THIS IS A NEW SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

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Friday 20 January 2012 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE PHYSICS A

A181/02 Modules P1 P2 P3 (Higher Tier)

A131500112

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 **12** 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 **(a)** An astronomer measures the distance to an object in space as about 100 light-years.

The distance from the Sun to the nearest neighbouring star is about 4 light-years.

Which statement best describes the position of the object?

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

as far as very distant galaxies	☐
outside the Milky Way, but not as far as nearby galaxies	☐
outside the solar system but inside the Milky Way galaxy	☐
outside the solar system but closer than the nearest stars	☐
inside the solar system	☐

[1]

(b) Observations of the light from different galaxies show that galaxies are moving away from each other.

This suggests that the Universe is expanding.

Describe these observations and explain how they are consistent with the idea of an expanding Universe.

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

(c) The big bang is one explanation for why the Universe is expanding.

Another explanation is that new galaxies form in the spaces in between existing galaxies, pushing them further apart.

(i) Both explanations are based on the same observation.

How is it possible for scientists to reach different conclusions that account for the same data?

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

(ii) We now accept the big bang theory as the explanation of why the Universe is expanding.

How do scientists decide between different theories?

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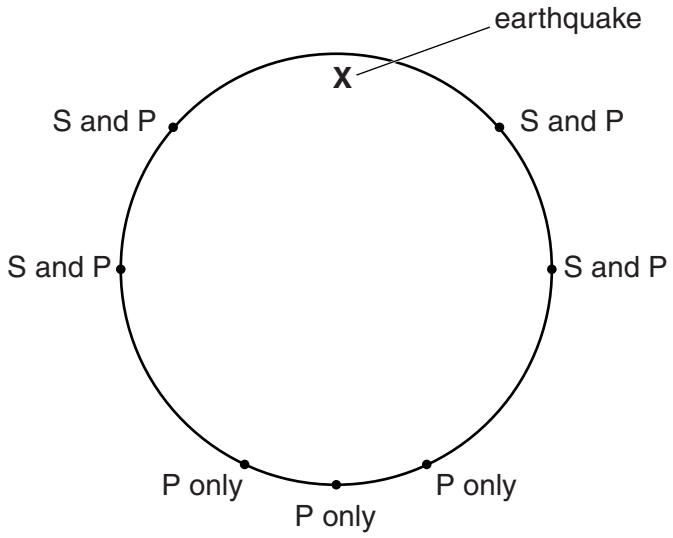
..... **[2]**

[Total: 8]

2 This question is about earthquakes and the structure of the Earth.

An earthquake occurs at **X**.

The diagram shows places where S-waves and P-waves from the earthquake are detected.



Explain what we can tell about the structure of the Earth from these results.

You may add to the diagram if this helps you.

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

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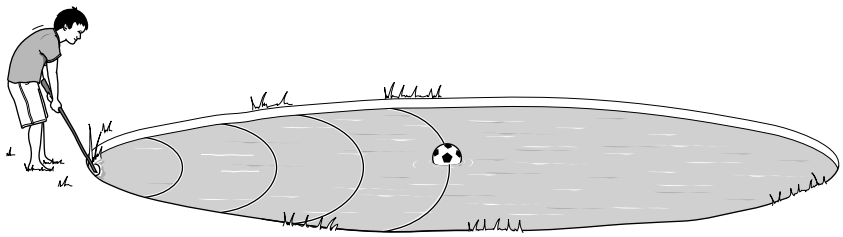
..... **[6]**

[Total: 6]

3 This question is about the properties of waves.

Bobby has kicked his ball into the middle of a pond.



The ball is 10 m from the edge of the pond.

He tries to move the ball by making waves on the water with a stick.

(a) Bobby hits the edge of the pond with the stick. He makes 6 complete waves in 12 seconds.

He counts exactly 4 complete waves between his stick and the ball.

The waves are all equal.

(i) What is the frequency of Bobby's wave?

Show your working.

frequency = ... hertz **[2]**

(ii) What is the wavelength of Bobby's wave?

Show your working.

wavelength = ... m **[2]**

(b) **(i)** Calculate the speed of the wave.

Show your working.

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

(ii) Bobby thinks his ball will be carried by the waves to the shore.

Is Bobby right?

Explain your answer.

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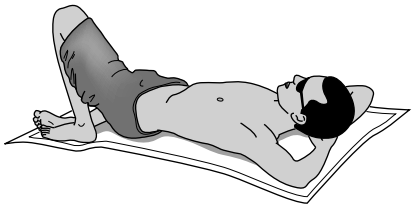
[Total: 8]

4 Ultraviolet radiation can be harmful.

Sunbathing exposes people to ultraviolet radiation.



Why do people sunbathe in spite of the risks?

Your answer should consider the risks and benefits.

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

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

[Total: 6]

5 Venus has a much higher average surface temperature than the Earth.

Venus has an average surface temperature of approximately 480 °C.

The Earth has an average surface temperature of approximately 15 °C.

(a) One factor that makes Venus so much hotter than the Earth is its atmosphere.

gas in atmosphere	Earth	Venus
nitrogen	78%	3.5%
oxygen	21%	less than 0.05%
carbon dioxide	less than 0.05%	96%
neon	less than 0.002%	less than 0.002%

(i) Use the data in the table to suggest why Venus is much hotter than the Earth.

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..... **[3]**

(ii) Scientists suggest other conclusions about Venus from the data in the table.

They conclude that

- there are no green plants on Venus
- Venus has no ozone layer. Ozone is O_3.

Use straight lines to join each **conclusion** to each piece of **evidence** that supports it.

conclusion	evidence
	nitrogen 3.5%
no green plants	
	oxygen less than 0.05%
	carbon dioxide 96%
no ozone layer	
	neon less than 0.002%

[2]

(b) (i) A second reason for the high temperature on Venus is that more energy from the Sun reaches Venus than the Earth.

Why is this?

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

The photons have more energy when they get to Venus.	☐
More photons hit Venus than Earth.	☐
A day on Venus is about 240 times as long as on Earth.	☐
The Earth takes longer to orbit the Sun than Venus.	☐

[1]

(ii) The intensity of electromagnetic radiation from the Sun decreases with distance.

Complete the sentences explaining this.

Use words from this list.

area **decreases** **distance** **energy** **frequency**

increases **intensity** **stays the same**

As electromagnetic radiation travels out from the Sun, it spreads out as the surface of a sphere.

The area of the sphere ..... with ..... ,

but the total ..... stays the same.

Therefore the amount of energy for each square metre ..... .

[4]

(iii) Experiments show that intensity is inversely proportional to the square of the distance. This is called the inverse square law.

The distance from Venus to the Sun is about 0.7 of the distance from the Earth to the Sun.

How much more intense does this suggest that the radiation reaching Venus will be compared to the radiation reaching the Earth?

Put a (ring) around the correct answer.

$(0.7)^2$ **0.7** **1** $\frac{1}{0.7}$ $\frac{1}{(0.7)^2}$

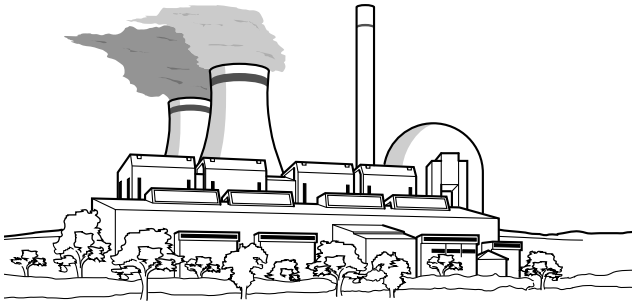
[1]

(iv) The amount of energy reaching the planets from the Sun is actually less than expected by the inverse square law. Suggest a reason for this.

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

[Total: 12]

6 The Government is considering building new nuclear power stations. The power stations will produce a lot of electricity and will replace older nuclear power stations and some fossil fuel power stations. Nuclear waste will be transported to a central location for processing.



A Government inquiry is asking for groups to provide advice on whether to build the power stations or not.

Identify groups who will want to contribute to the inquiry, including groups for and against the building of the nuclear power stations. Explain the arguments they may make, including any key scientific issues.

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

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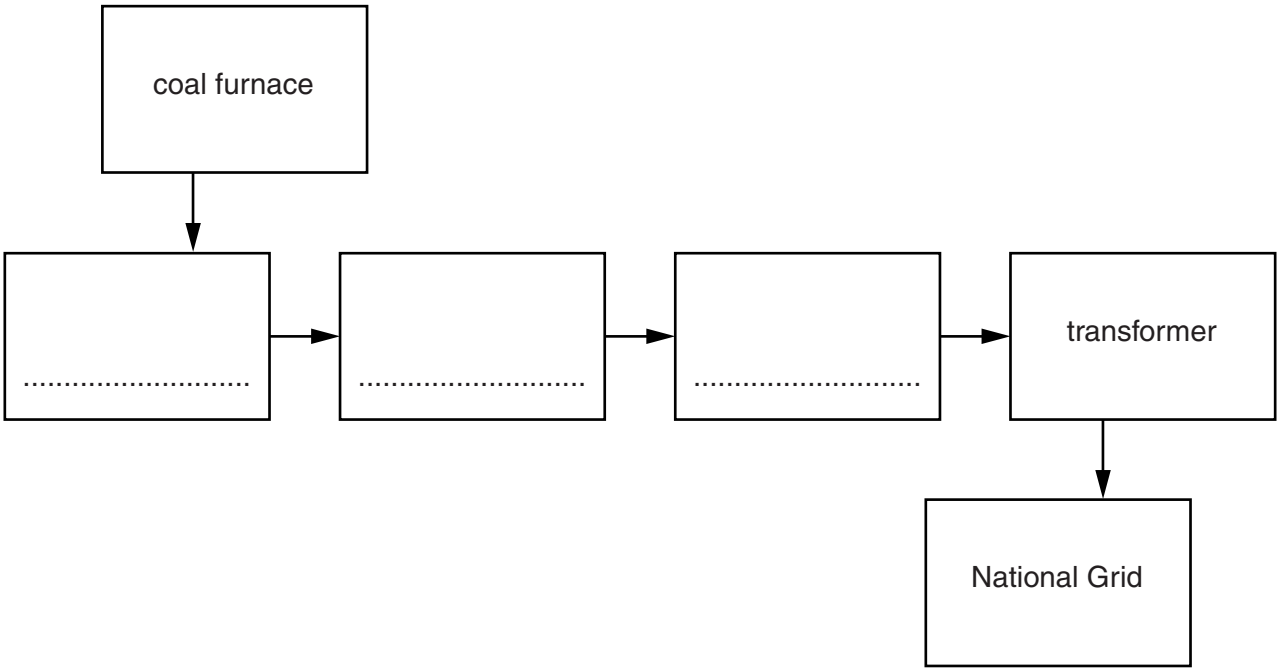
[Total: 6]

7 **(a)** Jenny has drawn a block diagram of a coal-burning power station.

Complete the diagram with the names of the **structures** that will produce the electricity.



[3]

(b) There are many different types of power station.

A – coal-burning power station
B – hydroelectric power station
C – nuclear power station
D – oil power station
E – wind power station

Look at the statements in the table below. Each statement applies to one or more types of power station.

Complete the table by writing down the **letters** of the power station types that fit the statements.

Each row may contain **one**, **two** or **more** letters.

statement	type(s) of power station
uses a non-renewable energy source	
does **not** use a boiler to turn water into steam	
produces carbon dioxide when generating power	
generates a voltage by spinning a magnet near a coil	
irradiation is a hazard	

[7]

(c) Some of the electricity produced by power stations is used in our homes.

(i) A kettle is 90% efficient.

To boil the water 420 kJ is needed.

Calculate how much electrical energy is used by the kettle.

energy = ... kJ **[2]**

(ii) Suggest reasons why the kettle is only 90% efficient.

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

[Total: 14]

END OF QUESTION PAPER