

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE

A143/02

TWENTY FIRST CENTURY SCIENCE
SCIENCE A

Modules B3 C3 P3 (Higher Tier)

THURSDAY 24 JANUARY 2013: Morning

DURATION: 1 hour
plus your additional time allowance

MODIFIED ENLARGED 18pt

Candidate forename		Candidate surname	
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Centre number						Candidate number				
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Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:

Pencil
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

INSTRUCTIONS TO CANDIDATES

- **Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.**
- **Use black ink. HB pencil may be used for graphs and diagrams only.**
- **Answer ALL the questions.**
- **Read each question carefully. Make sure you know what you have to do before starting your answer.**
- **Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).**

INFORMATION FOR CANDIDATES

- **Your quality of written communication is assessed in questions marked with a pencil (✎).**
- **The number of marks is given in brackets [] at the end of each question or part question.**
- **A list of useful relationships is printed on pages 4–5.**
- **The total number of marks for this paper is 60.**

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TWENTY FIRST CENTURY SCIENCE EQUATIONS

USEFUL RELATIONSHIPS

THE EARTH IN THE UNIVERSE

$$\text{distance} = \text{wave speed} \times \text{time}$$

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

SUSTAINABLE ENERGY

$$\text{energy transferred} = \text{power} \times \text{time}$$

$$\text{power} = \text{voltage} \times \text{current}$$

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

EXPLAINING MOTION

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\begin{array}{l} \text{change of} \\ \text{momentum} \end{array} = \text{resultant force} \times \text{time for which it acts}$$

$$\begin{array}{l} \text{work done} \\ \text{by a force} \end{array} = \text{force} \times \begin{array}{l} \text{distance moved in the} \\ \text{direction of the force} \end{array}$$

$$\text{amount of energy transferred} = \text{work done}$$

$$\text{change in gravitational potential energy} = \text{weight} \times \text{vertical height difference}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

ELECTRIC CIRCUITS

$$\text{power} = \text{voltage} \times \text{current}$$

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

RADIOACTIVE MATERIALS

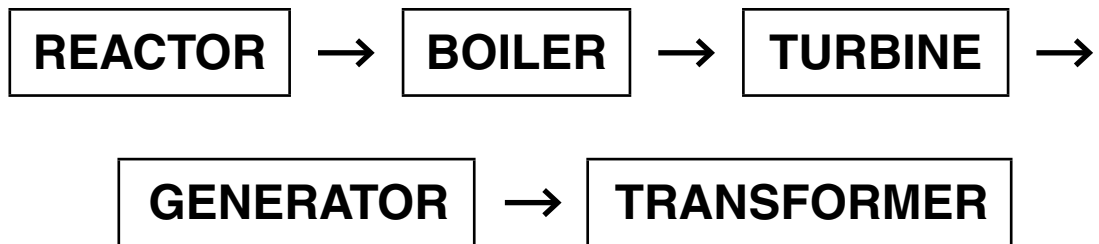
$$\text{energy} = \text{mass} \times [\text{speed of light in a vacuum}]^2$$

Answer ALL the questions.

1 This question is about different types of power station.

(a) Different power stations use different components.

One possible combination of components is:



In the table below are three types of power station.

Each one uses some or all of these components.

Put ticks (✓) in the boxes to show EACH component used by each type of power station.

One component has been done for you. [3]

TYPE OF POWER STATION	REACTOR	BOILER	TURBINE	GENERATOR	TRANSFORMER
coal-burning					✓
hydroelectric					✓
nuclear					✓

- (b) Wave power generators have advantages and disadvantages.**

State and explain ONE advantage and ONE disadvantage of using wave power generators.

[2]

- (c) In 2011, a severe earthquake in Japan, followed by a tsunami, released radioactive material from a nuclear power station. Most of the radioactive material went into the sea.**

Discuss the risk of CONTAMINATION to the Japanese people from this released radioactive material in the months after the earthquake.

[3]

[TOTAL: 8]

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QUESTION 2 BEGINS ON PAGE 10

- 2 The table below shows the power usage of different electrical appliances used in the home.

APPLIANCE	POWER (W)
hair dryer	1200
kettle	2000
microwave oven	850
television	250
vacuum cleaner	1400

- (a) (i) Which appliance will transfer 6800 J of energy in 8 seconds?

_____ [1]

- (ii) Which appliance has a current of about 6 A passing through it when it is switched on?

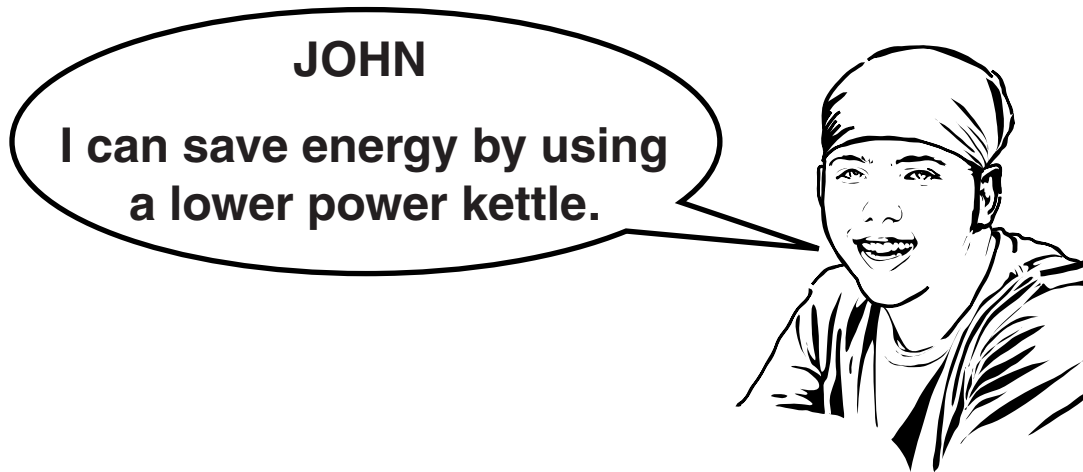
_____ [1]

- (b) In one day, the kettle is used for a total of 20 minutes.

Calculate the cost of using the kettle in one day.
One kilowatt hour costs 12 p.

cost = _____ [3]

(c)



Explain why John is not correct.

[1]

[TOTAL: 6]

- 3 The following table has information about different types of lamps often used in the home.

	TYPE OF LAMP		
	LOW-ENERGY LAMP	QUARTZ-HALOGEN LAMP	LED LAMP
input power (W)	11	50	4
efficiency	50%	10%	95%
lamp cost	£2.50	£1.50	£10
lifetime (hours)	10 000	2500	40 000
light quality	blue-white	yellow-white	blue-white

Use the information above to choose a type of lamp to light your bedroom.

You should use all the information given in the table to justify your choice.



The quality of written communication will be assessed in your answer.

[6]

[TOTAL: 6]

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- 4 (a) There are lots of different species found in natural woodland.

Put a tick (✓) in one box next to each statement about species to show whether it is **TRUE** or **FALSE**.

Organisms of the same species ...

	TRUE	FALSE
... may live in the same habitat.	<input type="checkbox"/>	<input type="checkbox"/>
... can breed together.	<input type="checkbox"/>	<input type="checkbox"/>
... reproduce to make fertile offspring.	<input type="checkbox"/>	<input type="checkbox"/>
... are all genetically identical to one another.	<input type="checkbox"/>	<input type="checkbox"/>
... may compete with each other.	<input type="checkbox"/>	<input type="checkbox"/>

[1]

(b) Read the following article.

THE DECLINE OF NATURAL WOODLANDS

Natural woodland supports more species than any other UK habitat. However, over the last century more than 50% of natural woodland has disappeared. Much has been replaced with conifer trees to supply us with timber.

As a result, the biodiversity of our woodlands has decreased. Conifers allow very little light to reach the ground and their leaves make the soil acidic. This means that fewer plants can grow under the trees.

Some organisations, such as the Woodland Trust, are very keen to conserve the natural woodlands of the UK. They encourage the planting of trees such as oak and beech.

Replacing natural woodland with conifer trees decreases biodiversity.

Which two of the following statements, when taken together, give an explanation for this?

Put ticks (✓) in the boxes next to the TWO correct answers.

Conifer trees let more light through to the ground.

☐

The acidic soil helps plants on the ground grow more quickly.

☐

Conifer trees produce a dense shade.

☐

Ground plants can not photosynthesise as well.

☐

The conifer trees are cut down to provide us with timber.

☐

Oak and beech trees make the soil acidic.

☐

[1]

(c) Suggest how the work of the Woodland Trust promotes sustainability.

[3]

(d) Look at the data.

	FOREST AREA IN THOUSAND HECTARES	TOTAL LAND AREA IN THOUSAND HECTARES	FOREST AS % OF LAND AREA
UK	2 845	24 088	
Europe	145 589	385 135	37.8
World	3 952 025	13 052 852	30.3

- (i) Calculate the total amount of forest in the UK as a percentage of the total UK land area.**

answer = _____ % [1]

- (ii) Use the data to suggest why the Woodland Trust is encouraging tree planting.**

_____ [1]

- (e) The bar chart shows the amount of tree planting that has taken place in the UK over the last 12 years.**

Bob and Stu are monitoring the effect of a campaign to promote the planting of trees.

The campaign started in 2010.

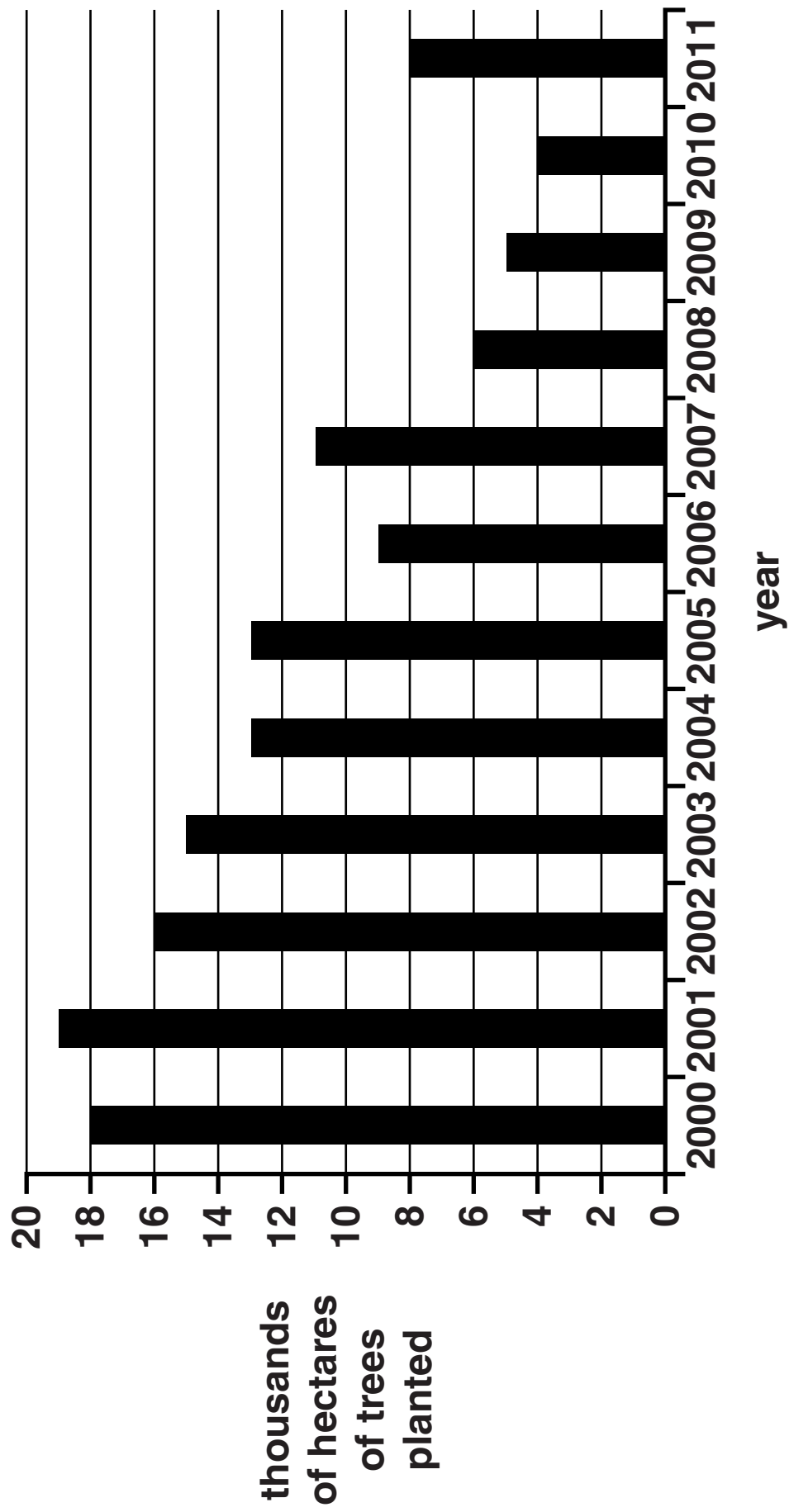
Bob believes the bar chart confirms that the campaign is working.

Stu does not think the bar chart provides enough evidence to be certain that the campaign is working.

Evaluate the data to explain why Bob and Stu's ideas could both be correct.

[3]

[TOTAL: 10]



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- 5 Richard Owen was a geologist who lived at the same time as Charles Darwin.**

Like Darwin, he was interested in the diversity of life.

Both scientists tried to explain how the large diversity of life had occurred.

Darwin used fossils and the structure of living animals and plants as evidence for his theory of evolution.

Owen also studied fossils, including some brought back by Darwin, yet refused to accept Darwin's theories.

Owen believed that all living things are created separately.

- (a) Suggest why, despite having the same fossil evidence, Owen's and Darwin's explanations for the diversity of life were different.**

[2]

(b) Archaeopteryx was a bird that had some features of a reptile.

Archaeopteryx is now extinct, but fossil evidence of its existence has been found.

A photograph of an Archaeopteryx fossil is shown on page 25.

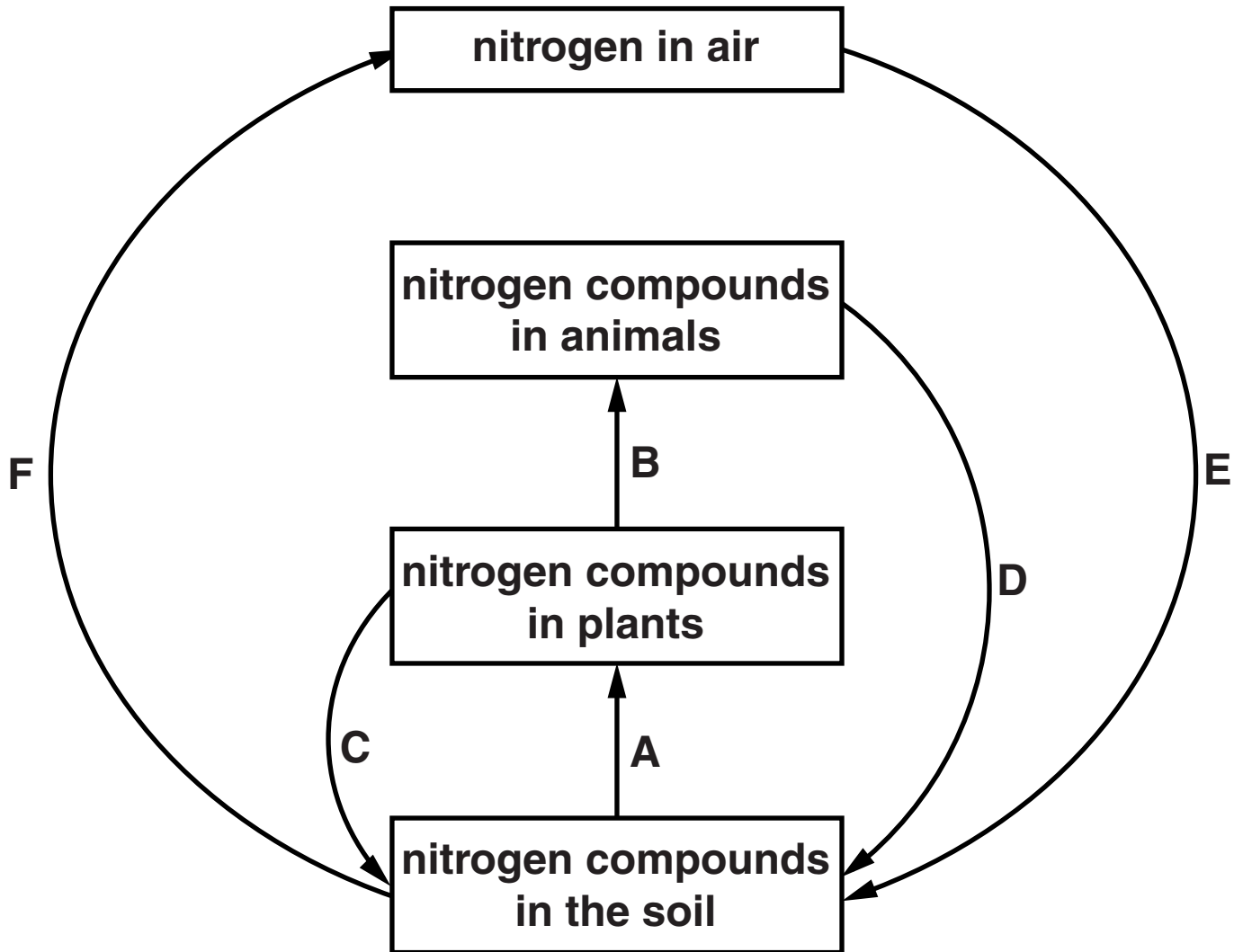
Suggest whose ideas, Darwin's or Owen's, are supported more strongly by the discovery of this fossil. Explain your answer.

[2]

[TOTAL: 4]



6 The diagram shows part of the nitrogen cycle.



Use the diagram to explain how nitrogen is recycled in the environment.



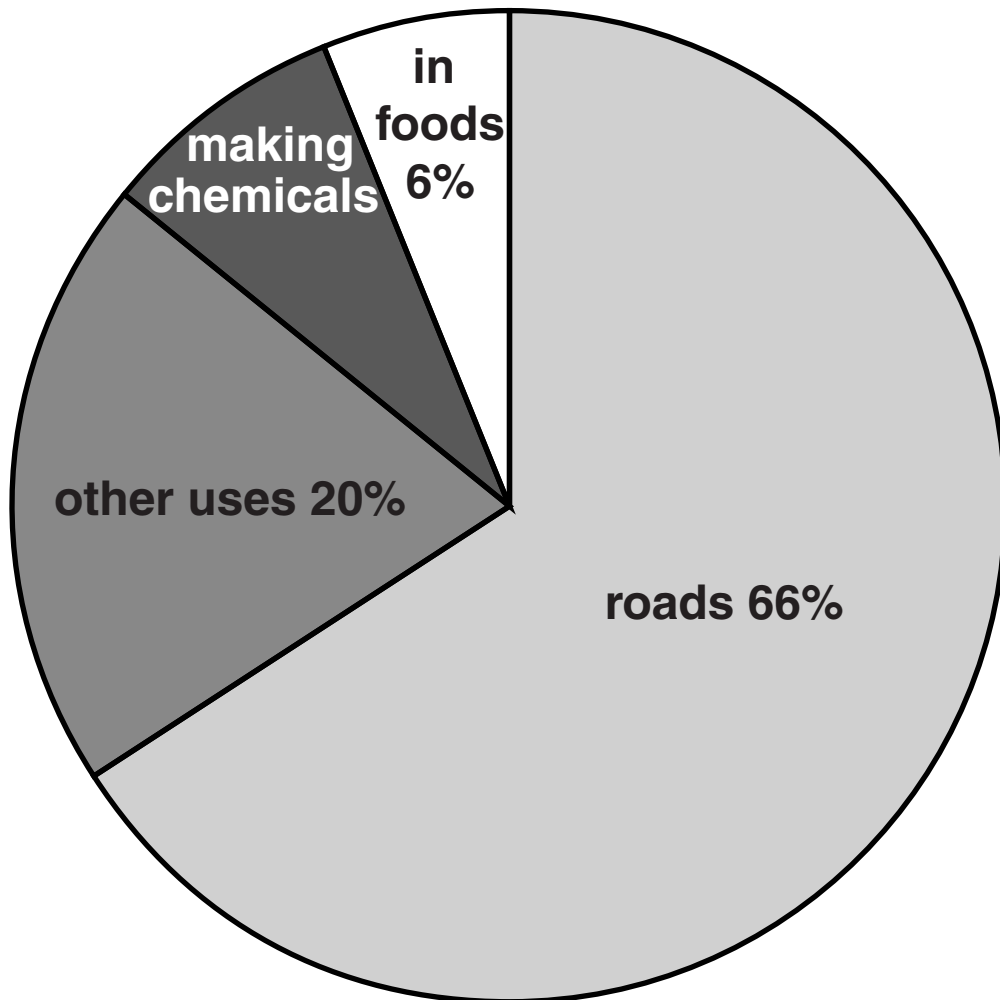
The quality of written communication will be assessed in your answer.

[6]

[TOTAL: 6]

- 7 A total of 6 000 000 tonnes of salt is extracted each year in the UK.

(a) The chart shows uses of this salt.



- (i) How many tonnes of salt are used each year to make chemicals?

Show your working.

answer = _____ tonnes

[2]

(ii) Much of this salt comes from underground.

Some salt is mined with machines and then crushed.

Salt can also be dissolved in water, pumped to the surface and used in solution or crystallised by evaporation.

Use the examples in the chart to explain why salt for different uses is obtained in different ways.

[3]

(b) Chemicals can be made by passing an electric current through salt solution.

Complete the sentences describing this process.

Passing an electric current through salt solution causes a _____ change.

This process is called _____ .

The products of this process are chlorine,

_____ and

_____ .

[3]

[TOTAL: 8]

8 The World Health Organisation wants more water treatment in poorer, developing countries.

Water is treated using chlorine.

Many charities raise money to treat water supplies.

In richer, developed countries, there are people who campaign against the addition of chlorine to their water.

Here are two scientists discussing water treatment.

JANE BROWN

More than three million people die each year from drinking unsafe water. Those who die are mainly children in developing countries. Treating water with chlorine and storing it safely can make an immediate reduction in water-borne diseases such as cholera and typhoid.

MATT SMITH

Chlorine can react with organic matter in water to make trihalomethanes (THMs). These enter the body when people drink water and there is a very small risk that they may cause cancer.

- (a) Attitudes to the risks from water chlorination are very different in richer, developed countries to those in poorer, developing countries. Explain why.**

[3]

- (b) Which of the following will lower the risk from THMs in drinking water?**

Put a tick (✓) in the box next to the BEST answer.

Filter out organic matter before chlorination. ☐

Filter out organic matter after chlorination. ☐

Heat household water to remove chlorine. ☐

Only put chlorine into water used for drinking. ☐

Neutralise the chlorine. ☐

[1]

[TOTAL: 4]

9 This is a question about PVC.

(a) John is building a new house.

He can choose window frames made of wood or PVC.

He wants to compare wood and PVC window frames by carrying out a Life Cycle Assessment (LCA).

He finds some energy data on the internet.

Energy use is only one part of the Life Cycle Assessment.

	ENERGY USED IN MJ	
	PVC	WOOD
Obtaining the material	12.2	6.6
Making the window frames	3.0	3.9
Transport	3.6	5.3
Maintenance	0.1	1.1
Disposal	3.4	3.4

What can be concluded from this energy data and what further data does John need for a complete Life Cycle Assessment?



The quality of written communication will be assessed in your answer.

[6]

(b) Plasticizers are added to PVC to make it more flexible.

There is evidence that some plasticizers are harmful to humans.

Which TWO sentences, when put together, explain why plasticized PVC can be harmful?

Put ticks (✓) in the boxes next to the TWO correct answers.

Plasticizer chemicals can damage animal cells. ☐

PVC contains an element that is poisonous. ☐

Plasticizers modify the properties of PVC. ☐

Plasticizers can leak out of PVC. ☐

PVC breaks up into its elements. ☐

Most PVC is recycled. ☐

[2]

[TOTAL: 8]

END OF QUESTION PAPER

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