OCR
Oxford Cambridge and RSA

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Friday 23 June 2017 – 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

* A 1 8 3 0 1 *

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 barcodes.

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

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

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

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

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

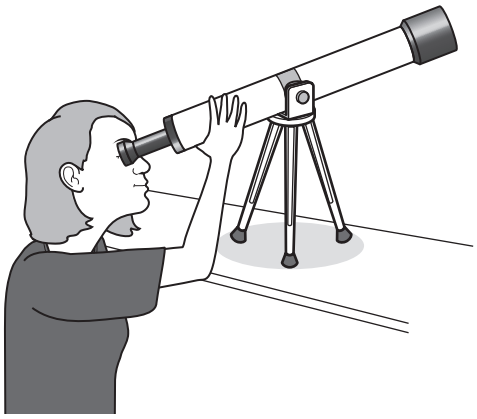
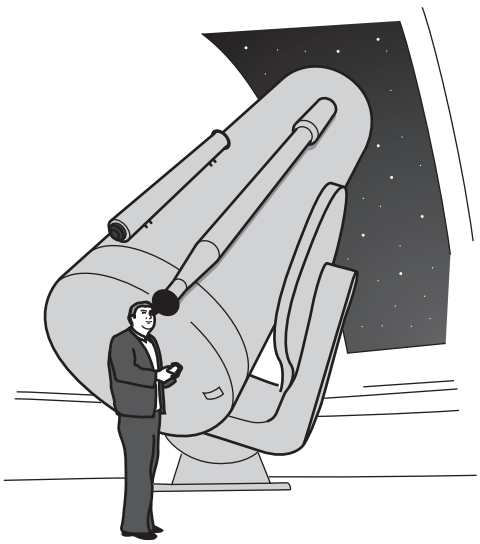
$$\frac{\text{pressure}}{\text{temperature}} = \text{constant}$$

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

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

Answer **all** the questions.

1 This question is about different types of telescope.

Simple telescope	Astronomical telescope
	
A simple optical telescope is made from lenses.	Astronomical telescopes are usually made with a mirror in place of one of the lenses.

Draw a diagram of how a simple optical telescope works and explain why astronomical telescopes use mirrors.

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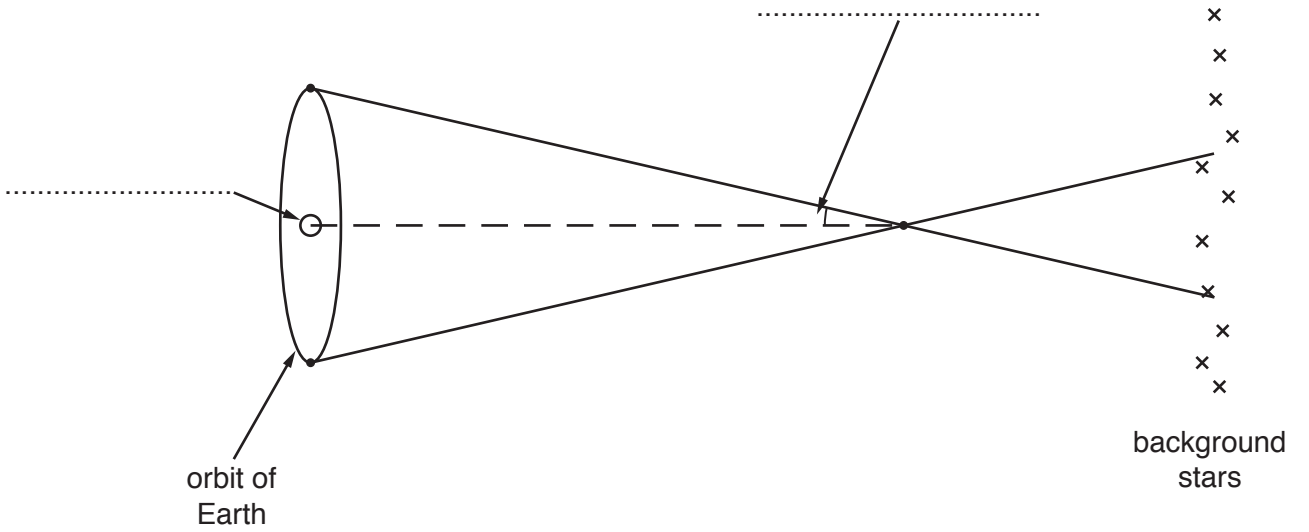
..... **[6]**

[Total: 6]

2 The diagram shows how parallax works.

(a) Complete the labels on the diagram.



[2]

(b) (i) What happens to the parallax angle as the distance to a star increases?

Put a (ring) around your answer

decreases **stays the same** **increases** **[1]**

(ii) Calculate the distance to a star with a parallax of 0.02 arc seconds and give the units.

distance = ... units ..... **[2]**

(c) Parallax is used to measure astronomical distances.

To find the distance to a nearby star, measurements from Earth are taken 6 months apart.

For each of the following, suggest why parallax, using measurements taken 6 months apart, is **not** a suitable method.

(i) A planet in the Solar System:

.....

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

(ii) A star in a nearby galaxy.

.....

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

(d) Suggest **two** other methods for measuring astronomical distances.

1 .....

2 .....

[2]

[Total: 9]

3 The Andromeda galaxy is a nearby galaxy.

(a) Scientists have measured the distance to the Andromeda galaxy.

They have got different measurements.

Distance to Andromeda galaxy in kpc
810
750
280
760
780
800

(i) Which **one** of the measurements given above is an outlier?

Justify your answer.

Outlier ..... kpc

.....

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

(ii) What is the mean distance to the Andromeda galaxy?

mean distance = ... kpc **[3]**

(iii) Calculate the thickness of the Andromeda galaxy.

thickness = ... kpc **[2]**

(b) A measurement of the distance to the Andromeda galaxy was used by Edwin Hubble to decide who was correct in the Curtis-Shapley debate.

Explain how the Curtis-Shapley debate demonstrates that scientists can have different conclusions about the same data and how Hubble's measurement resolved the debate.

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

[Total: 13]

4 The Sun is a low mass star.

(a) In the Sun's core hydrogen is fused to form helium.

(i) Complete the overall equation for this nuclear reaction.

$$\text{.....}\,{}^{1}_{1}\text{H} \rightarrow {}^{4}_{2}\text{He} + 2e^{+} + \gamma$$ **[1]**

(ii) The $\mathbf{e^{+}}$ balances the charge in the equation.

What does the symbol $\mathbf{e^{+}}$ mean?

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

(iii) The energy released by the reaction, appears in two forms.

One is kinetic energy, what is the other?

Put a (ring) around the correct answer.

chemical **gamma radiation** **gravitational potential energy** **renewable** **[1]**

(iv) Use words from the list to complete the sentences about energy in the Sun.

You may use each word once, more than once or not at all.

conduction **convection** **insulation** **radiation**

Energy is released in the core of the Sun.

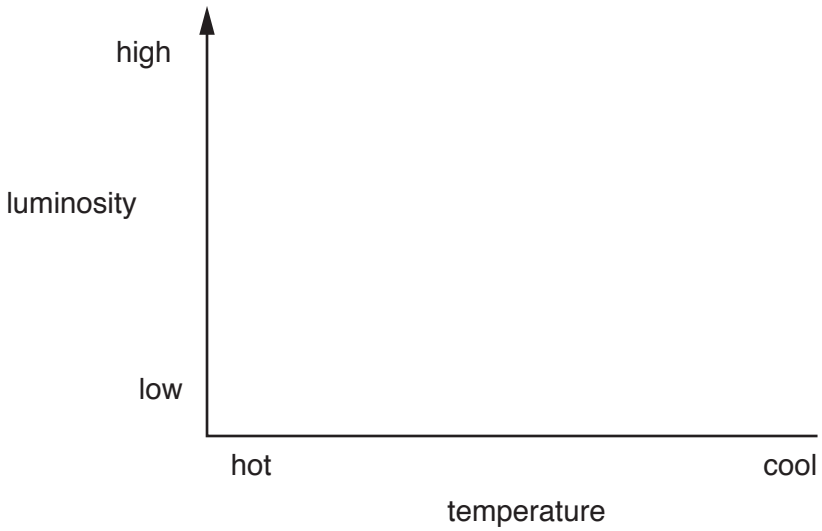
This energy is transferred to the surface by ..... and ..... .

The energy is then released from the photosphere into space as ..... .

[3]

(b) The Sun will spend most of its life as a main sequence star.

(i) On the Hertzsprung-Russell diagram sketch the main sequence.



[1]

(ii) What is the likely future of the Sun?

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

It will turn into a supernova and then a black hole. ☐

It will turn into a red giant and then a white dwarf. ☐

It will turn into a red giant and then a neutron star. ☐

It will turn into a supergiant star and then into a supernova. ☐ **[1]**

(iii) After the Sun leaves the main sequence it will fuse helium to make new elements.

Write down **two** elements that will be produced.

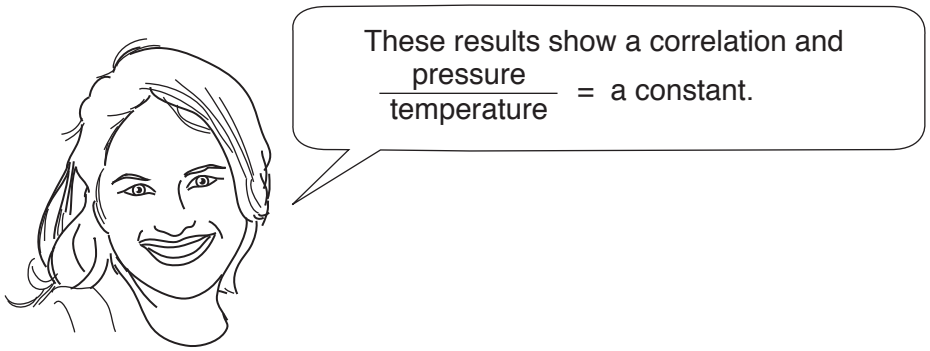
..... and ..... **[2]**

[Total: 10]

5 Gail does an experiment to test the effect of temperature on the pressure in a gas.
Here are her results.

Pressure in Pa	Temperature in K
1000	250
1080	270
1160	290
1240	310

Gail says



(a) Is Gail correct?
Justify your answer.

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

(b) The temperature rises to 310 K.

What is this temperature in °C?

temperature = ... °C **[2]**

[Total: 5]

6 A group of scientists and business people are deciding whether to build a space telescope or a telescope on a high, dry mountain.

The telescope is to observe infrared light.
Infrared light is absorbed by water in the atmosphere.

The group have the following information about estimated costs.

Building optics for space telescope.	£3500 million
Launching the telescope into space.	£80 million per tonne
Mass of space telescope to be launched.	6.5 tonnes
Other costs for space telescope.	£4000 million
Building a high mountain based telescope and observatory.	£1100 million

Suggest which type of telescope the group should build.

Use your knowledge and the data above to justify your conclusion.

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

[Total: 6]

7 Sam has a telescope with a motor and computer controls.

(a) Sam inputs two numbers to tell the telescope where to point.

What are these two numbers?

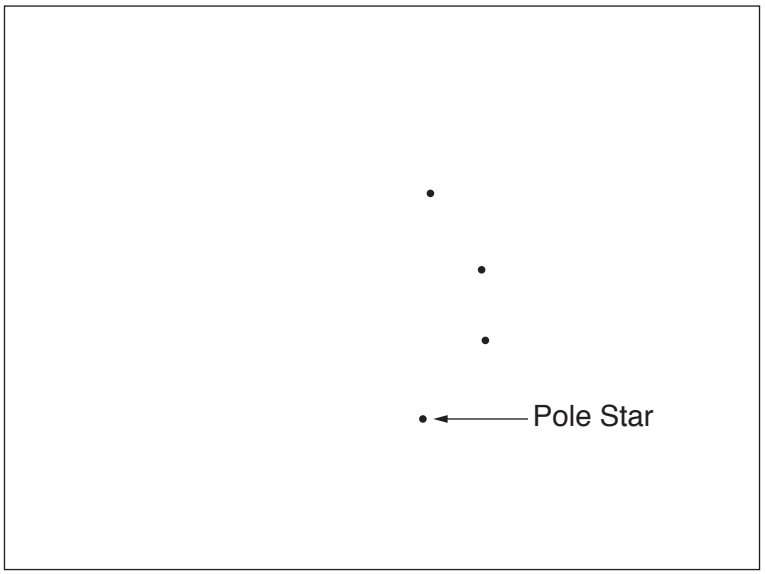
Put a (ring) around the correct answer.

angles **distances** **parallax** **heights** **[1]**

(b) Sam takes a photograph of the constellation of Ursa Minor and the Pole Star.

He knows the stars are faint so he sets the camera to take a picture over 6 hours. The stars show as lines on his photograph.

Draw the lines Sam saw on his photograph.



[4]

(c) Use words from the list to complete the following sentence about 'retrograde' motion.

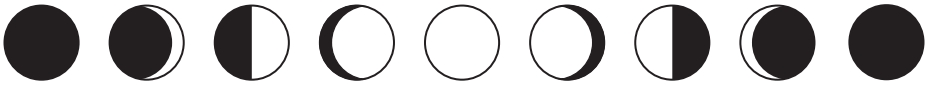
You may use each word once, more than once or not at all.

backwards **faster** **forwards** **galaxies** **planets** **slower** **stars** **Sun**

Retrograde motion is when ..... appear to move .....

compared to their usual motion against the fixed ..... . **[3]**

(d) The Moon shows a cycle of phases.



Explain why we see the different phases and why the cycle repeats.
Use diagrams in your answer.

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

[Total: 11]

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).