THIS IS A NEW SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

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Tuesday 14 May 2013 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE SCIENCE A

A141/02 Modules B1 C1 P1 (Higher Tier)

A137030613

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

A141102

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 (✎).
- 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**.
- A list of physics equations is printed on page 2.
- This document consists of **20** 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)** Draw a straight line from each **word** to its correct **definition**.

word	definition
genotype	the alternative form of a gene
heterozygous	the combination of alleles in an organism
homozygous	the observable characteristics of an organism
phenotype	when two alleles for a gene, in an individual, are different
	when two alleles for a gene, in an individual, are the same

[3]

(b) Genes are instructions for a cell that describe how to make proteins.

Complete the following sentence.

The proteins produced by cells may be structural, for example …… ,

or functional, for example …… .

[1]

[Total: 4]

2 Heather is 24 years old.

Heather's father has Huntington's disease and is heterozygous for the gene.

Heather's mother does not have the allele for Huntington's disease.

(a) Draw a Punnett square to calculate the probability of Heather having the allele for Huntington's disease.

Use **H** to represent the dominant allele and **h** to represent the recessive allele.

		mother	
father			

probability = ... **[2]**

(b) Symptoms of Huntington's disease do not usually appear until the age of 40.

The disorder is usually fatal.

(i) Heather is thinking of having a genetic test to find out whether she has Huntington's disease like her father.

Discuss the possible implications to Heather and her family of having this genetic test.

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

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

(ii) Other genetic disorders can also be fatal. People with these disorders usually show symptoms from birth.

Suggest reasons why Huntington's disease remains at a higher level in the population than many of these disorders.

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

[Total: 10]

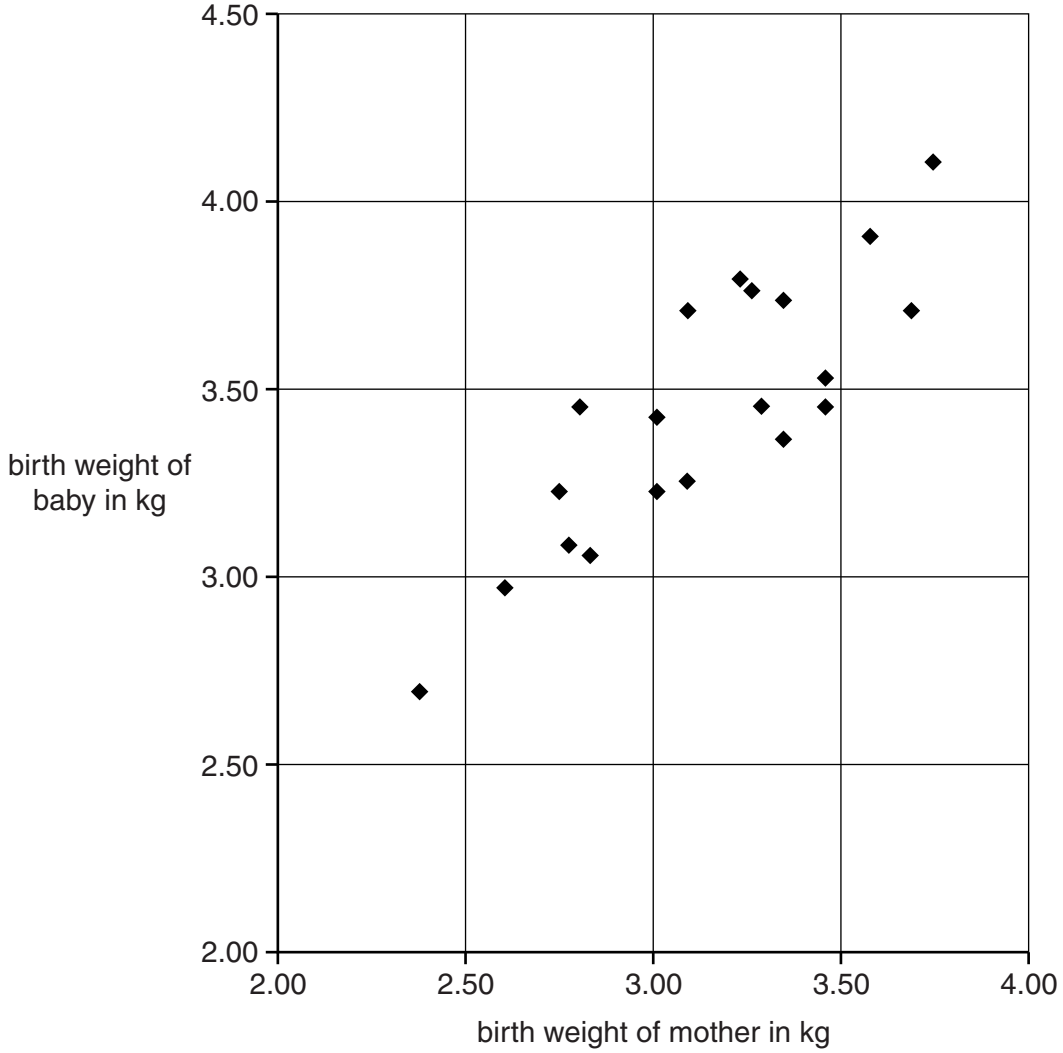
3 Leila is a midwife.

She is investigating if there is a link between a mother's own birth weight and the birth weight of her first baby.

Every baby is weighed soon after it is born. This value is their birth weight.

Leila asks twenty mothers to take part in the study.

She plots a graph of her results.



(a) Describe the correlation shown by the graph.

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

(b) Leila asks another mother to take part in the survey.

The mother's own birth weight was 3.5 kg and her first baby's birth weight is 3.0 kg.

Both weights were measured accurately.

(i) Use a cross (×) to add this data to the graph. **[1]**

(ii) Suggest **two** explanations for this result.

1 .....

2 .....

[2]

(iii) Leila's colleague, Debbie, thinks this data point is an outlier and should be ignored.

Leila thinks the data point is valid and should be included in her study.

Give reasons why Leila is correct.

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

[Total: 6]

4 Joe and Anne investigate how much fuel their car burns at different speeds.

Here are their data for speeds up to 40 miles per hour (mph).

Speed in mph	Fuel consumption in miles per gallon
10	22
20	40
30	48
40	52

(a) What is the correlation shown by these data?

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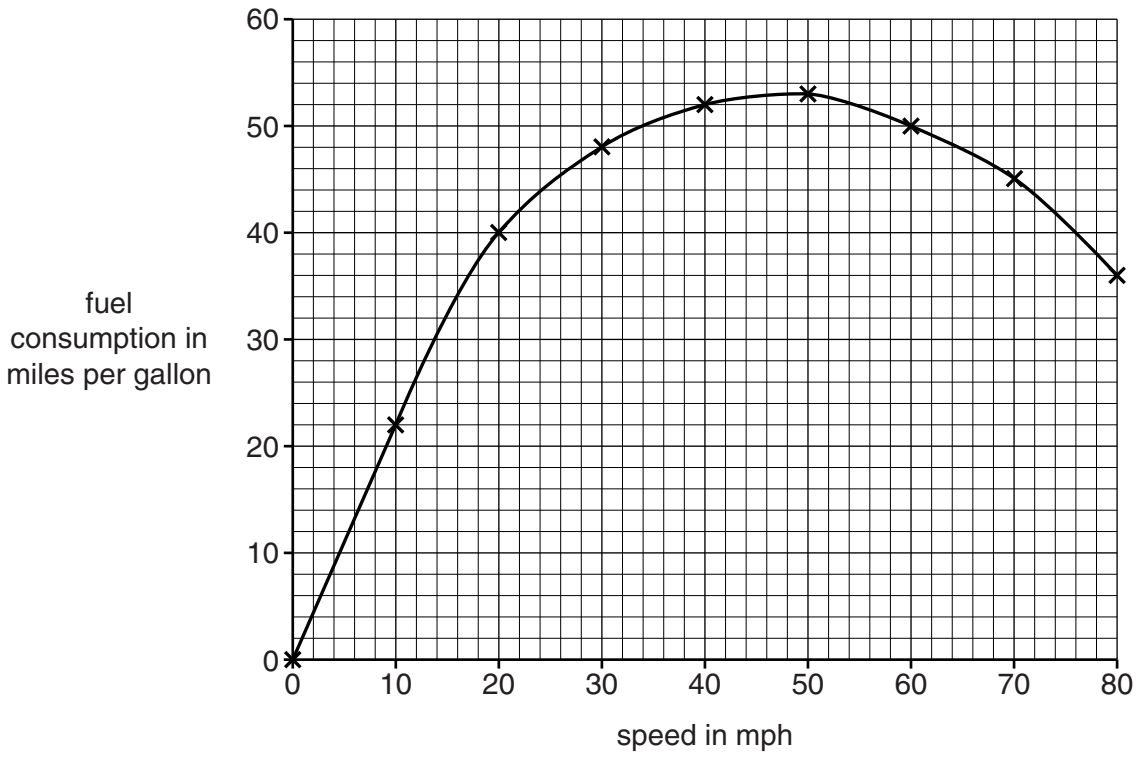
..... **[1]**

(b) Joe and Anne see this item in a newspaper.

HIGHER SPEED LIMITS ON MOTORWAYS

The Government plans to increase the speed limit on motorways from 70 mph to 80 mph.
The Government believes shorter travelling times will save the country money.

Joe and Anne collect more data up to a speed of 80 mph.
They plot a graph.



Anne is worried about changes in air pollution if the speed of motorway traffic increases from 70 mph to 80 mph.

Joe says it doesn't matter how fast you go.

Use the graph to explain who you think is right and why.

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[Total: 4]

5 Coal-fired power stations make air pollutants.
One of these air pollutants is sulfur dioxide.
Equipment for removing sulfur dioxide by wet scrubbing is installed in a power station.

(a) Here are some statements about how sulfur dioxide is made and how it is removed by wet scrubbing using alkaline slurry.
One statement is **incorrect**.

A	Sulfur dioxide in the flue gases reacts with the slurry to make calcium sulfate.
B	Sulfur in the coal reacts with oxygen from the air at the high temperatures of the furnace.
C	Sulfur is removed from the coal before it is burned.
D	There is little sulfur dioxide in the flue gases that flow into the air.
E	The alkaline slurry is a mixture of calcium oxide and water, which is sprayed onto flue gases.

Put the **four** correct statements in the order in which they occur.

[3]

(b) The engineers want to know how well the new wet scrubbing equipment is working.

They measure the sulfur dioxide in the flue gases the day before and the day after the new equipment is put in.

Suggest **two** factors that they must keep the same.
Suggest how their results would change if each factor did change.

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

(c) The table shows the values of sulfur dioxide concentration the day before and the day after the equipment is put in.

	Before the new equipment is put in	**After** the new equipment is put in
sulfur dioxide concentration	0.4 mg/m^3	0.02 mg/m^3

(i) The total volume of flue gases is 150 000 m^3 in one hour.
Show that the amount of sulfur dioxide entering the air from this power station in one hour **before** the new equipment is put in is 60 g.

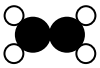
[1]

(ii) How much sulfur dioxide is **taken out** of the flue gases by the new equipment in one hour?

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

[Total: 9]

6 Ethene is a hydrocarbon.



ethene

(a) What is meant by a hydrocarbon?

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

(b) Ethene burns in air to make different products.

Water is always made, but the other products depend on the amount of oxygen available.

Use molecule diagrams to help you describe and explain these differences.

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

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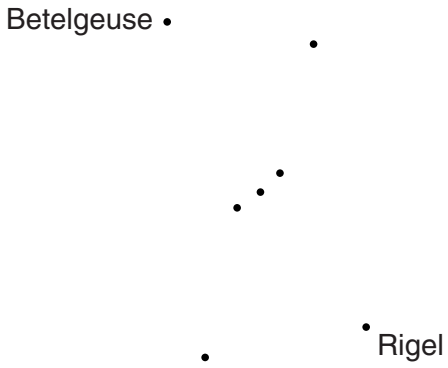
[Total: 7]

7 The constellation Orion includes the bright stars Betelgeuse and Rigel.



The following table gives data on these two stars.

Star	Colour	Actual brightness	Brightness as seen from the Earth	Distance from the Earth (light years)
Betelgeuse	red	1	1.3	600
Rigel	blue-white	4	1	900

(a) The table shows that Betelgeuse looks brighter than Rigel when seen from the Earth. Use data from the table to **explain** why.

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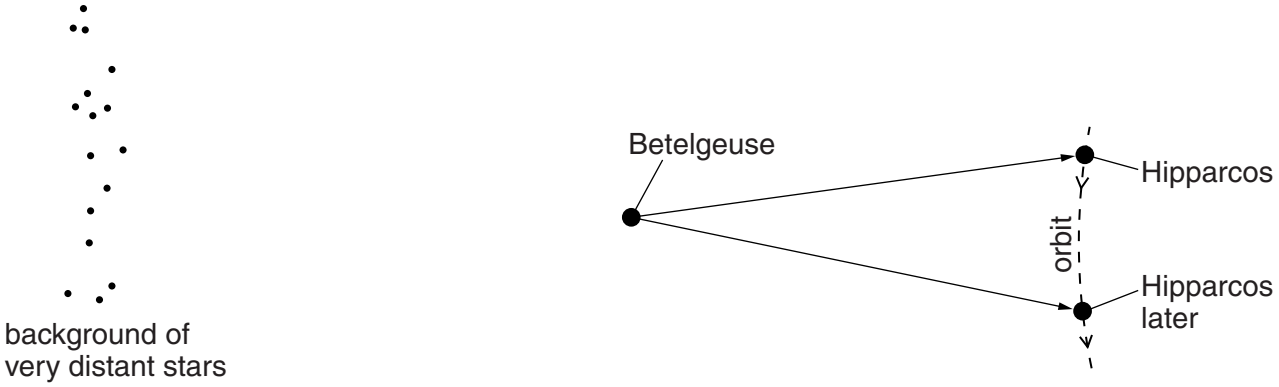
(b) The distance data in the table were measured by a satellite called Hipparcos. This measured the position of the stars from different places in its orbit around the Sun.



(not to scale)

Explain how observing a star from different positions allows the distance to be found.

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

[Total: 4]

8 In the 19th century, many scientists thought that the Earth was no more than 20 million years old. Charles Darwin disagreed.

Charles Darwin

At the coast, the sea is eroding cliffs. It can cut back a 300 m high cliff by about 1 cm every 100 years.

The valley of the Weald in southern England was eroded by a river. The valley is 300 m deep and 36 km wide.

I assume that the river has eroded the valley at a similar rate to the sea eroding the cliff.

I conclude that it must have taken much more than 20 million years to make the valley this wide, so the Earth must be much older than this.

Justify Darwin's conclusion and suggest reasons why other scientists disagreed with it.

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

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[Total: 6]

9 This question is about the Earth's crust and earthquakes.

(a) Scientific explanations of changes in the Earth developed during the 20th century.

When Alfred Wegener suggested that the continents moved, there was evidence for and against his ideas.

Here is a list of geological facts known at the time.

Put a tick (✓) in the one correct box after each fact.

	for Wegener's theory	**against Wegener's theory**	**neither for nor against**
Lower sedimentary rocks are usually older than ones above them.			
Similar rock layers are found in different continents.			
Fossils are found in rocks on every continent.			
The outlines of continents looked as if they once fitted together.			
There was no detectable movement of the continents.			

[3]

(b) Earthquakes produce P-waves and S-waves.

(i) Which **one** of these statements about P-waves and S-waves is correct?

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

P-waves are longitudinal waves and cannot travel through the Earth's liquid core. ☐

P-waves are transverse waves and cannot travel through the Earth's liquid core. ☐

S-waves are longitudinal waves and cannot travel through the Earth's liquid core. ☐

S-waves are transverse waves and cannot travel through the Earth's liquid core. ☐

[1]

(ii) An earthquake generates P-waves travelling at 8 km/s and S-waves travelling at 5 km/s.

The waves both have a frequency of 2 Hz.

Which of the following statements about the two waves are correct?

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

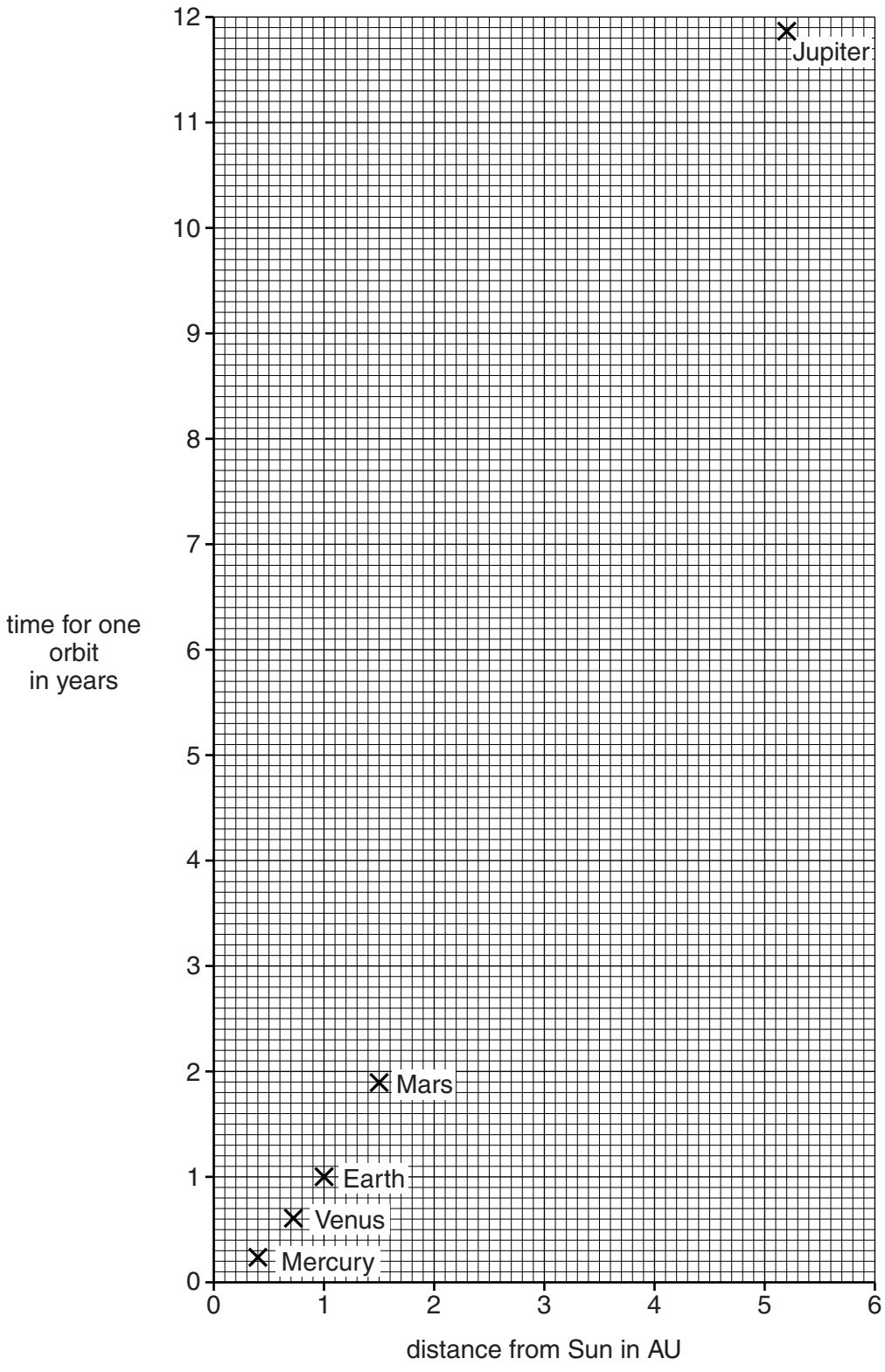
S-waves of large amplitude are less damaging than S-waves of small amplitude.	☐
The P-waves arrive at a detector 800 km away after 10 seconds.	☐
The waves make the ground vibrate 30 times each minute.	☐
10 seconds after the earthquake, the S-waves and P-waves will be 30 km apart.	☐
The P-waves have a longer wavelength than the S-waves.	☐
The lag time between the arrival of P-waves and S-waves is the same for detectors at different distances from the earthquake.	☐

[2]

[Total: 6]

10 The graph shows how the time taken for one orbit of a planet around the Sun depends on its distance from the Sun.

The distances are measured in AU, where 1 AU = the distance from the Earth to the Sun.



(a) The dwarf planet Ceres was found between Mars and Jupiter. It takes 4.6 years to orbit the Sun once.

Draw a best-fit curve through the points on the graph, and use it to find the distance between Ceres and the Sun.

distance = ... AU **[2]**

(b) Jo suggests that the rule describing the data above is

$$\frac{(\text{distance from the Sun})^3}{(\text{time for one orbit})^2} = \text{constant}$$

Jo tests this rule by filling in the table for four planets.

Planet	**Distance from the Sun in AU**	**Time for one orbit in years**	$\frac{(\text{distance})^3}{(\text{time})^2}$
Mercury	0.39	0.24	1.03
Venus	0.72	0.62	0.97
Earth	1.00	1.00	1.00
Mars	1.52	1.88	0.99
Jupiter			

Complete the table for Jupiter.

Explain whether the rule works for all these planets.

Conclusion: .....

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

[Total: 4]

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE