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Thursday 24 January 2013 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE PHYSICS A

A181/02 Modules P1 P2 P3 (Higher Tier)

A138120113

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 **16** 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

Answer **all** the questions.

1 In 1912 Alfred Wegener proposed a theory of continental drift to explain some observations about continents, fossils and mountains.

At the time his idea of continental drift was rejected by geologists for various reasons.

By considering the evidence **at the time**, explain if the geologists were right to reject the idea of continental drift.

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

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

[Total: 6]

2 Evidence for the expansion of space was found by measuring the distance to many galaxies and the speed of the galaxies as they move away from the Earth.

Here are some measurements.

Galaxy location	Distance in millions of light-years	Speed in km/s	Speed in light-years per year
Bootes	2740	39 300	.....
Corona Borealis	1440	21 600	0.072
Hydra	3960	.....	0.204
Ursa Major	990	15 000	0.051

(a) (i) How do scientists measure the speed of galaxies?

.....

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

(ii) A speed of 300 000 km/s is 1 light-year per year.

Fill in the missing speeds in the table. **[2]**

(b) We see the Ursa Major galaxy as it was many years in the past.

(i) How many years in the past? ..... **[1]**

(ii) Why do we see the galaxy as it was in the past?

.....

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

(iii) Use speed and distance data from the table to calculate the distance to the Ursa Major galaxy **as it actually is now**.

distance = ... million light-years **[3]**

(iv) This is a minimum distance.

Explain why the distance is actually much larger.

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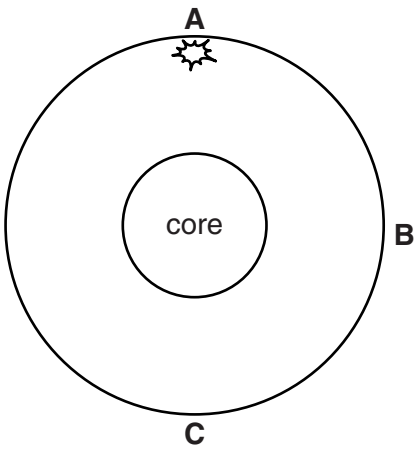
..... **[2]**

[Total: 10]

3 Earthquake waves travel through the Earth from **A** to **B** and from **A** to **C**.



(a) (i) On the diagram draw the complete paths of S-waves travelling from **A** to **B** and from **A** to **C**. **[1]**

(ii) Which of the following statements about P-waves are correct?

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

P-waves cannot be detected at **C**. ☐

The distance from **A** to **B** can be calculated just using P-waves. ☐

At **B**, P-waves are detected before S-waves. ☐

P-waves transfer energy and matter from **A** to **B**. ☐

P-wave vibrations are perpendicular to their direction of motion. ☐

P-wave frequencies are inversely proportional to their wavelength for a constant speed. ☐

[2]

(b) Describe how tectonic plates could cause a **P-wave**.

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

[Total: 5]

4 Over the last few years nearly all telephone and TV signals have become digital.

Explain the advantages of using digital signals.

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

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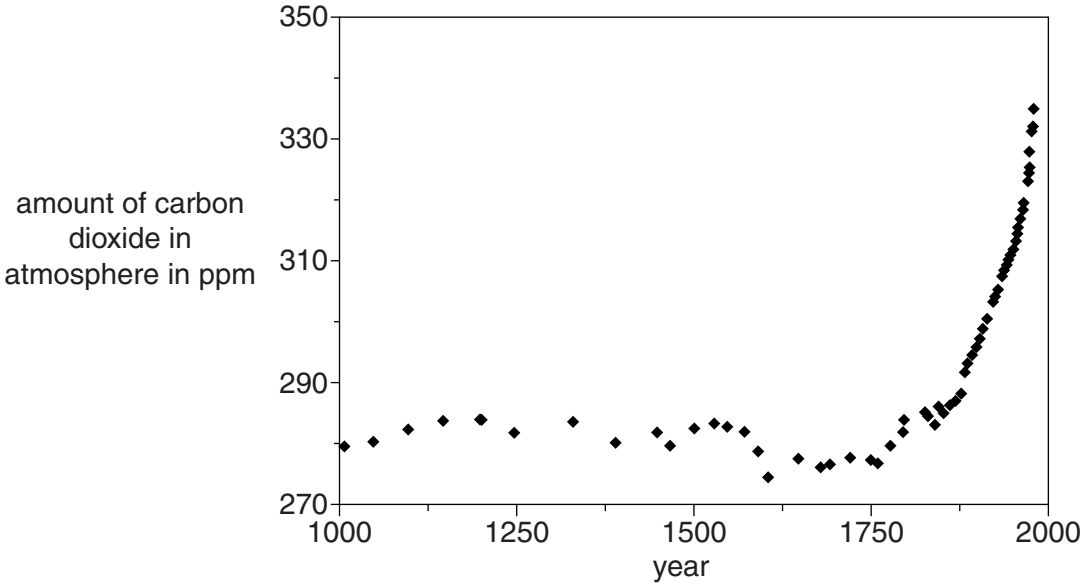
..... **[6]**

[Total: 6]

5 This graph shows the amount of carbon dioxide in the atmosphere over a 1000 year period.



(a) Many scientists think this is evidence that human activity has had an effect on the amount of carbon dioxide in the atmosphere.

Explain how the graph supports this idea.

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

(b) Many scientists think that human activity is causing global warming.

What additional evidence would you need to show this causal relationship?

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

A cause for the melting icecaps.	☐
A correlation between global temperatures and atmospheric carbon dioxide levels.	☐
A correlation between global temperatures and sea levels.	☐
A mechanism linking atmospheric carbon dioxide and global warming.	☐
A mechanism linking plant growth and carbon dioxide.	☐

[2]

(c) The consequences of global warming could be very bad for everyone on the planet.

However, most people do very little to change their lifestyle to reduce this risk.

Suggest reasons why people are willing to accept the risks associated with global warming.

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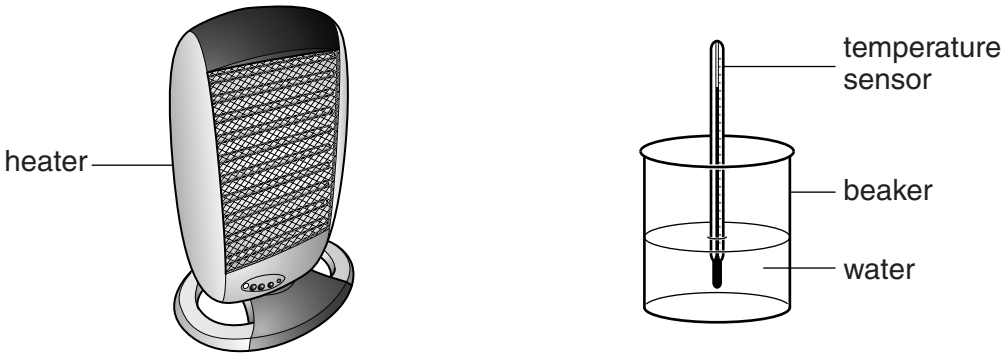
..... **[2]**

[Total: 8]

6 Rachel does an experiment to investigate the heating effect of electromagnetic radiation.



She measures the temperature change of the water in the beaker.

(a) Describe what is happening to the electromagnetic radiation from the heater.

Your description should include the words absorbed, emitted and transmitted.

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

(b) **(i)** One factor that affects the temperature of the water is the intensity of the electromagnetic radiation.

Which of the following will increase the intensity of radiation arriving at the water?

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

Increase the energy of the photons in the radiation.	☐
Decrease the frequency of the radiation.	☐
Increase the temperature of the water.	☐
Decrease the number of photons in the radiation.	☐
Decrease the wavelength of the radiation.	☐

[2]

(ii) Rachel keeps the distance between the heater and the water constant in her experiments.

Explain why changing the distance would affect the intensity of the radiation arriving at the water.

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

[Total: 6]

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Question 7 begins on page 12

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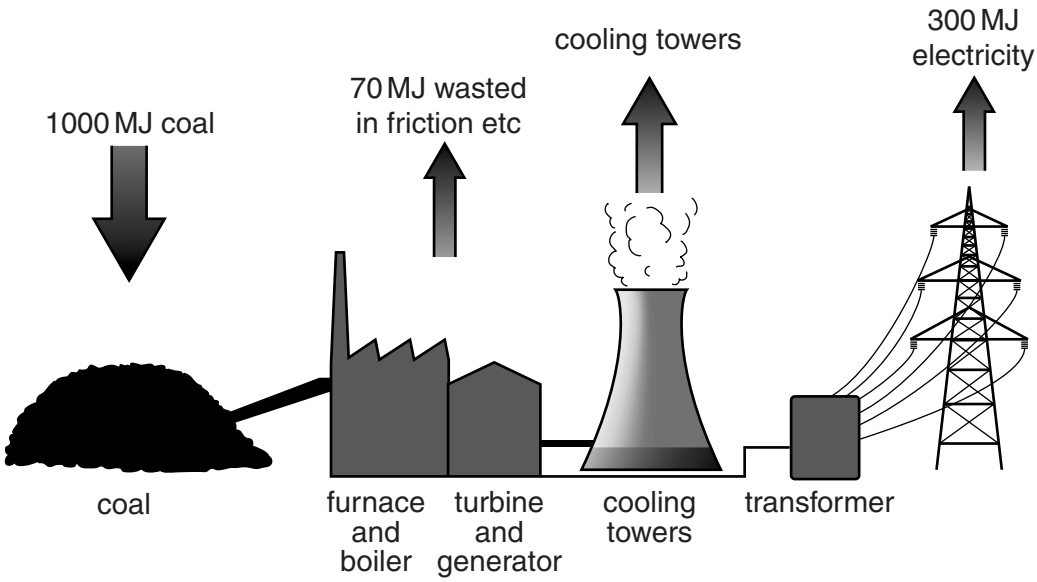
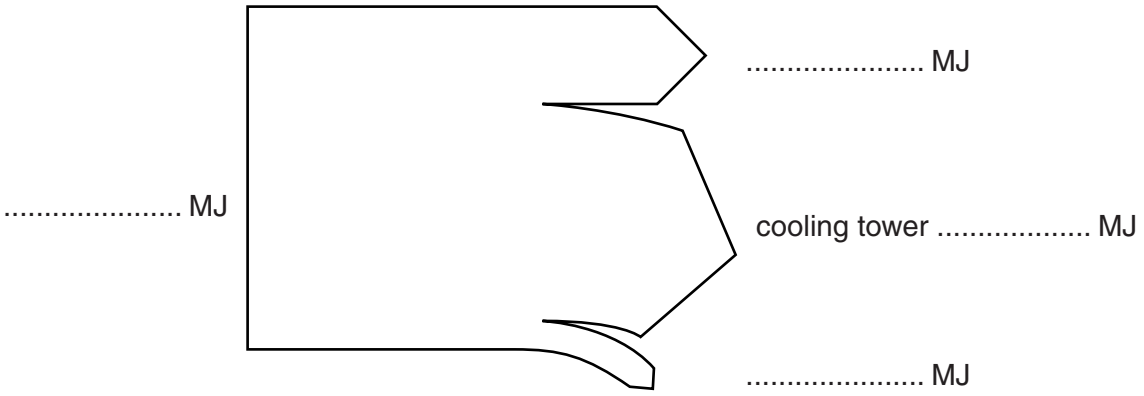
7 **(a)** The diagram shows the energy flow through a coal-burning power station each second.



(i) Complete the Sankey diagram to show this energy flow.



[3]

(ii) What is the efficiency of the coal-burning power station?

efficiency = ... % **[1]**

(b) Not all energy sources need a furnace or boiler.

Which energy sources drive the turbine directly when generating electricity?

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

biofuel	☐
nuclear	☐
oil	☐
solar	☐
wind	☐
wave	☐

[1]

(c) The radioactive waste from nuclear power stations can be a hazard through contamination or irradiation.

Which of the following statements are correct?

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

Contamination results in a long period of exposure to radiation.	☐
Contamination causes cancer, but irradiation just damages cells.	☐
Ionising radiation causes contamination.	☐
Exposure to radiation from an external source is irradiation.	☐
Protective clothing mainly protects from irradiation.	☐

[2]

[Total: 7]

8 Here is data about the capacity and power rating of some kettles.

Kettle	Maximum volume in litres	Power rating in kilowatts
A	0.5	3
B	1	2
C	2	3
D	1.5	1.5

(a) How many seconds will it take kettle **B** to transfer 6 kilojoules of energy?

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

(b) (i) Which kettle will boil 1 litre of water the fastest?

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

(ii) Justify your answer to part **(b)(i)**.

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

(c) The mains voltage is 230V.

What is the current in kettle **D** when it is heating water?

current = ...A **[2]**

[Total: 6]

9 Many people object to the pollution produced by the UK's gas and coal power stations. The current nuclear reactors are coming to the end of their working lives.

What factors should a government take into account when planning a future energy policy?

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

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

[Total: 6]

END OF QUESTION PAPER

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