

Surname	Centre Number	Candidate Number
Other Names		0



GCSE

4461/02



W16-4461-02

SCIENCE A/BIOLOGY

**BIOLOGY 1
HIGHER TIER**

A.M. THURSDAY, 7 January 2016

1 hour

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	6	
2.	7	
3.	5	
4.	6	
5.	6	
6.	7	
7.	5	
8.	6	
9.	6	
10.	6	
Total	60	

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication (QWC) used in your answer to questions **4** and **10**.

Answer **all** questions.

1. Phenylketonuria (PKU) is an inherited disease caused by a recessive allele. PKU results in damage to the nervous system in the early years of life.

Key – **N** represents the allele for **not** having PKU

n represents the allele for having PKU

A couple, neither of whom suffer from PKU, have a child who is found to have PKU.

- (a) (i) State the genotype of: [1]

I. the mother

II. the father

- (ii) Complete the Punnett square below to show the possible genotypes of the children produced by this couple. [2]

Gametes		

- (iii) Place a circle in the Punnett square around the genotype of a child suffering from PKU. [1]
- (iv) From your Punnett square, what is the probability of a child **not** having PKU? [1]

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(b) At birth a sample of blood is taken from babies to check for PKU.



Suggest why the screening of newborn babies for genetic conditions like PKU is important. [1]

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2. Vitamin A deficiency occurs when humans do not obtain enough of this vitamin from their food. It is very common in developing countries. It can result in blindness and between 250 000 and 500 000 children in these countries go blind each year from vitamin A deficiency. Approximately half of these children die within one year of becoming blind.

Golden Rice is a genetically modified (GM) crop plant which contains high levels of vitamin A. It was developed to help prevent vitamin A deficiency and has been grown in field trials in the Philippines, Taiwan and other countries.



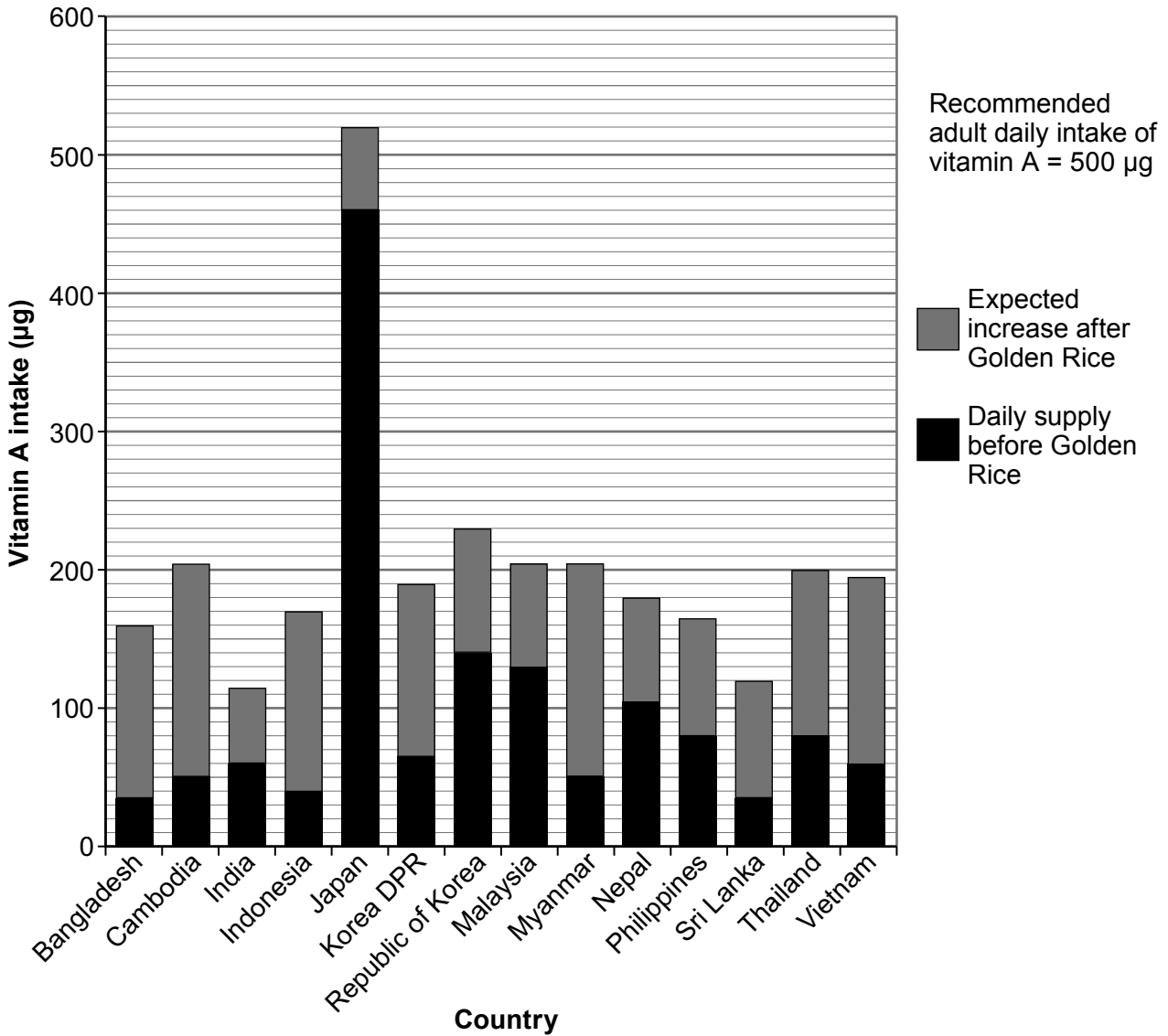
- (a) State the meaning of the term genetically modified (GM).

[1]

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(b) The graph below shows the mass of additional vitamin A which could be obtained each day if the countries indicated were to replace the rice varieties they grow with Golden Rice.



(i) In which of the countries in the graph would the people have sufficient vitamin A each day if they grew Golden Rice? [1]

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(ii) In how many of the countries shown could the people increase the intake of vitamin A per day by 50% or more, if they grew Golden Rice? [1]

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- (iii) Since the data for the graph were obtained, a new variety of golden rice, Golden Rice 2, has been developed. The table below shows the potential benefits of Golden Rice 2 in Bangladesh.

	Adults	Children under 7 years of age
Recommended daily intake of vitamin A (μg)	500	450
Vitamin A provided by Golden Rice 2 (μg)	775	338
Vitamin A provided by other food eaten (μg)	245	112

Explain the effect of a diet containing Golden Rice 2 on the number of cases of blindness caused by vitamin A deficiency in Bangladesh. [2]

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- (c) In August 2013 a crop of Golden Rice that was being grown in a field trial was destroyed by protesters in the Philippines. The protesters said they had many concerns about the growth of GM crops.

Suggest what **two** of these concerns might have been. [2]

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3. (a) (i) What is meant by the term indicator species? [1]

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(ii) Name **one** factor of water quality which can be assessed by using indicator species. [1]

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(b) Lichens can be used as indicators of air quality and are often found covering the bark of trees. The amount of tree bark covered with lichen is known as the percentage cover. In the photograph below the lichen is covering about 40% of the bark i.e. the percentage cover is 40%.

Lichen on the bark of a tree



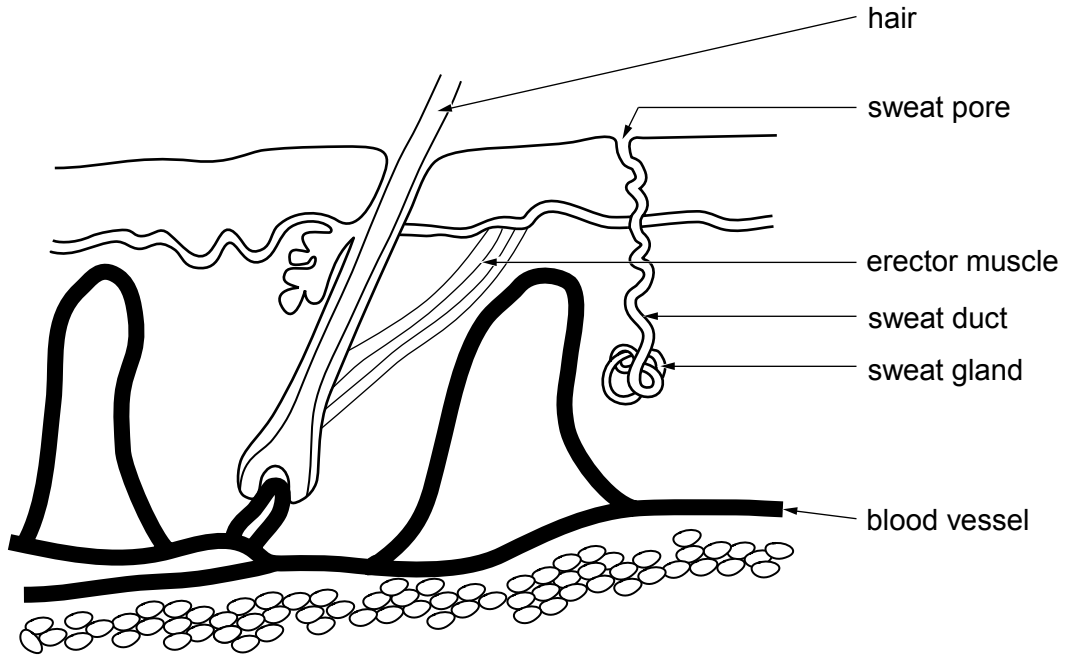
The table below shows the pH of the bark of ash trees and the percentage (%) cover of a lichen which is very sensitive to air quality. The data were collected along a 19 mile line, starting from the centre of a large industrial city.

Distance from city centre (miles)	0	1.0	1.7	3.0	4.7	6.0	6.5	7.0	8.0	9.0	9.5	10.5	12.5	14.5	16.5	19.0
pH	3.2	3.4	3.4	3.5	3.4	3.6	3.6	3.7	3.6	3.9	4.4	4.4	4.3	4.3	4.5	4.5
% cover of lichen	0	0	0	0	0	0	0	0	1	12	23	25	54	57	66	66

Describe and explain the change in the percentage (%) cover of lichen as you move out of the city centre. [3]

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4. Explain how human skin helps to control body temperature in hot conditions. Use the features labelled on the diagram below to help with your answer. [6 QWC]



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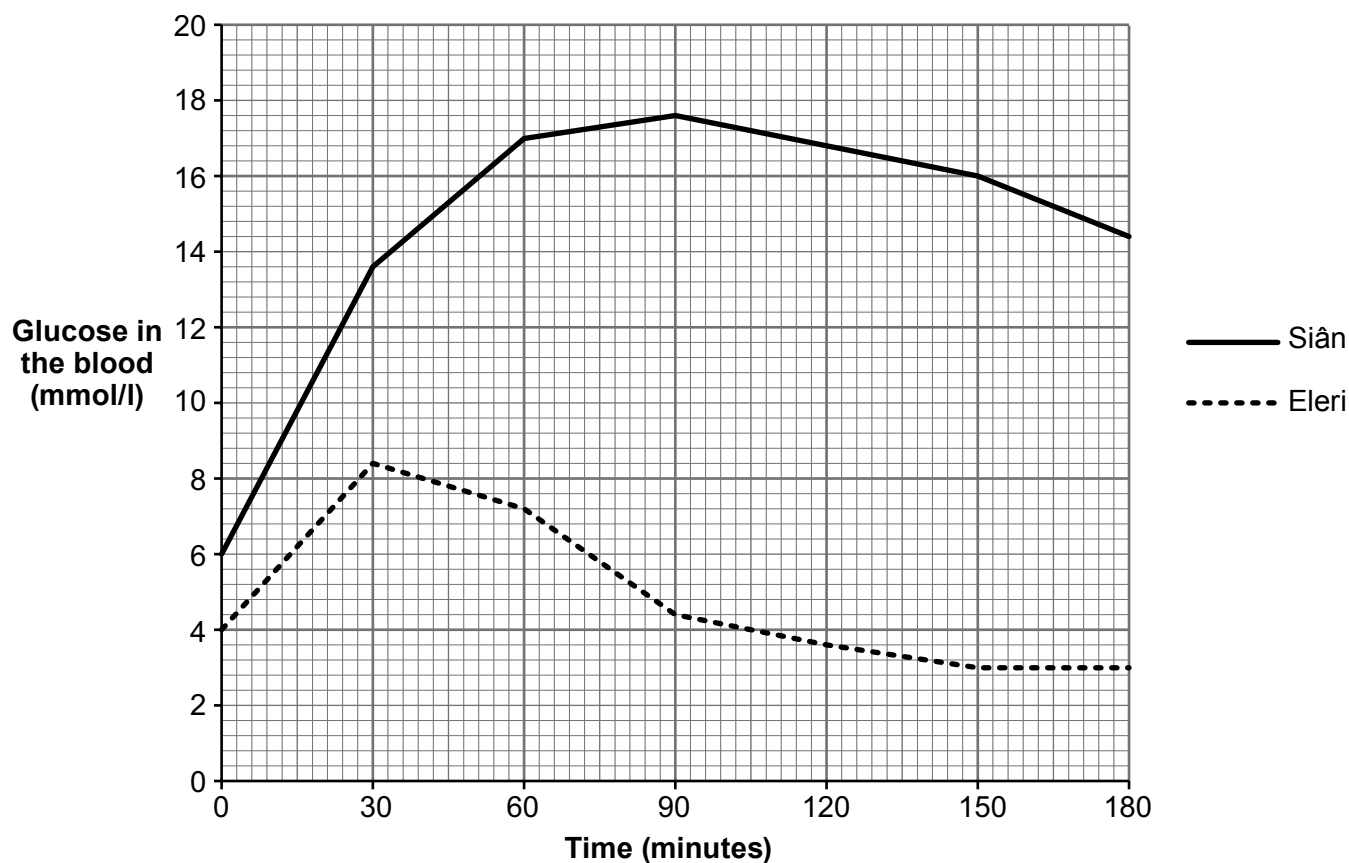
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5. Eleri and Siân ate identical meals. After the meal the concentration of glucose in their blood was measured at regular intervals over the next 180 minutes. The graph below shows the results obtained.



- (a) The meal both Eleri and Siân ate contained no added glucose or other sugars. Suggest which type of food in the meal could have caused the increase in blood sugar. [1]

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- (b) It is important that the concentration of glucose in the blood remains between 3.5 and 7.5 mmol/l. Explain how the level of glucose in Eleri's blood is reduced after 30 minutes. [2]

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(c) What evidence, shown in the graph, suggests that Siân is suffering from diabetes? [1]

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(d) A student tested an artificial urine sample for the presence of glucose.

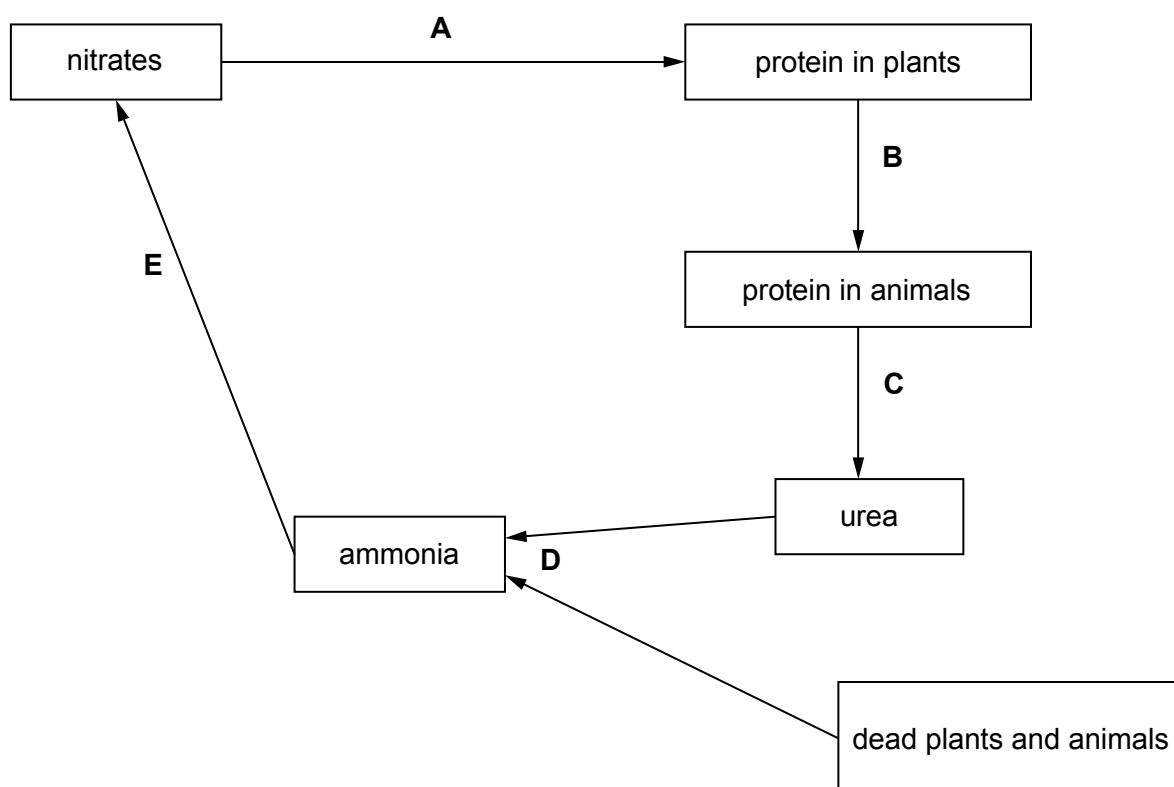
In the table below **circle**

- **one** correct **chemical test** for glucose.
- the correct **process** for that test.

Complete the third column to show a positive result for the artificial urine test you have chosen. [2]

chemical test	process	colour of positive result for glucose
Biuret test	dip in urine sample	
Benedict's test	mix with urine sample and heat gently	
Iodine test	mix with urine sample and cool in refrigerator	
Diastix / Clinistix	mix with urine sample and heat strongly	

6. (a) The diagram below shows some stages of the nitrogen cycle.



Use the diagram to match the correct letter with the name of the process given in the table below. [2]

process	letter
absorption by plants	
decay by decomposers	
feeding	
excretion	

- (b) During the severe flooding in North Wales in November 2012, raw sewage was washed into a lake. The concentration of nitrate in this lake was measured before and after the flooding. The table below shows the results.

time	concentration of nitrate (mg/l)
October 2012	0.4
November 2012	1.0
January 2013	2.2
May 2013	63.0

Use the data in the table above, the diagram of the nitrogen cycle in part (a) and your knowledge to describe and explain the change in the nitrate concentration throughout this period. [5]

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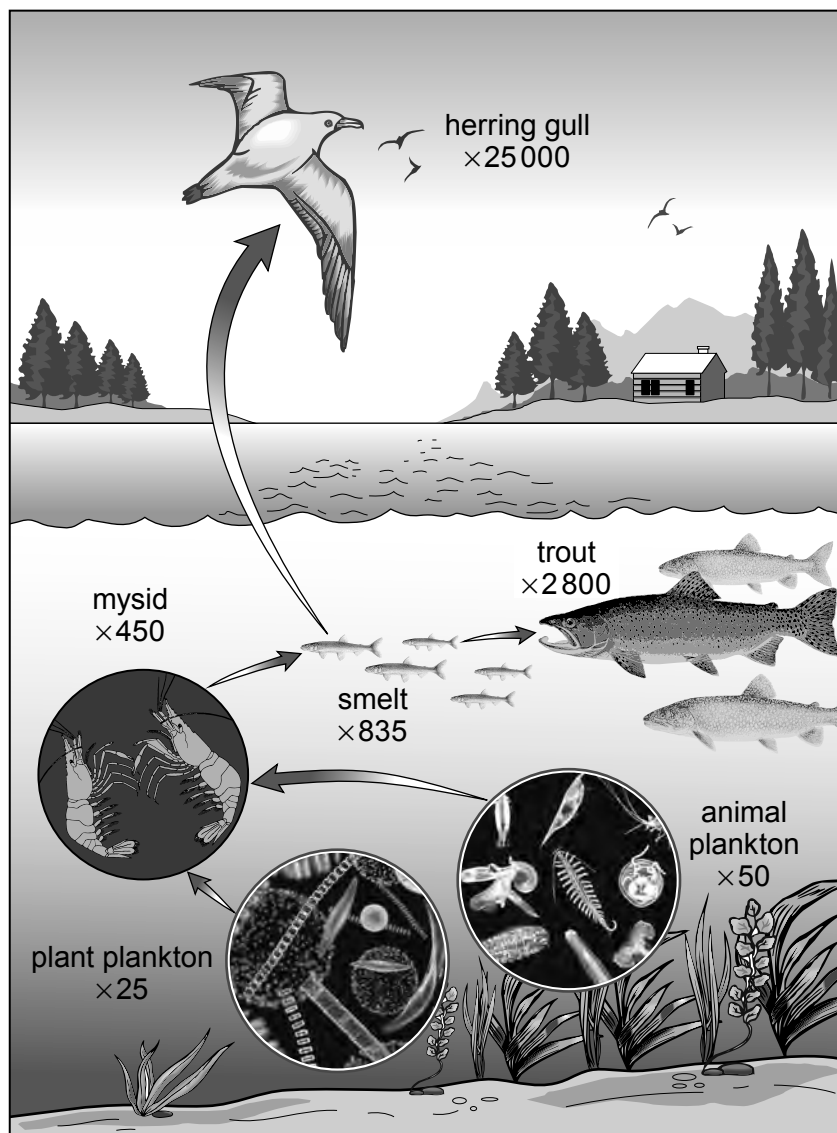
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7. A factory producing polyvinyl chloride plastics (PVC) discharged its waste chemicals into a lake in Canada. Lead is used in the manufacture of PVCs.

The diagram below shows a food web for the lake.



The numbers represent the increase in concentration of lead through the food chains of the food web when compared to the water. For example, smelt has $\times 835$ times more lead than the water.

(a) If the concentration of lead in the water of the lake was 0.002 ppm (parts per million), calculate the concentration in the herring gull. [1]

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(b) The herring gull population in a breeding colony near the lake is decreasing. Use the food web and your knowledge to give reasons for this. [3]

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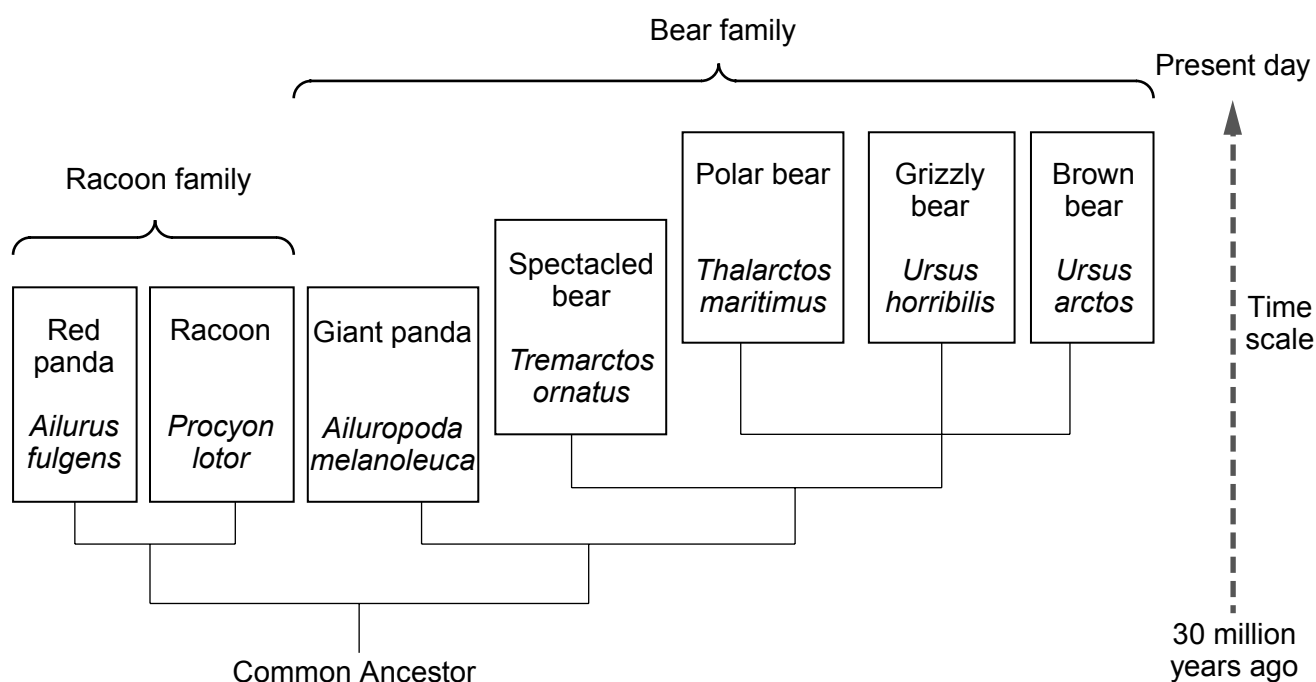
(c) In order to reduce this form of pollution, scientists have developed a type of plastic called Biopol. It is decomposed by micro-organisms when buried in the soil.

Name the gas which is produced during the decomposition of Biopol in the soil. [1]

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8. The diagram shows a suggested simplified evolutionary history for bears, racoons and pandas.



(a) Which animals in the diagram have the most recent common ancestor? [1]

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(b) (i) Name the **two** animals which you would expect to have the most similar DNA and give a reason for your choice. [2]

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(ii) Name the technique that would be used to analyse DNA samples from these animals. [1]

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(c) How does the diagram show that the red panda is more closely related to the racoon than it is to the giant panda? Give **two** reasons. [2]

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9. *Plasmodium falciparum* is a single-celled organism which causes malaria when it is in human blood.

Chloroquine is a medication which kills *Plasmodium falciparum*.

In the early 20th century a lot of chloroquine was used throughout Africa and was very successful. By the 1980s *Plasmodium falciparum* showed widespread resistance to chloroquine.

The mutation which caused resistance was originally very rare in the population.

(a) (i) Name the chemical that had become mutated. [1]

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(ii) Explain how natural selection caused the mutated *Plasmodium falciparum* to become very common in the 1980s. [4]

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(b) In the 1980s, some Health Authorities in Africa stopped using chloroquine. In 2011, a trial using chloroquine again took place in the African country of Senegal. It was then found that 70% of *Plasmodium falciparum* had been killed by chloroquine. Suggest a reason for this observation. [1]

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