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Friday 3 November 2017 – Afternoon

GCSE TWENTY FIRST CENTURY SCIENCE PHYSICS A / SCIENCE A

A181/01 Modules P1 P2 P3 (Foundation Tier)

2769812637

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

A181101

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. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with a pencil (✎).
- A list of physics equations 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 **16** pages. Any blank pages are indicated.

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TWENTY FIRST CENTURY SCIENCE DATA SHEET

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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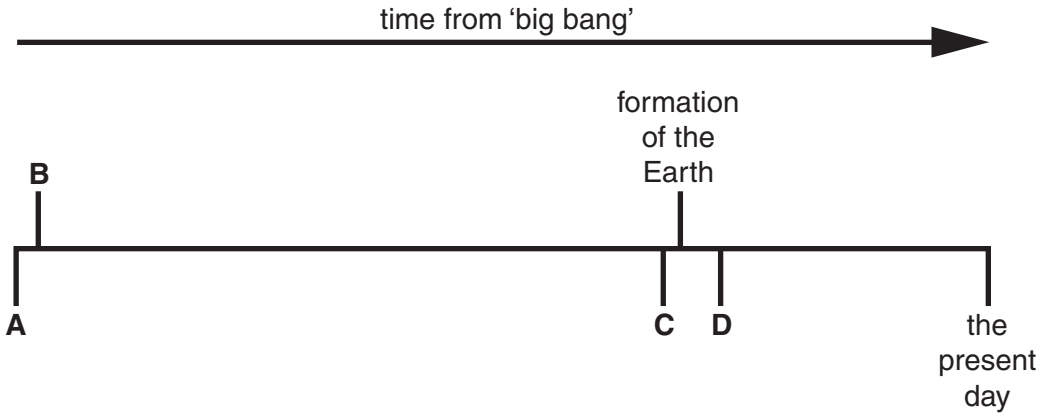
Answer **all** the questions.

1 **(a)** The timeline below shows the whole history of the Universe, starting at the 'big bang'.



(i) Which of **A**, **B**, **C** and **D** is the beginning of life on Earth?

answer .....

(ii) Which of **A**, **B**, **C** and **D** is the time when the Sun started giving out energy?

answer .....

(iii) Which of **A**, **B**, **C** and **D** is the formation of the first galaxies?

answer .....

[3]

(b) The sentences below describe parts of the Universe.
Complete the sentences using the **best** words from the list.

asteroid

dust

galaxy

moon

planet

star

Our solar system was formed from a cloud of gas and ..... .

At its centre is a ..... called the Sun, which is one among thousands of millions found in the Milky Way ..... .

An object which orbits a planet is called a ..... .

[3]

[Total: 6]

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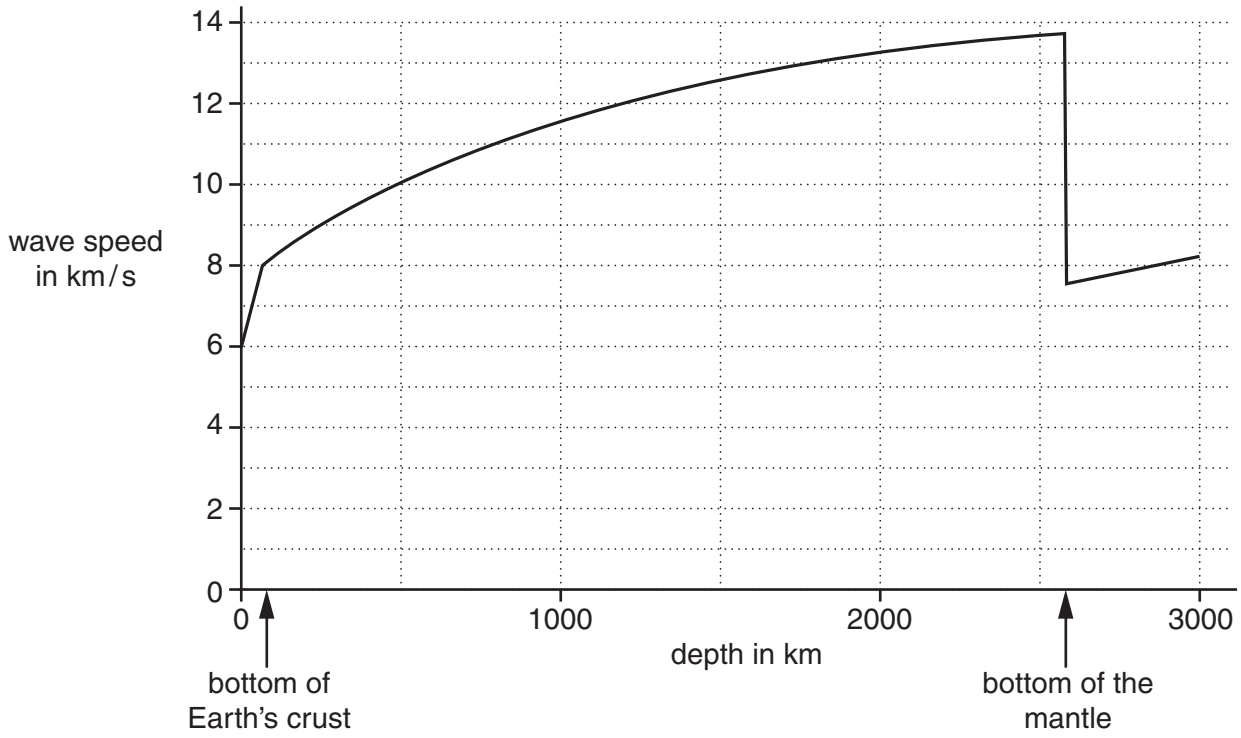
2 The boxes below show three quantities and their values.
Draw one straight line from each **quantity** to its correct **value**.

quantity	value
the speed of light in km/s	5000
the age of the Universe in millions of years	14 000
the age of the solar system in millions of years	300 000

[2]

[Total: 2]

3 The graph shows how the speed of earthquake P-waves changes as they travel deeper into the Earth.



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Describe how the speed of the P-waves changes with depth, and suggest reasons for these changes based on your knowledge of the structure of the Earth.

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

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

[Total: 6]

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4 The table shows data for P-waves and S-waves produced by an earthquake.
Each type has a range of frequencies.

Type of wave	Speed in m/s	Smallest frequency in Hz	Largest frequency in Hz
P-wave	7000	2	10
S-wave	4000	2	10

(a) Use the equation

$$\text{wavelength} = \frac{\text{speed}}{\text{frequency}}$$

to calculate the **longest** wavelength of any of these waves.

wavelength = ... m **[2]**

(b) There is an earthquake 500 km away from a city.
Use the equation

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

to calculate the time taken for S-waves to reach the city.

time = ... seconds **[2]**

(c) It is now accepted that most earthquakes are caused by the movement of tectonic plates.
When this theory was first proposed, it was rejected by many scientists.
Suggest reasons why these scientists did not accept this theory.

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

[Total: 6]

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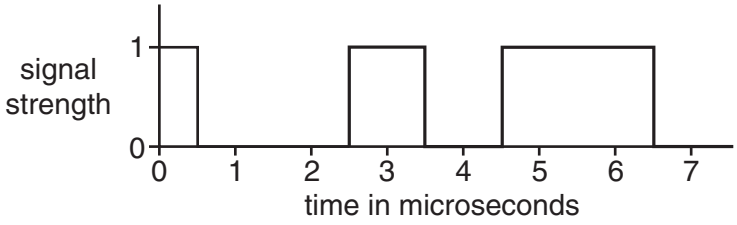
5 The diagram shows a signal carrying information.



(a) The signal has only two possible values, 0 or 1.
What is the name for this type of signal?

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

(b) Write down the code for this signal.
The first two values have been done for you.

Time in microseconds	0	1	2	3	4	5	6	7
Signal strength	1	0	.....	.....	.....	.....	.....	.....

[2]

(c) Each pulse of this signal lasts for 1 microsecond.
New computing networks have pulses that last for 0.01 microseconds.
Explain an advantage of having shorter times for each pulse.

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

[Total: 5]

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6 **(a)** The table shows different regions of the electromagnetic spectrum in terms of their frequency.

Frequency	Region of electromagnetic spectrum
Low to medium	Radio, microwave, infrared, visible light
High to extremely high	Ultraviolet, X-rays, gamma rays

Use information from the table to explain why ultraviolet, X-rays and gamma rays are dangerous to living things.

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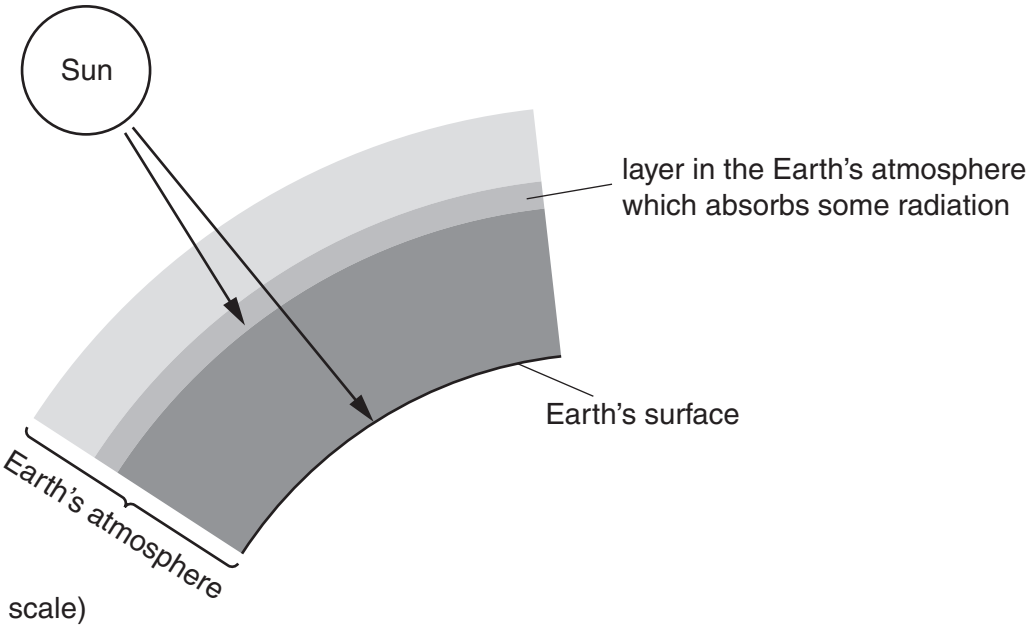
..... **[2]**

(b) The diagram below shows how some radiation from the Sun reaches the Earth, but some does not.



(not to scale)

Use the diagram and the table in part **(a)** to explain how the atmosphere protects living things.

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

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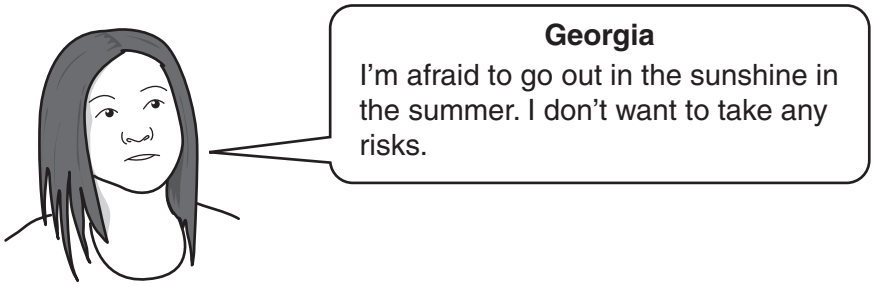
(c) Georgia is worried about the risks from the Sun's radiation.



Suggest some benefits from being in the sunshine and explain how Georgia can take precautions to reduce any risks.

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

[Total: 7]

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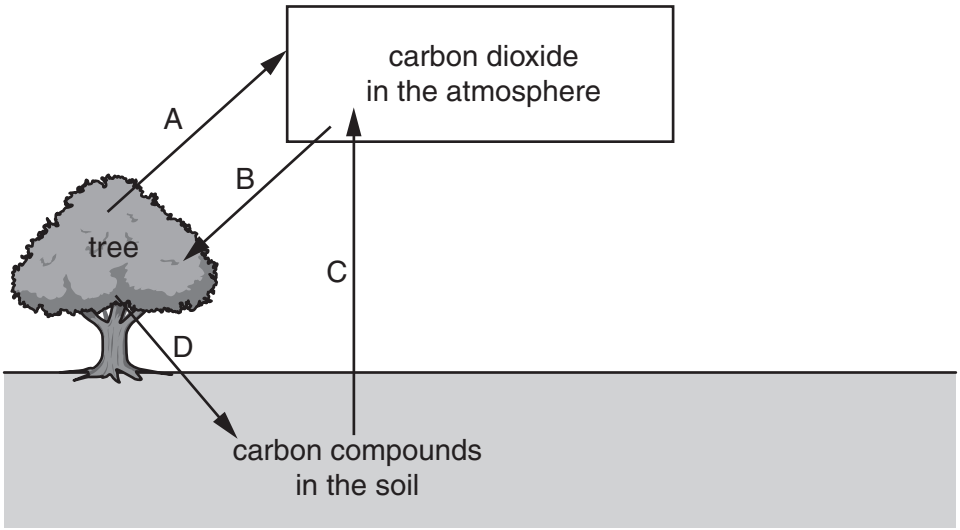
7 **(a)** The diagram shows **part** of the carbon cycle.



The carbon dioxide levels in the atmosphere were approximately constant for thousands of years but have risen steadily over the past two hundred years.

Use the diagram and other ideas to explain this.

You may add to the diagram to help your answer.

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

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

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(b) Carbon dioxide is not the only important greenhouse gas.
Some of the other gases in the Earth's atmosphere are listed below.
Put ticks (✓) in the boxes next to the **two** greenhouse gases.

argon	☐
hydrogen	☐
methane	☐
nitrogen	☐
oxygen	☐
water vapour	☐

[2]

[Total: 8]

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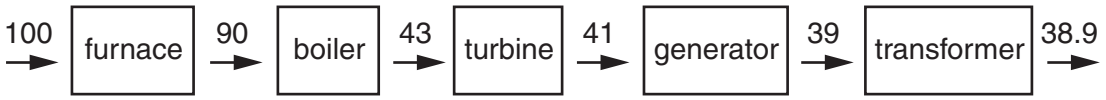
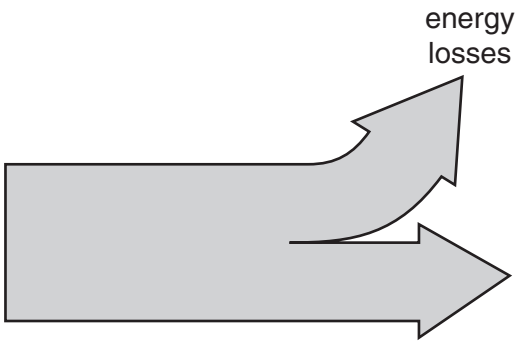
8 The block diagram below represents a coal-burning power station.
The numbers show the energy in megajoules going into and out of each stage each second.



(a) Which stage loses the **least** energy?

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

(b) The Sankey diagram below shows the energy transfers at one of the stages in the coal-burning power station.



Which stage is this?

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

(c) Calculate the efficiency of the turbine.

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

[Total: 4]

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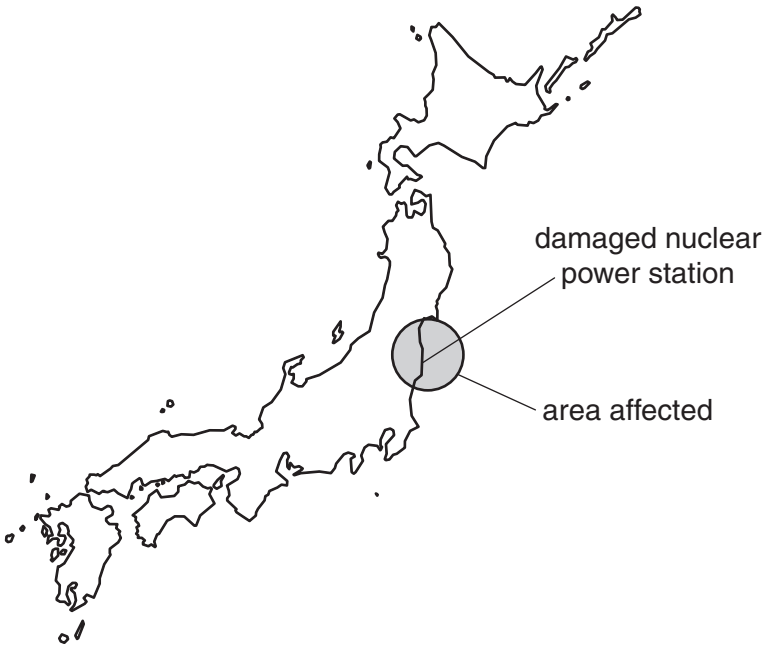
9 In March 2011, an earthquake and tsunami caused serious damage to a nuclear power station in Japan and spread radioactive materials over the area shown on the map.



Children are more sensitive to radiation than adults. The Japanese government told schools in the affected area to remove the top layer of soil from the school grounds and to bury it deep underground.
Explain why this was a sensible plan.

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

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

[Total: 6]

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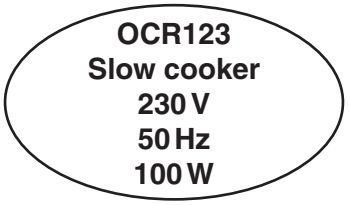
10 A slow cooker has a low power. It takes eight hours to cook a meal.
The diagram below shows the information plate on the bottom of a slow cooker.



(a) Use this information to calculate the electric current for this slow cooker.
Put a (ring) around the **closest** value in amperes.

0.22 **0.43** **2.3** **4.0**

[1]

(b) **(i)** What is the power of this slow cooker in kilowatts?
Put a (ring) around the correct value in kW.

0.1 **10** **100** **1000**

[1]

(ii) Calculate the cost of using the slow cooker for 8 hours.
1 kilowatt hour costs 20p.

cost = ... p **[2]**

(c) An ordinary oven could be used instead of the slow cooker.
The ordinary oven has a power of 3000 watts and cooks the meal in 2 hours.
Suggest one advantage and one disadvantage of using a slow cooker instead of an ordinary oven.

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

[Total: 6]

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11 The amount of energy lost each second by a house depends on the temperature difference between the inside and the outside.
The table gives government statistics for an average house in the UK in two different years.

Year	Energy loss in joules per second for every degree difference			
	Walls	**Windows**	**Roofs**	**Floors**
1970	130	70	65	21
2005	105	50	20	25

(a) Suggest reasons for the change in energy loss through roofs and floors.

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

(b) The data in the table are for the years 1970 and 2005 only.
Using only these two years might not give a true value of the trends in reducing energy demands in the home.
Suggest reasons why.

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

[Total: 4]

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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