OCR
Oxford Cambridge and RSA

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Wednesday 25 May 2016 – 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

A181/01

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 bar codes.

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

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

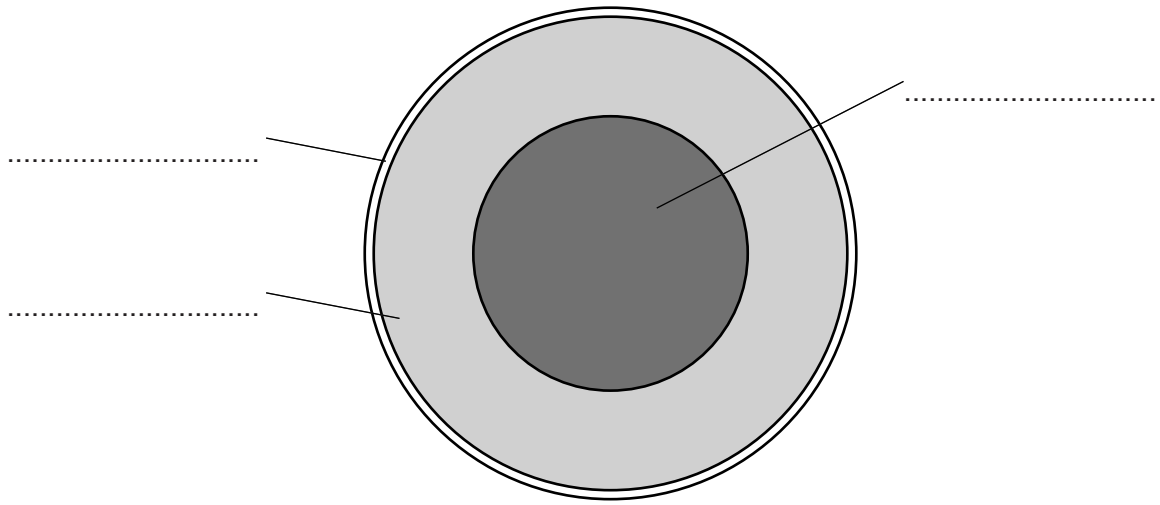
$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

Radioactive materials

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

Answer **all** the questions.

1 The diagram shows a section through the Earth.



Label the three parts shown. Choose from these terms:

core **crust** **Moon** **mantle** **nucleus**

[3]

[Total: 3]

2 Astronomers find it very difficult to predict how the Universe will end.

Which of the following statements are correct reasons for this difficulty?

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

Galaxies contain thousands of millions of stars.	☐
It is hard to measure large distances accurately.	☐
They would have to wait until the end to find out.	☐
It is hard to study the motion of very distant objects.	☐
The Universe contains thousands of millions of galaxies.	☐

[2]

[Total: 2]

3 The table below shows some distances in order from the smallest to the largest.
There are three gaps in the table marked **A**, **B** and **C**.

A	(smallest)
The diameter of the Sun.	
B	
The diameter of the solar system.	
C	
The diameter of the Milky Way.	
The distance from the Milky Way to the nearest galaxy.	(largest)

The distances missing from the table are given below.
Next to each distance, write its correct place in the table (**A**, **B** or **C**).

The distance from the Sun to the nearest star. .....

The diameter of the Earth's orbit. .....

The diameter of the Earth. .....

[2]

[Total: 2]

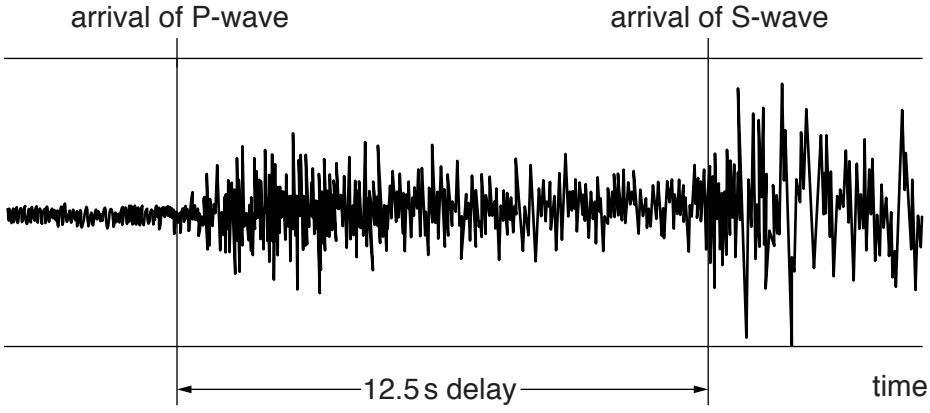
4 An earthquake happened 100 km away from town **A**.

(a) The P-waves arrived at town **A** 12.5 s later.

(i) Calculate the speed of the P-waves.

speed = ...km/s **[1]**

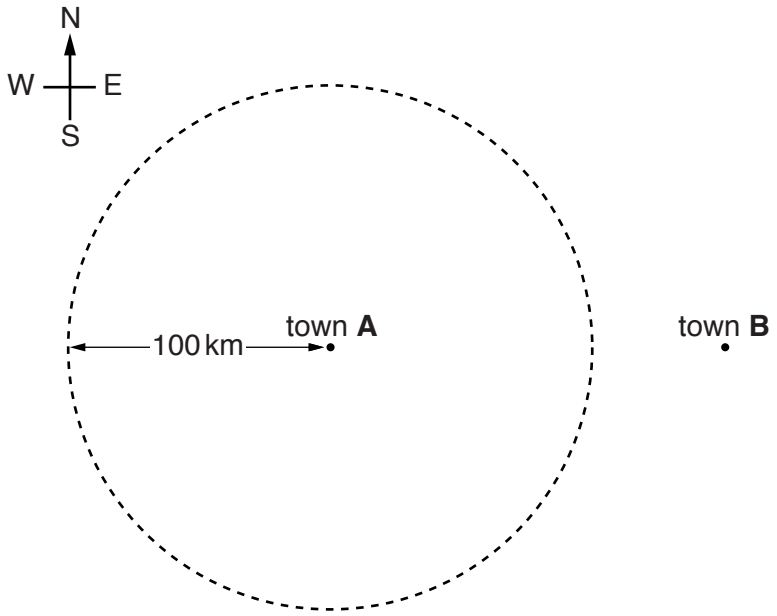
The diagram shows the earthquake detector trace in town **A**.



(ii) Calculate the speed of the S-waves.
Show your working.

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

(b) Below is a map showing town **A** and another town, **B**, which is 150 km due east of town **A**.



(i) The dotted line on the map is a circle of radius 100 km centred on town **A**.
The earthquake which caused the trace in **4(a)** was close to the surface of the Earth.

Explain why the earthquake must be somewhere on this line, but it is not possible to say where.

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

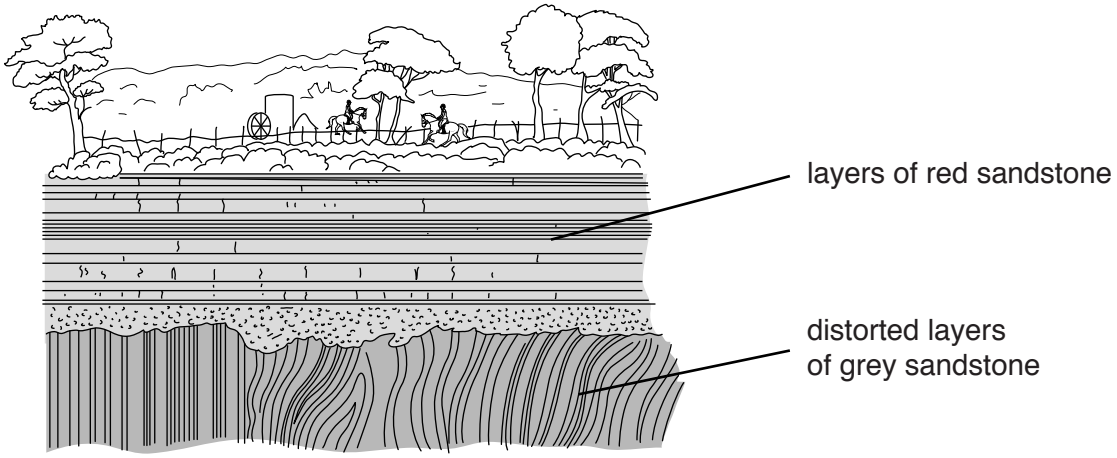
(ii) An earthquake detector in town **B** also recorded the earthquake. The trace in town **B** also had a delay of 12.5 s between the arrival of P-waves and S-waves.

Mark with an **X** on the diagram to show where the earthquake may have taken place. **[2]**

[Total: 7]

5 The geologist James Hutton studied sedimentary rocks. He was particularly interested in places where the layers of rocks were distorted.

The diagram is a drawing made in 1787. It shows a section through rock layers.



In 1787, people believed that the Earth was only a few thousand years old.

Hutton thought that the distorted layers of rock were evidence that the Earth must be very much older than people believed.

Describe how sedimentary rocks are formed and explain how the drawing supports Hutton's theory that the Earth is very old.

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

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

[Total: 6]

6 Complete the following sentences about light.

Use words from the list.

atoms blue electromagnetic electrons green ionising photons red

Light is one of a family of radiations called the ..... spectrum.

It transfers energy in 'packets' called ..... .

The colour of visible light with the smallest energy 'packets' is ..... .

[3]

[Total: 3]

7 Radiographers work in hospitals and are regularly exposed to X-rays. X-rays cause damage to the human body.

(a) State the damage that may be caused by X-rays.

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

(b) Suggest and explain how people working with X-rays can be protected from damage.

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(c) Radiographers also use gamma ray sources.
X-rays are produced by electrically powered machines.
Gamma rays cause similar damage to X-rays, but the radioactive materials giving out gamma rays are more dangerous than X-ray machines.

Explain why this is so.

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

[Total: 5]

8 A digital camera records each image as a digital signal which is saved onto a memory card. The size of the digital image is measured in megabytes (MB).
The table shows the size of the three images stored in the memory card.

Image number	1	2	3
Size (MB)	2.4	2.2	2.0

(a) Calculate the mean size of these three images.

mean size = ... MB **[2]**

(b) The largest image size produced by this camera is 2.5 MB.

Calculate the number of digital images of this size that can be stored on a 500 MB memory card.

number of images = ... **[2]**

(c) Which of the following are good reasons for replacing the 500 MB memory card with a 1000 MB memory card?

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

The 1000 MB card can hold more images. ☐

The 1000 MB card may not fit in the camera. ☐

The 1000 MB card may be very expensive. ☐

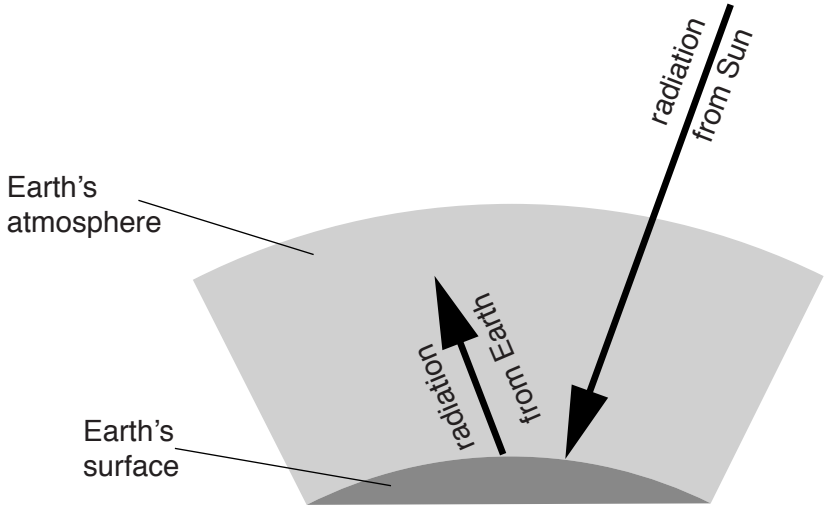
The digital images on the 1000 MB card can be stored in a computer. ☐

The 1000 MB card can hold bigger, higher quality images. ☐

[2]

[Total: 6]

9 This question is about the greenhouse effect. The diagram below shows radiation from the Sun reaching the Earth and radiation leaving the Earth's surface.



The Earth's atmosphere affects these two radiations differently.

Describe how the radiation from the Sun is different from the radiation from the Earth, and explain how the atmosphere is responsible for the greenhouse effect.

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

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

[Total: 6]

10 (a) Complete the following sentences about generating electricity.

In many power stations, a fossil fuel is burnt to boil ..... into steam.

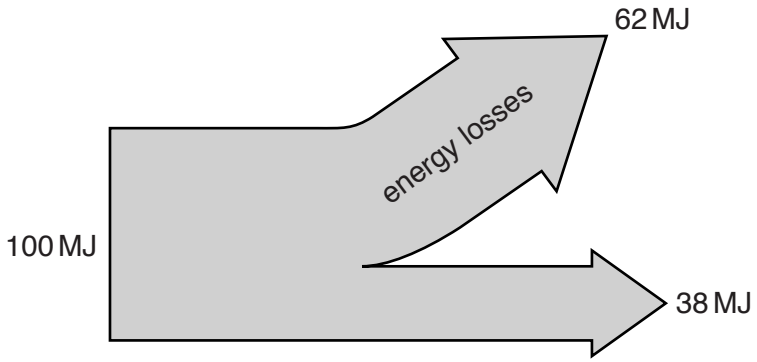
The steam rotates a turbine, and the turbine then turns a ..... which

produces electricity.

The electricity is produced when a coil of wire has a ..... spinning near it.

[3]

(b) The Sankey diagram (energy flow diagram) shows the energy transferred by a power station from 100 MJ in the primary fuel.



Which **one** of the following values is the efficiency of this power station?

Put a (ring) around the correct value.

38% **62%** **100%**

[1]

[Total: 4]

11 (a) The diagram shows a British family's electricity meter on two different dates.

6 March 6 April

Which **one** of the following values is the number of kilowatt hours of energy transferred between 6 March and 6 April?

Put a (ring) around the correct number.

333 **29328** **29661** **58989**

[1]

(b) The family's meter readings can be used to calculate the cost of energy transferred in that time.

Which **one** of the following is the correct calculation to do this?

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

$\frac{\text{number of kWh transferred}}{\text{cost of 1 kWh}}$ ☐

number of kWh transferred × cost of 1 kWh ☐

$\frac{\text{cost of 1 kWh}}{\text{number of kWh transferred}}$ ☐

[1]

(c) The family's electricity bill for March was more than their bill for June.

Which of the following statements could explain this?

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

The weather was colder in March. ☐

The cost of 1 kWh was less in March. ☐

The family used electric lights more in March. ☐

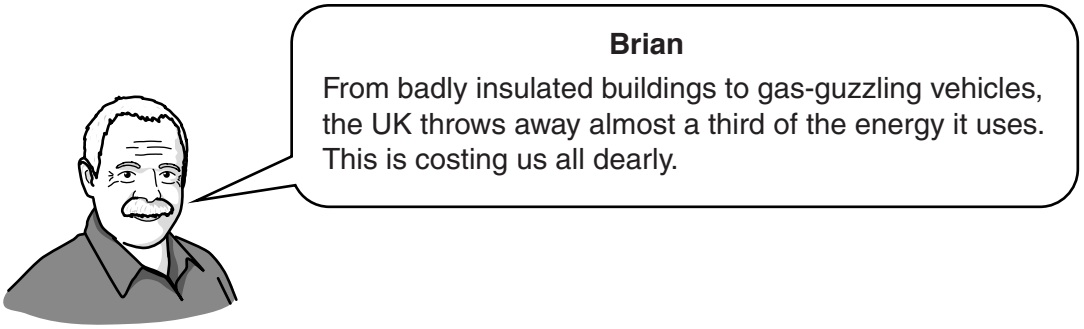
The family used the tumble drier for clothes less in March. ☐

The family used their washing machine more in June. ☐

[2]

[Total: 4]

12 An environmental speaker made this statement.



Explain the science that supports Brian's comments regarding energy waste and make suggestions to reduce these problems.

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

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

[Total: 6]

13 A 230 V mains-powered electric drill draws a current of 2.5 A.

(a) Calculate the power of the drill when it is in use.

power = ... W **[2]**

(b) Another electric drill has a power rating of 600 W. Calculate the number of joules of energy transferred when this drill is in use for 5 minutes.

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

(c) During one day, an electric light is left on for 8 hours. The table below shows how much energy was transferred, measured in both joules and in kilowatt hours.

Energy in joules	1 440 000
Energy in kilowatt hours	0.4

The electricity bill sent to a house for all the energy transferred in three months is always written in kilowatt hours, not joules.

Compare the two numbers in the table to explain why these bills are always written in kilowatt hours.

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

[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).