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Friday 22 June 2012 – Afternoon

GCSE TWENTY FIRST CENTURY SCIENCE PHYSICS A

A181/02 Modules P1 P2 P3 (Higher Tier)

A135840612

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

A181102

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 (✎).
- 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

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

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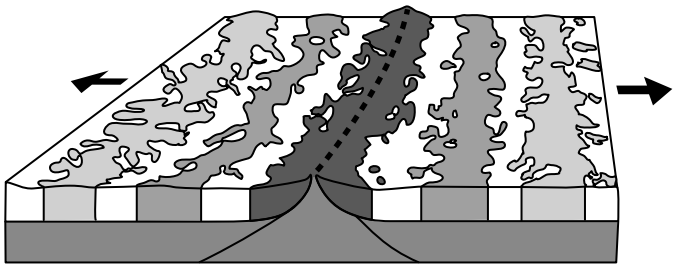
Answer **all** the questions.

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 indicate 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 produced**.**

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

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

Wegener's theory of continental drift was rejected by leading geologists when he first proposed it.

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

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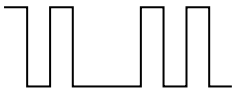
..... **[2]**

[Total: 8]

2 (a) (i) One reason mobile phones use digital signals is because the effect of noise in the transmission process can be reduced.

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

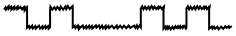
A



B

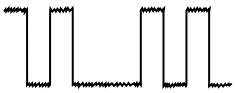
C

D



E

F



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.

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[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
A	mp3	300	2.4
B	mp3	200	2.4
C	mp4	200	1.8
D	Ogg	240	2.3
E	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) The Earth contains many different chemical elements. 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.

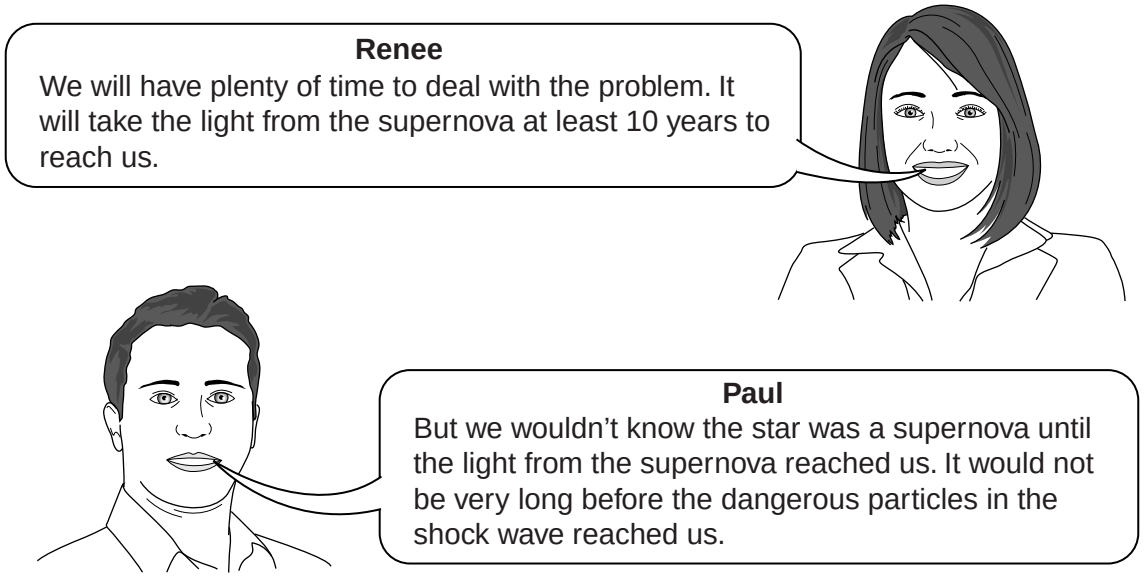
carbon **gold** **helium** **hydrogen** **iron** **[2]**

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

The chance of a supernova

The frequency of a supernova explosion close enough to harm the Earth has been estimated as 1 in every 250 million years. If the supernova is closer than about 30 light-years it 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 hazards. One is the high energy gamma radiation produced 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.



11

Evaluate the information about supernovas and write a brief report suggesting 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.

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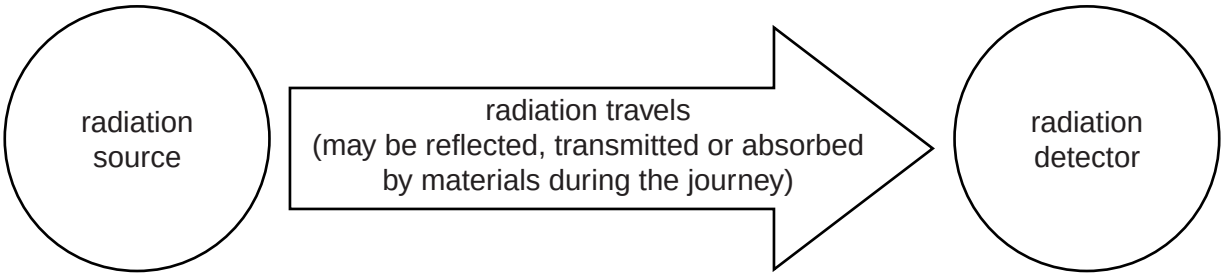
..... **[6]**

[Total: 12]

4 Scientists use models to help them think about difficult ideas. The diagram shows a general model for radiation.



Rachel has noticed that the closer her hand is to a hot radiator the warmer it feels.

Rachel thinks that she needs to use ideas about photons as well as this general model of radiation to explain why.

Is she correct?

Justify your conclusion carefully.

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

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

[Total: 6]

5 **(a)** Sometimes people get confused over 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.	☐
Carbon dioxide absorbs some radiation in the Earth's atmosphere.	☐
The atmosphere reflects radiation from the Sun.	☐
The Earth emits radiation at a lower principal frequency than it absorbs.	☐
Ultraviolet radiation comes from the Sun.	☐
The principal frequency of radiation emitted from the Earth decreases with its temperature.	☐
Radiation absorbed by the atmosphere may be radiated towards the Earth.	☐

[3]

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

Explain how this deforestation affects the atmosphere.

.....

.....

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..... **[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]**

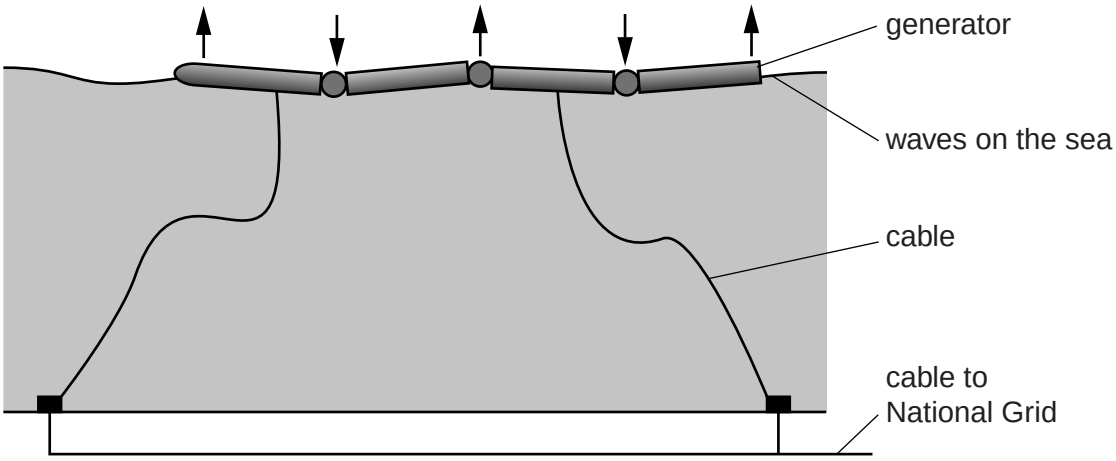
(b) Many power stations of the type described in part **(a)** produce large amounts of carbon dioxide.

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

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

[Total: 4]

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



As the waves pass the generator they make it bend.

This bending movement is used to produce electricity.

The electricity can then be distributed using the National Grid.

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

What is meant by 'renewable energy source'?

.....

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

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

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

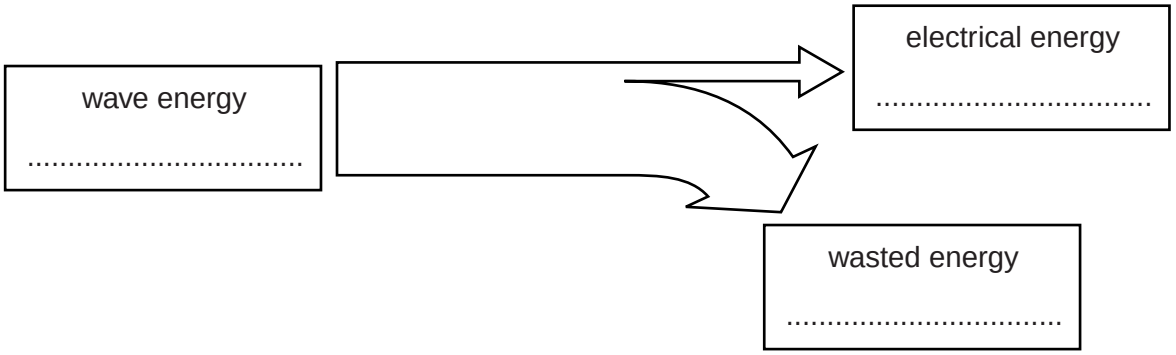
Use the data above to show whether or not the wave generator will work with these waves.

Show any calculation.

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

(c) The wave generator is 150 m long. When it is working, it produces 750 kJ of electrical energy from a wave energy input of 8250 kJ 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 750 kW.

(i) How much energy will it produce 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]

8 A small island in the South Atlantic Ocean needs to produce more electricity than it can at present.

Here is some information about the electricity production on the island.

Electricity consumption	15 880 000 kWh
Electricity production	16 000 000 kWh
Produced by burning oil and peat	100%
Produced by hydroelectricity	0%
Produced by nuclear	0%
Produced by wind	0%
Produced by waves/tides	0%
Oil imported	248.9 barrels/day
Peat used for fuel	13 000 ton/year

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

Justify your suggestions.

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

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

[Total: 6]

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