



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE
NAME

CENTRE
NUMBER

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ENVIRONMENTAL MANAGEMENT

5014/21

Alternative to Coursework

October/November 2013

1 hour 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Ruler

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 a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

Study the appropriate source materials before you start to write your answers.

Credit will be given for appropriate selection and use of data in your answers and for relevant interpretation of these data. Suggestions for data sources are given in some questions.

You may use the source data to draw diagrams and graphs or to do calculations to illustrate your answers.

At the end of the examination, fasten all your work securely together.

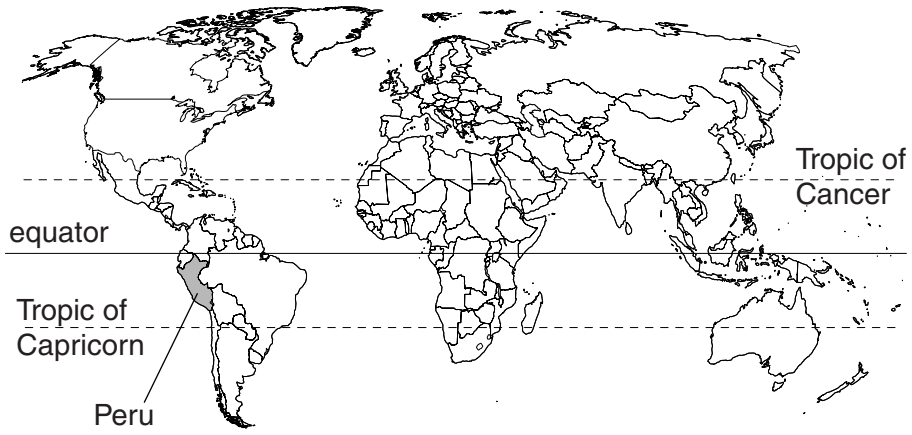
The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
1	
2	
Total	

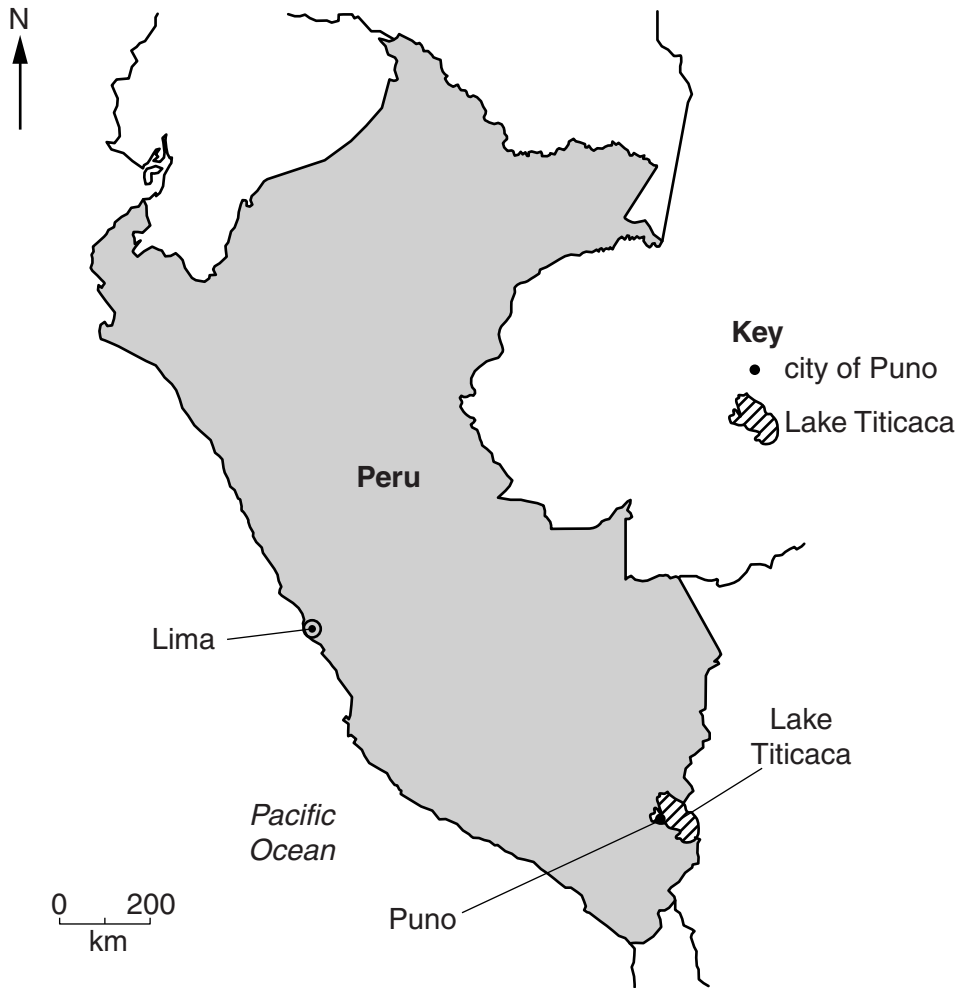
This document consists of **18** printed pages and **2** blank pages.



world map



map of Peru



Area of Peru: 1 285 216 sq km

Population: 30 million

Children per woman: 2.6

Life expectancy: 74 years

Currency: soles (2.9 = 1US\$)

Language: Spanish, indigenous languages

Climate: driest in the west, cold mountains in the centre, equatorial in the east

Terrain: western coastal plain, high Andes mountains in the centre, eastern lowlands in the Amazon Basin

Main exports: minerals, such as copper, gold, zinc and many others, fishmeal and agricultural produce.

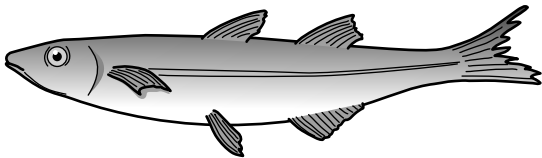
Peru is a developing country with large mineral resources in the Andes mountains. The coastal waters are excellent fishing grounds. Economic growth has resumed after the world recession and levels of poverty have been reduced in recent years. Peru has developed many trade links with other countries.

1 (a) What are the advantages for Peru of improved trade links with other countries?

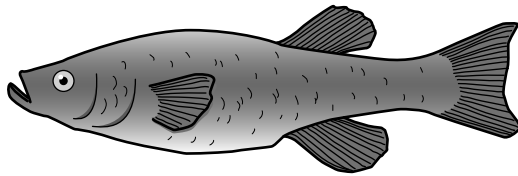
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..... [2]

(b) Lake Titicaca is a large lake at 3800m above sea level. Many indigenous communities farm the surrounding land; other communities fish in the lake or carry out informal mining along the rivers that flow into the lake.

The lake has provided a supply of fish to local people for many years. Some fish are also sold in markets in local towns. To increase the fish catch a new species called 'pejerrey' was introduced. They are now caught in large numbers. However, a native fish species called 'carache' is now rarely caught, although it was common in the past.



pejerrey fish



carache fish

(i) Suggest how the introduction of new species like pejerrey could alter the natural lake ecosystem.

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

The pejerrey is now the main fish caught and sold in local markets. The carache fish is only used to make soup. Some people were worried that these fish were not safe to eat as a result of mining in the surrounding mountains. They asked a scientist to test fish muscle for mercury (a heavy metal).

The scientist used the following method:

- catch fish of both species in five different locations on the lake
- visit three fish markets and buy fish of both species
- record the length of all these fish
- remove a piece of muscle tissue of the same size from just behind the gills of each fish
- pack the muscle samples in ice and send to the laboratory

(ii) Suggest why the scientist collected fish from three markets as well as catching fish.

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

(iii) Why did the scientist pack the muscle samples in ice?

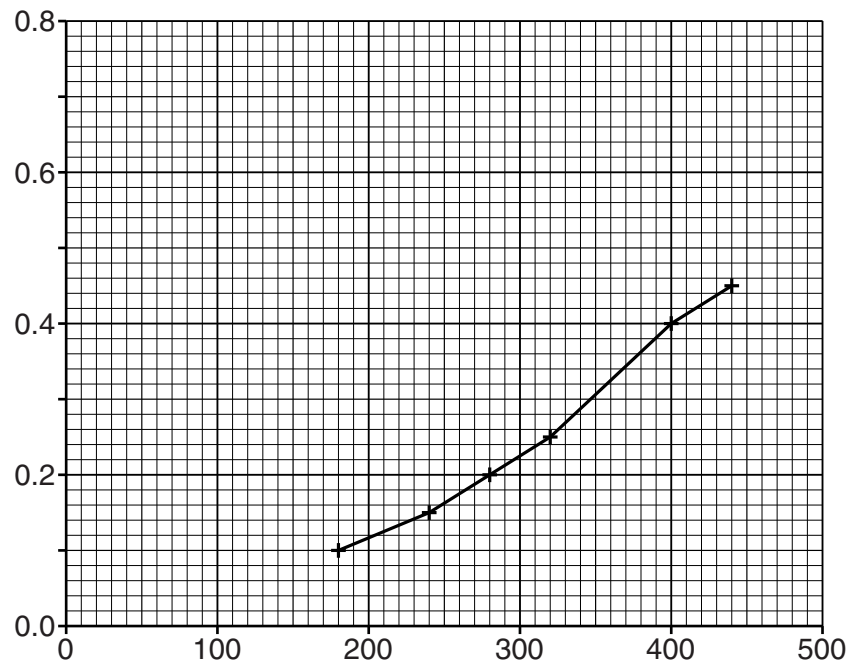
.....
..... [1]

- (iv) The average (mean) results for analysis of the fish of differing lengths are shown in the table below.

For
Examiner's
Use

pejerrey fish		carache fish	
length/mm	average mercury concentration of fish/ppm	length/mm	average mercury concentration of fish/ppm
180	0.10	100	0.10
240	0.15	120	0.20
280	0.20	140	0.35
320	0.25	160	0.50
400	0.40	180	0.70
440	0.45		

Complete the graph below by labelling the axes, plotting the results for the carache fish and completing the key.



Key

pejerrey fish

carache fish

[3]

(v) The safe limit for mercury concentration in fish that are being eaten is 0.30 ppm.

Show clearly on the graph the maximum length for each fish that can be safely eaten. Write the maximum length that can safely be eaten in the spaces below.

pejerrey fish carache fish [2]

(vi) Suggest reasons to explain the relationship between mercury concentration and fish length.

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

(c) The scientist discovered that a mining community 100km from the lake was using mercury to extract gold from a river flowing into Lake Titicaca. He took water samples at intervals down the river between the mining community and the lake. The results are shown in the table.

distance downstream from the mining community/km	mercury concentration in the river/ppm
1	580
10	92
40	10
60	2
80	1
100	1

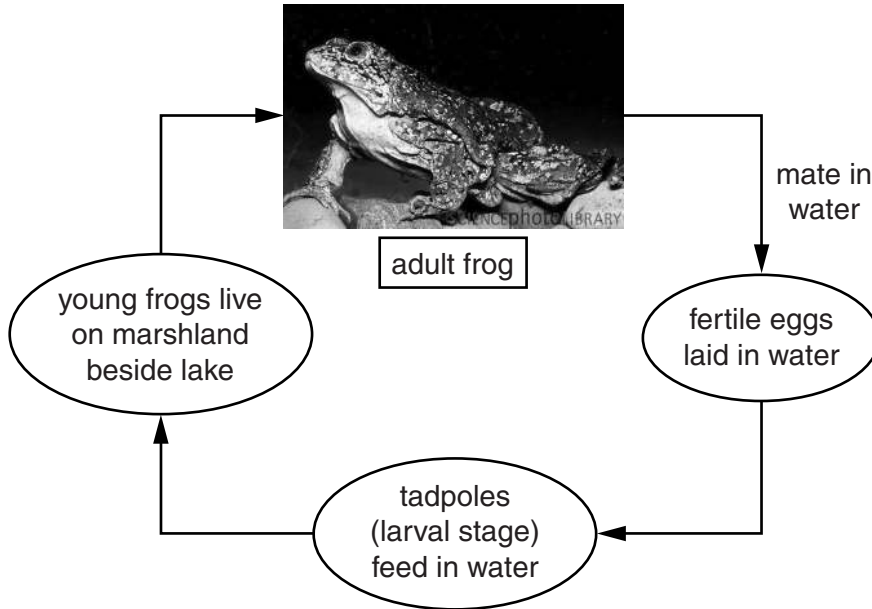
The scientist decided that this mining was not the main source of mercury entering Lake Titicaca. Explain why he came to this decision.

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

- (d) Lake Titicaca is the habitat of many endemic species (found nowhere else in the world). One of these species, the Lake Titicaca frog, is endangered and its population is in decline.

For
Examiner's
Use

life cycle of the Lake Titicaca frog



When visiting the local markets the scientist noticed that some frogs were for sale. He decided to carry out another survey of six markets to try to estimate how many frogs were being caught for sale in the area. He decided not to buy any frogs.

- (i) Why did the scientist decide not to buy any frogs?

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

- (ii) Describe how the scientist should undertake the survey to achieve his aim.

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

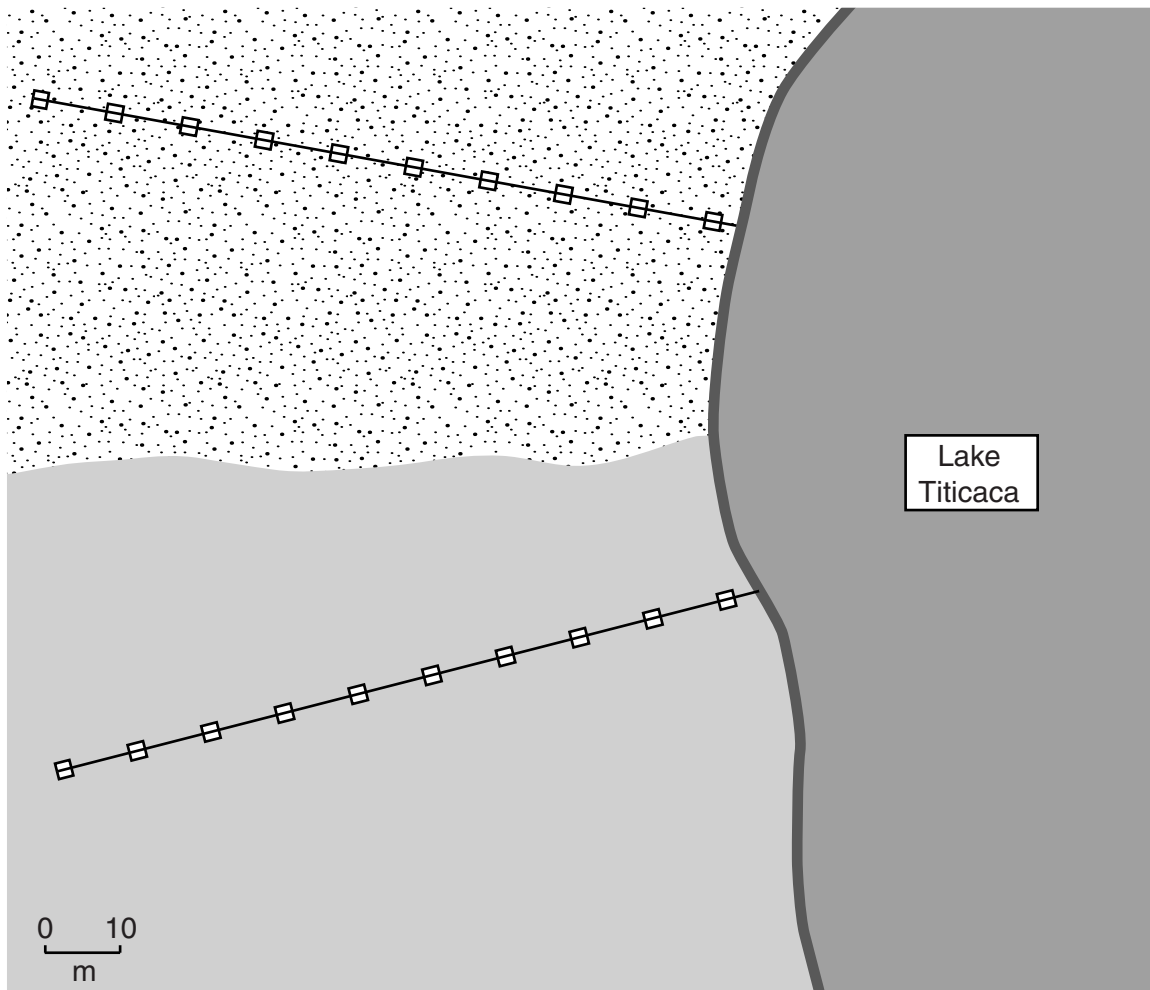
- (iii) In the space below, draw a table that could be used to record the results of the survey of six markets.

*For
Examiner's
Use*







[3]

- (e) Next, the scientist carried out a survey of the frogs' habitat, in the area shown on the map.

For
Examiner's
Use



Key

shingle		1 m x 1 m quadrat	
sandy soil		transect line	
lake water			
edge of lake			

The scientist carried out the following tasks, but not in the order given below:

- A** collect ten 1 m × 1 m square quadrats
- B** place a 40 m tape on the ground, laid out at 90° to the shoreline
- C** count all the young and adult frogs
- D** catch all the young and adult frogs in each quadrat
- E** place quadrats at 4 m intervals along the tape
- F** release the animals back into their habitat
- G** take a pH reading from the soil in each quadrat

(i) The statements **A** to **G** are not in the correct order. Arrange the statements in a suitable order in the boxes below. One has been done for you.

steps 1	2	3	4	5	6	7
.....	G

[2]

The results of the survey are shown in the table below.

soil	frog	quadrat sample										average (mean) number of frogs
		1	2	3	4	5	6	7	8	9	10	
shingle	young	4	3	4	6	5	3	3	0	5	5	3.8
shingle	adult	1	2	1	3	1	2	1	1	2	2	1.6
sandy	young	6	3	5	4	2	4	3	5	5	4
sandy	adult	4	3	1	1	2	3	1	1	3	1

(ii) Complete the table.

Space for working.

Write your answers in the spaces in the table. [1]

(iii) Which quadrat sample does not fit the general pattern of results?

..... [1]

(iv) Suggest why there are more young frogs than adults.

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

(v) The scientist studied the results carefully. What conclusions might he have come to?

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

(vi) Suggest how the scientist could carry out more research to confirm his findings.

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

(f) Some frogs were collected to breed in captivity in a local zoo.

(i) What are the advantages of breeding animals in captivity?

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

(ii) What else could be done to help conserve this endangered species for the future?

..... [1]

[Total: 36]

- 2 (a) About 120000 people live in the city of Puno. Many of them have small businesses along the edge of the lake. Less than half the city has a daily collection of waste. This means that a large amount of waste finds its way into the lake.

For
Examiner's
Use

percentage of different types of waste produced in the city

type of waste	percentage of total waste
organic matter	30
plastic bags	13
plastic bottles	6
tins	8
glass	7
pottery	4
shoes	5
iron	20
other types of waste
total	100

- (i) In the table, state the percentage of other types of waste.

Space for working.

Write your answer in the space in the table. [1]

- (ii) Select one type of waste from the survey and describe how it can be recycled.

.....

 [2]

- (iii) What are the environmental advantages of recycling some waste materials?

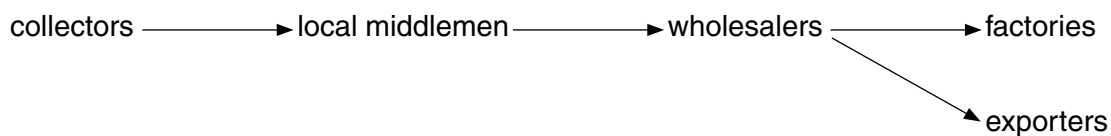
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 [2]

- (b) Some people try to make a living collecting materials from the streets and municipal waste tips to sell.

For
Examiner's
Use

flow diagram to show how selling waste is organised



waste material	price/soles per kilogram		
	local middlemen pay collectors	wholesalers pay middlemen	factories or exporters pay wholesalers
mixed paper	0.15	0.20	0.36
newspaper	0.15	0.18	0.30
cardboard	0.15	0.25	0.40
plastic	0.80	1.20	1.50
iron	0.40	0.60	1.00

- (i) Which recyclable material is least profitable for **wholesalers** to buy and sell? Explain your answer.

.....

 [2]

- (ii) Much of the iron waste and plastic waste is exported, whereas the other wastes are not.

Suggest reasons for this.

.....

 [2]

- (c) Children often help their parents sort waste materials for sale. Some containers have harmful wastes inside them. Industrial and hospital wastes may be mixed with household waste.

Look at the comments of the children.

'Sometimes I go to work with my mother on the waste site. I collect plastic bottles; we have to take plastic rings off the necks. We need a small fire to melt plastic rings off these bottles.'

'I work fulltime and do not go to school now. I collect and sort hospital waste. I dismantle syringes. Next year I hope to start work on a waste truck and be paid a wage.'

Why is the health risk high, especially for children?

.....

.....

.....

..... [2]

- (d) A student wanted to find out how much money waste collectors could make in a day. To make sure he interviewed each waste collector in the same way he completed a questionnaire for each interview.

He asked them questions and then recorded the answers on this tally sheet.

How many hours do you collect waste in one day?	1–3	4–5	6–7	8–9	10 or more
answers	I I I	I I I	I I I	I I I I I	I I
How many kilograms of plastic are collected?	4–6	7–9	10–12	13–15	
answers	I I I I I I	I I I	I I I I	I I I	
How many kilograms of cardboard are collected?	3–5	6–8	9–11	12–14	15–17
answers	I I I	I I I	I I I I I I	I I I	I

~~I I I I~~ = 5

- (i) How many waste collectors were asked the questions?

..... [1]

- (ii) The average amount of plastic collected was 8kg per collector and 11kg for cardboard.

Using this information, and the prices in the table on page 14, how much is one collector paid by the local middlemen for 8 kg of plastic and 11 kg of cardboard?

Space for working.

plastic

cardboard

[2]

(e) Many tourists already come to Puno and Lake Titicaca. The city authorities want to increase numbers further. Tourists often complain about the waste left around the city.

The city authorities estimate that only 23% of households carry out any recycling.

They proposed the following plan which included:

- buying more waste trucks
- building more waste recycling centres
- building special waste pits lined with plastic outside the city

(i) How could this plan help to make the city more attractive to tourists?

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

(ii) How could the city authorities make money from the plan?

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

(iii) How could the population of Puno benefit from the plan?

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

(iv) Some of the waste collectors do not like this plan. Suggest why.

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

Factsheet about the Puno area

- Livestock farming dominates the area around Puno
- Where crops are grown, lake water for irrigation is used
- Only 10% of households have a piped water supply
- Tourists hire boats to go sport fishing in the lake
- Some tourists stay with local families
- Tourists walk around the lake to see the birdlife

(v) Suggest a development plan that encourages tourism, but prevents further damage to the environment and does not change local people’s way of life.

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..... [5]

[Total: 24]

Copyright Acknowledgements:

© Ref: Z700 / 0608; *Titicaca frog (Telmatobius culeus)*; Dante Fenolio / Science Photo Library.

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