

Candidate forename						Candidate surname					
Centre number						Candidate number					

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE
A181/02
TWENTY FIRST CENTURY SCIENCE
PHYSICS A

Modules P1 P2 P3 (Higher Tier)

FRIDAY 22 JUNE 2012: Afternoon
DURATION: 1 hour
plus your additional time allowance

MODIFIED ENLARGED

Candidates answer on the Question Paper.
A calculator may used for this paper.

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:


Pencil
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes on the first page. 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).

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (.
- A list of physics equations is printed on pages 4 and 5.
- 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.

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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

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

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

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

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

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

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

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

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

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

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

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.**

_____ [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?

[2]

[Total: 8]

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Question 2 begins on page 10

- 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, from the insert to go with each statement in the explanation below.

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

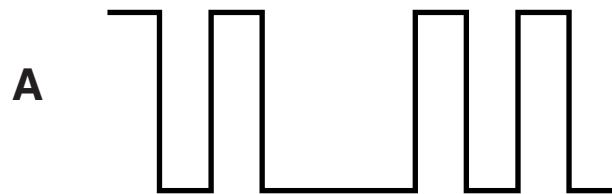
The first one has been done for you.

- | | |
|-------------------------------------|---|
| <input checked="" type="checkbox"/> | Sue speaks into the microphone. |
| <input type="checkbox"/> | The sound wave is converted to a digital signal, which is transmitted. |
| <input type="checkbox"/> | The signal picks up noise and decreases in intensity as it travels to the receiver (detector). |
| <input type="checkbox"/> | The signal in the receiver (detector) is cleaned up. |
| <input type="checkbox"/> | The signal is then amplified. |
| <input type="checkbox"/> | The signal is decoded and converted back to sound. |

[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.

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

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

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.

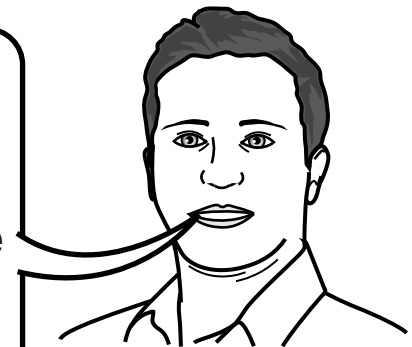
RENEE

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 and write a brief report suggesting what the Government should do about the risk of supernovas. Make sure you justify your suggestions.

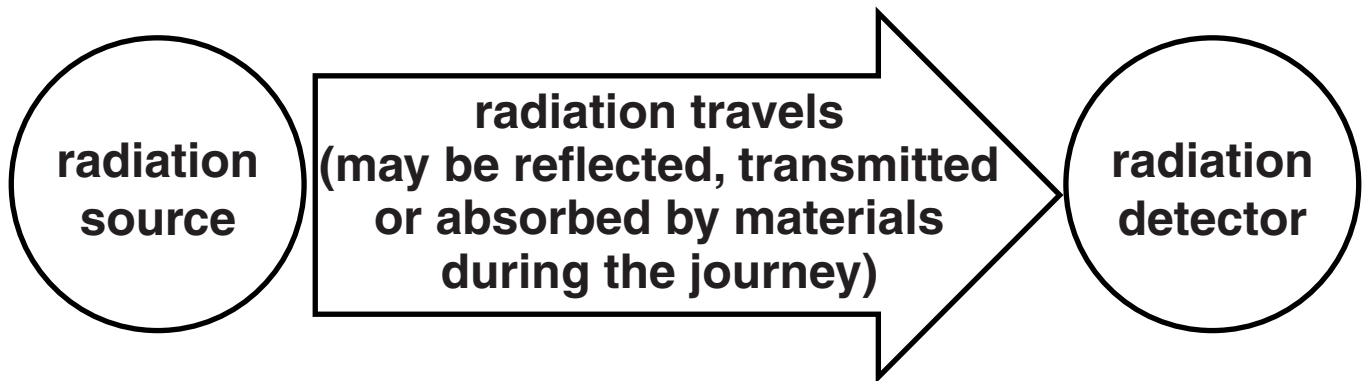


The quality of written communication will be assessed in your answer.

[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.

[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.

[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.

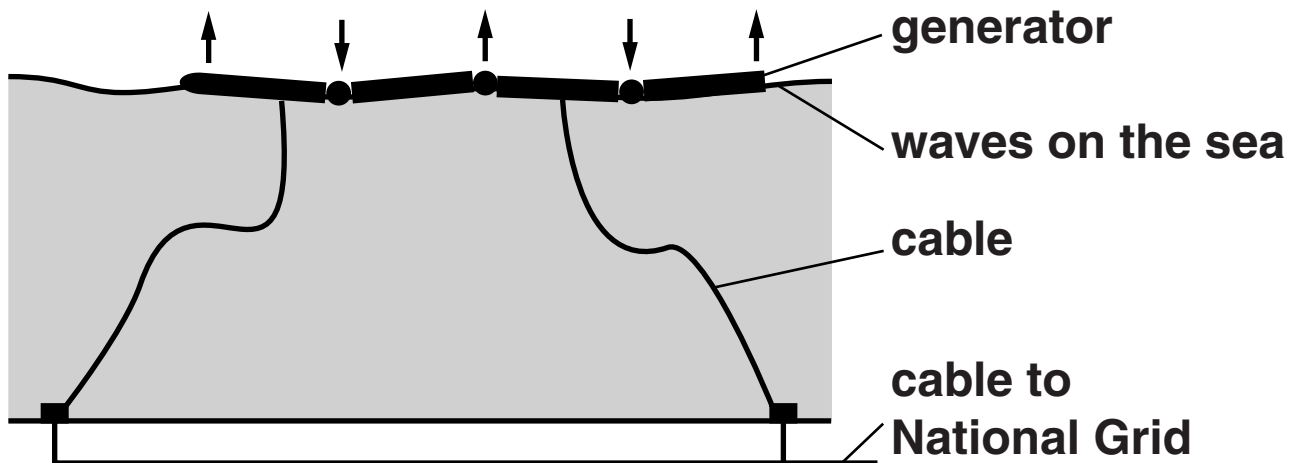
answer _____ [1]

[Total: 4]

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Question 7 begins on page 22

- 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.

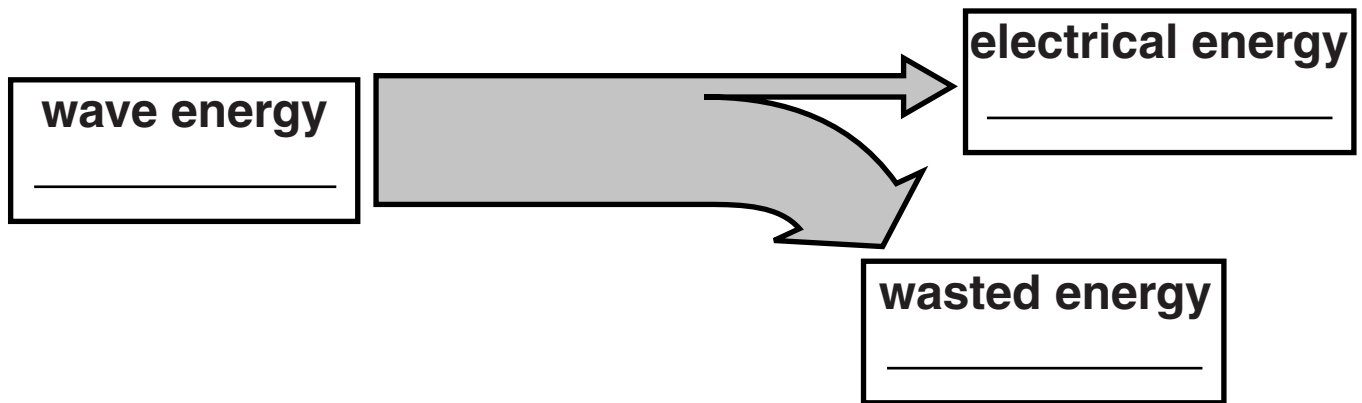
Use the data above to show whether or not the wave generator will work with these waves.

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.

[6]

[Total: 6]

END OF QUESTION PAPER

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