

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE**

A183/01

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

Module P7 (Foundation Tier)

FRIDAY 19 JUNE 2015: Morning

DURATION: 1 hour

plus your additional time allowance

MODIFIED ENLARGED 24pt

Candidate forename						Candidate surname				
Centre number						Candidate number				

**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

The quality of written communication is assessed in questions marked with a pencil ().

A list of useful relationships is printed on pages 3–5.

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.

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

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{change of momentum} = \text{resultant force} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \begin{array}{l} \text{distance moved in} \\ \text{the direction of the} \\ \text{force} \end{array}$$

$$\text{amount of energy transferred} = \text{work done}$$

$$\begin{array}{l} \text{change in} \\ \text{gravitational} \\ \text{potential energy} \end{array} = \text{weight} \times \begin{array}{l} \text{vertical} \\ \text{height} \\ \text{difference} \end{array}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

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

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

Observing the Universe

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

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

$$\text{speed of recession} = \text{Hubble constant} \times \text{distance}$$

$$\text{pressure} \times \text{volume} = \text{constant}$$

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

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

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

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.**

[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.**

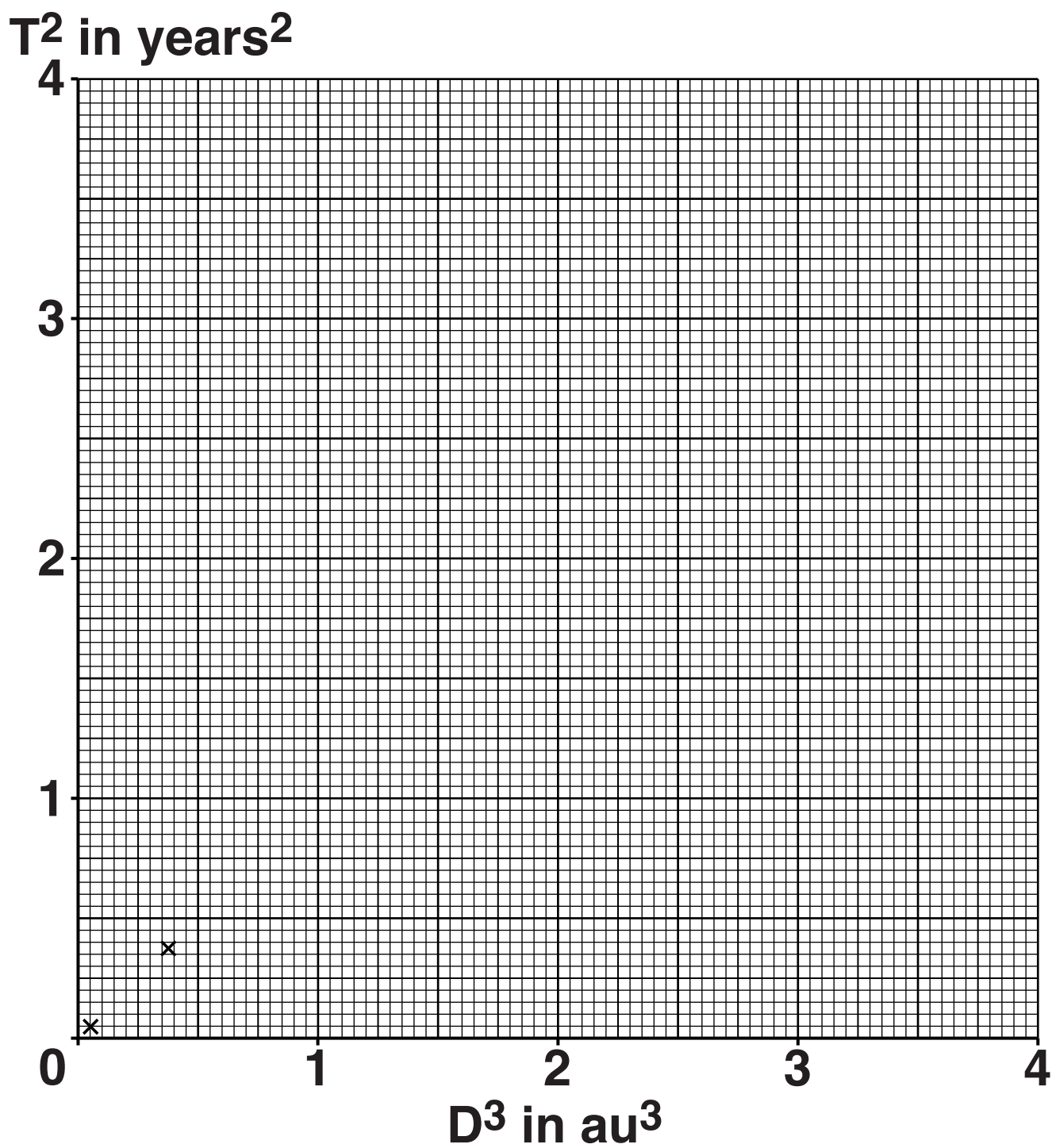
[3]

(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 au³ for D³.

Use the graph to find T² for the asteroid.

T² = _____ years² [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

1000 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.

[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 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.

[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]

[6]

[6]

[TOTAL: 8]

END OF QUESTION PAPER

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