OCR
Oxford Cambridge and RSA

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Friday 24 June 2016 – Morning

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

A183/02 Module P7 (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

* A 1 8 3 0 2 *

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. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- 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

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

Observing the Universe

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

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

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

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

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

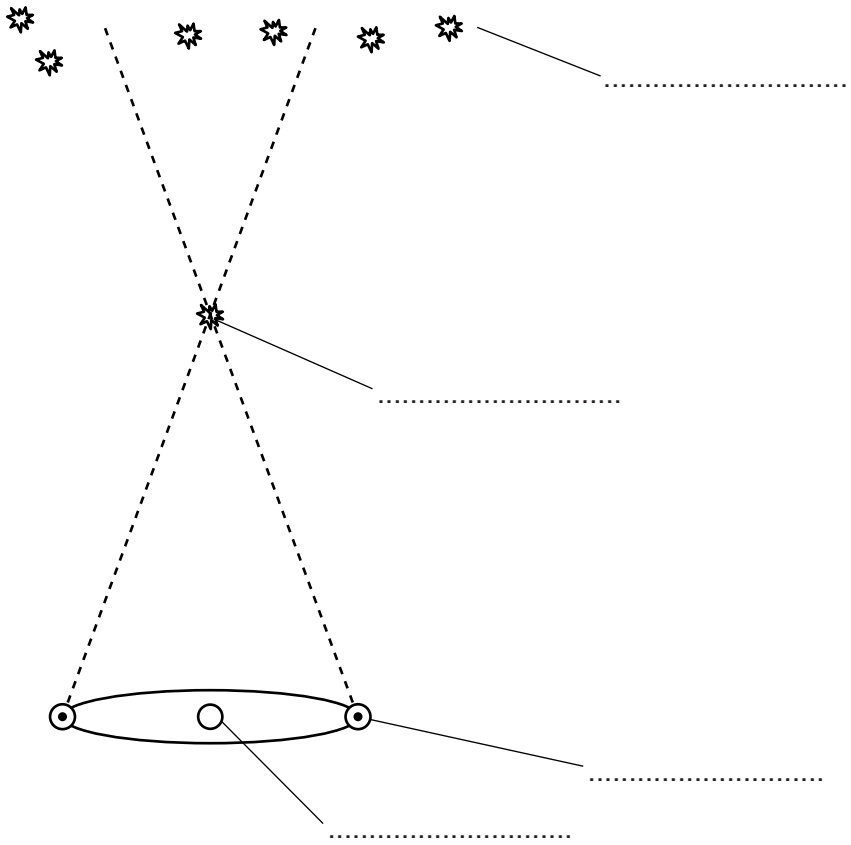
$$\frac{\text{volume}}{\text{temperature}} = \text{constant}$$

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

Answer **all** the questions.

1 Parallax can be used to find the distance to stars.

(a) **(i)** The diagram can show how parallax is used to find the distance to a star. Complete the labels on the diagram.



[4]

(ii) Draw a line on the diagram to show the parallax angle.
Label the **angle P**. **[1]**

(b) A star has a parallax angle of 0.71 seconds of arc.

Calculate the distance to the star and state the unit.

distance to star = ... unit ..... **[3]**

[Total: 8]

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Question 2 begins on page 6

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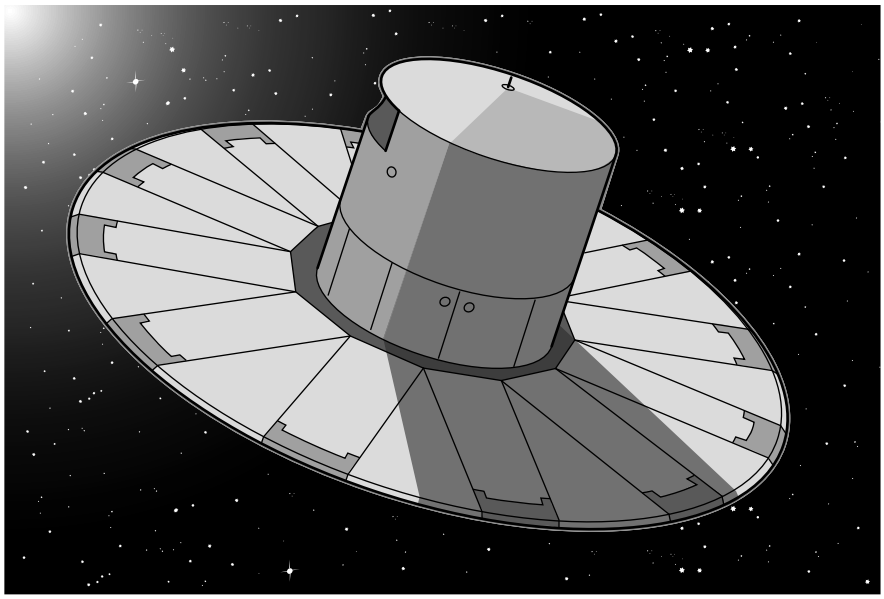
2 In 2014 the European Space Agency launched a space telescope called Gaia. Its main purpose is to measure the parallax of stars more accurately than ever before.



(a) The European Space Agency is an international organisation.
What are the advantages of having an international organisation involved in a project such as developing a space telescope?

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

(b) The final decision about Gaia was not made by the scientists.

(i) Suggest who would have made the final decision to build Gaia.

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

(ii) Suggest arguments for and against a space telescope. You should include both scientific and non-scientific reasons.

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

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

[Total: 9]

3 **(a)** A lens refracts light passing through it.

(i) Explain why a light ray can change direction when passing through a lens.

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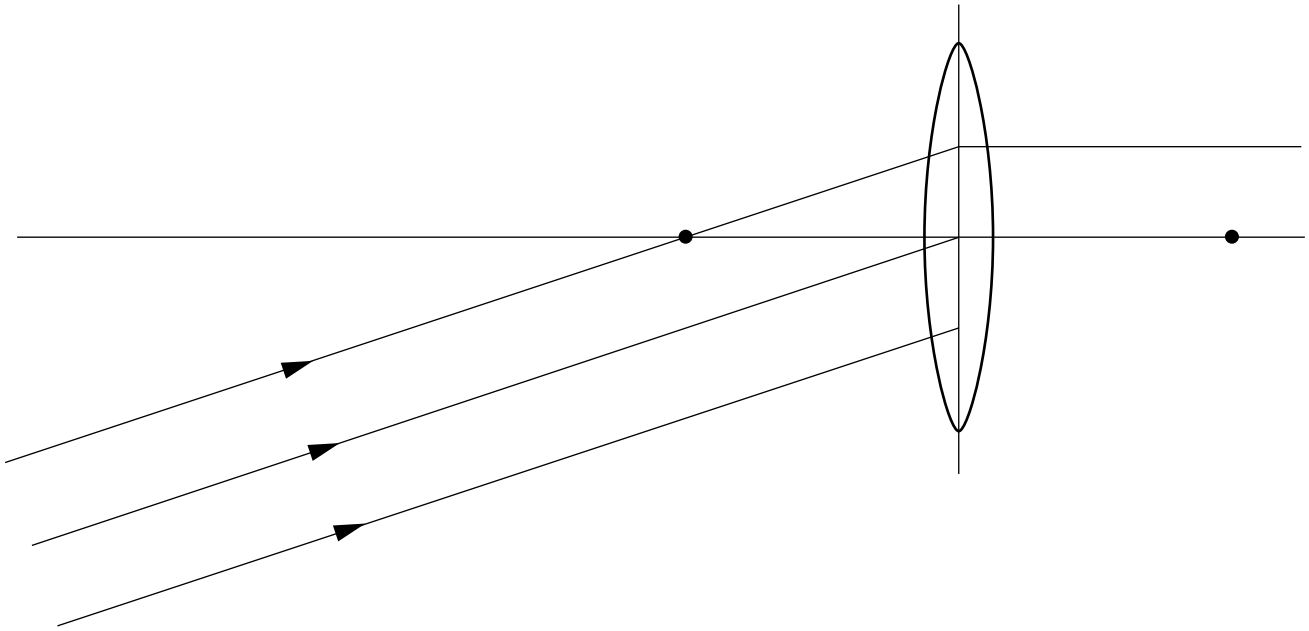
..... **[3]**

(ii) Complete the diagram to show how a lens can form an image of a distant object.
The dots on the diagram are the focal points of the lens.
Label the position of the image.



[3]

(b) June examines a set of converging lenses all made from the same glass.

Lens	Diameter (cm)	Focal length (m)
W	4	0.05
X	5	1
Y	9	1.5
Z	10	0.8

(i) Which lens will be the most powerful? ..... **[1]**

(ii) Which would be the best lens to use as an **eyepiece** lens in a telescope?
Explain your answer.

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

(iii) Which would be the best lens to use as the objective lens in a telescope for viewing **faint** stars?
Give reasons for your answer.

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

(iv) June says that lenses **W** and **Y** would give a telescope with the highest magnification, with a magnification of 300.

Is June correct? Justify your answer.

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..... **[4]**

[Total: 16]

4 Here are the distances to some young stars that appear close together in the sky.

Star	Distance (light years)
A	165
B	570
C	160
D	320
E	175
F	40
G	180
H	1040

(a) Some of the stars formed from the same gas cloud.

Calculate the best estimate for the approximate distance to the centre of the original gas cloud.
Justify your answer.

distance = ... light years

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

(b) Suggest the approximate depth (thickness) of the original gas cloud.
Justify your answer.

depth = ... light years

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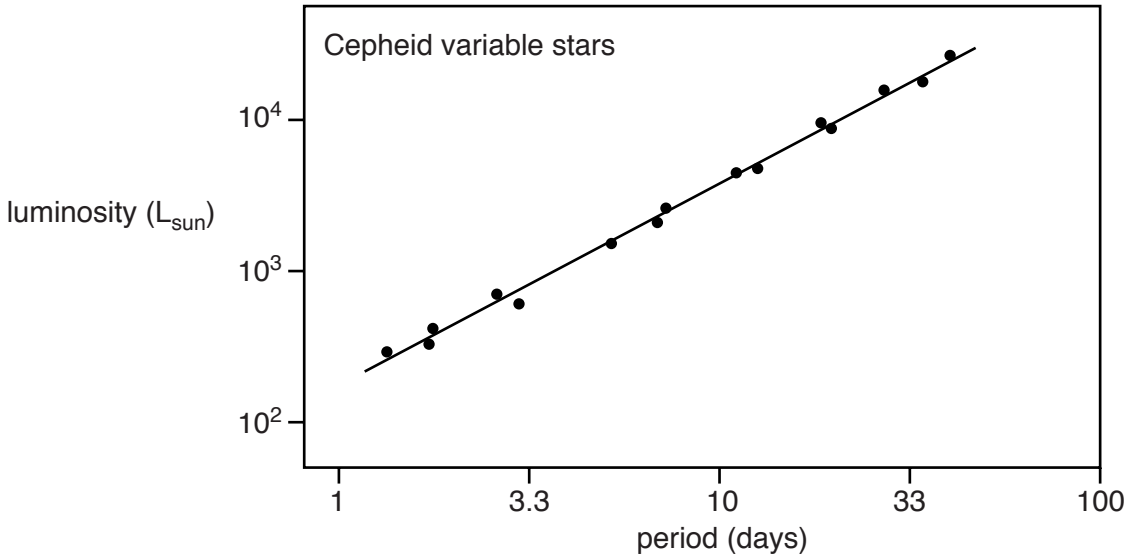
..... **[2]**

[Total: 4]

5 This graph shows the relationship between period and luminosity for Cepheid variable stars.



Explain how this relationship can be used to find the distance to a Cepheid variable and hence support the value of the Hubble constant in the equation for distant galaxies:

Speed of recession = Hubble constant × distance

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

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[Total: 6]

6 Stars produce a great deal of energy.

(a) Describe the nuclear reaction producing energy in the Sun.

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

(b) A single nuclear reaction in the Sun results in 4.3×10^{-12} J of energy being produced.

(i) How much mass is converted to energy in the nuclear reaction?
(speed of light = 3.0×10^{8} m/s)

mass = ... kg **[3]**

(ii) The Sun's luminosity is 3.9×10^{26} J per second.

Calculate how many nuclear reactions are taking place in the Sun each second.

number of nuclear reactions each second = ... **[2]**

(c) Describe how this energy is transferred within the Sun and then into space.

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

[Total: 11]

7 The Sun, Moon and stars all take about one day to travel East-West across the sky. But each takes a slightly different time.

Explain why they each take about a day and why they are each slightly different.
You may use diagrams to help your answer.

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

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[Total: 6]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).