THIS IS A NEW SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

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Tuesday 15 May 2012 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE SCIENCE A

A141/02 Modules B1 C1 P1 (Higher Tier)

A135760612

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

A141102

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 (✎).
- 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**.
- A list of physics equations is printed on page 2.
- 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 **(a)** Some people choose to use pre-implantation genetic diagnosis (PGD).

Complete the sentences about PGD by choosing the correct words from this list.

Each word may be used once, more than once, or not at all.

embryos

egg cells

fetuses

fertilised

stem cells

cloned

A woman's ..... are removed from her body and

..... in a laboratory.

The ..... are then tested before one is selected and placed back into the woman. **[2]**

(b) Many people have strong opinions about PGD because it raises ethical issues.

Describe **two** ethical implications of PGD.

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

(c) Genetic tests can also be carried out on fetuses whilst they are developing inside the mother.

Alison is pregnant and Mike is the father. They both have relatives who have cystic fibrosis.

Mike thinks they should have a genetic test carried out on their baby before it is born.

Alison does not want to have the test.

Discuss the reasons **for** and **against** having a genetic test on the fetus.

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

[Total: 7]

2 Animal clones occur naturally.

It is now possible to produce animal clones **artificially**.

The embryos produced contain **embryonic stem cells**.

Explain how an adult body cell can be used to produce a cloned embryo and suggest the possible uses of this technique.

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

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

[Total: 6]

3 **(a)** There are 23 pairs of chromosomes in human body cells.

One of these pairs is called the sex chromosomes.

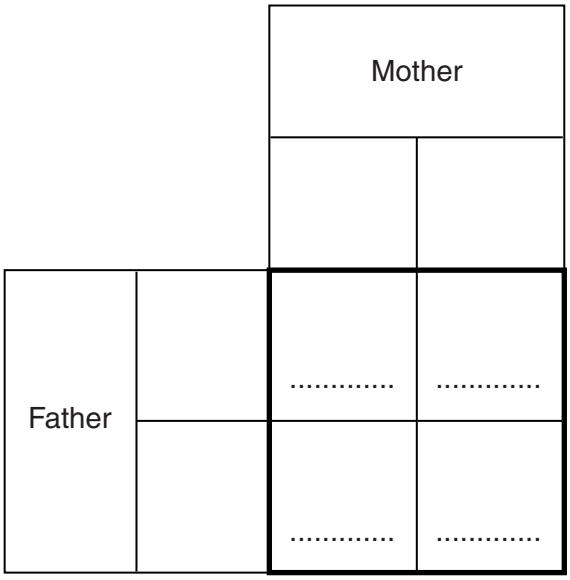
What might be different between the two chromosomes in each of the **other** pairs of chromosomes?

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

the alleles	☐
the genes	☐
the shape	☐
the size	☐

[1]

(b) **(i)** Complete the Punnett square to show how the sex chromosomes are inherited.



[1]

(ii) What is the expected ratio of boys to girls?

expected ratio of boys to girls = ... : ..... **[1]**

(c) The table below shows the total number of girls and boys born in four hospitals, **A**, **B**, **C** and **D**, during one year.

	Number of babies born in one year in each hospital			
	A	**B**	**C**	**D**
Girls	7	105	266	350
Boys	19	79	254	350
Total	26	184	520	700

(i) Calculate the ratio of girls to boys born in hospital **D**.

ratio of girls to boys born in hospital **D** = ... : ..... **[1]**

(ii) Use the data to describe how the ratios of girls to boys in each hospital compare to the expected ratio, and explain how this might be related to the total number of babies born in each hospital.

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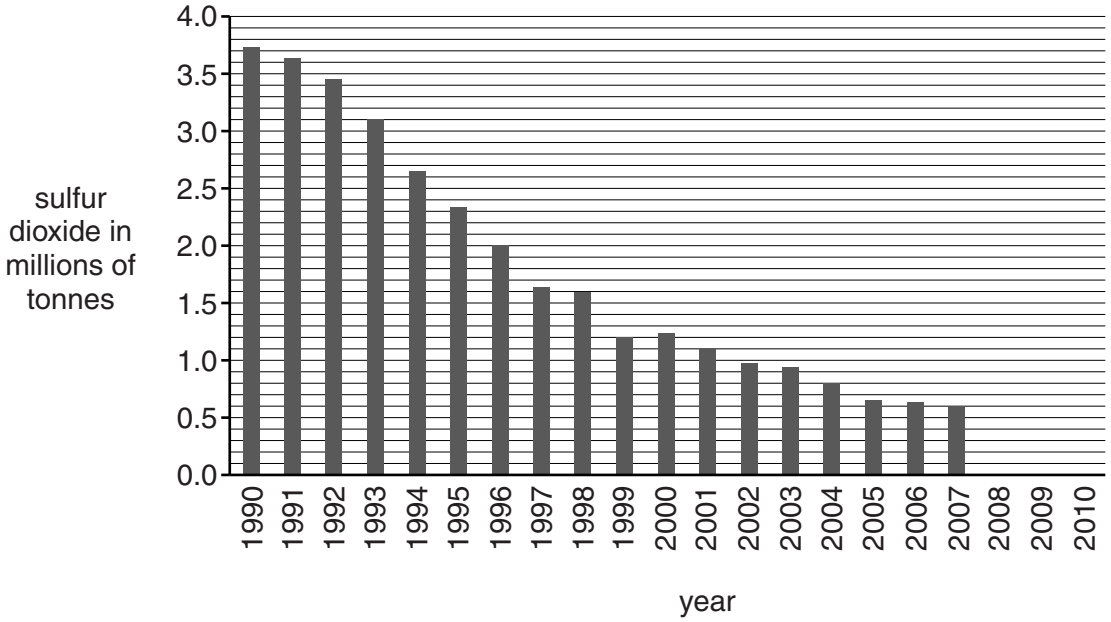
..... **[3]**

[Total: 7]

4 The chart shows how much sulfur dioxide entered the air in the UK each year from 1990 to 2007.



(a) Here are some statements about the chart.

They are either true or false.

Put a tick (✓) in the correct box next to each statement to show whether it is **true** or **false**.

	True	**False**
The average annual decrease in sulfur dioxide from 1999 to 2007 was 0.2 million tonnes / year.	☐	☐
From 1992 to 1997 the amount of sulfur dioxide put into the air each year decreased at a steady rate.	☐	☐
The biggest drop in the amount of sulfur dioxide put into the air from one year to the next was from 1993 to 1994.	☐	☐
The average annual decrease in sulfur dioxide was greater before 1999 than after 1999.	☐	☐
The amount of sulfur dioxide put into the air each year halved between 1999 and 2007.	☐	☐

[2]

(b) A scientist wants to find out if there is a correlation between

- the quantity of sulfur dioxide entering the air in the UK each year, and
- the quantity of electricity generated in the UK each year.

The scientist needs **extra data**, as well as the chart, to decide if there is a correlation.

Suggest what the scientist should do to find out if there is a correlation.

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

(c) Use the chart to estimate the amount of sulfur dioxide put into the atmosphere in 2010.

Give a reason for your answer.

answer .....million tonnes

reason .....

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

(d) Suggest why the amount of sulfur dioxide put into the atmosphere has changed since 2000.

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

[Total: 7]

5 **(a)** Nitrogen monoxide is an air pollutant.
It is made inside car engines when fossil fuels burn.

Explain how.

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

(b) Since 1993 new cars have been fitted with catalytic converters.
The table shows amounts of polluting gases in the exhaust gases from a car.
Pollutants are measured both before they enter the catalytic converter and after they leave it.

	Amount of pollutant in the exhaust gases		
	Carbon dioxide (%)	**Carbon monoxide (%)**	**Nitrogen monoxide (%)**
Before the catalytic converter	23	0.80	0.50
After the catalytic converter	25	0.15	0.10

Use the data in the table **and** your knowledge of these gases to explain how the catalytic converter is improving air quality.

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

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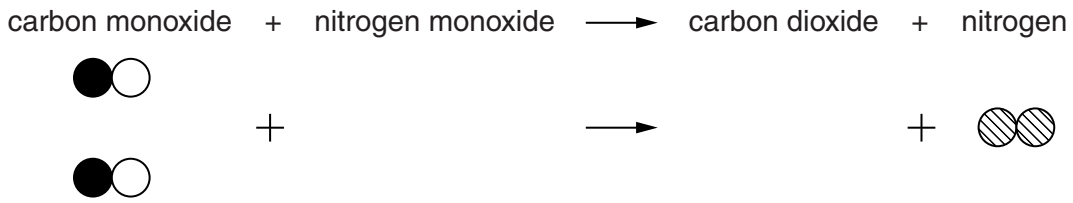
..... **[6]**

(c) In a catalytic converter carbon monoxide reacts with nitrogen monoxide to make carbon dioxide and nitrogen.

Complete the diagram to show this reaction.



[3]

(d) Some cars burn biofuels. These fuels are made from plants.
Some cars run on batteries. These batteries have to be charged up regularly.

The statements in the table show possible advantages of using biofuels and batteries in cars, instead of petrol or diesel.

Is each statement **true only for cars burning biofuels**, **true only for cars running on batteries**, **true for both** types of car, or **true for neither** of them?

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

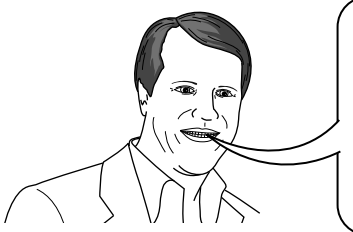
	True only for cars burning biofuels	**True only for cars running on batteries**	**True for both**	**True for neither**
Air quality in towns is improved.				
Demand for fossil fuels could be reduced.				

[2]

[Total: 13]

6 Five scientists are discussing the ages of the Universe and our solar system.

They are all referring to data from their research.

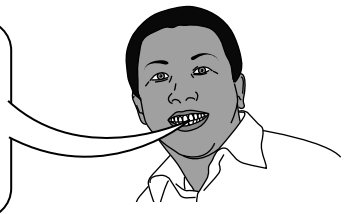


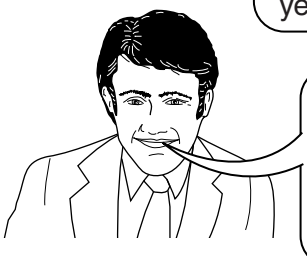
Dr Adams
I use a telescope to study the movement of galaxies. By analysing their distances and speeds, I found that the best estimate of the age of the Universe is 13.7 thousand million years old.

Dr Baker
I study rocks. The age of the oldest rocks on the surface of the Earth is about 3.8 thousand million years old.

Dr Curtis
I study the light from nearby stars. This shows me they are approximately 12 thousand million years old.

Dr Das
I study meteorites – bits of asteroid that get through our atmosphere. The oldest of these is around 5 thousand million years old.





Professor Eddington
I use satellite observations to study images from the Sun at different wavelengths. The Sun is less than 8 thousand million years old.

(a) Which three scientists study the radiation emitted from stars?

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

Dr Adams	☐
Dr Baker	☐
Dr Curtis	☐
Dr Das	☐
Professor Eddington	☐

[2]

(b) Use the data given by these scientists to choose the best estimate for the age of our **solar system**.

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

less than 3.8 thousand million years old	☐
between 3.8 and 5 thousand million years old	☐
between 5 and 8 thousand million years old	☐
between 8 and 12 thousand million years old	☐
between 12 and 13.7 thousand million years old	☐

[1]

(c) Which scientist expresses the most confidence in their data?

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

Dr Adams	☐
Dr Baker	☐
Dr Curtis	☐
Dr Das	☐
Professor Eddington	☐

[1]

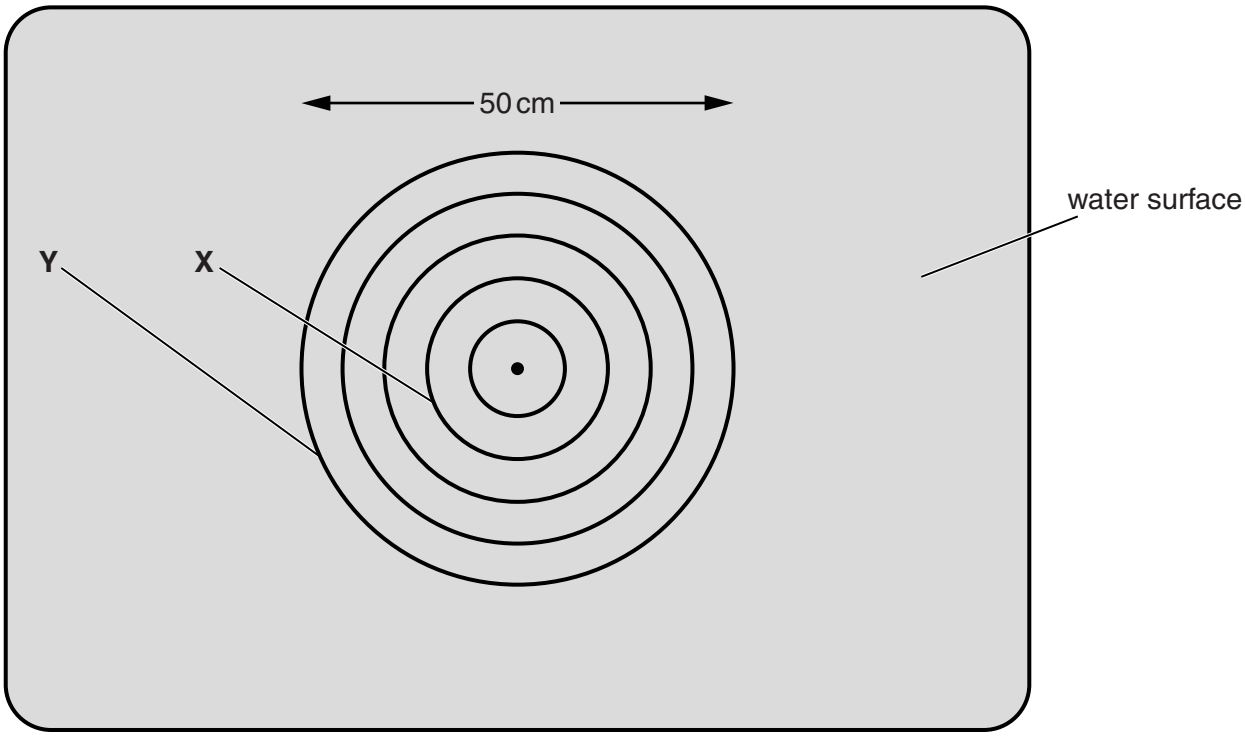
[Total: 4]

7 A fountain in the middle of a pond makes waves.

The diagram shows this fountain and pond from above.

Waves spread out from the fountain in a circular pattern, as shown.

Each circle shows the crest of a wave.



(a) Use information from the diagram to calculate the wavelength of the waves.

Show your working clearly.

wavelength = ... cm **[2]**

(b) It takes 1.2 seconds for the waves to move from **X** to **Y**.

Calculate the frequency of the waves.

Show your working clearly.

frequency = ...Hz **[2]**

(c) The fountain is adjusted.

The frequency of the waves doubles and the wavelength halves.

Explain what this tells you about the speed of the new waves.

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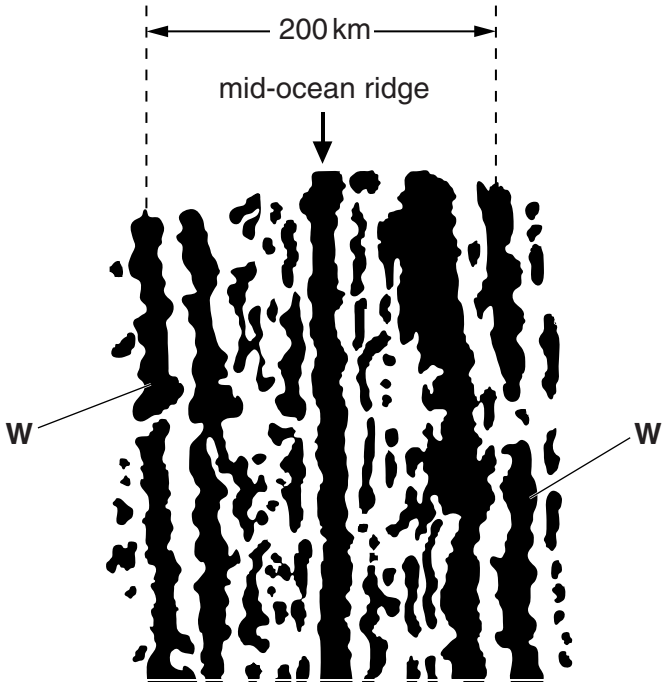
..... **[2]**

[Total: 6]

8 The diagram shows magnetic stripes near the mid-ocean ridge on the floor of the Atlantic Ocean, as viewed from above.



Rocks with normal magnetism are shown black in the diagram, while rocks with reversed magnetism are shown white.

(a) The Atlantic Ocean is getting wider at a rate of 2 cm per year at the present time.

(i) Which of the following is the best estimate, in years, of the age of the rocks in the stripes labelled **W**?

Choose from this list.

100 **200** **100 000** **200 000** **10 000 000** **20 000 000**

[1]

(ii) Explain why the age estimate in part **(a)(i)** is not likely to be accurate.

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

(iii) Which of the following is part of the correct explanation for the existence of these different magnetic stripes on the sea floor?

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

Different sedimentary rocks have different magnetic properties.	☐
Rocks change their magnetism after some time on the sea floor.	☐
The black and white stripes show different magnetic strengths.	☐
The Earth's magnetic field changes direction from time to time.	☐

[1]

(b) The discovery of these magnetic stripes supported the ideas of Wegener's theory.

This theory had been introduced 50 years previously but had not been believed by the scientific community.

Explain why Wegener's ideas were not accepted at the time they were proposed, but are accepted now.

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

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[Total: 10]

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