AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

A-level BIOLOGY

Unit 4 Populations and environment

Thursday 16 June 2016 Afternoon Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a ruler with millimetre measurements
- a calculator.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- You may ask for extra paper. Extra paper must be secured to this booklet.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The maximum mark for this paper is 75.
- The marks for questions are shown in brackets.
- You are expected to use a calculator, where appropriate.
- Quality of Written Communication will be assessed in all answers.
- You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use scientific terminology accurately.

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Answer **all** questions in the spaces provided.

1 (a) What term is used to describe populations of different species living in the same habitat?

[1 mark]

1 (b) Different species occupy different ecological niches.

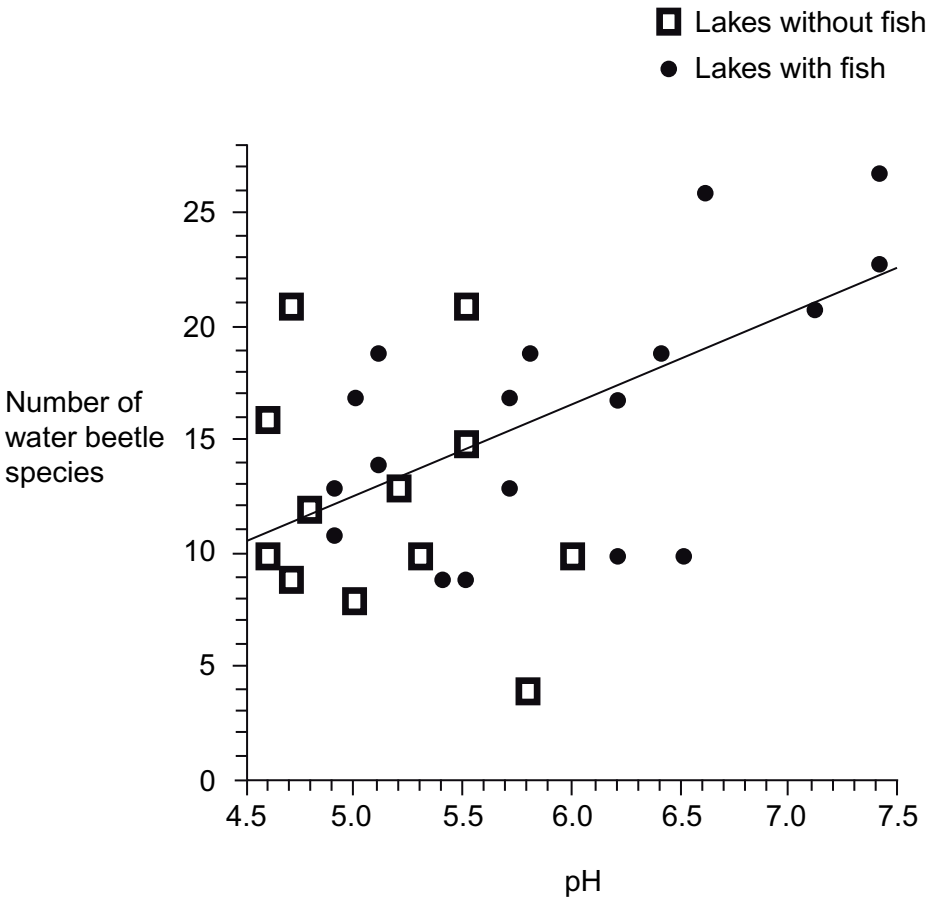
Explain the advantage of species occupying different niches.

[1 mark]

Scientists recorded the number of water beetle species in 30 lakes. In each lake, they measured the pH of the water and recorded whether there were any fish present.

Figure 1 shows their results.

Figure 1



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1 (c) A student concluded that a decrease in acidity caused an increase in the number of water beetle species.

Evaluate this conclusion.

[3 marks]

1 (d) Explain how the presence of fish in a lake could cause an increase in the number of water beetle species.

[1 mark]

6

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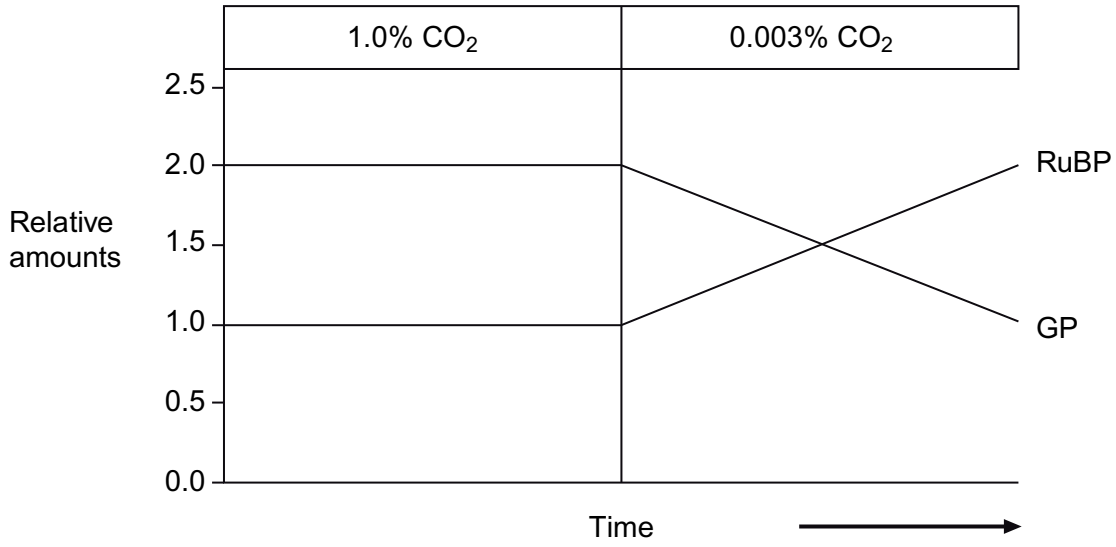
2 (a) Where precisely in a cell does the Calvin cycle take place?

[1 mark]

2 (b) A scientist investigated the effect of changing the carbon dioxide concentration on the amounts of glycerate-3-phosphate (GP) and ribulose bisphosphate (RuBP) in photosynthesising cells.

Figure 2 shows the results obtained when the carbon dioxide concentration was reduced.

Figure 2



2 (b) (i) Explain the decrease in the amount of GP after the carbon dioxide concentration was reduced.

[1 mark]

Do not write outside the box

2 (b) (ii) The scientist carried out a similar experiment but increased the carbon dioxide concentration from 1% to 2%. The relative amounts of GP and RuBP remained the same.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

2 (c) Some bacteria use hydrogen sulfide, H_2S, to produce organic compounds. The hydrogen sulfide has a similar role to that of water in photosynthesis.

A simple equation for this process in bacteria is shown below:

hydrogen sulfide + carbon dioxide $\longrightarrow$ glucose + sulfur + water

Suggest what the hydrogen sulfide is used for in these bacteria.

[2 marks]

_____

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6

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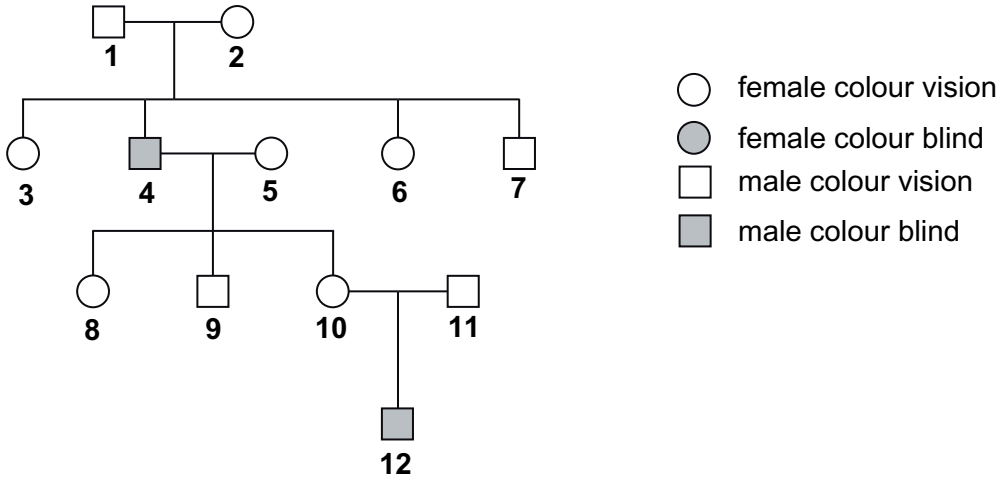
3 (a) Explain what is meant by the term phenotype.

[2 marks]

3 (b) One type of colour blindness is controlled by a gene carried on the X chromosome. The allele for this type of colour blindness, **b**, is recessive to the allele for colour vision, **B**.

Figure 3 shows the phenotypes in a family tree for this sex-linked condition.

Figure 3



3 (b) (i) Explain **one** piece of evidence from **Figure 3** which shows that colour blindness is recessive.

[2 marks]

Do not write outside the box

3 (b) (ii) Give the genotype of individual **8**.

[1 mark]

_____

3 (c) (i) The allele for tongue-rolling, **T**, is dominant to the allele for non-tongue rolling, **t**.

The gene controlling tongue-rolling is **not** sex-linked. Individuals **10** and **11** are both heterozygous for tongue-rolling.

What is the probability that individuals **10** and **11** will produce a male child who is colour blind and a non-tongue roller?

[2 marks]

Answer = _____

3 (c) (ii) In a population, the frequency of the allele for tongue-rolling, **T**, is 0.4.

Use the Hardy-Weinberg equation to calculate the percentage of people in this population that are heterozygous for tongue-rolling.

[2 marks]

Answer = _____ %

9

Turn over for the next question

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4 There are nine subspecies of giraffe. These subspecies evolved when populations of giraffe were separated for long time periods. Each subspecies has distinct coloured skin markings. Some biologists have suggested that up to six of these subspecies should be classified as different species.

4 (a) Explain how different subspecies of giraffe may have evolved from a common ancestor. Use information from the passage in your answer.

[5 marks]

4 (b) Biologists compared the mitochondrial DNA of the different subspecies of giraffe. They used the results from comparing this DNA to conclude that six of the nine subspecies are separate species.

Suggest how they came to this conclusion.

[2 marks]

7

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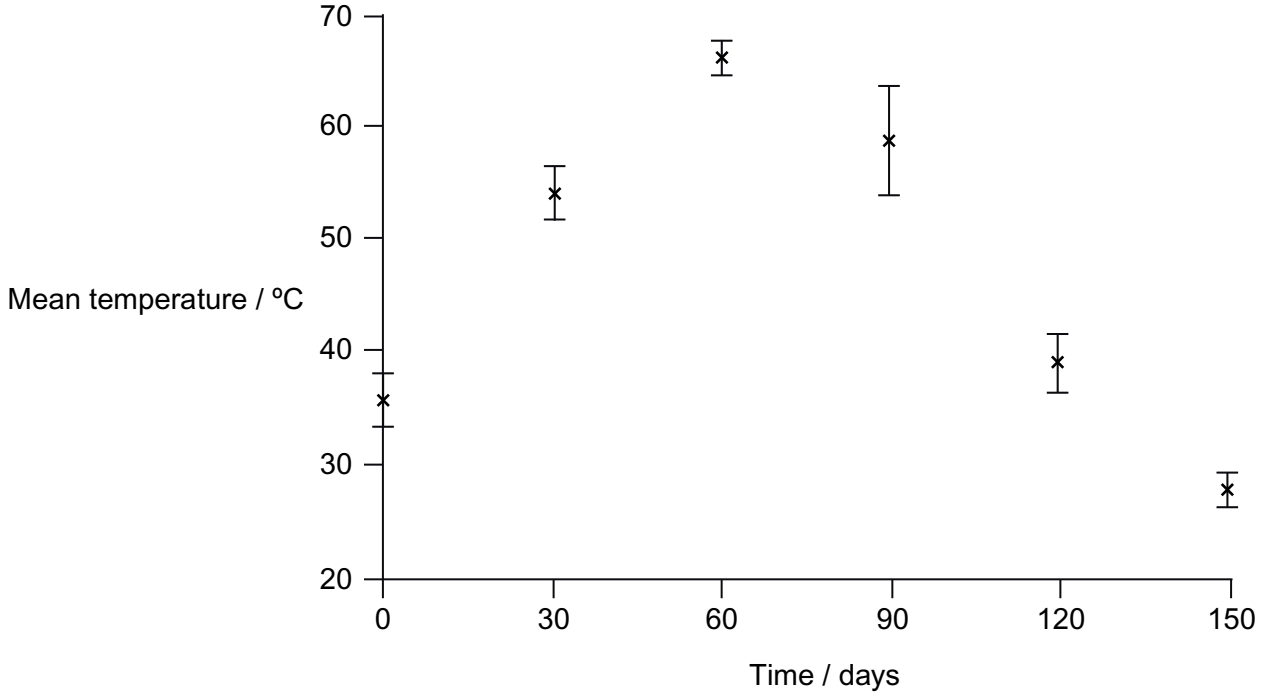
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5 The organic material in household waste can be used to make compost for use as a fertiliser. Scientists investigated changes during one process used to make this compost. The method involved placing the waste in large containers for 150 days. At regular intervals the containers were rotated. The scientists measured the temperature of samples of waste during the investigation.

Figure 4 shows the results they obtained. The vertical bars show standard deviations.

Figure 4



5 (a) Explain how microorganisms contributed to the increase in temperature during processing of organic waste.

[2 marks]

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5 (b) Explain the advantage of showing the data using standard deviations rather than ranges.

[2 marks]

5 (c) Suggest **two** advantages of rotating the containers during the process.

[2 marks]

1

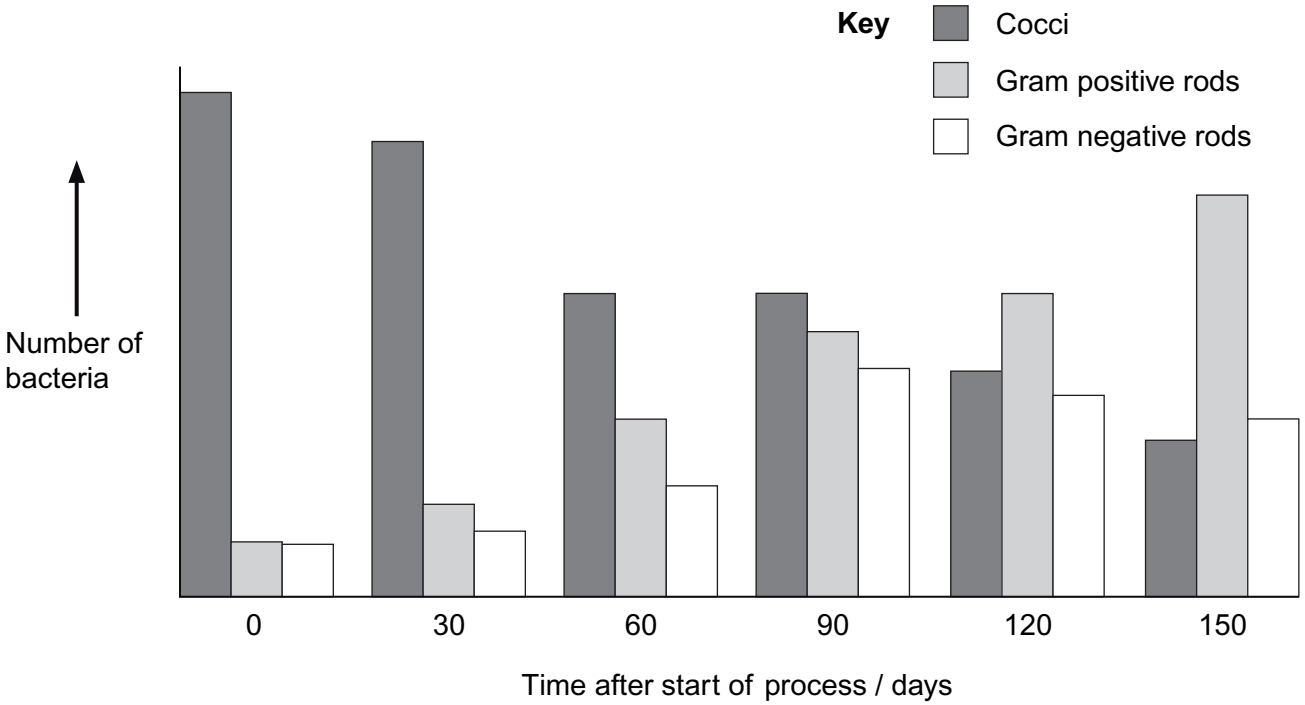
2

Question 5 continues on the next page

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5 (d) The scientists took a sample of the waste at the start of the process. They then took samples every 30 days. In each sample, they determined the numbers of particular types of bacteria.
Figure 5 shows the changes in the number of three types of bacteria during the process.

Figure 5



The scientists concluded that the results in **Figure 4** and **Figure 5** are evidence for a form of succession during the process.

Use the information to suggest how they reached this conclusion.

[3 marks]

9

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6 Some plant seeds can respire aerobically and anaerobically. A summary of the process of anaerobic respiration is shown below.

glucose $\xrightarrow{\textbf{stage 1}}$ pyruvate $\xrightarrow{\textbf{stage 2}}$ ethanol and carbon dioxide

6 (a) (i) Where in a cell does **stage 1** occur?

[1 mark]

6 (a) (ii) Explain how **stage 2** enables **stage 1** to continue.

[2 marks]

6 (b) The Respiratory Quotient (RQ) can provide information on the type of respiration taking place in an organism. The following equation is used to calculate the RQ.

$$\text{RQ} = \frac{\text{volume of carbon dioxide produced during respiration}}{\text{volume of oxygen used during respiration}}$$

6 (b) (i) What would be the RQ for aerobic respiration of glucose?

[1 mark]

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6 (b) (ii) A student calculated that the RQ of germinating seeds was 1.8.

Use the information provided to explain this result.

[2 marks]

6 (c) Aerobic respiration produces more ATP per molecule of glucose than anaerobic respiration.

Explain why.

[2 marks]

8

Turn over for the next question

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7 Algae are photosynthesising organisms. Some grow on rocky shores. Scientists investigated the abundance of different species of algae at two sites, **A** and **B**, on a rocky shore. Site **A** was on the upper shore and site **B** was on the lower shore. **Figure 6** shows the location of sites **A** and **B** on the rocky shore.

Table 1 shows some of the results the scientists obtained.

Figure 6

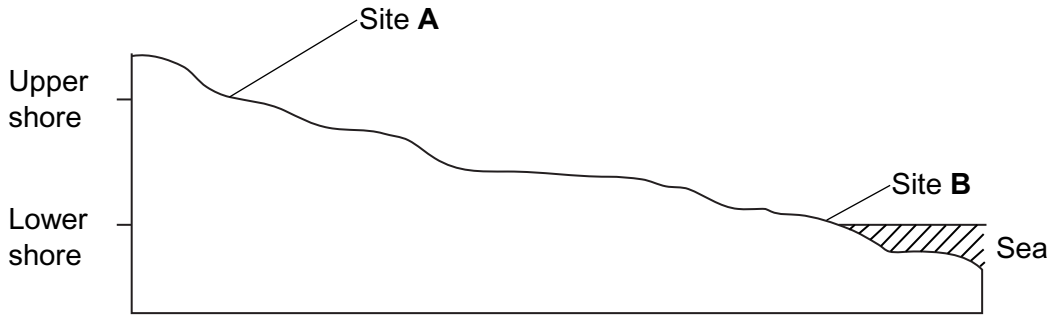


Table 1

	Site A Upper shore	**Site B Lower shore**
Species of algae with percentage cover more than 1%	*Gigartina leptorhynchos* *Gigartina canaliculata* *Gelidium coulteri* *Rhodoglossum affine*	*Gigartina spinosa* *Rhodoglossum affine* *Laurencia pacifica* *Gastroclonium coulteri* *Centroceros clavulatum* *Gigartina canaliculata* *Corallina vancouveriensis*

7 (a) The scientists recorded data from 40 large rocks at each site.

Describe **one** method that the scientists could have used to ensure that the large rocks were chosen without bias.

[2 marks]

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7 (b) The scientists used percentage cover rather than frequency to record the abundance of algae present.

Suggest why.

[1 mark]

_____

_____

7 (c) Apart from availability of water, describe and explain how **two** abiotic factors may have caused differences in the species of algae growing at sites **A** and **B**.

[2 marks]

Factor 1 _____

Explanation _____

_____

Factor 2 _____

Explanation _____

_____

7 (d) Use the information provided in **Table 1** to explain why the diversity of consumers will be greater at site **B**.

[2 marks]

_____

_____

_____

_____

Question 7 continues on the next page

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7 (e) The scientists also investigated the algae eaten by two consumers found on the rocky shore, the sea slug and the shore crab. The scientists carried out their investigation in a laboratory.

- They put each consumer into a separate tank through which aerated seawater flowed slowly.
- Each tank contained 5 grams of one species of alga.
- After 50 hours, they measured the mass of the alga remaining in each tank.
- They repeated this procedure several times using a different sea slug and a different shore crab each time.

The scientists then calculated the mean mass of each species of alga eaten by the consumers. They used a statistical test to determine the P value.

Table 2 shows some of the results they obtained.

Table 2

Species of alga	Mean mass eaten / g		P value
	Sea slug	Shore crab	
Laurencia pacifica	4.42	0.22	<0.01
Egregia leavigata	0.12	0.08	>0.05
Microcystis pyrifera	0.19	0.14	>0.05
Cystoseira osmondacea	0.17	0.04	<0.05

7 (e) (i) The consumers were starved for 5 days before the investigation.

Explain why.

[2 marks]

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7 (e) (ii) The data in **Table 2** for the mean mass of alga eaten were adjusted for loss of mass by the alga due to respiration.

Suggest how the scientists were able to determine the loss of mass due to respiration of a sample of alga.

[3 marks]

7 (e) (iii) Suggest what conclusions the scientists could have made from this investigation when using the probability values in **Table 2**.

[3 marks]

15

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8 (a) Crops use light energy to produce photosynthetic products.

Describe how crop plants use light energy during the light-dependent reaction.

[5 marks]

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8 (b) Describe the advantages and disadvantages of using chemical pesticides to control pests of crops.

[5 marks]

Extra space

Question 8 continues on the next page

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8 (c) After harvesting, the remains of crop plants are often ploughed into the soil.

Explain how microorganisms in the soil produce a source of nitrates from these remains.

[5 marks]

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END OF QUESTIONS

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