Cambridge O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER				

ENVIRONMENTAL MANAGEMENT **5014/22**

Paper 2 **October/November 2017**

1 hour 30 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, 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.

This document consists of **13** printed pages and **3** blank pages.

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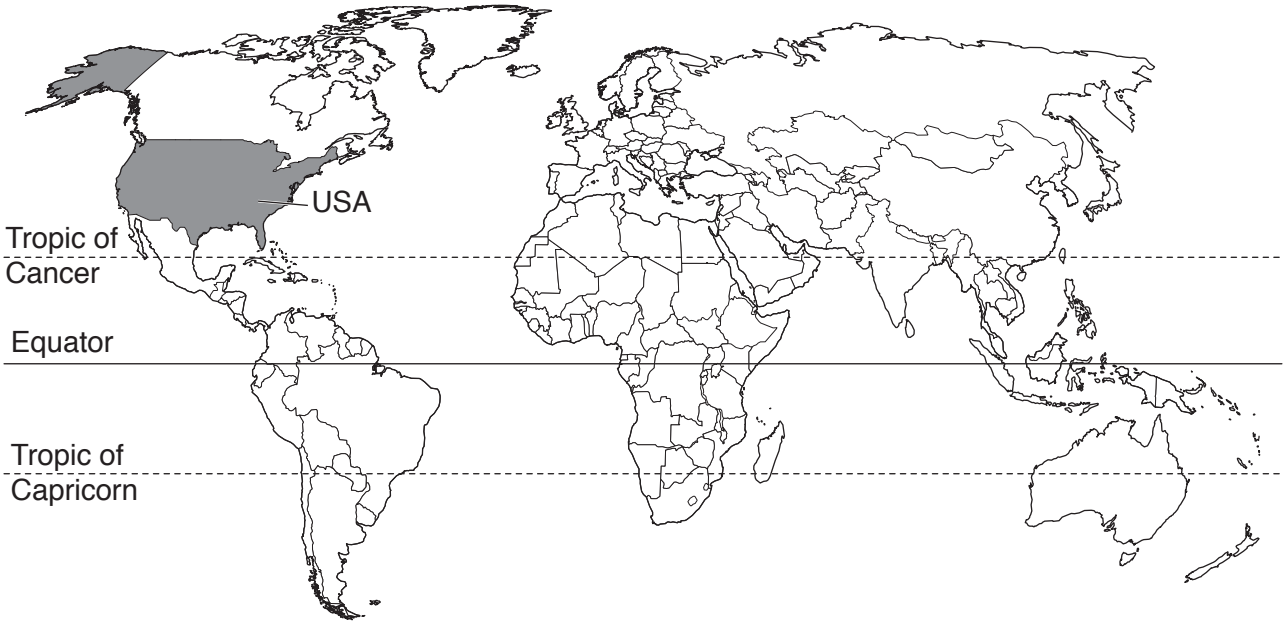
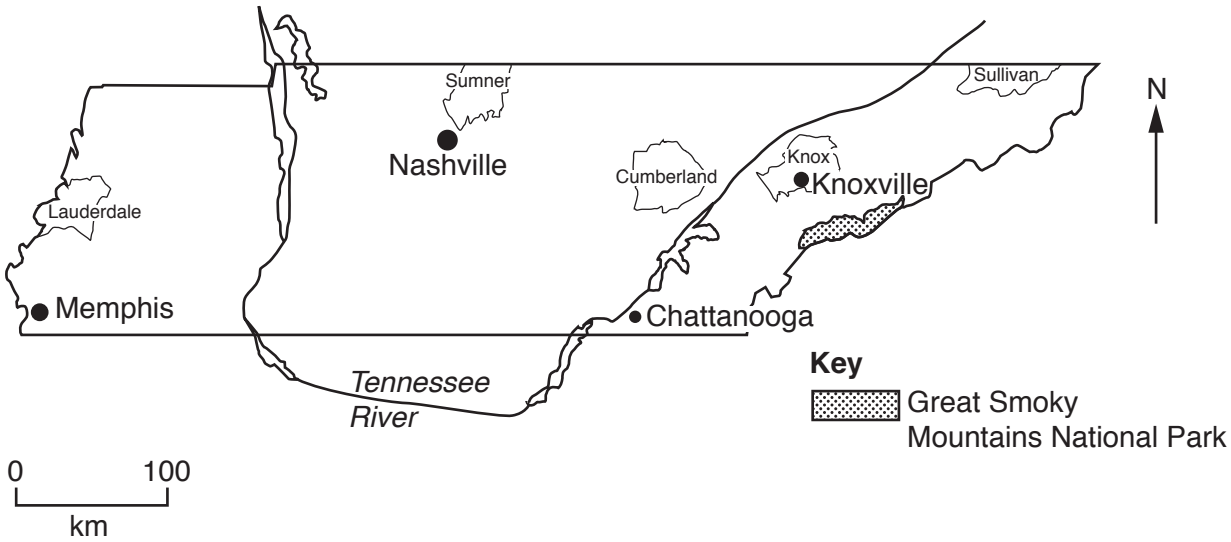
CAMBRIDGE International Examinations

map of the world



map of USA

map of Tennessee



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area of Tennessee: 109 152 km^2

population: 6.5 million (in 2016)

children per woman: 2.1

life expectancy: 76 years

currency: USD

languages: English

main economic activities: agricultural production, electrical power generation, mining, music, tourism and vehicle manufacture

1 The state of Tennessee has large areas of fertile land. The Tennessee River is used to generate electricity. Coal and zinc mining take place in the east of the state. Many tourists visit the Great Smoky Mountains National Park and the state capital, Nashville.

(a) Tennessee is divided into 95 counties. The population of five counties is shown in the table.

county	population
Sumner	166 000
Knox	441 000
Sullivan	157 000
Lauderdale	28 000
Cumberland	57 000
total	.....

(i) Complete the table. [1]

(ii) Calculate the percentage of the population of Tennessee that live in these five counties.

Show your working.

.....% [2]

(iii) Present the population data in rank order from highest to lowest by completing the table.

highest ↓ lowest

county	population

[2]

(b) Cumberland county has many small abandoned coal mines. Water draining from these mines still pollutes streams. A scientist carried out an analysis of water samples from three streams polluted with mine water. The results for the three polluted streams are shown in the table.

ppm = parts per million

	stream **A**	stream **B**	stream **C**	average values
pH	4.4	5.3	4.7	4.8
iron / ppm	216	110	145	157
sulfate / ppm	690	375	492	519
manganese / ppm	58	26	39	41
aluminium / ppm	260	128	182	.....
selenium / ppm	150	90	114	.....

(i) Complete the table.

Space for working.

[2]

(ii) Calculate the range for sulfate and selenium.

sulfate ..... ppm

selenium ..... ppm

[2]

(iii) Name the stream which has the lowest concentration of all pollutants.

stream ..... [1]

(iv) Describe the relationship between pH and the concentration of pollutants in the three streams.

.....

..... [1]

(v) Name the stream that the scientist decided was the most polluted. Give **two** reasons for your answer.

name .....

reason 1 .....

.....

reason 2 .....

.....

.....
[3]

(c) Selenium is stored in the cells of living organisms.

Suggest how low concentrations of selenium can cause the death of fish in streams.

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..... [3]

(d) The scientist took samples of water from three other streams that were not polluted with mine water. The table shows the results.

	stream **D**	stream **E**	stream **F**	average values
pH	6.6	6.8	6.7	6.7
iron / ppm	14	10	12	12
sulfate / ppm	8	6	7	7
manganese / ppm	0.5	0.5	0.5	0.5
aluminium / ppm	0.2	0.2	0.2	0.2
selenium / ppm	10	8	9	9

(i) Explain why the scientist took water samples from these streams.

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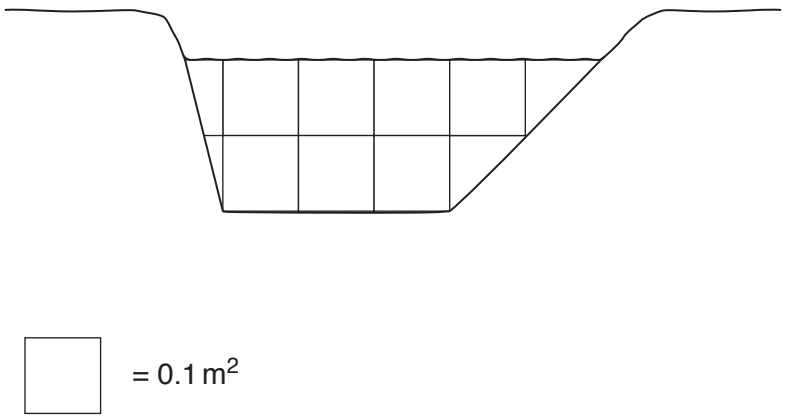
..... [2]

(ii) The scientist also measured the velocity (flow rate) and cross sectional area of all six streams near the water sample points.

To find the cross sectional area of each stream, measurements were plotted onto a grid.

cross section of stream **F**



Use the diagram and the scale to calculate the cross sectional area of stream **F**. Enter your answer in the table.

Show your working.

	stream					
	A	**B**	**C**	**D**	**E**	**F**
velocity in m/s	0.26	0.15	0.18	0.22	0.20	0.18
cross sectional area/m^2	1.35	1.05	1.00	1.10	0.75	.....

[2]

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(iii) State the stream with:

the lowest velocity .....

the largest cross sectional area. .....

[2]

(iv) The scientist measured the velocity of each stream using the following equipment:

marker poles, stopwatch, float, measuring tape, notebook and pen.

Using the equipment, describe a method the scientist could have used to measure the velocity of a stream.

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..... [5]

(v) The scientist then worked out the volume of water (discharge) passing a certain point at a given time.

The scientist used the formula:

discharge in m^3/s = cross sectional area/m^2 × velocity in m/s

Complete the table below.

Show your working.

	stream					
	A	**B**	**C**	**D**	**E**	**F**
discharge in m^3/s	0.35	0.16	0.18	0.24	0.15	.....

[2]

(e) One strategy for reducing pollution is to add limestone rocks along the stream. The limestone slowly dissolves and makes the water less acidic.

Suggest advantages and disadvantages of this strategy.

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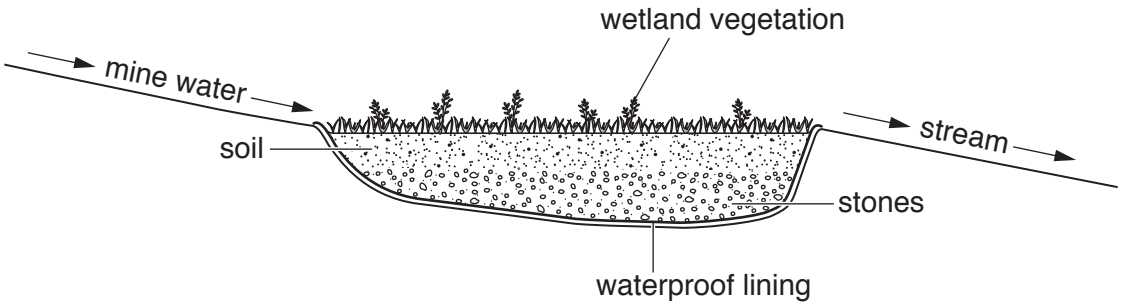
..... [3]

(f) An alternative strategy for reducing pollution is to construct a wetland into which several streams flow. A low lying area is dug out and sealed with a waterproof lining. This is covered with stones, soil and wetland plants. The bacteria in the wetland remove most of the pollutants.



not to scale

(i) Suggest advantages and disadvantages of this strategy.

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..... [3]

(ii) The climate data for Cumberland county is shown in the table.

	month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
average monthly temperature /°C	2	4	8	13	18	22	22	22	20	14	8	6
average monthly rainfall /mm	120	113	125	121	135	117	131	101	99	77	130	126

In which 5 months would bacteria be expected to remove pollutants the fastest? Give **two** reasons for your answer.

months .....

reason 1 .....

.....

reason 2 .....

.....
[3]

(iii) Explain why the scientist decided to take samples of water flowing out of the wetland in May and October each year.

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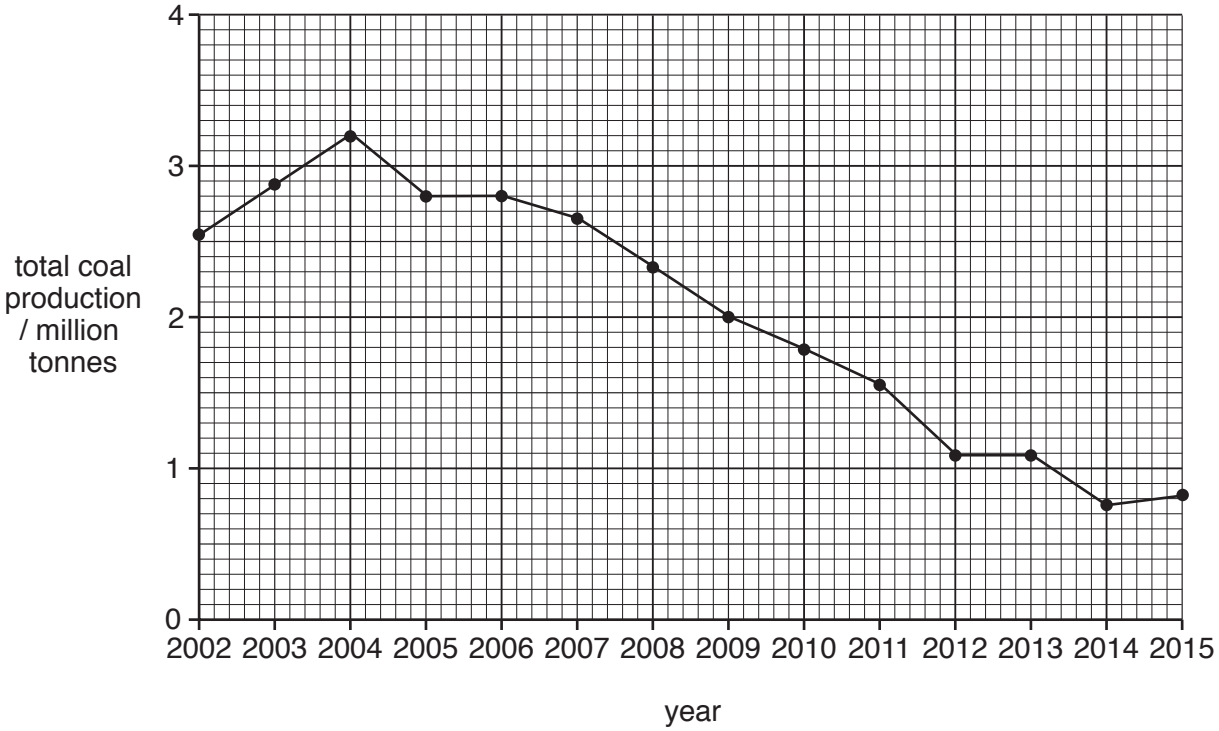
..... [3]

2 **(a)** The amount of coal extracted from underground mines in Tennessee has been decreasing. However, there has been an increase in surface (opencast) mining.

The graph shows the total production of coal from mines in Tennessee over 14 years.



(i) Describe the change in total coal production between 2008 and 2012.

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..... [1]

(ii) Suggest a reason for the change in total coal output between 2008 and 2012.

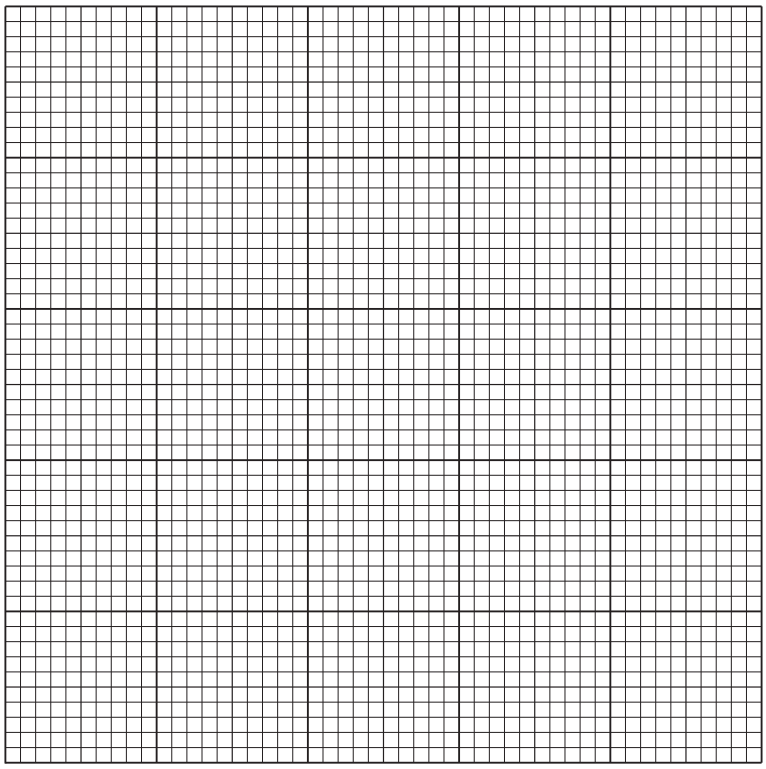
.....

..... [1]

(b) The number of miners employed in Tennessee between 2008 and 2012 is shown in the table.

	year				
	2008	2009	2010	2011	2012
number of miners employed	570	560	550	480	340

(i) Plot a bar graph of the data on the grid.



[4]

(ii) Use the graph to estimate the likely number of miners employed in 2013.

.....[1]

(iii) Suggest **two** reasons why the number of miners has been declining in recent years.

1 .....

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2 .....

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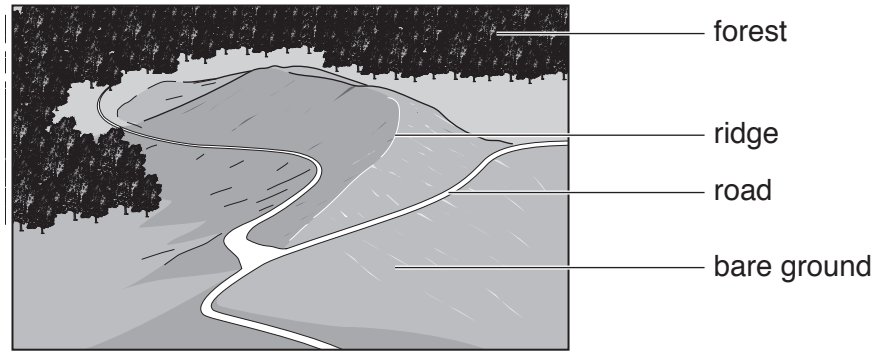
[2]

(c) Most of the surface mining in Tennessee is now on mountain tops. The forest vegetation and overburden are removed using explosives and large machines.

The coal is then extracted and the overburden is spread into valleys. Some of the overburden is used to reshape the mountain top.



Describe the environmental damage that can be caused by this type of mining.

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..... [5]

(d) Coal mining companies are controlled by state laws in Tennessee. Some money from selling coal must be spent on restoring the land after mining.

fact sheet for coal mining in Tennessee

Tennessee has a working population of 3.1 million.

Some mining companies have stopped working because of the high cost of land restoration.

Many local people are trying to stop new licences for mining mountain tops being granted.

Much of the coal mined in Tennessee is not suitable for burning in power stations.

Coal mining still receives Tennessee state subsidies.

Most of the coal has to be exported to other states in the United States of America or overseas to be used to produce steel.

Do you think that coal mining in Tennessee is likely to stop completely in the next few years?

Explain your point of view.

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..... [4]

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