OCR
Oxford Cambridge and RSA

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Friday 19 June 2015 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE PHYSICS A/FURTHER ADDITIONAL SCIENCE A

A183/01 Module P7 (Foundation 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

- The quality of written communication is assessed in questions marked with a pencil (✐).
- A list of useful relationships is printed on pages **2** and **3**.
- 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

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

Observing the Universe

$$\text{lens power} = \frac{1}{\text{focal length}}$$

$$\text{magnification} = \frac{\text{focal length of objective lens}}{\text{focal length of eyepiece lens}}$$

speed of recession = Hubble constant × distance

pressure × volume = constant

$$\frac{\text{pressure}}{\text{temperature}} = \text{constant}$$

$$\frac{\text{volume}}{\text{temperature}} = \text{constant}$$

energy = mass × [speed of light in a vacuum]^2

Answer **all** the questions.

1 Most large modern telescopes use a mirror to focus the parallel light rays from stars.

(a) Draw a diagram of a telescope mirror to show how the parallel light rays come to a focus.

[3]

(b) What is the name for what happens to the light at the mirror?

Put a (ring) around your answer.

absorption **diffraction** **reflection** **refraction**

[1]

(c) Why do most astronomical telescopes use mirrors instead of lenses?

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

Lenses can only be supported at the edges.	☐
Light is absorbed by mirrors.	☐
Mirrors only work when flat.	☐
Mirrors can be made bigger than lenses.	☐
Lenses don't bend light rays.	☐

[2]

(d) Why are modern telescopes so large?

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

Large telescopes are easy to move about. ☐

Large telescopes are very expensive. ☐

Large telescopes can collect more light. ☐

Large telescopes can be used to observe microbes. ☐

Large telescopes can be used to see very distant objects. ☐

[2]

(e) The eyepieces of telescopes are made using lenses.

What is the power of a lens with a focal length of 2 metres?

power = ... dioptres **[2]**

[Total: 10]

2 A star is made from a cloud of gas.
The first stage of a star is called a protostar.

Describe how a protostar forms and what is happening to the gas particles inside the protostar. You should include ideas about temperature, pressure and volume.

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

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.... **[6]**

[Total: 6]

3 **(a)** **(i)** The Sun, Moon and stars all appear to move across the sky.
In which direction do they move?

Put a (ring) around your answer.

east to west **north to south** **south to north** **west to east**

[1]

(ii) Why do the stars appear to move across the sky?

.... **[1]**

(iii) Here are some data about the Sun, Moon and stars.

	Distance from Earth	**Time to travel once across the sky and return to the same position**
Moon	380 000 km	27 days
Sun	150 000 000 km	24 hours
Stars	more than 3 light years	23 hours 56 minutes

Do the data show a relationship?
Justify your answer.

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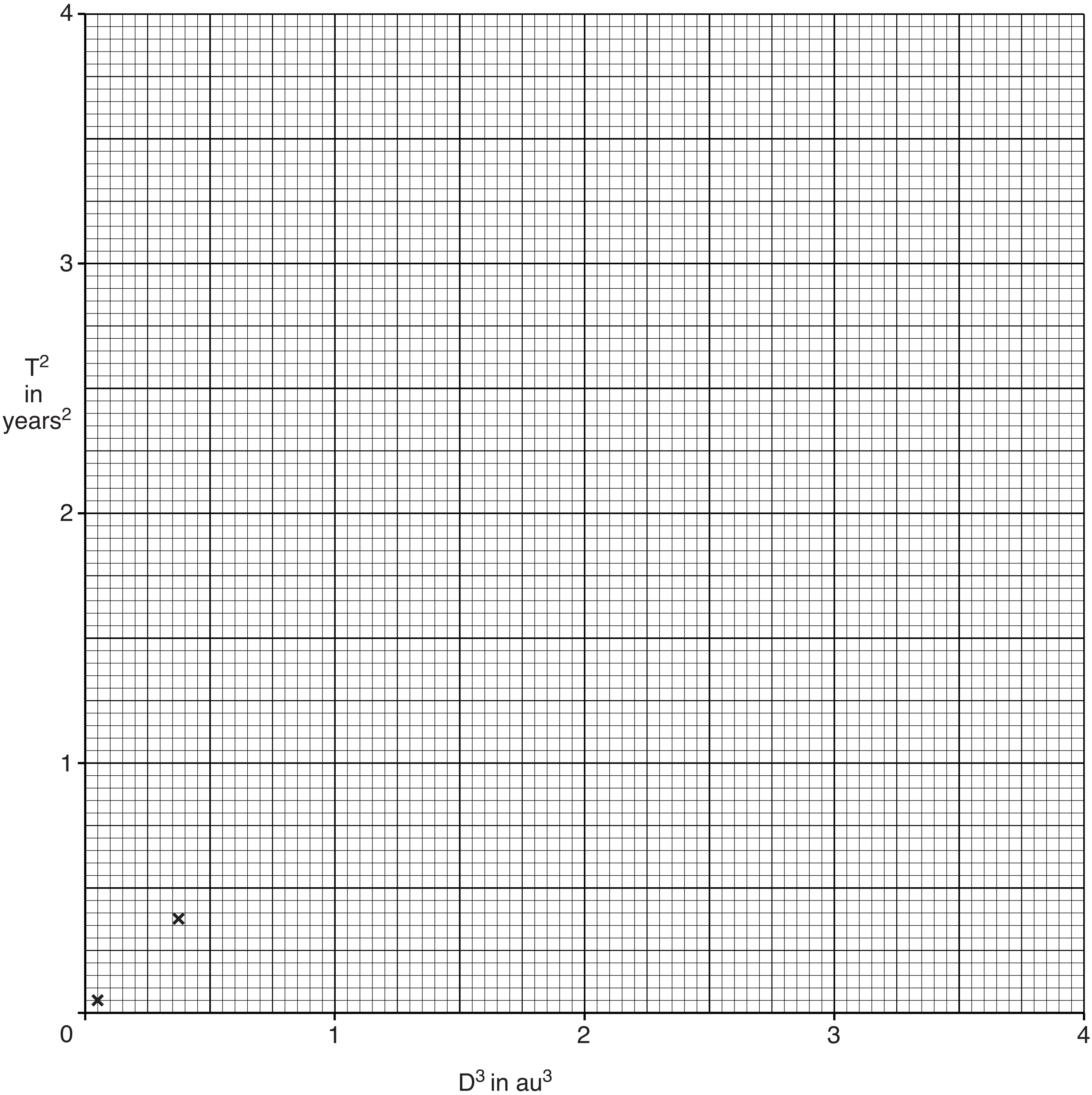
.... **[3]**

(b) Johannes Kepler found a relationship between the distance from the Sun and the time it takes the planets to orbit the Sun.

The table shows data for some of the planets.

	Distance (D) from Sun in astronomical units (au)	**D^3 in au^3**	**Time (T) to orbit the Sun in years**	**T^2 in $years^2$**
Mercury	0.39	0.05	0.24	0.06
Venus	0.72	0.37	0.62	0.38
Earth	1.00	1.00	1.00	1.00
Mars	1.52	3.50	1.88	3.53

Some of the data have been plotted on the graph.



(i) Plot the points for **Earth** and **Mars** on the graph. **[2]**

(ii) Draw a line of best fit on the graph. **[1]**

(iii) The asteroid Geographos has an average distance from the Sun of 1.25 au.

This gives a value of 1.95 au^3 for D^3.

Use the graph to find T^2 for the asteroid.

T^2 = ... $years^2$ **[1]**

[Total: 9]

4 Cepheid variable stars are important in measuring distances to galaxies.

(a) Complete the sentences about Cepheid variables.
Use words from the list.

brightness **distance** **luminosity** **period** **shape**

Cepheid variables pulse in brightness.

By comparing a Cepheid variable's observed .... , as seen from Earth,

with its luminosity, the .... of the Cepheid variable can be found.

The .... of the pulsing brightness is related to the .... **[4]**

(b) A scientist measures the distance to four Cepheid variables in a galaxy.

Distance to Cepheid variable in megaparsecs
0.83
0.77
0.74
0.82

(i) Calculate the mean distance of the Cepheid variables.

mean distance = ... megaparsecs **[2]**

(ii) Here is a table of the distance to some nearby galaxies.

Galaxy	Distance to galaxy in megaparsecs
Wolf-Lundmark	0.97
Andromeda	0.79
Triangulum	0.81
Cetus dwarf	0.75

In which galaxy are the Cepheid variables most likely to be?

.... **[1]**

(iii) How many parsecs are equal to one megaparsec?

Put a (ring) around your answer.

100 **1000** **1 000 000** **100 000 000**

[1]

(c) Calculate the speed of recession of a distant galaxy that is 500 megaparsecs away.
The Hubble constant is 70 km/s per megaparsec.

speed of recession = ... km/s **[2]**

[Total: 10]

5 Astronomers use the method of parallax to measure the distance to nearby stars.

(a) Describe how parallax is used to measure the distance to nearby stars.
Include a labelled diagram in your answer.

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

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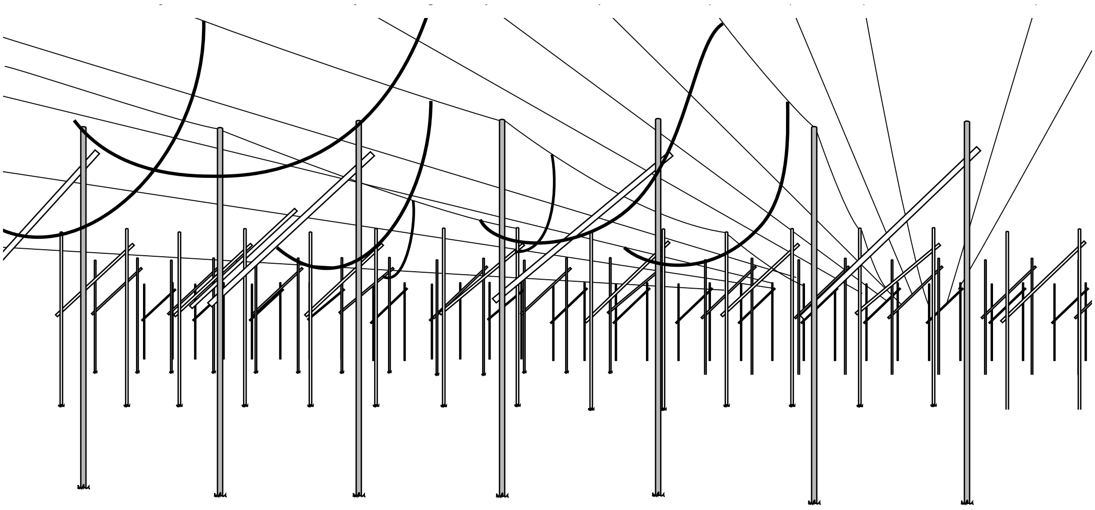
.... **[6]**

(b) Calculate the distance to a star with a parallax angle of 0.2 seconds of arc.

distance to star = ... parsecs **[2]**

[Total: 8]

6 The picture shows a radio telescope.



In 1967 a scientist used a radio telescope and recorded a regular series of pulses, one every 1.33 seconds, coming from the sky. She took more readings over a number of nights. The signal came from a location that moved across the sky with the stars.

Observations made with another telescope confirmed the pulses existed, with the same location in the sky and with the same timing.

(a) Why did the scientist repeat the readings over a number of nights?

.... **[1]**

(b) At first the scientist thought the signal might be a fault in the radio telescope.

How could the scientist be sure this was not the explanation for the pulses?

....

.... **[1]**

(c) Some people suggested that this signal was from extraterrestrial life, an alien civilisation.

(i) Would it be a good idea to send a signal back to an alien civilisation?
You should justify your answer by considering the possible **advantages** and **disadvantages**.

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.... **[3]**

(ii) What evidence of extraterrestrial life have scientists found?

.... **[1]**

(iii) Over the last few years scientists have found objects in space that they think make it much more likely that extraterrestrial life exists.

What objects have scientists found?

....

.... **[1]**

(d) Scientists eventually agreed that the signal came from a spinning neutron star.

How are neutron stars formed?

....

.... **[2]**

[Total: 9]

7 Most major astronomical observatories are in very isolated places on high mountains.

(a) Which **two** of the following are examples of places with major optical and infrared astronomical observatories?

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

Canada **Canary Islands** **Chile** **London** **The North Sea**

[2]

(b) Explain why observatories are built on isolated high mountains. You should consider **both** advantages **and** disadvantages of the isolated high location. Suggest, with a justification, an alternative location.

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

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.... **[6]**

[Total: 8]

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE