

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**  
**GCSE**  
**TWENTY FIRST CENTURY SCIENCE**  
**A181/02**  
**PHYSICS A**  
**Modules P1 P2 P3**  
**(Higher Tier)**

**THURSDAY 23 MAY 2013: Morning**  
**DURATION: 1 hour**  
**plus your additional time allowance**

**MODIFIED ENLARGED**

<b>Candidate forename</b>		<b>Candidate surname</b>	
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<b>Centre number</b>						<b>Candidate number</b>				
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**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)**

**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 4–5.
- 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.
- Any blank pages are indicated.

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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 Margaret runs a small transport company.**

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

**At present all her vehicles use petrol.**

**She finds the following table of information on the internet.**

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

**The data given is for equal masses of fuel.**

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

**Use the information in the table and your knowledge of energy sources to discuss the three fuel sources and make a recommendation about which one Margaret should use.**



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

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**[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 CO<sub>2</sub> equivalent emissions to be as low as possible.**

☐

**She thinks nuclear fuel is probably better.**

☐

**[1]**

**[TOTAL: 7]**



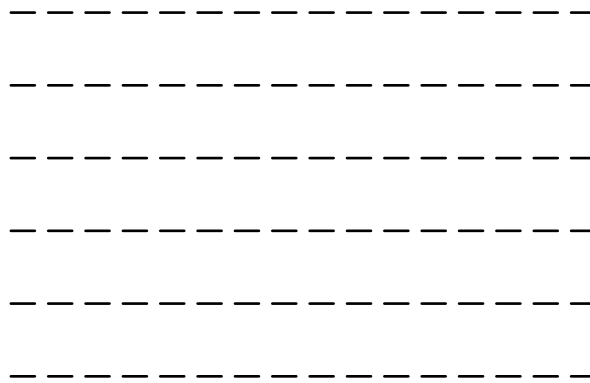
- 2 (a) A TV set uses 500 J of energy from the mains electricity.**

**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 300W.**

**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.**

<b>coil</b>	<b>current</b>	<b>electricity</b>
<b>energy</b>	<b>magnet</b>	<b>resistance</b>
<b>turbine</b>	<b>transformer</b>	<b>voltage</b>

**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]**

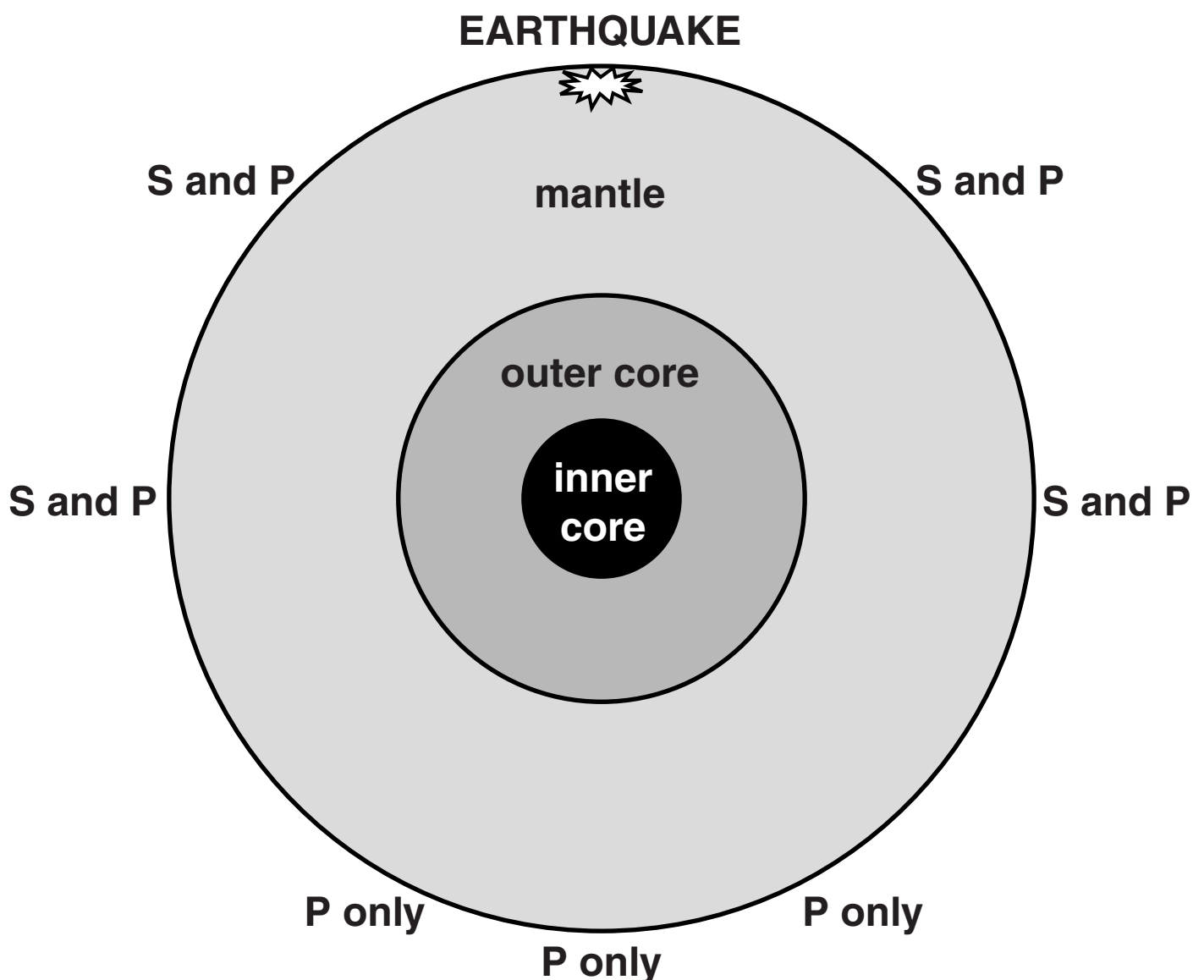
**[TOTAL: 10]**

- 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.**

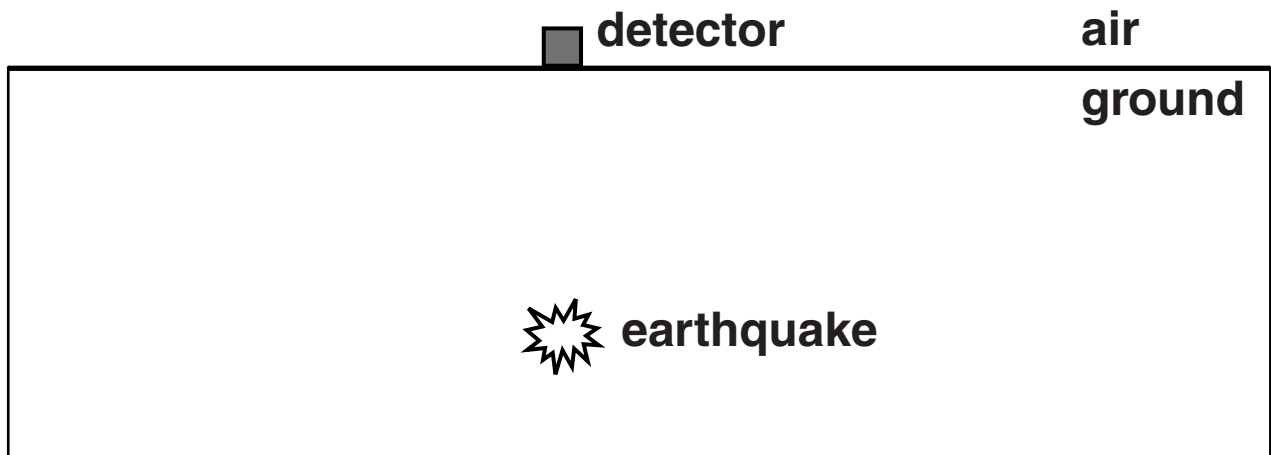
**Put one tick (✓) in each row.**

	<b>is liquid</b>	<b>is solid</b>	<b>cannot tell</b>
<b>crust</b>			
<b>mantle</b>			
<b>outer core</b>			
<b>inner core</b>			

**[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.**

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[2]

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

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[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]

- 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 conclusions about each of the theories can be correctly made from the new data?**

**In the table opposite, put a tick (✓) in the correct box next to each theory. [2]**

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

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**[2]**

**[TOTAL: 6]**

	proved theory false	decreased confidence in theory	no effect on confidence in theory	increased confidence in theory	proved theory correct
<b>Curnow's theory</b>					
<b>Moore's theory</b>					

- 6 All of the information we have about stars is based on the radiation that comes from the stars.**

**Explain methods that can be used to find the distance to a star using the light from it, including why there are uncertainties in the measurements of distance.**



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

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**[6]**

**[TOTAL: 6]**

**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.**

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**[3]**

- (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.

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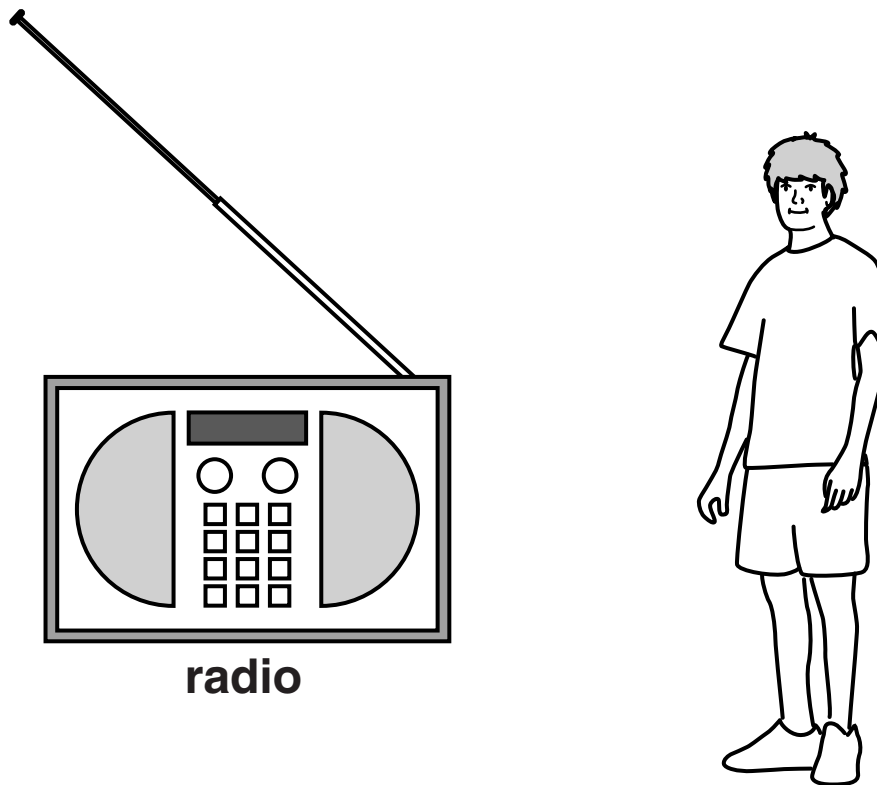
[3]

[TOTAL: 8]

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**QUESTION 8 BEGINS ON PAGE 24**

- 8 Rai is listening to a recorded concert on his digital radio.**



**The original sound waves produced by the band are analogue.**

**The radio picks up a digital signal.**

**The sound Rai hears is analogue.**

**Explain how and why the signal is transmitted as a digital signal rather than an analogue signal.**





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

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**[6]**

**[TOTAL: 6]**

**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.**

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**[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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