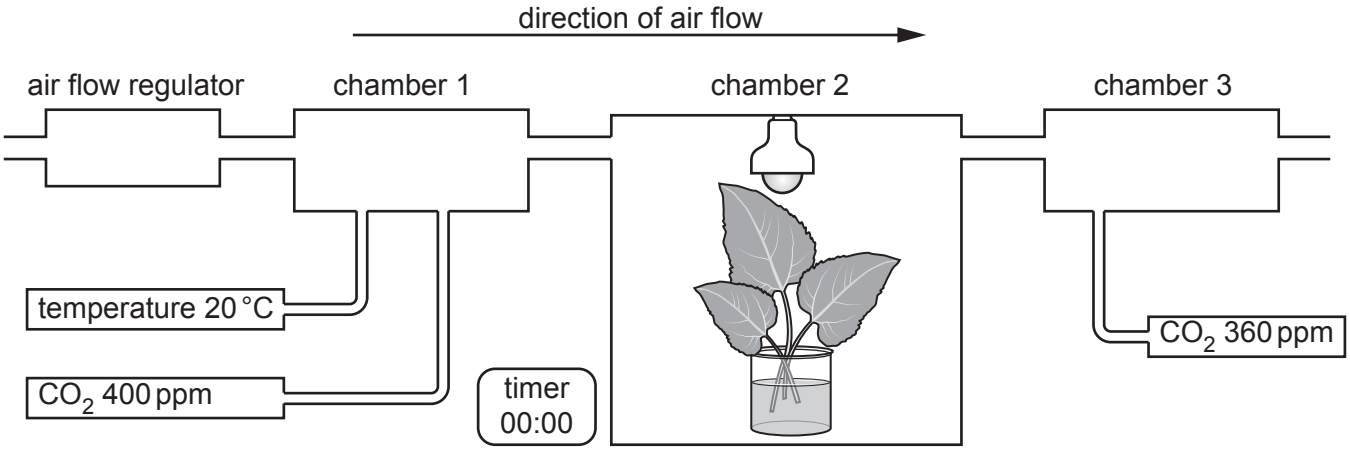

Fig. 3.1

(a) The apparatus in Fig. 3.1 maintains a constant temperature and a constant humidity.

View solution

(i) Explain why temperature has an effect on the rate of photosynthesis.

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(ii) Explain why the rate of photosynthesis will decrease if the humidity in the apparatus becomes very low.

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(iii) The apparatus was left for 15 minutes.

Explain how the scientists would use the readings for the concentration of carbon dioxide in chambers 1 and 3 to calculate the rate of photosynthesis.

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..... [2]

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(b) The scientists carried out another investigation using the same apparatus at different temperatures.

View solution

They measured the rate of uptake of carbon dioxide in the light and then they measured the rate of release of carbon dioxide in the dark.

The results are shown in Fig. 3.2.

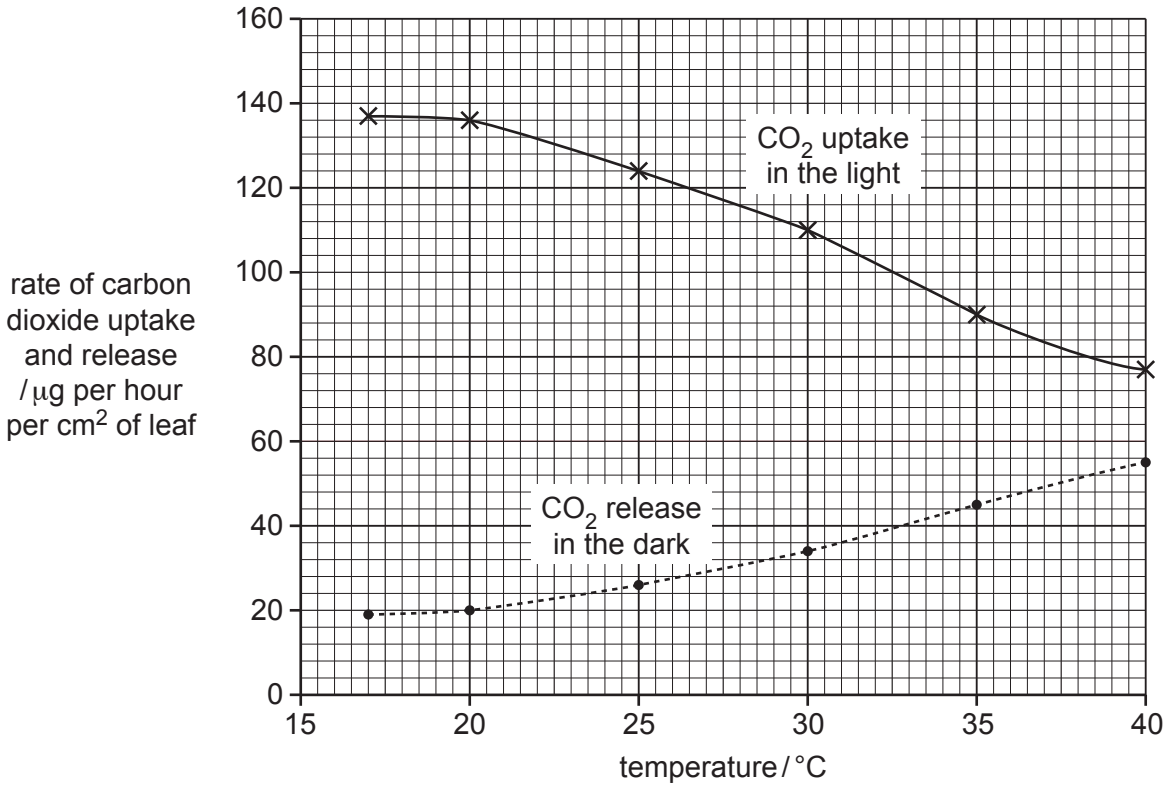

Fig. 3.2

(i) Use the information in Fig. 3.2 to complete Table 3.1.

Table 3.1

temperature / °C	rate of uptake of carbon dioxide in the light / μg per hour per cm^2 of leaf	rate of release of carbon dioxide in the dark / μg per hour per cm^2 of leaf
20		
35	90	45

[2]

(ii) The scientists determined that photosynthesis in the leaves at 35 °C used carbon dioxide at a rate of 135 μg per hour per cm^2 of leaf. Fig. 3.2 shows that the rate of carbon dioxide uptake at 35 °C was 90 μg per hour per cm^2 of leaf.

Explain why the rate at which carbon dioxide is used in photosynthesis is greater than the rate of carbon dioxide uptake.

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..... [2]

(iii) Explain why the results in Table 3.1 are expressed as 'per cm^2 of leaf' rather than 'per leaf'.

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..... [1]

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(c) Some crops are grown in controlled environments. Glasshouses are an example of a controlled environment. Fig. 3.3 shows a glasshouse where lettuces are growing.

View solution



Fig. 3.3

Discuss the advantages of growing crops in glasshouses.

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..... [6]

[Total: 20]

4 There are three species of rhinoceros in Asia. Fig. 4.1 shows an Indian rhinoceros, *Rhinoceros unicornis*, in a national park being observed by tourists who are riding on an elephant.



Fig. 4.1

The International Union for Conservation of Nature (IUCN) collects data on animal species and places them into categories based on estimated numbers.

Table 4.1 summarises the conservation status of the three species of rhinoceros, as available in 2020.

Table 4.1

species	location	approximate number in the wild	approximate number in captivity	IUCN category
Indian rhinoceros *Rhinoceros unicornis*	national parks in south Nepal and north India	3588	160	vulnerable
Javan rhinoceros *Rhinoceros sondaicus*	one national park in Java, Indonesia	72	0	critically endangered
Sumatran rhinoceros *Dicerorhinus sumatrensis*	national parks in Sumatra and Borneo in Indonesia	<80	7	critically endangered

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(a) Outline the reasons why large mammals, such as some species of rhinoceros, are endangered.

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..... [5]

(b) In 2013, Cincinnati Zoo in the USA announced that they were hoping to breed together rhinoceros that were brother and sister as part of their captive breeding programme.

View solution

(i) Discuss the problems that using such closely related animals might have for the conservation of rhinoceros.

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(ii) Captive breeding programmes often use artificial insemination.

View solution

Outline the process of artificial insemination.

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[Total: 10]

5 **(a)** Table 5.1 shows four functions of the human gas exchange system.

View solution

Complete Table 5.1 by identifying the part of the human gas exchange system that carries out each function.

Table 5.1

function	part of the human gas exchange system
contracts to decrease air pressure in the lungs	
allows air to flow between the larynx and the lungs	
contracts to lower the ribs in forced expiration	
site of gas exchange	

[4]

(b) Scientists investigated the effect of increasing carbon dioxide concentration in the air on the rate and depth of breathing. The people who took part in the investigation were healthy volunteers.

View solution

The people breathed atmospheric air containing 0.04% carbon dioxide for five minutes. They then breathed air containing 2% carbon dioxide for five minutes and then returned to breathing atmospheric air for a further five minutes.

The results are shown in Fig. 5.1.

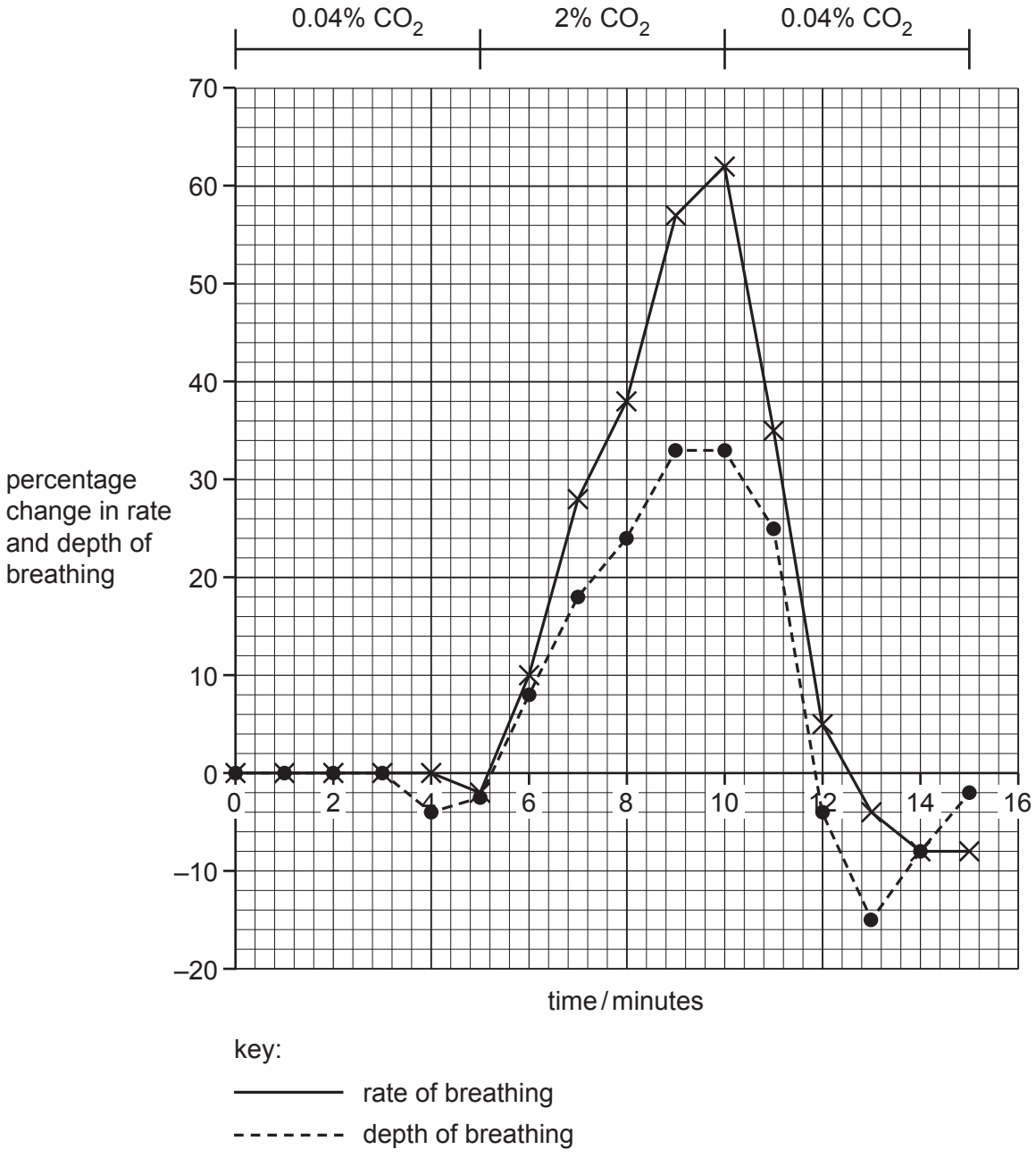

Fig. 5.1

Describe the effects of changing the carbon dioxide concentration of the air on the rate and depth of breathing, as shown in Fig. 5.1.

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(c) Complete the sentences by writing the appropriate word or phrase in the spaces provided.



During physical activity the carbon dioxide concentration in the blood increases. The reason for this is an increase in the rate of ..... that occurs in the ..... in muscle cells.

The increase in the concentration of carbon dioxide in the blood is detected by the ..... , which increases the rate and depth of breathing so that carbon dioxide can be ..... from the body. This is important because carbon dioxide is a ..... substance and can cause harm if it accumulates. [5]

[Total: 13]

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6 There are four blood groups in the ABO system in humans: A, B, AB and O.

The gene that determines blood group has three alleles: I^A, I^B and I^o.

View solution

(a) Parents with the genotypes I^AI^o and I^BI^o are planning to have more children.

Complete the genetic diagram to determine the probability that the next child will have blood group O.

parental blood groups A B

parental genotypes I^AI^o I^BI^o

Punnett square

phenotypes of the children .....

probability that the child will have blood group O .....

[4]

View solution

(b) Explain why the ABO blood group system is an example of co-dominance.

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(c) Fig. 6.1 shows the percentages of the global population with the four different blood groups in the ABO system.

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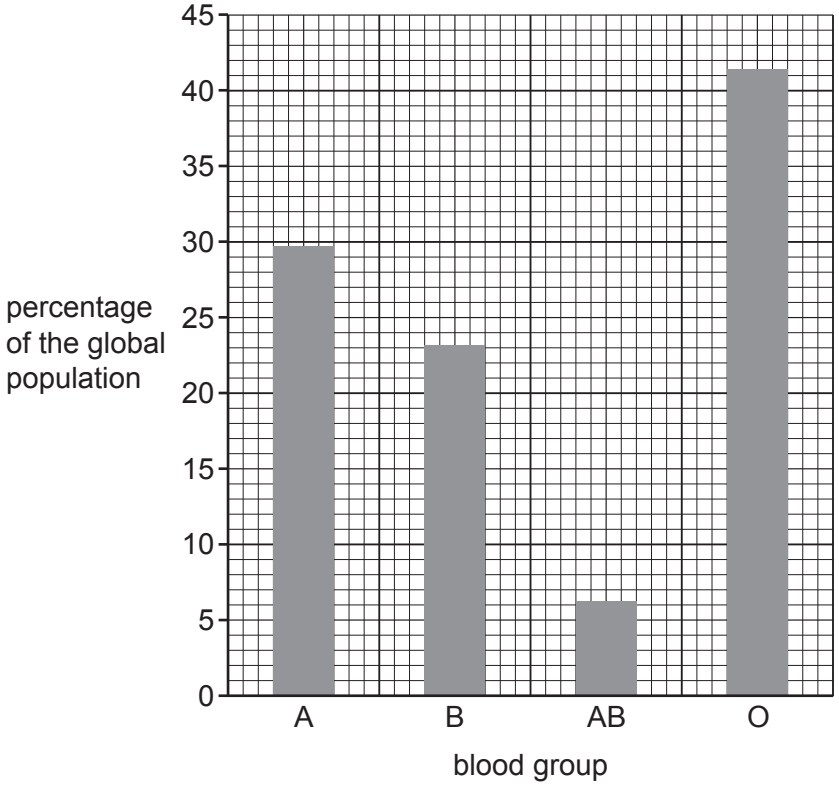

Fig. 6.1

With reference to Fig. 6.1, explain why the ABO blood group system is an example of discontinuous variation.

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[Total: 8]

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