OCR RECOGNISING ACHIEVEMENT

F

Wednesday 9 January 2013 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE
SCIENCE A

A141/01   Modules B1 C1 P1 (Foundation 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

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.
* A list of useful relationships is printed on page 2.
* The total number of marks for this paper is **60**.
* This document consists of **24** pages. Any blank pages are indicated.

OCR is an exempt Charity

Turn over

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

PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

1 **(a)** This question is about inheritance.

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

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

nucleus

DNA

genes

protein

Chromosomes are made from a chemical called ....

Chromosomes in a pair always carry the same .... in the same place.

[2]

(b) The family tree shows the inheritance of a genetic condition called polydactyly.

People with polydactyly have extra fingers and toes.
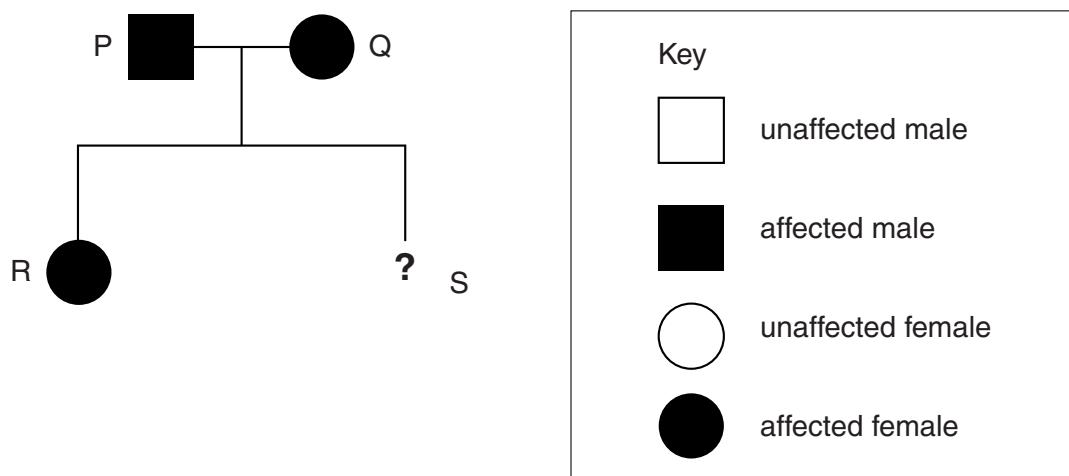
Karen looks at the family tree.

She thinks that the condition is caused by a recessive allele.

(i) Karen draws a Punnett square based on her assumption that the condition is caused by a recessive allele.

Complete Karen's Punnett square for the cross between individuals **P** and **Q**.

key

D = normal allele
d = polydactyly allele

		individual P	
		d	d
individual Q	d	....	....
	d	....	....

[1]

(ii) Karen finds out that individual S **does not** have polydactyly.

Should this alter her conclusion that polydactyly is caused by a recessive allele?

Explain your answer.

....

....

....

.... [2]

[Total: 5]

2 This question is about genetic testing.

(a) In December 2010, a baby boy was born to help save the life of his older sister.

She has a rare blood disease.

She needs regular blood transfusions in hospital and can't fight infections.

An embryo was selected because it had an identical tissue match to the ill child.

Once the baby boy was born, some of his bone marrow was given to his sister.

This helped treat her illness.

The baby boy was the first successful 'saviour sibling' born in the UK.

Testing embryos for embryo selection is used to create 'saviour siblings'.

Here are some steps in this procedure.

   A The embryos are genetically tested.

   B A selected embryo develops into a baby.

   C Embryos with an identical tissue match to the ill child are selected.

   D Some of the mother's sex cells are removed from her body.

   E A number of embryos are produced.

   F The cells are fertilised by the father's sperm in a laboratory.

   G Some of these embryos are implanted into the mother.

Write the letters in the boxes to show the correct order.

One has been done for you.

			A			

[2]

(b) Genetic testing can also be carried out on fetuses.

Examples are:

- testing to find out if a fetus has a genetic disease
- testing the sex of a fetus.

Discuss the different views that people have about genetic testing on fetuses, using these examples to help you.

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

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.... **[6]**

[Total: 8]

3 William takes some cuttings from a geranium plant.

All the cuttings are clones.

(a) What is a clone?

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

individuals that have different characteristics ☐

individuals that have identical genes ☐

individuals that look the same ☐

individuals that show some variation ☐

[1]

(b) Write down one way in which clones of plants can occur **naturally**.

.... **[1]**

(c) William puts his cuttings in the garden for four weeks.

He randomly selects 50 cuttings and measures their height.

Here are his results.

Height range in cm	Number of plants
< 16	0
16.0 – 17.9	5
18.0 – 19.9	12
20.0 – 21.9	19
22.0 – 23.9	10
24.0 – 25.9	3
> 25.9	1

(i) Look at the table of results and use it to complete the sentence.

The greatest number of plants lie within the height range .... to

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

(ii) William draws a sketch to show the pattern of his results.
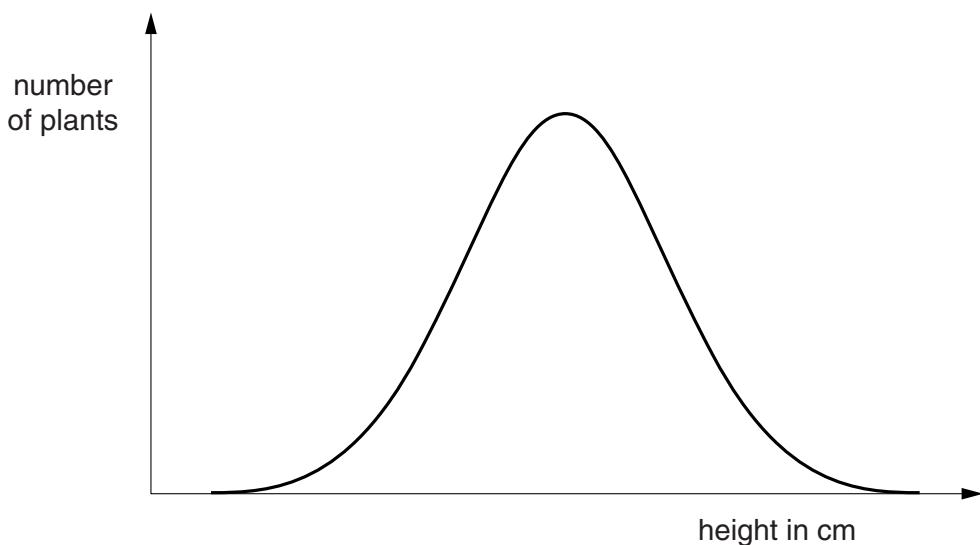
Describe the pattern shown by the sketch.

....

....

....

.... **[2]**

(iii) William's friend, Karen, looks at the data.

Karen does not think all the plants can be clones because they are different heights.

William insists they are clones, but says there are other ways of explaining why they are different heights.

Use your knowledge and the data to explain why William is correct.

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.... **[2]**

[Total: 7]

Turn over

4 Cars use petrol as a fuel.

When petrol burns in a car engine it makes air pollutants.

(a) (i) Look at the formulae and diagrams of the molecules for some air pollutants.

Draw a straight line from each **formula** to the **diagram** of its molecule.

Use the key to help you.

One has been done for you.

formula	**diagram**

CO_2

CO

NO_2

NO

Key
● carbon
⬱ nitrogen
○ oxygen
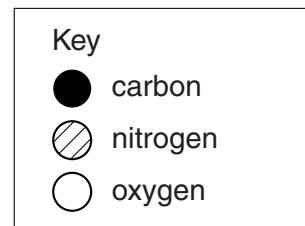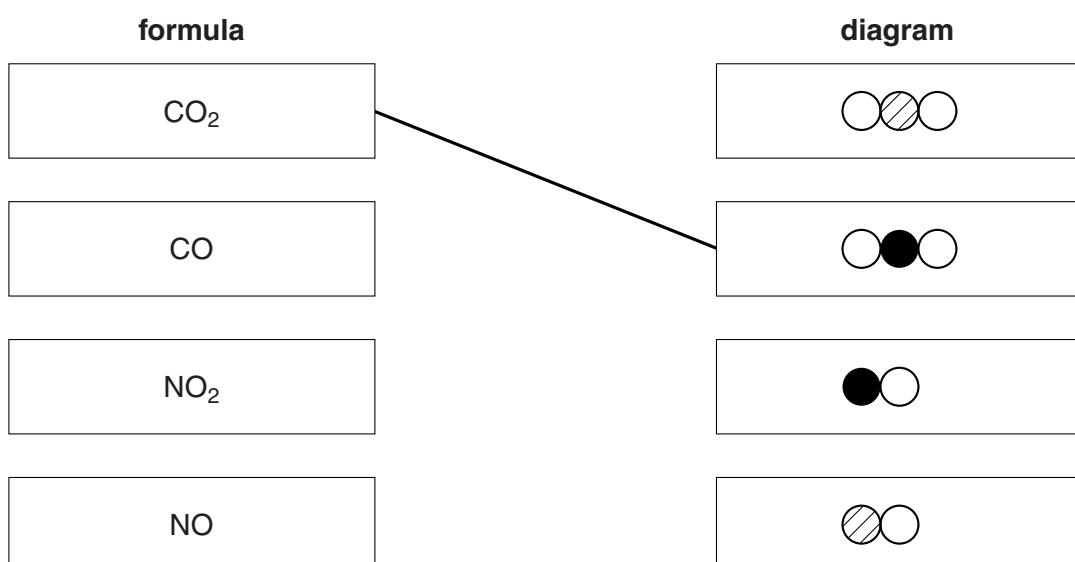
[2]

(ii) Explain how nitrogen monoxide is made in a car engine.

....

....

....

....**[2]**

(b) The concentrations of pollutants in the air are measured at the roadside.

The concentration of nitrogen dioxide is **much lower** when it is raining.

Why is the concentration lower when it is raining?

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

Plant photosynthesis increases when it rains. ☐

Nitrogen dioxide reacts with oxygen and water to make an acid. ☐

Nitrogen dioxide is left on surfaces. ☐

Rain washes surfaces clean. ☐

Rain washes acids out of the air. ☐

[2]

[Total: 6]

5 Look at the graphs about air pollution in the USA.

Graph 1 shows the predicted change in air pollution from 2020 to 2090 if all new cars run on petrol.

Graph 2 shows the predicted change in air pollution from 2020 to 2090 if all new cars are powered by electricity.

graph 1 – new cars run on petrol　　　　**graph 2 – new cars powered by electricity**
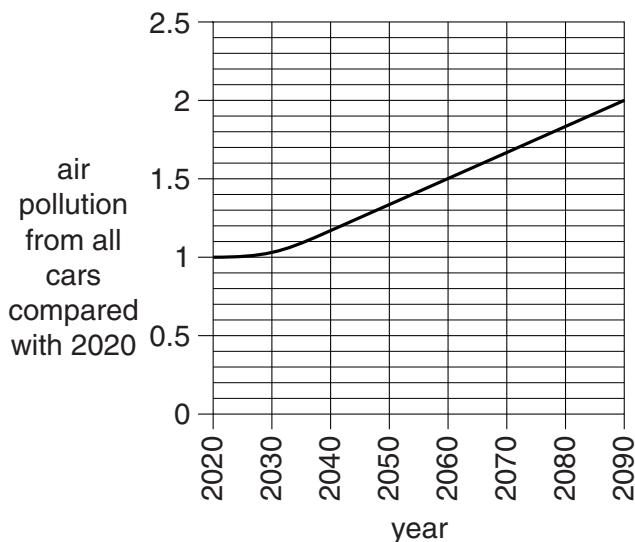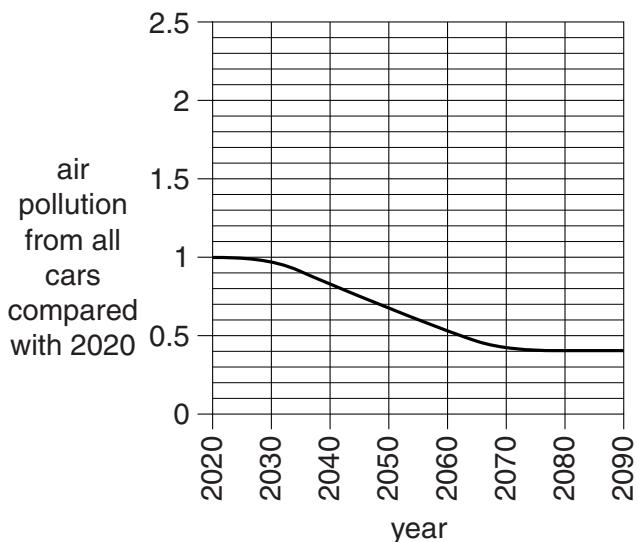
(a) Which of these statements explain the shape of graph 1?

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

More people are travelling on public transport. ☐

People drive further each year. ☐

Engines are more efficient. ☐

Car sharing is more popular. ☐

More cars are being driven. ☐

[2]

(b) Use graph 2 to describe how the air pollution from cars is predicted to change if all new cars are powered by electricity.

....

....

....

.... **[2]**

(c) A politician says that all new cars should be powered by electricity.

Use **both** graphs to explain why this is a good idea.

....

....

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.... **[2]**

[Total: 6]

Turn over

6 Some scientists have estimated the composition of the Earth's atmosphere **4000** million years ago and **1000** million years ago.

Here are the scientists' data.

	Composition of atmosphere % by volume	
	4000 million years ago	**1000 million years ago**
Carbon dioxide	82.0	48.0
Oxygen	0.0	
Water vapour	12.0	2.0
Other gases	6.0	47.5
Total	100.0	100.0

(a) Calculate the percentage of oxygen in the atmosphere **1000** million years ago.

Show your working.

.... **[2]**

(b) Between 4000 million years ago and 1000 million years ago:

- the Earth cooled down
- simple plant life evolved.

Look at the table.

Describe how the percentages of carbon dioxide, oxygen and water changed during this time.

Explain how these changes happened.

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

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.... **[6]**

[Total: 8]

7 Read the article.

In August 2010 there were two earthquakes in the region between China and Australia. The first, at Papua New Guinea, was of magnitude 6.4. The primary (P) wave was followed a quarter of an hour later by the secondary (S) wave, which was followed immediately by two small 'aftershocks'. About 11½ hours later there was a slightly weaker earthquake 34 km below the sea floor at Simeulue.

earthquake detector
in Thailand

Simeulue

Papua New Guinea

The graphs show two recordings made by an earthquake detector in Thailand.

Papua New Guinea earthquake
evening of 20 August 2010

A   B   C   D

18:10   18:20   18:30   18:40   18:50
time of day (hours:minutes)
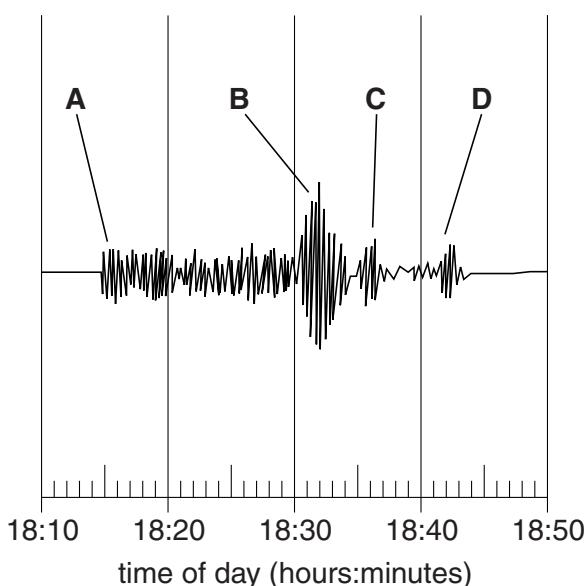
Simeulue earthquake
morning of 21 August 2010

5:30   5:40   5:50   6:00   6:10
time of day (hours:minutes)
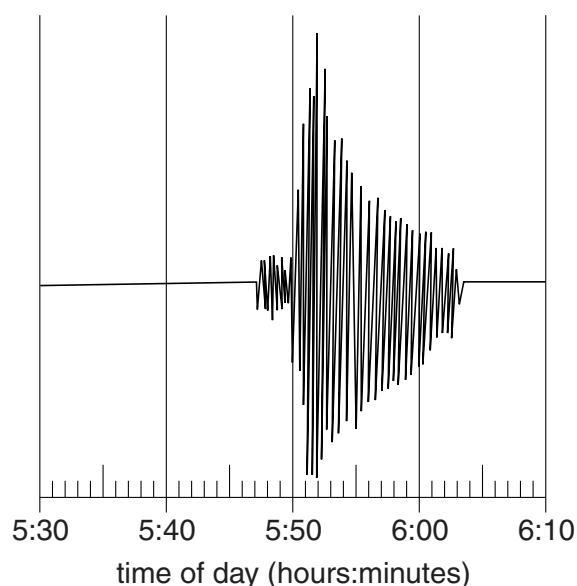
(a) Choose from the letters **A**, **B**, **C** and **D** from the **Papua New Guinea** graph above to identify the following parts of the recording.

primary (P) wave ....

secondary (S) wave ....

[2]

(b) (i) The **Simeulue** earthquake began at 5:43.

How many minutes did it take for the first of the earthquake waves to reach the detector in Thailand?

time to reach detector = ... minutes **[1]**

(ii) The speed of this earthquake wave was 420 km/minute (7 km/second).

Calculate the distance in km from Simeulue to the detector in Thailand. Use the following equation.

distance = speed × time

Show your working clearly.

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.... **[2]**

(iii) At the places where they started, the Simeulue earthquake was weaker than the Papua New Guinea earthquake.

However, the Simeulue earthquake caused **more** damage in Thailand than the Papua New Guinea earthquake.

Use the map and the two recordings to explain why.

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.... **[2]**

[Total: 7]

Turn over

8 The table shows the distances to four different galaxies, **A**, **B**, **C** and **D**, and the speed with which these galaxies are moving.

Galaxy	A	B	C	D
Distance (millions of light years)	300	800	1000	3000
Speed (km/s)	6500	18 000	21 000	67 000

(a) Describe the correlation shown by the data in this table.

....

....

.... **[1]**

(b) Another galaxy, **E**, is at a distance of 900 million light years.

Use the information in the table to estimate the speed of Galaxy **E**.

Show how you found your answer.

speed = ... km/s **[2]**

(c) Here are some statements about galaxies.

Only **two** of them are true.

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

The Milky Way is a galaxy. ☐

The Universe contains 300 000 galaxies. ☐

Some galaxies are bigger than the Universe. ☐

Distant galaxies are all moving away from us. ☐

Spacecraft have been sent to nearby galaxies. ☐

[2]

(d) Which measurements of distant galaxies are needed to predict the fate of the Universe?

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

their motion ☐

their shapes ☐

their distances ☐

their temperatures ☐

the number of stars in them ☐

[2]

[Total: 7]

Turn over

9 The diagram shows a section through the Earth's crust near the centre of the Atlantic Ocean.
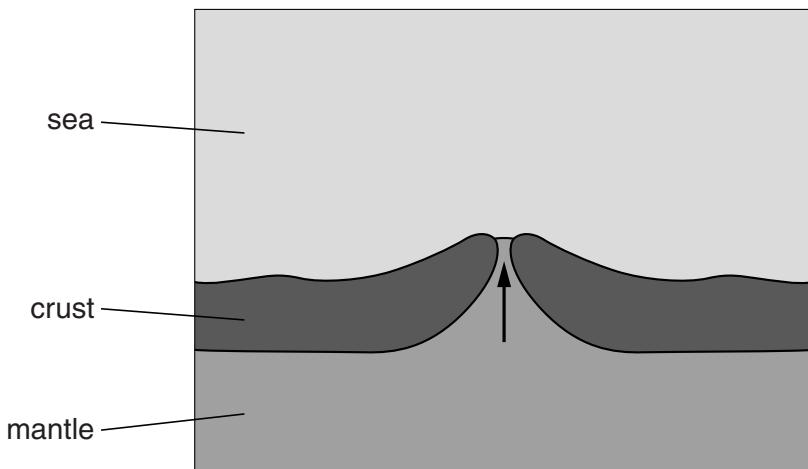
In the 1950s, it was discovered that the Atlantic seafloor is spreading. This discovery made scientists develop new explanations for the behaviour of the Earth's crust and mantle.

Discuss this discovery and the new explanations that were developed for it.

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

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.... **[6]**

[Total: 6]

END OF QUESTION PAPER

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