OCR
RECOGNISING ACHIEVEMENT

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE **A183/01**

PHYSICS A

Unit A183: 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 clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- Your 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 for each question is given in brackets **[ ]** at the end of the 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.

For Examiner's Use		
	Max	**Mark**
1	**12**	
2	**16**	
3	**6**	
4	**5**	
5	**11**	
6	**10**	
TOTAL	**60**	

TWENTY FIRST CENTURY SCIENCE DATA SHEET

Useful Relationships

The Earth in the Universe

distance = wave speed x time

wave speed = frequency x wavelength

Sustainable Energy

energy transferred = power x time

power = voltage x 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 x velocity

change of momentum = resultant force x time for which it acts

work done by a force = force x distance moved in the direction of the force

amount of energy transferred = work done

change in gravitational potential energy = weight x vertical height difference

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

Electric Circuits

power = voltage x 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 x [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.

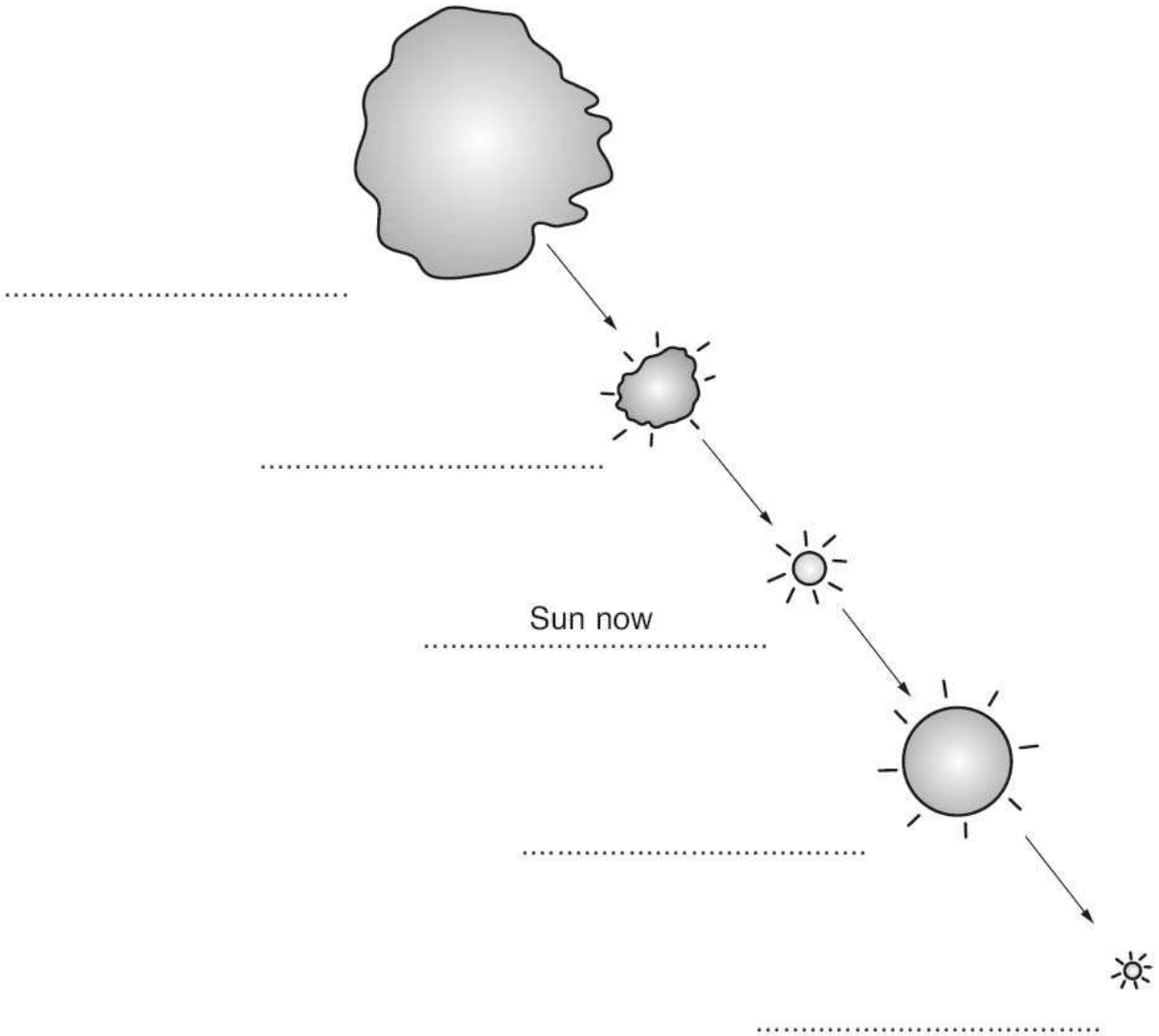
1 (a) The diagram shows the stages in the life of our Sun.

(i) Use some of the words from this list to label the different stages on the diagram.

cloud of gas **neutron star** **protostar** **red giant**

Sun now **supernova** **white dwarf**

The Sun as it appears now has been done for you.



[4]

(ii) A star that is much bigger than our Sun has different stages at the end of it's life.

Which two stages in the list only happen in the life of a very large star?

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

(b) Nuclear fusion takes place in the core of stars.

In nuclear fusion, elements with small nuclei fuse together to form elements with larger nuclei. Fusion in stars does not normally produce elements larger than iron.

Use the table to help you answer the following questions.

element	size of nucleus (mass units)
hydrogen	1
helium	4
oxygen	16
silicon	28
iron	56
lead	207
uranium	238

(i) Which element in the table cannot be formed by fusion?

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

(ii) Use one of the elements in the table to complete this sentence.

Red giants or red supergiants form when the stars run out of .....

in the core.

[1]

(iii) Write down two elements from the list, other than helium which might be produced in a red giant.

Explain your answer.

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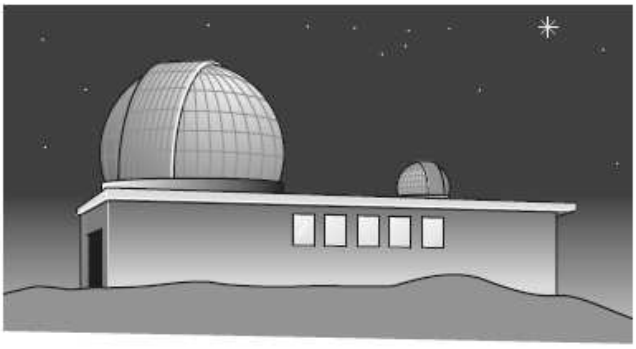
..... **[3]**

(iv) Name an element from the table which could only be produced in a supernova.

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

[Total: 12]

2 A group of countries are planning to build a new astronomical observatory.



(a) Write down the geographical location of a major astronomical observatory on Earth.

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

(b) Describe a good place to build the new observatory.

You should describe the factors that the astronomers would take into account when choosing the place for the new telescope.

What arguments could be made against building the telescope in this place?

✎ *The quality of written communication will be assessed in your answer to this question.*

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

(c) Astronomers will not make the final decision about building the observatory.

Suggest who will make the decision. Give reasons why they will make the decision, and not the astronomers.

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

(d) One group of astronomers thinks the money should be spent sending a telescope into space.

Should the money be spent on a space telescope?

Explain why you choose your answer.

You should include the advantages and disadvantages of a space telescope in your answer.

✎ *The quality of written communication will be assessed in your answer to this question.*

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

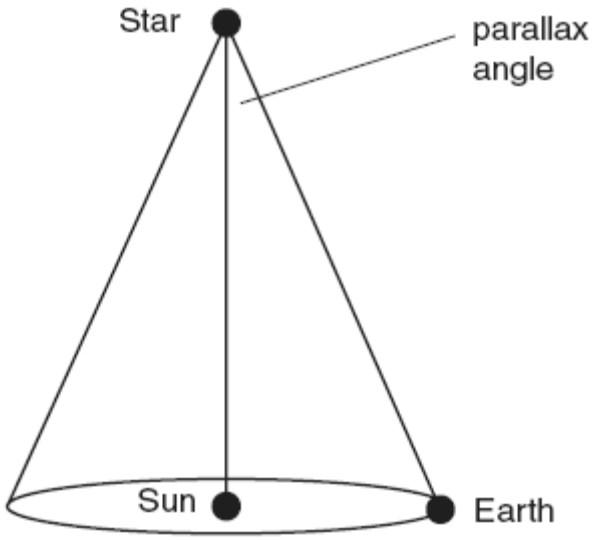
[Total: 16]

3 Sally is studying some nearby stars.

(a) She is using parallax to measure the distance to stars.

She measures the parallax angle.

The diagram shows the parallax angle for a star.



(i) All the stars she measures are more than 1 parsec from the Earth.

Which parallax angle must be **wrong**?

Put a (ring) around the angle that must be wrong.

2 arc seconds **0.1 arc seconds** **0.2 arc seconds** **0.01 arc seconds**

[1]

(ii) Sally records the parallax angle of two stars.

star	parallax angle in seconds of arc
A	0.549
B	0.274

Compare the distances to star **A** and star **B**.

.....

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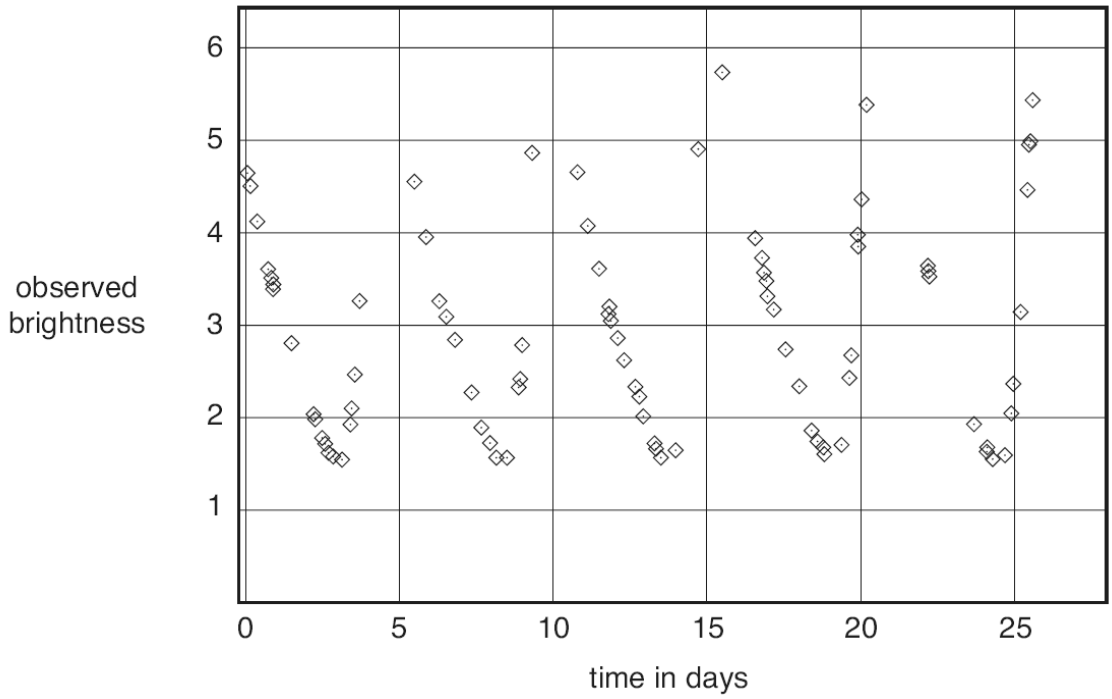
..... **[2]**

(b) Sally then makes some observations of a Cepheid variable star.

The graph shows how the observed brightness of the star, Delta Cephei, changes with time.



(i) What is the brightness of Delta Cephei at it's dimmest?

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

(ii) The period is the time taken for one cycle of brightness.

What is the period of Delta Cephei?

Use the graph to find your answer.

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

[Total: 6]

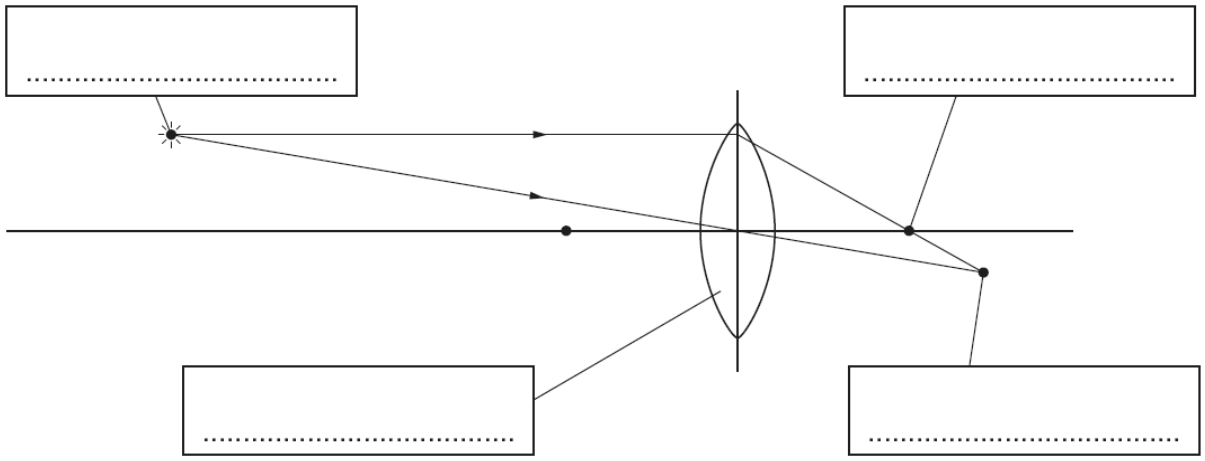
4 Billy is planning to make a telescope to look at distant stars.

He has some lenses made of glass.

(a) He draws a diagram to show how a lens can produce an image from an object.

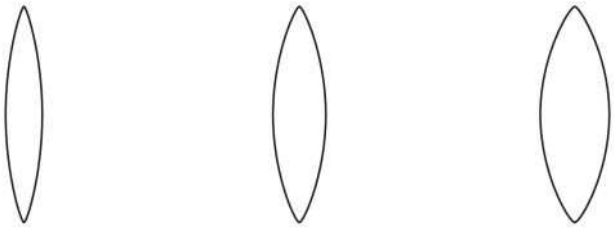
He forgets to label the diagram with the **lens**, **object, image** and **focus**.

Complete the diagram by adding the missing labels.



[3]

(b) Three of Billy's lenses are made from the same glass.



Which lens, **A**, **B**, or **C**, is the most powerful?

Explain your answer.

most powerful lens .....

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

[Total: 5]

5 The photograph shows stars forming.

SciencePhotoLibrary R590/049

When a large amount of gas in space is compressed a star is formed.

(a) What causes the gas to compress?

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

(b) As the gas compresses the temperature of the gas increases.

As the temperature increases, the pressure in the gas changes.

Explain how the pressure changes.

Your answer should include

- what happens to the pressure
- how the behaviour of the particles of the gas changes.

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

(c) When the temperature is high enough, nuclei can fuse together to form new elements. This releases energy.

(i) Complete the equation for this fusion reaction with the names of the elements.

4 ..... → ..... **+ energy**

[2]

(ii) Describe how energy is released inside the Sun and transferred from the centre of the Sun into space.

Your answer should include the energy process happening.

You should write about the processes in the correct order.

✎ *The quality of written communication will be assessed in your answer to this question.*

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

[Total: 11]

6 In the 1950s there were two main theories about how the Universe began.

Martin Ryle

The Universe started as a burst of energy at one point and rapidly got bigger. Galaxies are all moving outwards from this 'Big Bang'.

Fred Hoyle

I agree that galaxies are moving apart, but I don't think the Universe had a beginning like you say. It has always been the same. New galaxies are being made all the time. They form in the gaps between old galaxies, which are dying out.

(a) Here are some astronomical statements.

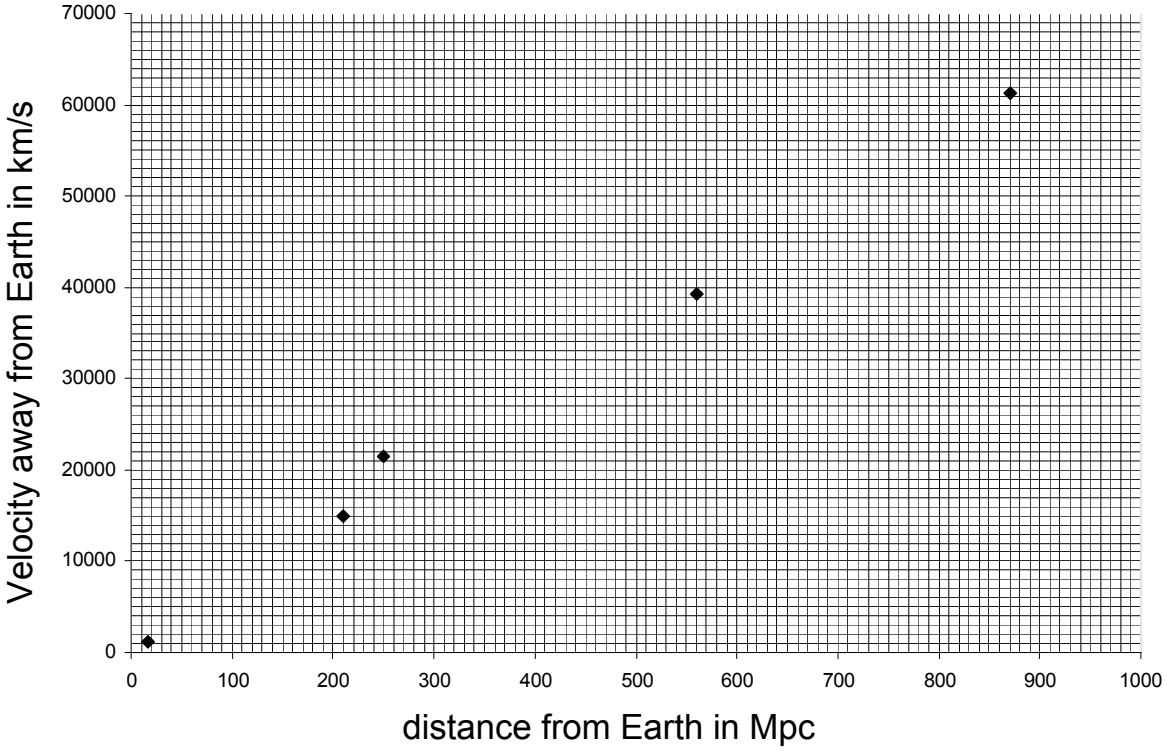
Each statement agrees with what is being said by **Ryle**, or by **Hoyle**, or by **both** of them, or by **neither** of them.

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

statement	Ryle	Hoyle	both	neither
In the past, all the galaxies would have been close together.				
There is no pattern in the age of galaxies.				
The Universe will eventually stop expanding.				

[3]

(b) The graph shows the speed at which some galaxies are moving away from the Earth.



(i) A galaxy has its distance from the Earth measured as 400 Mpc.

Use the graph to find the galaxy's velocity away from the Earth.

velocity away from the Earth = ... km/s **[1]**

(ii) The Hubble constant is now thought to be 72 km/s per Mpc.

Calculate how fast a galaxy at a distance of 1000 Mpc is moving away from the Earth.

velocity away from the Earth = ... km/s **[2]**

(c) Hubble's original measurements suggested the constant was about 500 km/s per Mpc.

(i) What can we measure more accurately now and what do we use to give more accurate measurements?

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

(ii) The Hubble constant is used to calculate the distance to galaxies.

How does decreasing the Hubble constant affect the distances calculated for distant galaxies?

Explain your answer.

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

[Total: 10]

[Paper Total: 60]

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE