

Thursday 23 May 2013 – Morning

**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	

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

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

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Question 1 begins on page 4

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(a) She decides to review the possible fuel sources for her delivery trucks.

She finds the following table of information on the internet.

Fuel	Energy efficiency	CO ₂ equivalent emission units	Cost of fuel per tonne
biogas	22%	20	similar for all three fuels
diesel	35%	750	
petrol	27%	740	

She wants to take into account economic factors, sustainability and environmental impact.

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



[6]

- (b) After reading all the advice, Margaret decides she will have some vehicles using each type of fuel.

Which of the following reasons best explains Margaret's choice?

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

She wants to use the cheapest fuel.

☐

It provides better security of supply.

☐

She wants CO₂ equivalent emissions to be as low as possible.

☐

She thinks nuclear fuel is probably better.

☐

[1]

[Total: 7]

- 2 (a) A TV set uses 500 J of energy from the mains electricity.

The TV produces 100 J of energy as sound and 300 J of energy as heat.

It also produces energy as light.

Draw and label a Sankey diagram to show the energy transfers by the TV set.

Some lines have been drawn for you.

.....

.....

.....

.....

.....

.....

[4]

- (b) A more modern TV set is 75% efficient.

The set has a power rating of 300 W.

How much energy is **wasted** by the TV set in 120 minutes of watching the television?

Put rings around the **two** correct answers.

9 kJ	27 kJ	36 kJ	540 kJ	1620 kJ
0.0025 kWh	0.0075 kWh	0.010 kWh	0.15 kWh	0.45 kWh

[2]

(c) The electrical energy used by the TV set is generated in a power station.

- (i) Complete these sentences about the production of electricity in some types of power station.

Use words from the list.

coil current electricity energy magnet
resistance turbine transformer voltage

The primary source directly turns the

In the generator, the spinning produces a voltage

in a

The electricity generated is distributed using a high in the

National Grid to homes and factories.

[3]

- (ii) Suggest a type of power station the sentences could be describing.

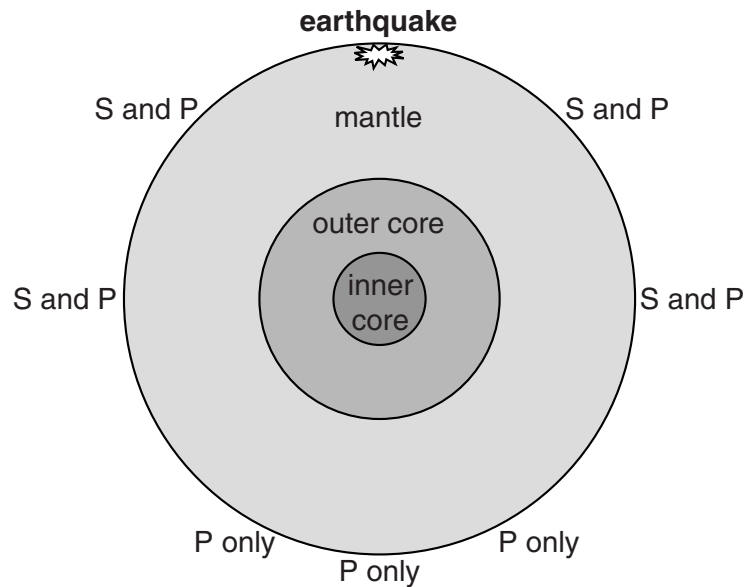
..... [1]

[Total: 10]

3 (a) Information from earthquake waves can be used to find out about the structure of the Earth.

- **S**-waves can only travel through solids.
- **P**-waves can travel through both solids and liquids.

The diagram shows which waves are detected at different points on the Earth from an earthquake.



This evidence can be used to make some conclusions about the structure of the Earth.

Complete the table to show which conclusions can be made from **this evidence**.

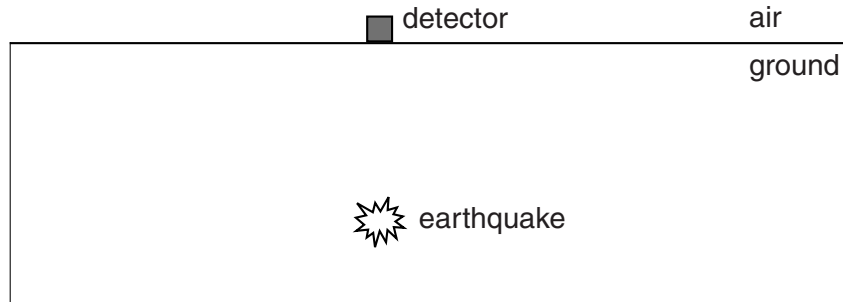
Put one tick (✓) in each row.

	is liquid	is solid	cannot tell
crust			
mantle			
outer core			
inner core			

[3]

- (b) The centre of most earthquakes is deep underground.

An earthquake happens directly below a detector.



When the P-wave arrives the ground moves up and down.

When the S-wave arrives the ground moves from side to side.

- (i) By using the properties of the waves, explain the different movement of the ground when each wave arrives.

.....

 [2]

- (ii) Suggest why S-waves usually do more damage to buildings than P-waves.

.....
 [1]

- (c) The P-waves and S-waves are produced at the same time, however the first P-wave arrives at the detector before the first S-wave.

The depth of the earthquake is 30 km.

The average speed of the P-wave is 6 km/s.

The average speed of the S-wave is 4 km/s.

Calculate the time difference between the arrival of the P and S-waves.

Time difference = ... s [3]

[Total: 9]

Turn over

- 4 Scientists have discovered that ocean floor sediments are very thin over oceanic ridges, but generally thicken steadily away from the ridges.

Which two statements about the sediments, taken together, provide support for the idea of sea floor spreading?

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

The weight of sediments pushes the continents down.

☐

Sediments fall to the sea floor at a steady rate.

☐

The movement of the sea floor stirs up the sediments.

☐

The longer the time, the more sediments fall.

☐

Sediments provide part of a mechanism for seafloor spreading.

☐

[2]

[Total: 2]

- 5 Scientists in the early part of the 20th century could see what appeared to be faint clouds of stars through their telescopes. They called these clouds 'nebulae'.

At the time, the furthest distance to a star in the Milky Way galaxy that had been measured was approximately 160 light years.

Two scientists had different ideas about the spiral nebula called Andromeda.

Curnow thought the Andromeda nebula was inside the Milky Way galaxy.

Moore thought the Andromeda nebula was outside the Milky Way galaxy.

Curnow and Moore had exactly the same data about the nebula.

- (a) To decide between the theories, the two scientists each made a prediction based on their theory.

Suggest suitable predictions for each scientist.

Curnow

.....

Moore

..... [2]

- (b) A new method for measuring the distances to stars provided new evidence.

This method measured the distance to a star in the Andromeda nebula at over 1 million light years, over 10 000 times further than any other star previously measured.

- (i) Which of the following conclusions about each of the theories can be correctly made from the new data?

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

	proved theory false	decreased confidence in theory	no effect on confidence in theory	increased confidence in theory	proved theory correct
Curnow's theory					
Moore's theory					

[2]

- (ii) Suggest reasons why scientists do not always give up on a theory when new data appear to conflict with it.

.....

.....

.....

..... [2]

[Total: 6]



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

..... [6]

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7 Ultraviolet, X-ray and gamma radiation are all used in medicine.

- (a)** What do high energy ultraviolet, X-ray and gamma radiation have in common?
Put a tick (✓) in the box next to each correct statement.

They are blocked by sun-screens.

☐

They are electromagnetic radiation.

☐

They can remove electrons from atoms.

☐

They have lower frequencies than microwaves.

☐

They are used to carry information in optic fibres.

☐

[2]

- (b) (i)** X-rays are used by doctors to produce pictures of the inside of the human body.

Explain how X-rays are used to produce pictures of the inside of the body and why they are used instead of ultraviolet radiation.

.....

.....

.....

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

Question 7 continues on page 14

- (ii) Joel thinks the X-rays are dangerous and might cause cancer. He asks each of the patients on a cancer ward if they have ever had an X-ray picture taken. Here are his results.

	male	female
had an X-ray	15	7
never had an X-ray	0	1

Joel thinks this shows he is correct.
Is Joel correct? Justify your answer.

.....

 [3]

[Total: 8]



The sound Rai hears is analogue.



[6]

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Turn over

- 9 Alice looks at the Moon.



- (a) Alice knows she sees the Moon using light from the Sun.

Explain how Alice sees the Moon.

Use the general model of electromagnetic radiation in your answer.

.....

.....

.....

.....

..... [3]

- (b) (i) The Earth and Moon have the same average distance from the Sun over a year. Therefore on average they receive the same intensity of light.

The diameter of the Moon is approximately 3500 kilometres.

The diameter of the Earth is approximately 13 000 kilometres.

How many times more energy is transferred directly by light from the Sun to the Earth than from the Sun to the Moon?

answer = ... [2]

- (ii) This would result in the Earth and the Moon having the same average temperature. Suggest why the Earth's average temperature is 15°C and the Moon's is -23°C .

.....

 [1]

[Total: 6]

END OF QUESTION PAPER

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