

**Friday 22 June 2012 – Afternoon**

**GCSE TWENTY FIRST CENTURY SCIENCE  
PHYSICS A**

**A181/02** Modules P1 P2 P3 (Higher 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	

**MODIFIED LANGUAGE**

**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 (✎).
- 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 **20** pages. Any blank pages are indicated.

## TWENTY FIRST CENTURY SCIENCE EQUATIONS

### Useful Relationships

#### The Earth in the Universe

$$\text{distance} = \text{wave speed} \times \text{time}$$

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

#### Sustainable Energy

$$\text{energy transferred} = \text{power} \times \text{time}$$

$$\text{power} = \text{voltage} \times \text{current}$$

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

#### Explaining Motion

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

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{change of momentum} = \text{resultant force} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \text{distance moved in the direction of the force}$$

$$\text{amount of energy transferred} = \text{work done}$$

$$\text{change in gravitational potential energy} = \text{weight} \times \text{vertical height difference}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

#### Electric Circuits

$$\text{power} = \text{voltage} \times \text{current}$$

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

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

#### Radioactive Materials

$$\text{energy} = \text{mass} \times [\text{speed of light in a vacuum}]^2$$

**BLANK PAGE**

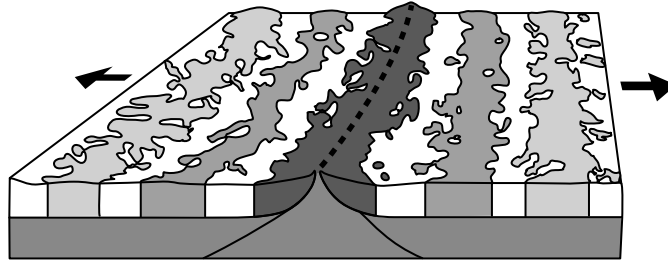
**Question 1 begins on page 4**

**PLEASE DO NOT WRITE ON THIS PAGE**

Answer **all** the questions.

- 1 The diagram shows seafloor spreading at the boundary between two tectonic plates.

The arrows show the direction the plates are moving.



- (a) The seafloors are moving apart.

Approximately how fast do the seafloors move?

Put a ring around the correct approximate speed.

10 mm/century    1 mm/year    10 cm/year    1 cm/century    10 m/year    1 m/second

[1]

- (b) (i) The alternating light and dark bands show different magnetic fields in the rock.

What is the key difference between the magnetic fields in the light and dark bands?

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

- (ii) Explain how the magnetic pattern in the rocks is made.

.....  
 .....  
 .....  
 .....  
 ..... [4]

- (iii) The discovery of the magnetic patterns happened many years after Alfred Wegener died.

When Wegener first proposed his theory of continental drift, the theory was rejected by leading geologists.

How do the magnetic patterns show Wegener's idea was essentially correct?

.....

.....

.....

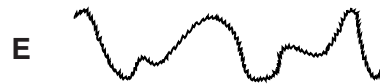
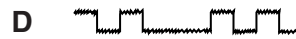
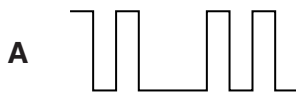
..... [2]

**[Total: 8]**

- 2 (a) (i) One reason mobile phones use digital signals is to reduce the effect of noise in the transmission process.



Choose a diagram, **A**, **B**, **C**, **D**, **E** or **F**, to go with each statement in the explanation below.



You may use each diagram once, more than once or not at all.

The first one has been done for you.

Sue speaks into the microphone.

diagram .....**C**.....

The sound wave is converted to a digital signal, which is transmitted.

diagram .....

The signal picks up noise and decreases in intensity as it travels to the receiver (detector).

diagram .....

The signal in the receiver (detector) is cleaned up.

diagram .....

The signal is then amplified.

diagram .....

The signal is decoded and converted back to sound.

diagram .....

[5]

(ii) Write down the signal in diagram **A** as a sequence of 0s and 1s.

.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

[1]

(b) Songs are often stored as compressed computer files.

The table below shows the length and compressed size of some songs.

File	Type of file	Length of file in seconds	Size of file in MB
<b>A</b>	mp3	300	2.4
<b>B</b>	mp3	200	2.4
<b>C</b>	mp4	200	1.8
<b>D</b>	Ogg	240	2.3
<b>E</b>	RAR	200	0.9

Which file, **A**, **B**, **C**, **D** or **E**, will probably have the best quality?

file ..... [1]

[Total: 7]

- 3 A supernova is the explosion of a giant star. It is one of the brightest objects in the sky for the short time it lasts.

- (a) The first recorded observation of a supernova was by Chinese astronomers in the year 185 CE (it is now 2012 CE).

Recent observations suggest the remains of the supernova are about 8200 light-years away.

How long ago did the supernova explode?

time = ..... years ago [2]

- (b) Supernovas are used to help find the distance to galaxies.

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

Distant galaxies are moving away from us.

☐

Galaxies contain a maximum of 100 000 stars.

☐

The distances to galaxies are known very accurately.

☐

The most distant galaxies move away from the Earth at the slowest speed.

☐

The movement of galaxies suggests the Universe is expanding.

☐

[2]

- (c) There are many different chemical elements in the Earth. Some elements are made in stars and some in supernovas.

Here is information about some elements found on Earth.

Element	Number of protons	Relative mass
carbon	6	12
gold	79	197
helium	2	4
hydrogen	1	1
iron	26	56

Two of these elements may **not** have been made in either stars or supernovas.

Put rings around these two elements.

**carbon**

**gold**

**helium**

**hydrogen**

**iron**

**[2]**

- (d) Two people have read the following article. They are discussing the risk of a supernova happening nearby in the galaxy.

### The chance of a supernova

Students estimate that a supernova explosion close enough to harm the Earth could happen once in every 250 million years. A supernova closer than about 30 light-years could destroy most of the life on Earth. Any star that could become a supernova in our galaxy is at least 10 light-years away.

There are two main dangers. One is the high energy gamma radiation made by the supernova explosion. The other is all the high energy particles in the shock wave, which travel at about 9/10ths the speed of light. So for each 10 light-years the light from the supernova travels, the shock wave will have travelled only 9 light-years.

**Renee**

We will have plenty of time to deal with the problem. It will take the light from the supernova at least 10 years to reach us.



**Paul**

But we wouldn't know the star was a supernova until the light from the supernova reached us. It would not be very long before the dangerous particles in the shock wave reached us.



Evaluate the information about supernovas. Write a brief report to suggest what the Government should do about the risk of supernovas. Make sure you justify your suggestions.



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

.....

.....

.....

.....

.....

.....

.....

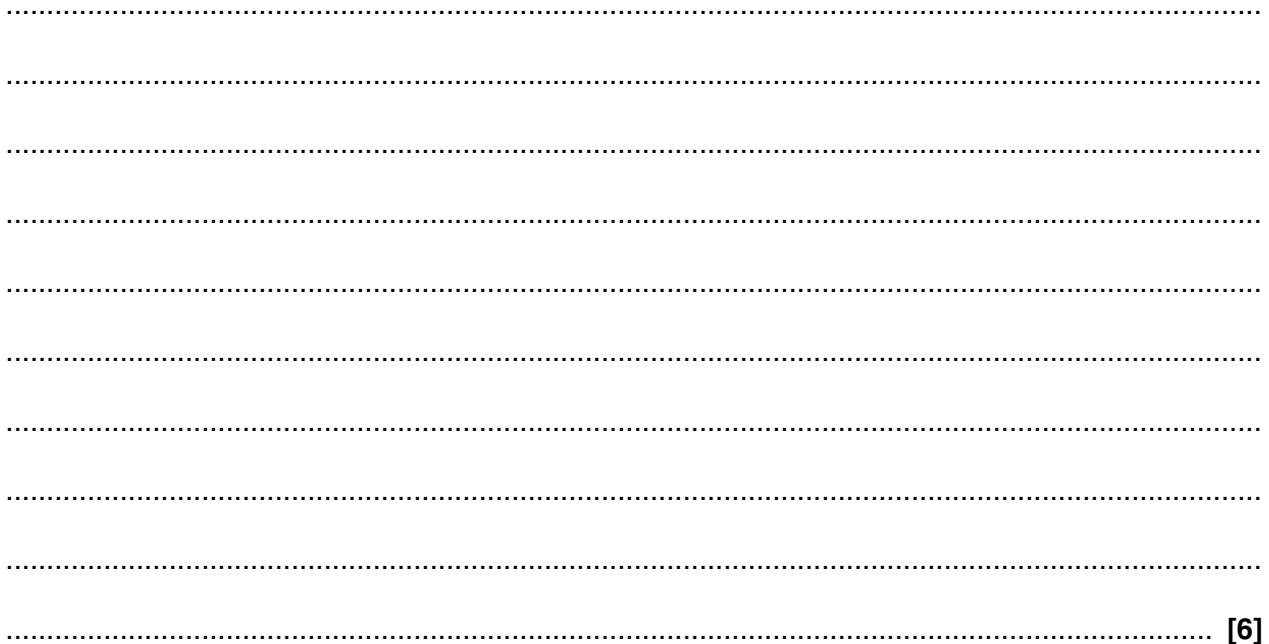
.....

.....

.....

..... [6]

[Total: 12]



© OCR 2012

- 5 (a) Some people are confused about what the greenhouse effect is.

Which three statements are parts of a description of the greenhouse effect?

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

- |   |                          |
|---|--------------------------|
| Ozone absorbs some ultraviolet radiation in the Earth's atmosphere.                         | <input type="checkbox"/> |
| Carbon dioxide absorbs some radiation in the Earth's atmosphere.                            | <input type="checkbox"/> |
| The atmosphere reflects radiation from the Sun.   | <input type="checkbox"/> |
| The Earth emits radiation at a lower principal frequency than it absorbs.                   | <input type="checkbox"/> |
| Ultraviolet radiation comes from the Sun.   | <input type="checkbox"/> |
| The principal frequency of radiation emitted from the Earth decreases with its temperature. | <input type="checkbox"/> |
| Radiation absorbed by the atmosphere may be radiated towards the Earth.                     | <input type="checkbox"/> |

[3]

- (b) Burning forests to clear land is one way that human activities affect carbon dioxide levels in the atmosphere.

Explain how this deforestation affects the atmosphere.

.....

.....

.....

.....

[3]

[Total: 6]

- 6 (a) Complete the sentences describing electrical power production.

In a power station a primary fuel is used to heat water to produce .....  
which drives a ..... which is connected to a generator.

Electricity is then distributed through the National Grid at high ..... to  
reduce energy losses.

[3]

- (b) Many power stations of the type described in part (a) make large amounts of carbon dioxide.

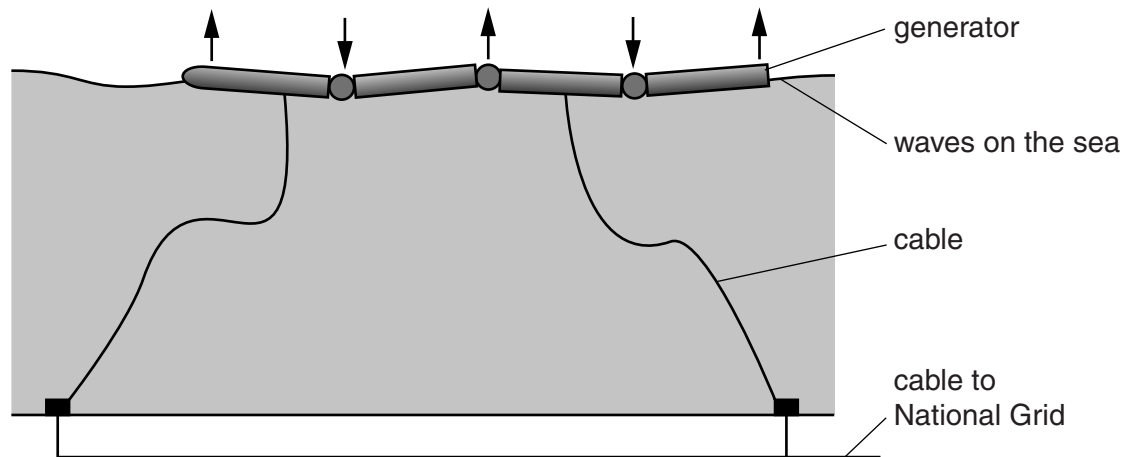
Suggest a type of primary fuel used in a power station that does not make carbon dioxide while making electricity.

answer ..... [1]

[Total: 4]

Turn over

- 7 A type of wave power generator is being tested in the North Sea.



As the waves pass the generator they make the generator bend.

This bending movement is used to produce electricity.

The electricity is distributed using the National Grid.

- (a) Waves are a **renewable** energy source.

What does 'renewable energy source' mean?

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

- (b) The wave generator only works when the wave speed is less than 10 m/s.

Waves passing the generator have a frequency of 0.2 Hz and a wavelength of 40 m.

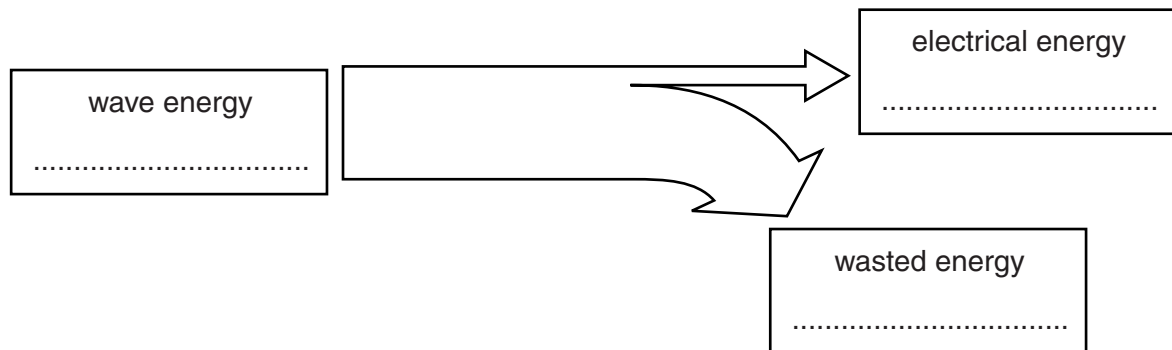
Use the data above to show if the wave generator will or will not work with these waves.

Show any calculation.

..... [2]

- (c) The wave generator is 150m long. When the wave generator is working, it makes 750kJ of electrical energy from a wave energy input of 8250kJ each second.

(i) Complete the Sankey diagram for the generator.



[2]

(ii) Calculate the efficiency of the generator.

Show your calculation.

efficiency = ..... % [2]

- (d) The average power output of the generator is 750kW.

(i) How much energy will it make in one day?

Give your answer in kilowatt hours.

Show your calculation.

energy = ..... kWh [2]

- (ii) The maximum output of the generator is 900 kW.

An engineer suggests using cables that can carry a maximum current of 100 A.

The generator produces electricity at 11 000 V.

Are these cables suitable?

Justify your answer.

..... [2]

[Total: 11]

Use the data in the table and your knowledge of energy sources to suggest an energy production plan for the island to make more electricity in the future.



..... [6]

**END OF QUESTION PAPER**

**18**  
**BLANK PAGE**

**PLEASE DO NOT WRITE ON THIS PAGE**

**19**  
**BLANK PAGE**

**PLEASE DO NOT WRITE ON THIS PAGE**

**PLEASE DO NOT WRITE ON THIS PAGE**



**Copyright Information**

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website ([www.ocr.org.uk](http://www.ocr.org.uk)) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.