THIS IS A NEW SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

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Thursday 23 May 2013 – Morning

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				

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 **20** 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

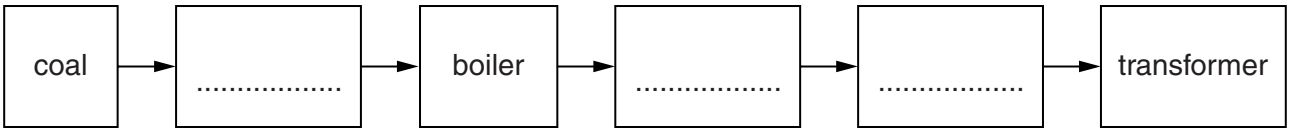
energy = mass × [speed of light in a vacuum]^2

Answer **all** the questions.

1 This question is about different types of power stations.

(a) The block diagram below shows the production of electricity in a coal-burning power station.

Complete the block diagram by writing a word in each of the empty boxes.



[2]

(b) The statements below are factors to be considered in choosing an energy source to provide electricity. Some of these factors favour the use of wind power, some favour the use of coal, while others favour neither.

Put a tick (✓) in the **one** correct box for each factor.

Factor	**Favours wind power**	**Favours coal**	**Favours neither**
Fuel cost			
Reliability			
Sustainability			
Voltage output			
Waste produced			

[3]

[Total: 5]

2 Read this advertisement from a firm selling loft insulation.

Are you losing money through your roof?

In a home without any insulation, a quarter of the heat is lost through the roof. Insulating your loft is a simple and effective way to save energy and reduce your heating costs. And the cost of fuel for heating is certain to increase in the next three years!

Even if your loft is already insulated, it may be only 100 mm thick – the recommended thickness is now 270 mm. Topping it up to 270 mm will still save you a lot of money.

Just look at the figures below. Can you afford to ignore them?

	Installing 270 mm of insulation in a loft with no insulation	**Topping up insulation to 270 mm in a loft which has only 100 mm of insulation**
approximate saving per year	£175	£25
cost to buy and install	£170	£150
time taken to pay for itself	less than a year	up to six years

Explain the differences between the two columns of data in the table and how these figures will be affected by rising fuel costs.

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

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[Total: 6]

3 Electrical tools used on building sites do not use the 230 V mains voltage.

A transformer is used to convert the 230 V to 110 V.

(a) The efficiency of any electrical device can be calculated using the equation

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

Explain why this equation is equivalent to the usual form

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

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

(b) A circular saw on a building site is used as described above. The mains current into the transformer is 7.7 amps.

Calculate the efficiency of the **transformer** if the electrical output power from the transformer is 1750 W.

efficiency = ... % **[3]**

(c) Suggest and explain what would happen if the circular saw above were connected to a transformer of efficiency 25%.

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[Total: 5]

4 This question is about nuclear power.

(a) Here are some statements about nuclear power.

Some are true and some are false.

Put a tick (✓) in the correct box after each statement.

	True	False
Waste nuclear fuel emits ionising radiation.		
Nuclear fuel is a renewable source of energy.		
Waste nuclear fuel remains radioactive for a very long time.		
The general public perceives the risk due to radiation as being greater than the real risk.		
Nuclear power stations give off greenhouse gases when they produce electricity.		

[2]

(b) In reprocessing plants, the waste from nuclear power stations is separated into different categories of radioactive waste.

Workers in these plants need protection from these radioactive materials.

Explain why **contamination** may be more hazardous than **irradiation** to workers in these reprocessing plants.

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

[Total: 4]

5 All living organisms are classified into groups by scientists.

New living organisms are being discovered all the time and scientists have to classify them.

For example, in 2012, a new venomous sea snake was discovered.

Discuss **how** scientists classify newly-discovered organisms and why they do this.

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

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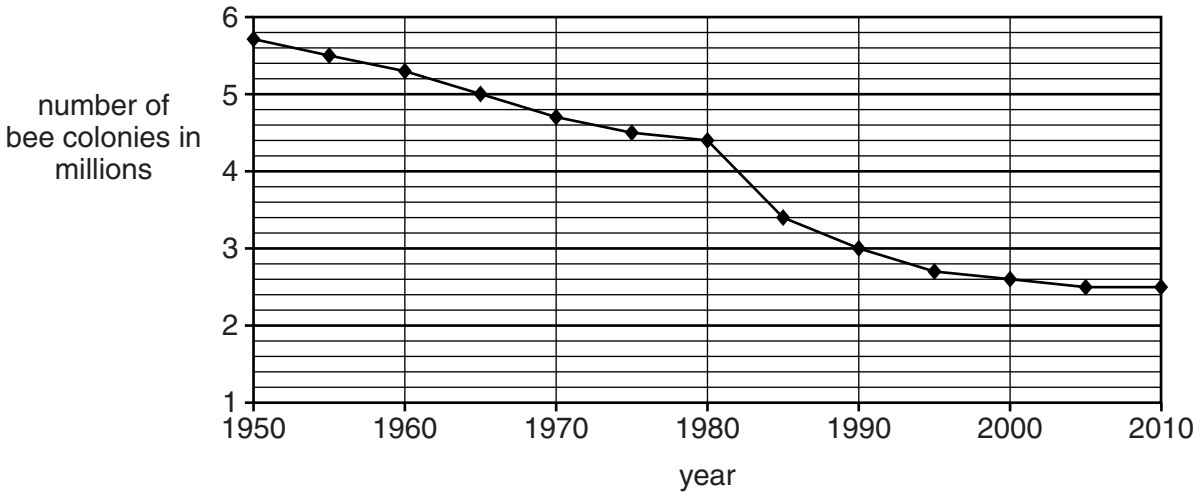
[Total: 6]

6 There has been a large decline in the number of bee colonies in the USA over the last 60 years.

(a) Look at the graph.



Which of the following sentences about the graph are true?

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

The number of bee colonies has declined at a constant rate since 1950. ☐

Between 1950 and 1970 the number of bee colonies dropped by approximately one million. ☐

The rate of decline is slowest in the last 10 years. ☐

The graph shows that there will be 2.5 million bee colonies in 2050. ☐

The percentage drop in the number of bee colonies between 1965 and 1990 was 50%. ☐

[2]

(b) (i) Judy thinks that signals from mobile phones prevent bees finding their way to flowers.

This could explain their decrease in numbers.

Richard knows that mobile phones were not in widespread use until the 1990s.

Richard is confident that the graph proves mobile phones cannot be the cause of the decline.

Use the graph to decide whether Richard is correct.

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(ii) In the USA, bees are used to pollinate crops in areas of monoculture.

Write down **two** reasons why many people are concerned about using large areas of land for monoculture.

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2 .....

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[Total: 6]

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7 Adelie penguins live in Antarctica where it is extremely cold.

(a) The penguins are adapted to live in this environment.

Physical adaptations are features of an animal's body that help them survive.

Behavioural adaptations are how animals behave to help them survive.

Look at the list of adaptations of the Adelie penguins.

Put a tick (✓) in the correct box in each row to show whether the adaptation is an example of a **physical** adaptation, a **behavioural** adaptation or **both**.

Adaptation	Physical	Behavioural	Both
leathery skin on the bottom of its feet to protect them on the rocks			
strong claws to grip onto the rocks			
gland produces oil that the penguin spreads over its feathers			
streamlined body shape			
huddles together in groups to keep warm			

[3]

(b) Krill is the main prey species for the Adelie penguin.

Whales are also predators of krill.

During the 1960s whale hunting was common in Antarctica.

Use this information to suggest and explain what is likely to have happened to the population of the Adelie penguin during the 1960s.

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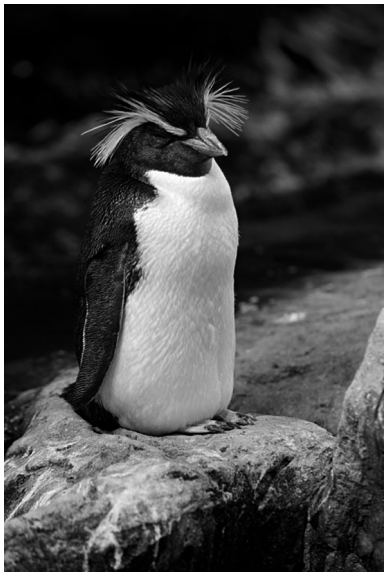
(c) Macaroni penguins also live in Antarctica and have many physical and behavioural similarities with Adelie penguins.



(i) Arthur tries to find out if Macaroni and Adelie penguins can reproduce together.

Arthur thinks that, if they can reproduce together, this means that the two penguins **must** belong to the same species.

Esme disagrees.

Write down who you think is correct and explain why.

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

(ii) The number of Macaroni penguins is so low that they are an endangered species and are at risk of extinction.

Extinctions are usually the result of a change in the environment. These changes can be natural or man-made.

Describe **and** explain one natural and one man-made change to the environment that might contribute to the Macaroni penguins becoming extinct.

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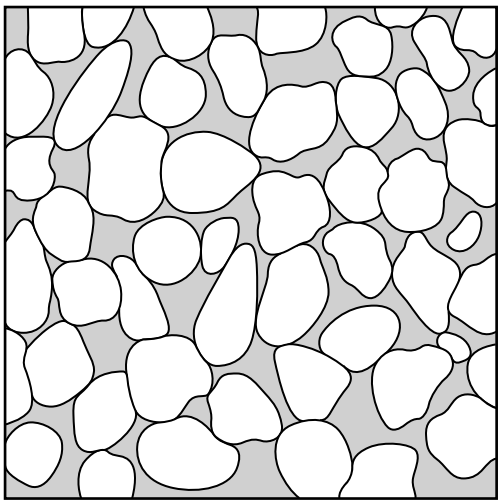
[Total: 8]

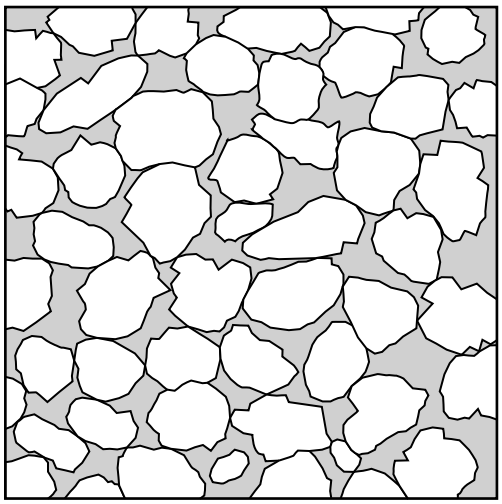
8 Some students are learning about the origin of rocks found in Britain.

(a) They use microscopes to look at the grains in two pieces of sandstone.

This is what they see.



sandstone **A**



sandstone **B**

Which one of these was formed in a desert and which one was formed under water?

Explain your answer.

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

(b) Magnetic crystals in rocks record the direction of the Earth's magnetic field when the rocks were made.

Scientists can work out the angle between the direction of magnetisation and the direction of the horizontal layers of rock when the rock was made.

The table shows data for three layers of rocks found in Britain.

Age of the rock in millions of years	Angle between the direction of magnetisation and the horizontal when the rock was made
280	0°
150	30°
60	50°

Describe and explain the conclusions you can draw from these data.

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

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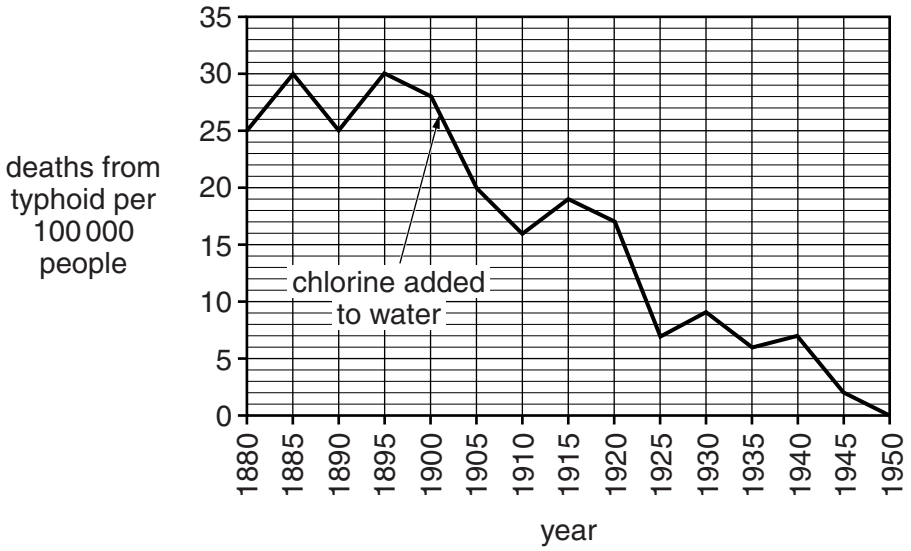
[Total: 8]

9 Typhoid is a disease that is passed on by infected water or food.

The graph shows the deaths in London from typhoid from 1880 to 1950.



(a) Use this table to record your answers to parts **(i)** and **(ii)** of this question.

	1890	**1945**
Population of London	4 000 000	8 000 000
Deaths from typhoid per 100 000 people		
Total number of deaths from typhoid per year		

(i) Use the graph to find the number of deaths per 100 000 from typhoid in 1890 and 1945.

Write these in the table.

[1]

(ii) Work out the total number of deaths in 1890 and 1945.

Write these in the table.

[1]

(iii) Why is the graph plotted for the number of deaths per 100 000 people rather than the total number of deaths?

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

The graph is easier to read because the numbers are smaller.	☐
So you can tell if the total deaths fell each year.	☐
Results could be misleading because of population changes.	☐
Data is collected every five years.	☐
A fair comparison can be made with other places.	☐

[2]

(b) Chlorination of drinking water in London began in 1901.

Suggest reasons why it took 50 years to stop deaths from typhoid in London.

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(c) Traces of harmful chemicals are sometimes made when chlorine is added to water.

Why is chlorine added to water even though harmful chemicals may be made?

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

The benefit of using chlorine is very small.	☐
The risk from the harmful chemicals is very small.	☐
Chlorine is a toxic chemical.	☐
Most people believe chlorine is risk free.	☐
Chlorine kills bacteria in the water supply.	☐

[2]

[Total: 8]

10 (a) A chemical industry grew up in the north west of England.

One reason for this was large amounts of salt found under the ground.

What other reasons were there for the industry to start in this part of the country?

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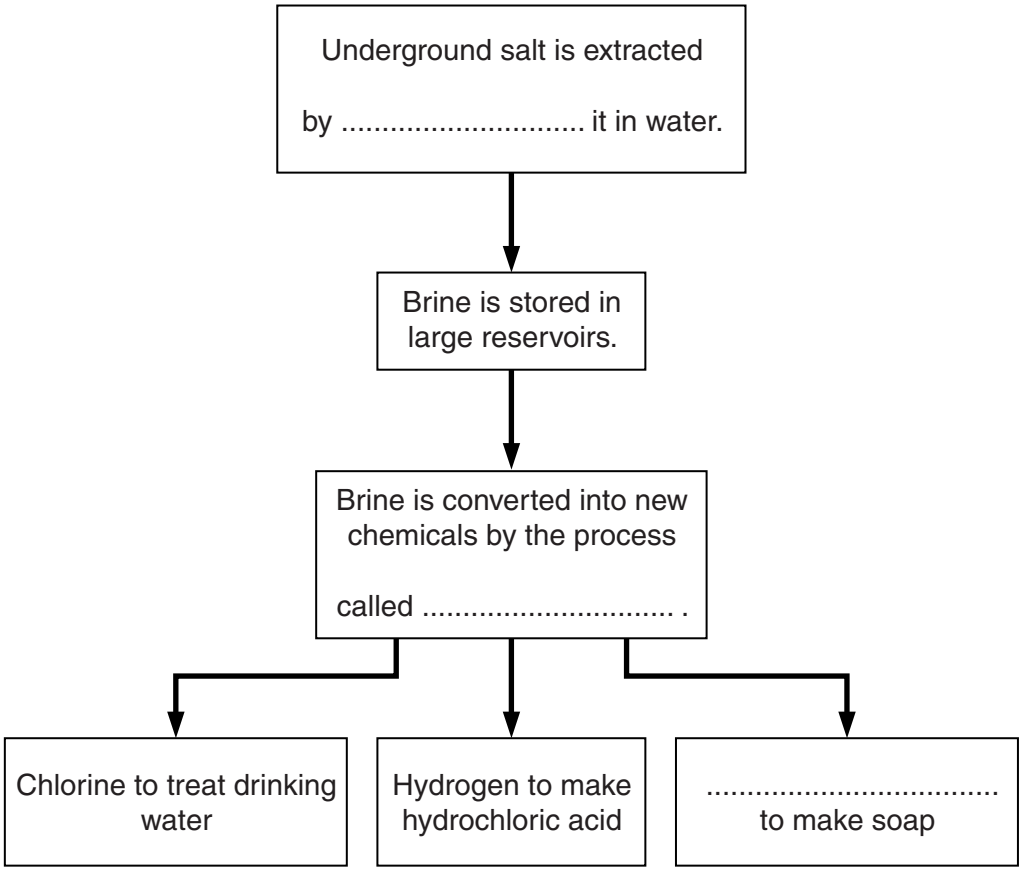
(b) The flow diagram shows how salt found underground is changed to other chemicals.
Finish the labels with the correct word or words.



[2]

[Total: 4]

END OF QUESTION PAPER

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