OCR
Oxford Cambridge and RSA

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Wednesday 24 May 2017 – Afternoon

GCSE TWENTY FIRST CENTURY SCIENCE PHYSICS A/SCIENCE A

A181/01 Modules P1 P2 P3 (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

* A 1 8 1 0 1 *

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.

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

Answer **all** the questions.

1 The table below shows four different ages.

A	the age of the Sun
B	the age of the Earth
C	the age of the Universe
D	the age of the Milky Way

(a) Which one of these is the **oldest**?

Put a (ring) around the correct answer.

The oldest of the four ages is **A** **B** **C** **D**.

[1]

(b) Which one of these is the **youngest**?

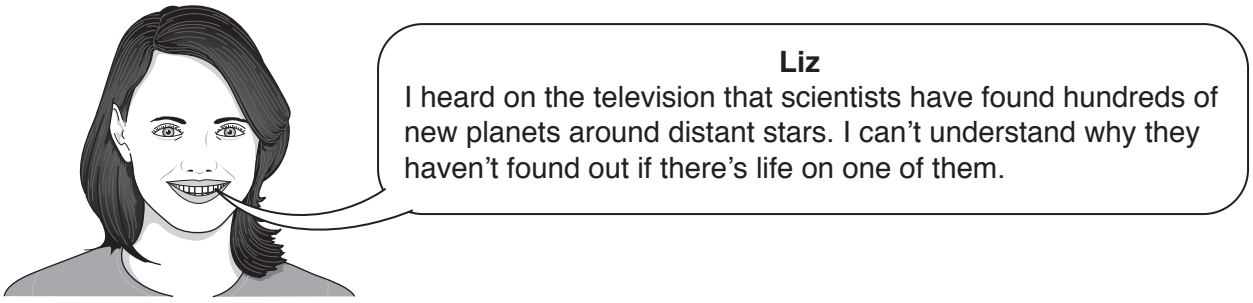
Put a (ring) around the correct answer.

The youngest of the four ages is **A** **B** **C** **D**.

[1]

[Total: 2]

2 Liz is very interested in the possibility of life on other planets.



Explain to Liz why it is very hard to find out if there is anything living on these new planets.

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

[Total: 2]

3 Below are four statements, **W**, **X**, **Y** and **Z**, about earthquake P-waves and S-waves.

Each statement is true.

Use these four statements to answer parts **(a)**, **(b)** and **(c)**.

W	P-waves move faster than S-waves.
X	Both P-waves and S-waves can travel through the Earth's mantle.
Y	P-waves can travel through the Earth's core, but S-waves cannot.
Z	Both P-waves and S-waves can be detected by seismometers on the surface of the Earth.

(a) Which one statement, **W**, **X**, **Y** or **Z**, shows that the Earth's core is liquid? ..... **[1]**

(b) Which one statement, **W**, **X**, **Y** or **Z**, shows that the Earth's mantle is solid? ..... **[1]**

(c) P-waves travel at a speed of 8000 m/s.

Which **one** of the following could be the speed of S-waves?

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

4000 m/s ☐

8000 m/s ☐

12 000 m/s ☐

[1]

[Total: 3]

4 The stars are tiny points of light. Since the beginning of the 19th century scientists have discovered what they are and how far away they are.

There are also faint smudges of light in the night sky called galaxies, but no-one knew what they were until less than a hundred years ago.

Explain what stars and galaxies are, and how the information about them was discovered.

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

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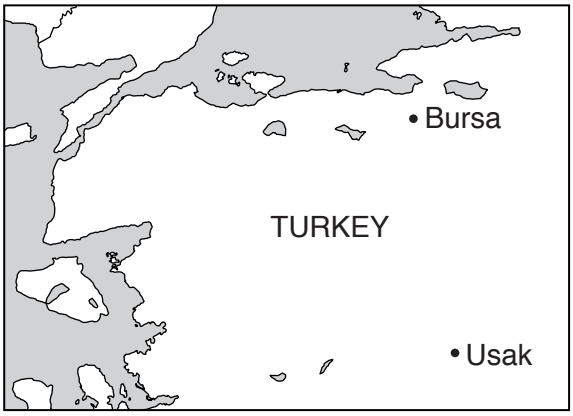
..... **[6]**

[Total: 6]

5 This question is about earthquakes in Turkey.

(a) P-waves travel at 8000 m/s from a small earthquake in Usak in Turkey. They are detected in Bursa 21 seconds later.



Calculate the distance from Usak to Bursa.

distance = ... m **[2]**

(b) Earthquakes are common in Turkey but are very rare in Britain.

Which of the following statements is the best explanation for this difference?

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

There are no volcanoes in Britain. ☐

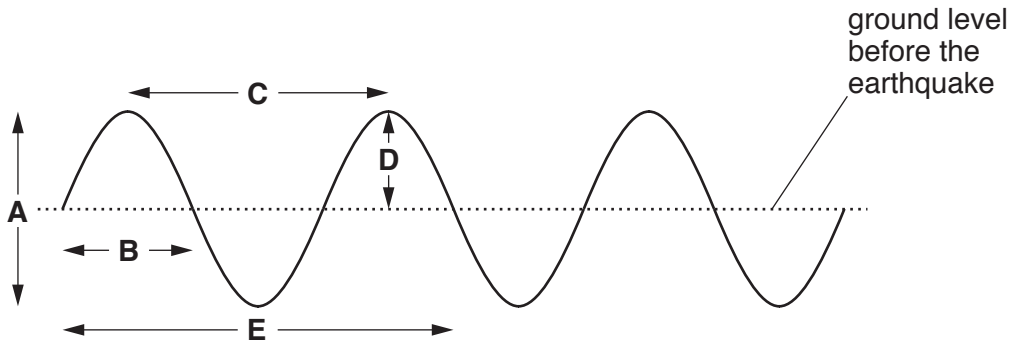
Turkey is at the edge of a tectonic plate. ☐

Britain is surrounded by sea on all sides. ☐

Turkey is nearer to the equator than Britain. ☐

[1]

(c) The diagram below shows the ground moving when an earthquake wave passes. The dotted line shows the ground level before the earthquake arrived.



The wave diagram has five different arrows labelled **A**, **B**, **C**, **D** and **E**.

(i) Which arrow, **A**, **B**, **C**, **D** or **E**, shows the **amplitude** of the wave?

the amplitude is shown by arrow ..... **[1]**

(ii) Which arrow, **A**, **B**, **C**, **D** or **E**, shows the **wavelength** of the wave?

the wavelength is shown by arrow ..... **[1]**

(iii) The wave in the diagram has a wavelength of 1 km and a frequency of 2 Hz.

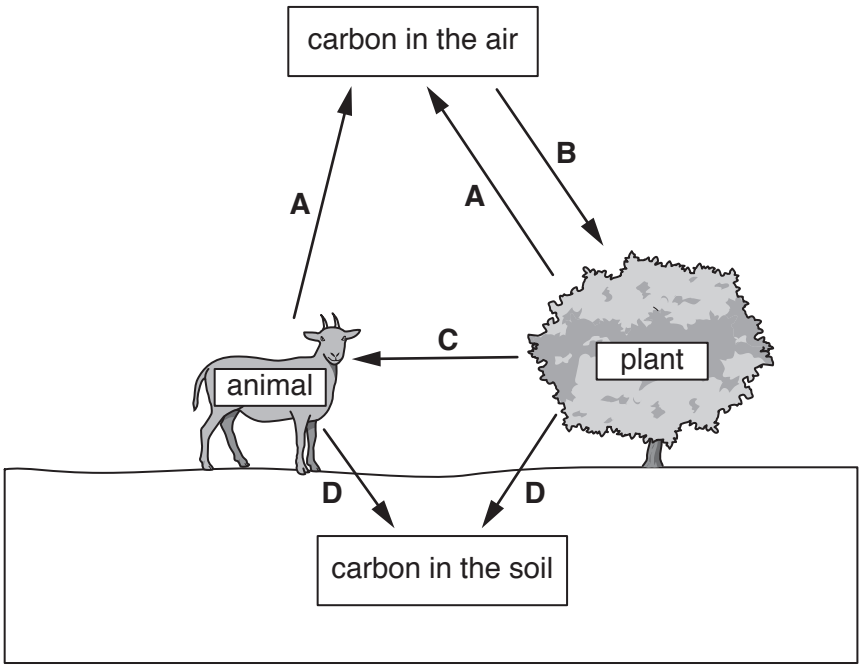
Calculate the speed of the wave in m/s.

Show your working.

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

[Total: 7]

6 The diagram shows part of the carbon cycle.



(a) For each of the following, the answer is one of the processes **A**, **B**, **C** and **D** in the diagram above.

(i) Which one is photosynthesis? answer ……...

[1]

(ii) Which one is respiration? answer ……...

[1]

(b) The amount of carbon dioxide in the atmosphere stayed constant for a very long time.

Use the correct scientific terms to explain why the amount of carbon dioxide did not change.

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

(c) Over the last two hundred years, the amount of carbon dioxide in the atmosphere has increased steadily.

Write down **two** reasons for this increase.

1 .....

2 .....

[2]

[Total: 6]

7 This table shows the radiations of the electromagnetic spectrum.
Two of the radiations are labelled **A** and **B** instead of using their correct names.

radio waves	**A**	**infrared**	**visible**	**B**	**X-rays**	**gamma rays**

(a) What are radiations **A** and **B**?

A is ……..…….……. **B** is ……..…..…….

[2]

(b) Which of the radiations in the table has the highest frequency?

The highest frequency radiation is ……..…….

[1]

(c) Write down the name of **two** radiations which are ionising.

…….……..……. and ……...……. are both ionising radiations.

[1]

(d) Write down the name of **one** radiation in the table which is used to carry information along optical fibres.

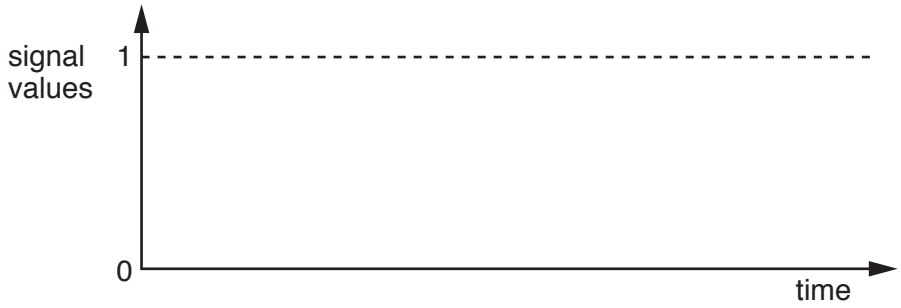
……...……. is used in optical fibres.

[1]

[Total: 5]

8 This question is about digital signals.

(a) On the graph axes below, sketch a graph to show how a digital signal changes with time.



[1]

(b) Radio and television are now both sent as digital signals.

Explain why a half-hour television programme and a half-hour radio programme need different numbers of bytes of information.

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

[Total: 3]

9 Read this article about a danger to life on Earth.

> Ultraviolet radiation from the Sun can be very dangerous to living things. In the 1970s, it was found that a natural layer of the atmosphere which blocks ultraviolet was getting very thin. This was caused by chemicals released when spray cans and fridges were thrown away.
>
> Action has been taken around the world to change the chemicals used in spray cans and fridges. This has helped to reduce the danger.

Using the correct scientific terms, describe the danger to life mentioned in the article, and the way in which it has been reduced.

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

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[Total: 6]

10 Complete the sentences below.
Use the best words from the list.

fossil **primary** **secondary** **solar**

Energy sources, such as coal, are used to make electricity, so electricity is called a ……. energy source.

Coal is the remains of long-dead plants, so it is called a ……. fuel.

[2]

[Total: 2]

11 A small hydroelectric power station is generating electricity.

For every 2000 J of total energy input, the energy wasted is 1200 J.

(a) Calculate the energy usefully transferred.

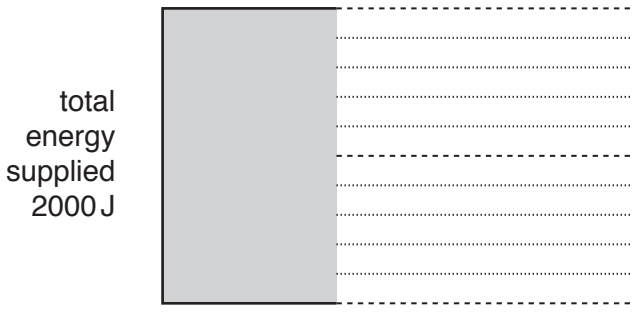
energy usefully transferred = ...J **[1]**

(b) Calculate the efficiency of the power station expressed as a percentage.

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

(c) Complete the following Sankey diagram (energy flow diagram) for the 2000 J supplied to this power station.

Make sure the output energies are drawn to the same scale as the energy supplied and are correctly labelled. The dotted lines are included to help you draw the energy outputs correctly.



[2]

[Total: 5]

12 **(a)** A washing machine, of power 2 kW, is being used all day.

(i) How many kWh of electrical energy are transferred in 12 hours?

Put a (ring) around the correct number.

2 **6** **12** **24**

[1]

(ii) On a different day, the washing machine transfers 18 kWh of electrical energy.

Each kilowatt hour costs 15 p.

What is the cost of the electrical energy transferred on this day?

Put a (ring) around the correct cost.

£1.20 **£2.70** **£120** **£270**

[1]

(b) A heater draws a current of 10 A from the 230 V mains electricity supply.

Calculate the energy transferred **in kilowatt hours** (kWh) when the heater is left on for 30 minutes.

energy transferred = ... kWh **[3]**

(c) The lamp in a torch draws a current of 0.6 A from a 3.0 V battery.

Calculate the energy transferred **in joules** (J) when the torch is left on for 5 minutes.

energy transferred = ...J **[2]**

[Total: 7]

13 New providers of electricity are attempting to gain customers who are concerned about the environment.

Here is the advertisement for one provider:

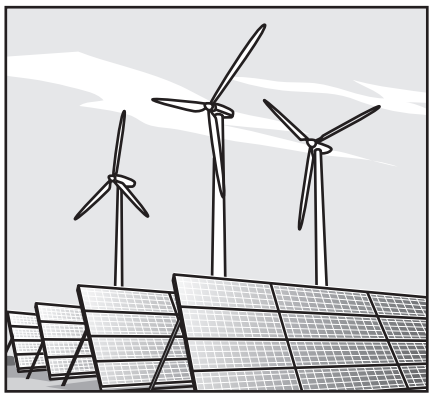
OCR Green Energy – the way forward

Change to our company, and we can guarantee that all your electricity will come from renewable sources – wind, solar, water and biofuel.

Do your bit to combat global warming!

And that's not all – we're cheaper than the big energy suppliers, too!

For more information, see our website www.OCRGreen.com



A householder is thinking about changing to this energy provider.

Discuss the advantages and disadvantages, for the householder and for the country as a whole, of making this change.

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

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

[Total: 6]

END OF QUESTION PAPER

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).