THIS IS A NEW SPECIFICATION

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Friday 15 June 2012 – Afternoon

GCSE TWENTY FIRST CENTURY SCIENCE SCIENCE A

A143/02 Modules B3 C3 P3 (Higher Tier)

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)

Duration: 1 hour

A143/02

Candidate forename		Candidate surname	

Centre number						Candidate number				

MODIFIED LANGUAGE

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. 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).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- A list of useful relationships is printed on page 2.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **24** pages. Any blank pages are indicated.

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful relationships

The Earth in the Universe

distance = wave speed × time

wave speed = frequency × wavelength

Sustainable energy

energy transferred = power × time

power = voltage × current

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

Explaining motion

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

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

momentum = mass × velocity

change of momentum = resultant force × time for which it acts

work done by a force = force × distance moved in the direction of the force

amount of energy transferred = work done

change in gravitational potential energy = weight × vertical height difference

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

Electric circuits

power = voltage × 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

energy = mass × [speed of light in a vacuum]^2

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Question 1 begins on page 4

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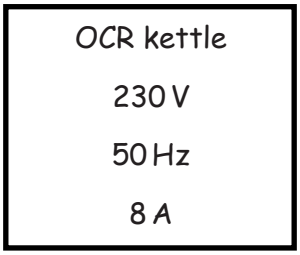
Answer **all** the questions.

1 The diagram shows information written on the bottom of an electric kettle.



(a) What is the power of this kettle when it is being used?

Put a (ring) around the number closest to the power, measured in **kilowatts**.

1.5 **2.0** **2.5** **1500** **2000** **2500**

[1]

(b) A different kettle has a power of 1.2 kW.

(i) In a whole week, this kettle is used for a total of 45 minutes.

Calculate the amount of energy, in **kilowatt hours**, transferred to heat in this time.

Show your working.

energy = ... kilowatt hours **[1]**

(ii) It takes 1 minute to boil a cup of water for tea with this 1.2 kW kettle.

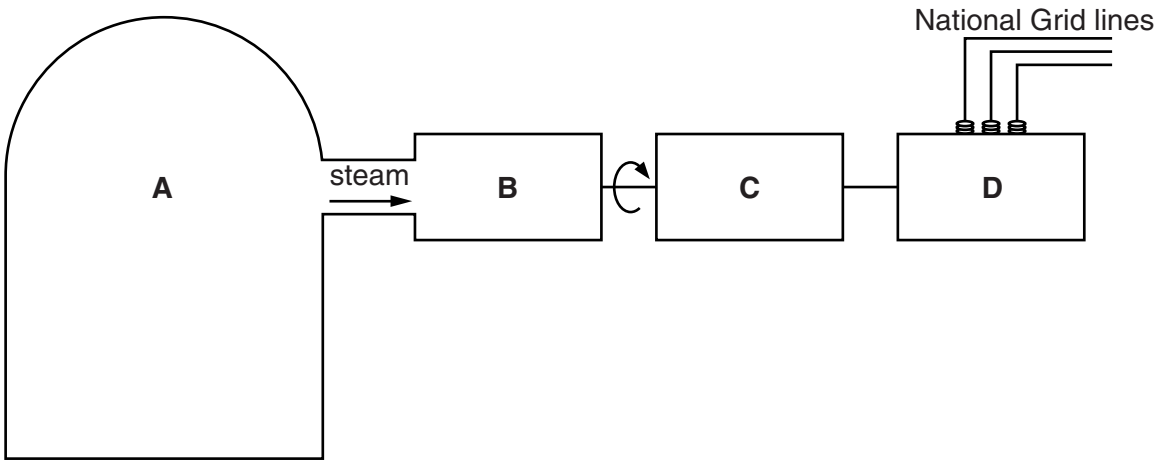
Calculate how much energy, in **joules**, is provided.

Show your working.

energy = ... joules **[2]**

[Total: 4]

2 **(a)** The block diagram below represents a nuclear power station.



Identify the four parts labelled **A**, **B**, **C** and **D**.

A .....

B .....

C .....

D ..... **[3]**

(b) A worker in the nuclear power industry is at risk from **contamination** and **irradiation**.

Discuss the difference in risk between contamination and irradiation.

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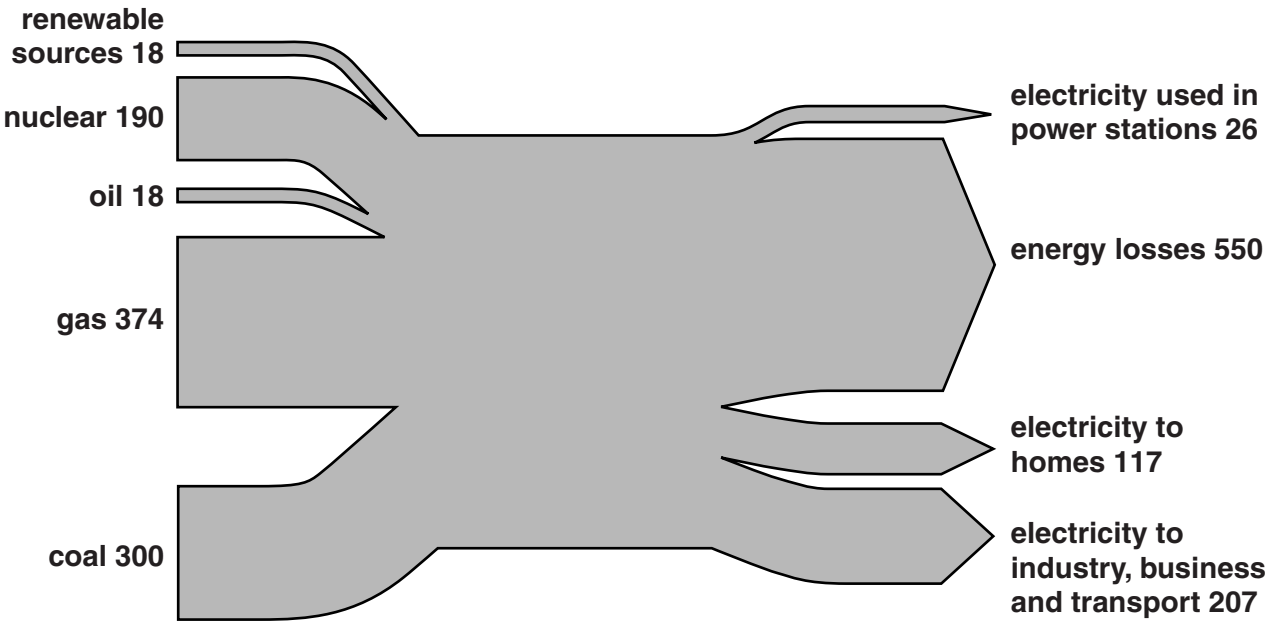
..... **[2]**

[Total: 5]

3 This question is about the generation of electrical energy in the UK in 2009.

The diagram below shows the energy input and output for all UK power stations in 2009.

The figures are all in terawatt hours (TWh). 1 TWh = 1000 million kWh.



(a) It has been claimed that nuclear power provides approximately 20% of Britain's electricity.

Use data from the diagram to check this statement.

Show your working.

conclusion ..... **[2]**

(b) New technology allows power stations to be more efficient. They can

- operate with half the electricity they use now
- reduce their energy losses by 10%.

If all power stations were improved in this way, there would be more energy for homes, industry, business and transport.

Calculate the extra energy in TWh which would be available for homes, industry, business and transport.

You can assume the same energy input to the power stations.

Put a (ring) around the correct value.

13 **55** **68** **392** **508**

[1]

(c) Over the next 50 years, it is expected that the energy needs of Britain will continue to grow, but that fossil fuels use will decrease.

Describe and explain the changes you would expect to the energy input side of the diagram. You do not have to do any calculations.

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

[Total: 5]

4 Shetland is a small island group 300 km north of mainland Scotland. It has a population of approximately 22 000 people. Electricity is provided by an oil-burning power station, which needs to be replaced.

The Shetland islanders need to consider the different energy options available to them. They can then decide on ways of meeting energy production and energy use over the next hundred years.

What recommendations would you make to the Shetland islanders?

Justify your advice.

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

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[Total: 6]

5 **(a)** Mayfly nymphs are an example of a living indicator.

Suggest why living indicators can be useful to scientists.

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

(b) The table shows the average number of mayfly nymphs found in rivers flowing through three different areas, **A**, **B** and **C**, over a period of five years.

	average number of mayfly nymphs		
year	area **A**	area **B**	area **C**
2007	0	94	0
2008	0	91	0
2009	0	92	12
2010	0	93	57
2011	0	91	135

Scientists wish to set up a nature reserve in one of these areas. This would be an area where the plants and animals are protected.

Suggest which area you would recommend to become the nature reserve.

Use the data to explain why you have chosen that area, and why you have not chosen the other two areas.

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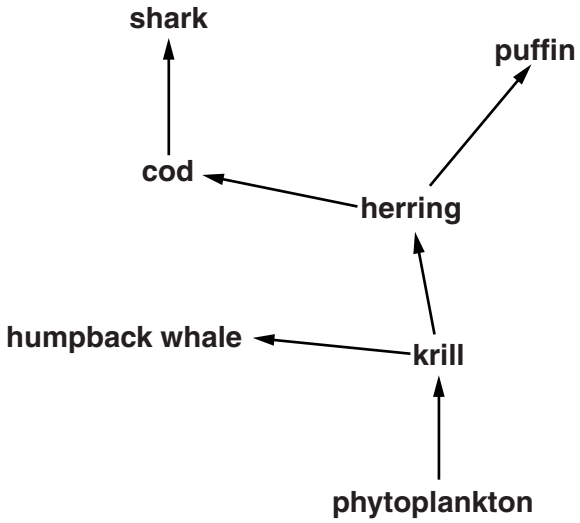
..... **[2]**

[Total: 3]

6 **(a)** Sarah is learning about food webs.

She finds this food web in her science text book.



(i) Jellyfish feed on krill.

Sea turtles are predators of jellyfish.

Add this information to the food web above. **[1]**

(ii) Detritivores are not shown on the food web but they are important.

Why are detritivores important?

Put a tick (✓) in the box next to **each** correct explanation.

They prevent nutrients being recycled in the food web. ☐

They fix nitrogen. ☐

They feed on dead organisms and waste materials. ☐

They are predators of decomposers. ☐

They carry out photosynthesis to recycle carbon in the food web. ☐

They release carbon dioxide back into the air. ☐

[1]

(iii) A disease-causing organism specific to puffins is introduced to the food web.

What might happen to the numbers of puffins, herring, cod and sharks?

Put a tick (✓) in the box next to the correct option to complete each sentence.

The number of puffins would ...

... increase.	
... stay the same.	
... decrease.	

Then the number of herring would ...

... increase.	
... stay the same.	
... decrease.	

Then the number of cod would ...

... increase.	
... stay the same.	
... decrease.	

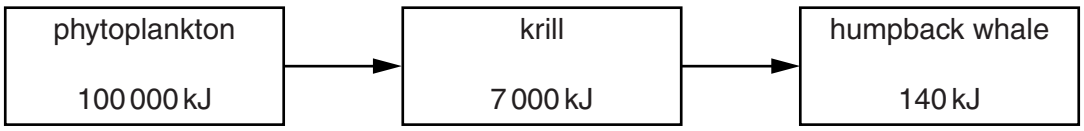
Then the number of sharks would ...

... increase.	
... stay the same.	
... decrease.	

[1]

(b) Look at the food chain which is part of the food web.

The figures show the energy transferred through each stage of the food chain.



(i) Calculate the percentage efficiency of energy transfer between the **phytoplankton** and the **humpback whale**.

Show your working.

efficiency = ... % **[2]**

(ii) Look at the food web.

Sarah thinks that the percentage efficiency of energy transfer between the **phytoplankton** and **sharks** would be less than the answer calculated in part **(i)**.

Explain why she is correct.

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

[Total: 8]

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Question 7 begins on page 14

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7 **(a)** In 1859, Charles Darwin proposed his theory of evolution by natural selection.

Describe how Darwin thought the process of natural selection occurred.

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

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..... **[6]**

(b) Lamarck was a French scientist who suggested an explanation for evolution before Darwin.

He suggested that the characteristics of living things changed during their lifetime.

For example, he believed that giraffes stretch up to reach leaves high in the trees and this causes their necks to become longer.

Which statements are reasons why scientists now accept that Darwin's ideas about evolution **are better than** Lamarck's?

Put ticks (✓) in the boxes next to the **three** correct reasons.

Lamarck proposed his ideas much earlier than Darwin.	☐
Some people believe that God created all living things.	☐
There is no scientific evidence to prove that Darwin was wrong.	☐
Fossils found in older rocks are different from those in younger rocks in the same area.	☐
There is no mechanism to explain how acquired characteristics could be inherited.	☐
Darwin used creative thought to develop his ideas about evolution.	☐
Darwin was not as well-known as Lamarck.	☐
Our understanding of genetics now supports Darwin's ideas of natural selection.	☐

[3]

[Total: 9]

8 Read this newspaper article.

NEW TARGETS FOR SALT IN FOODS

The Government has set new targets for salt in foods. Scientists have discussed the targets with consumer groups and food companies.

Some examples of these targets are

food	g salt in 100 g food
bacon	2.88
bread	0.68
cereals	1.00

Food labelling will show how much salt is in the food

- **high** salt = more than 1.5 g of salt in 100 g of food
- **low** salt = less than 0.3 g of salt in 100 g of food.

The Guideline Daily Amount (GDA) of salt is 6 g. This is the maximum amount of salt you should eat in one day.

(a) For his breakfast Tom eats 100 g cereals, 50 g bread and 50 g bacon.

Work out how much salt is in his breakfast.

Show your working.

answer = ... g salt

Is this more than the Guideline Daily Amount?

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[2]

(b) The Government has set new, lower targets for salt in foods.

They try to balance risks and benefits.

Some people and some companies are in favour of the new targets.

Others are against the change.

Explain why setting lower targets is controversial.

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

[Total: 5]

9 Coal, limestone and salt are resources found in the Earth's crust in Britain.

They were formed millions of years ago in different ways.

(a) There are large deposits of rock salt in the north west of England.

Explain how rock salt is formed.

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

(b) Coal and limestone are found very close together in Britain.

They were made in very different climatic conditions.

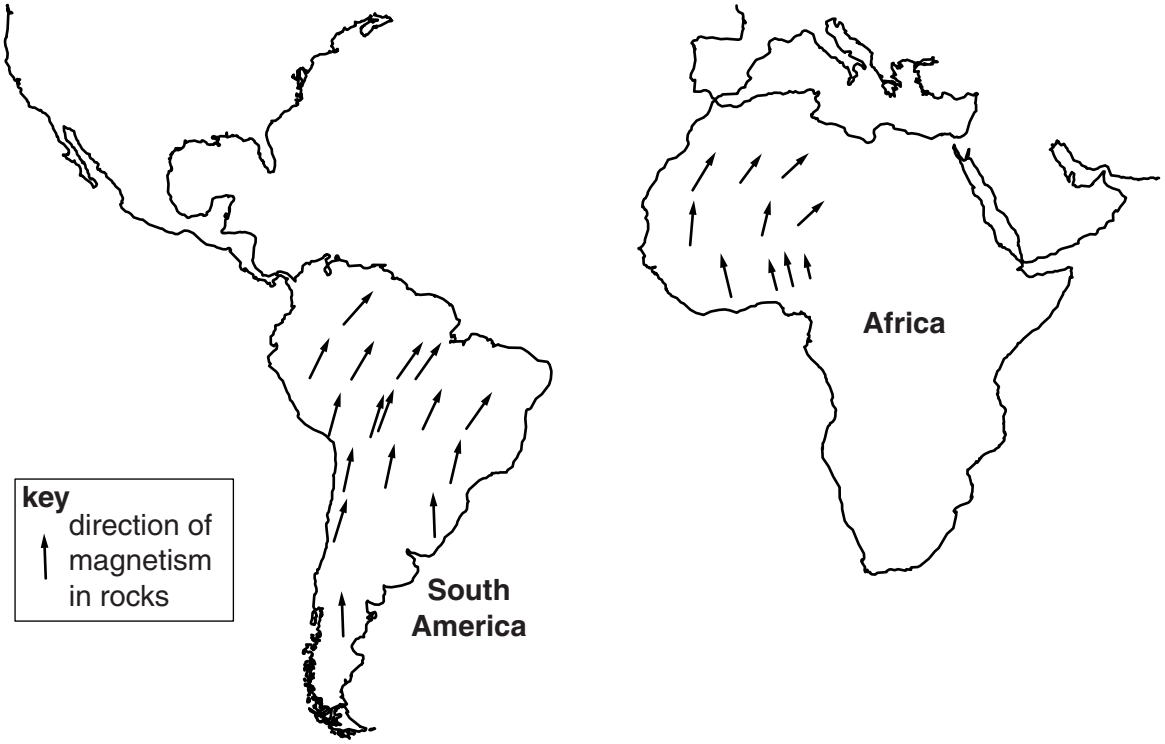
Which two statements, when taken together, explain how this happened?

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

Volcanoes erupt along the edge of tectonic plates.	☐
Climates are different at different places on the Earth.	☐
Climate changes depend on movement of the air.	☐
Land masses move because of the movement of tectonic plates.	☐
Concentrations of carbon dioxide increased during the formation of the Earth's resources.	☐
Global warming increases the temperature of the Earth.	☐

[2]

(c) Look at the diagram.



The diagram shows the direction of magnetism of some of the rocks in South America and Africa.

Scientists use these as evidence that South America and Africa were once part of the same land mass.

Why are there variations in the direction of magnetism in rocks, and how can they be used as evidence for the movement of continents?

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

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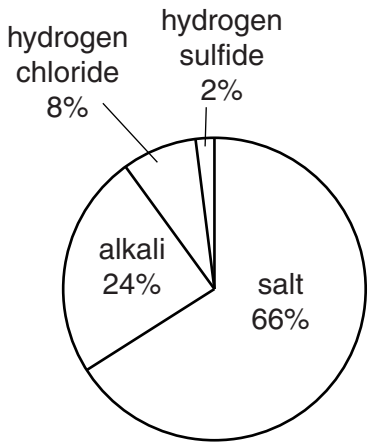
[Total: 10]

10 Look at the data about the production of alkali in 1810 and 2010.

products from one tonne of salt

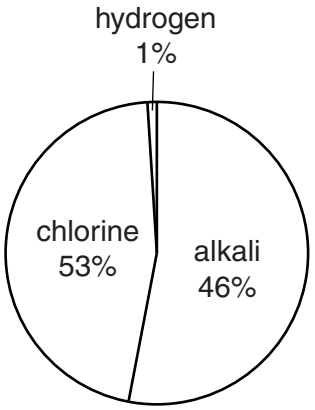
1810

Alkali is made by using coal to heat salt and limestone.



2010

Alkali is made by the electrolysis of salt solution.



(a) Calculate how much **more** alkali was produced from **10** tonnes of salt in 2010 compared with 1810.

Show your working.

answer = ... tonnes **[2]**

(b) The method of making alkali has changed over the past 200 years.

Explain why these changes happened.

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[Total: 5]

END OF QUESTION PAPER

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