OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE **A183/02**

PHYSICS A

Unit A183: 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

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 **20** pages. Any blank pages are indicated.

For Examiner's Use		
	Max	**Mark**
1	**10**	
2	**10**	
3	**7**	
4	**5**	
5	**6**	
6	**8**	
7	**14**	
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 The photograph shows stars forming.

SciencePhotoLibrary R590/049

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

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]**

(b) 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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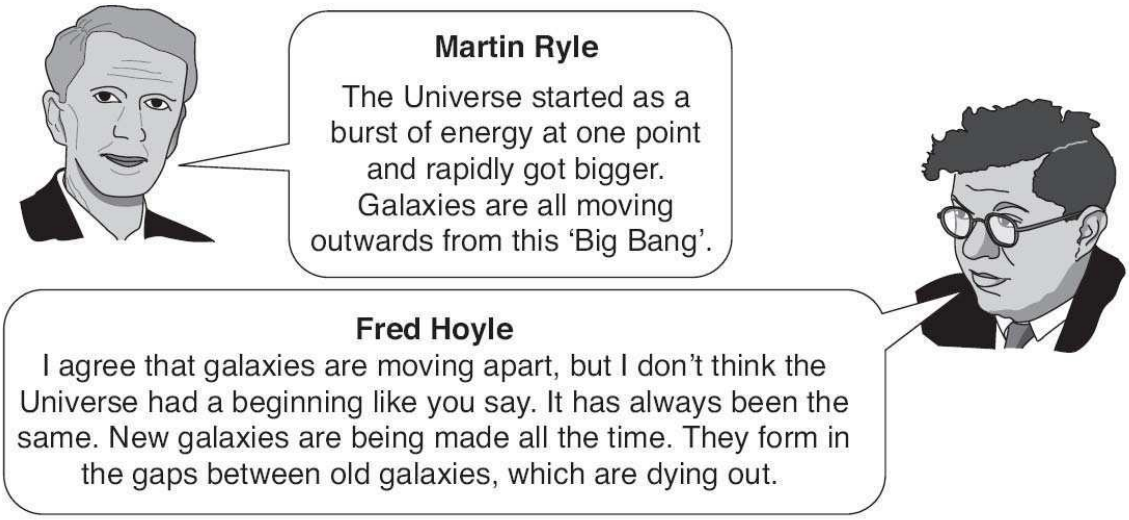
.....**[6]**

[Total: 10]

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



(a) Here are some astronomical statements.

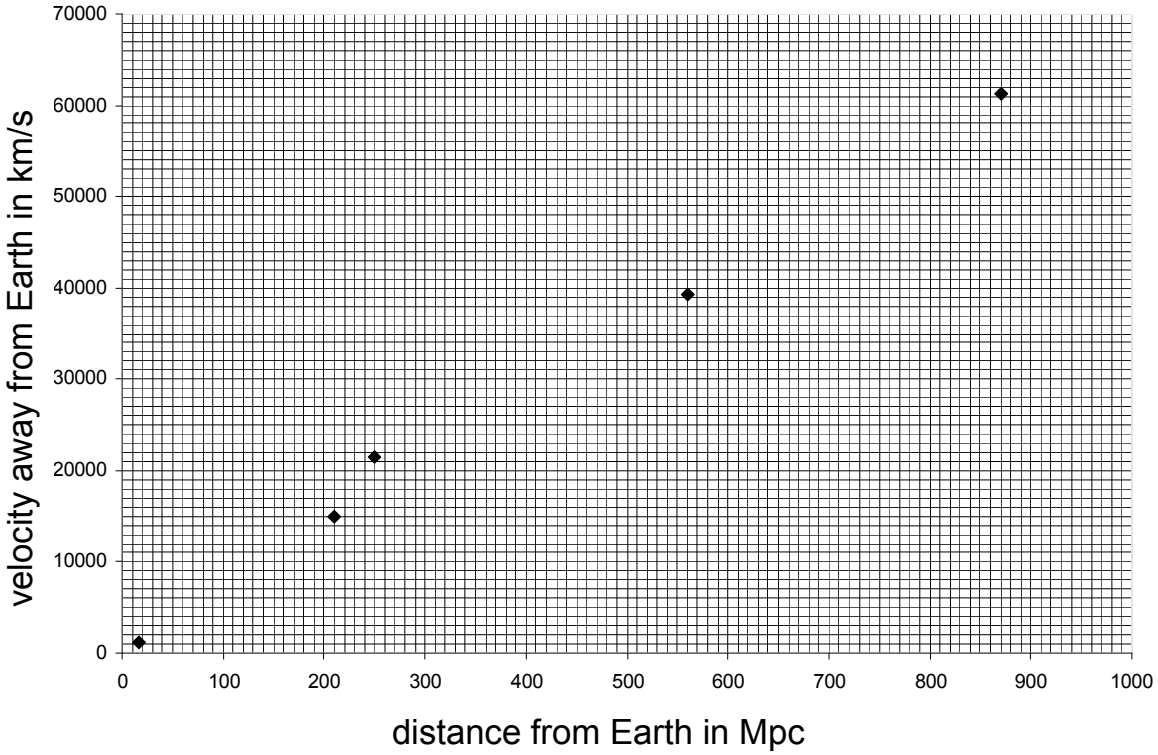
Each statement agrees with what is being said by **Ryle**, or by **Hoyle**, or by **both** of them, or by **neither** of them.

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) Describe the relationship shown by the graph.

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..... [1]

(ii) Use data from the graph to calculate a value for the Hubble constant.

Hubble constant = ... km/s per Mpc **[4]**

(iii) 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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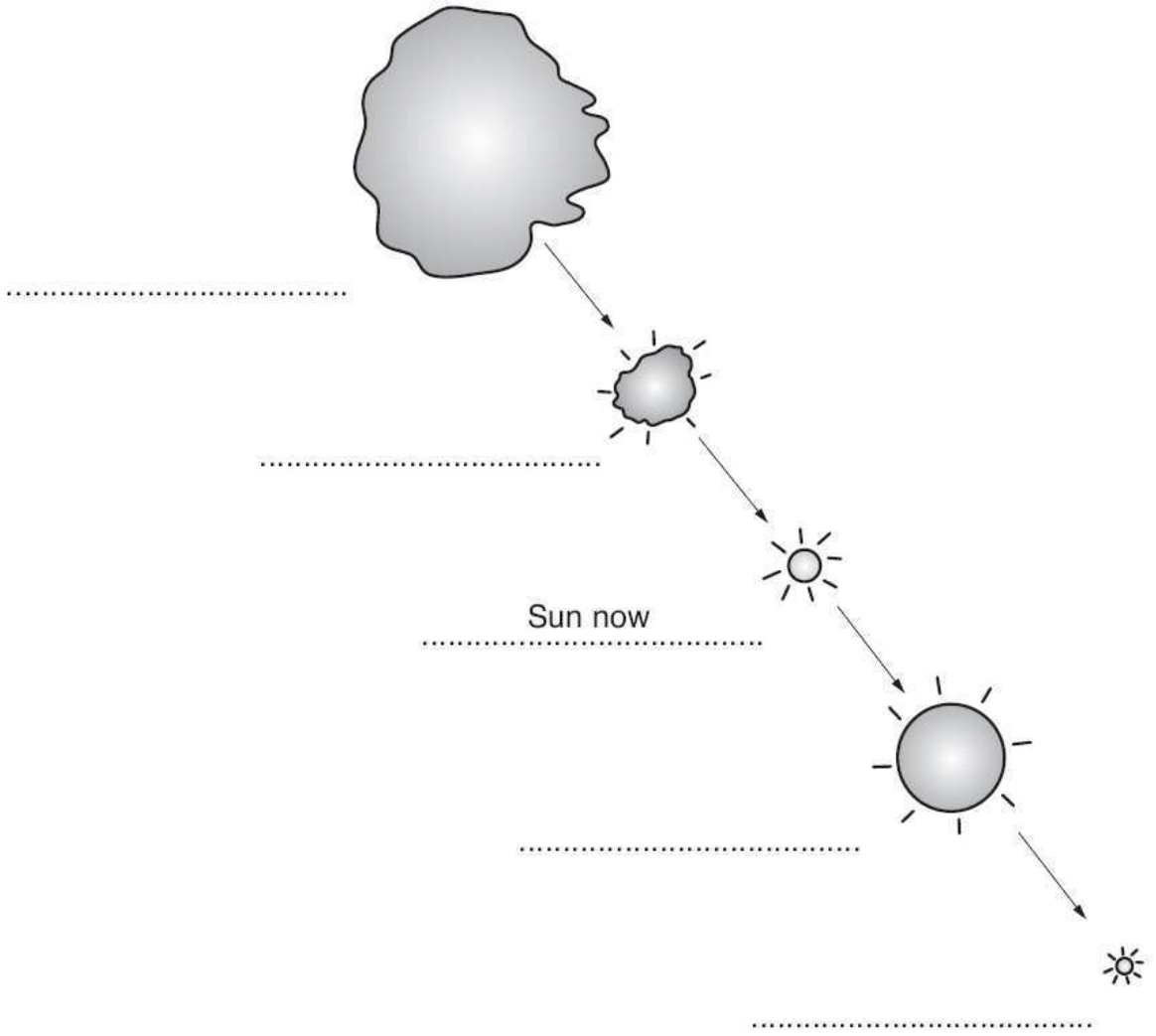
.....**[2]**

[Total: 10]

3 (a) The diagram shows the stages in the life of a low mass star such as the Sun.

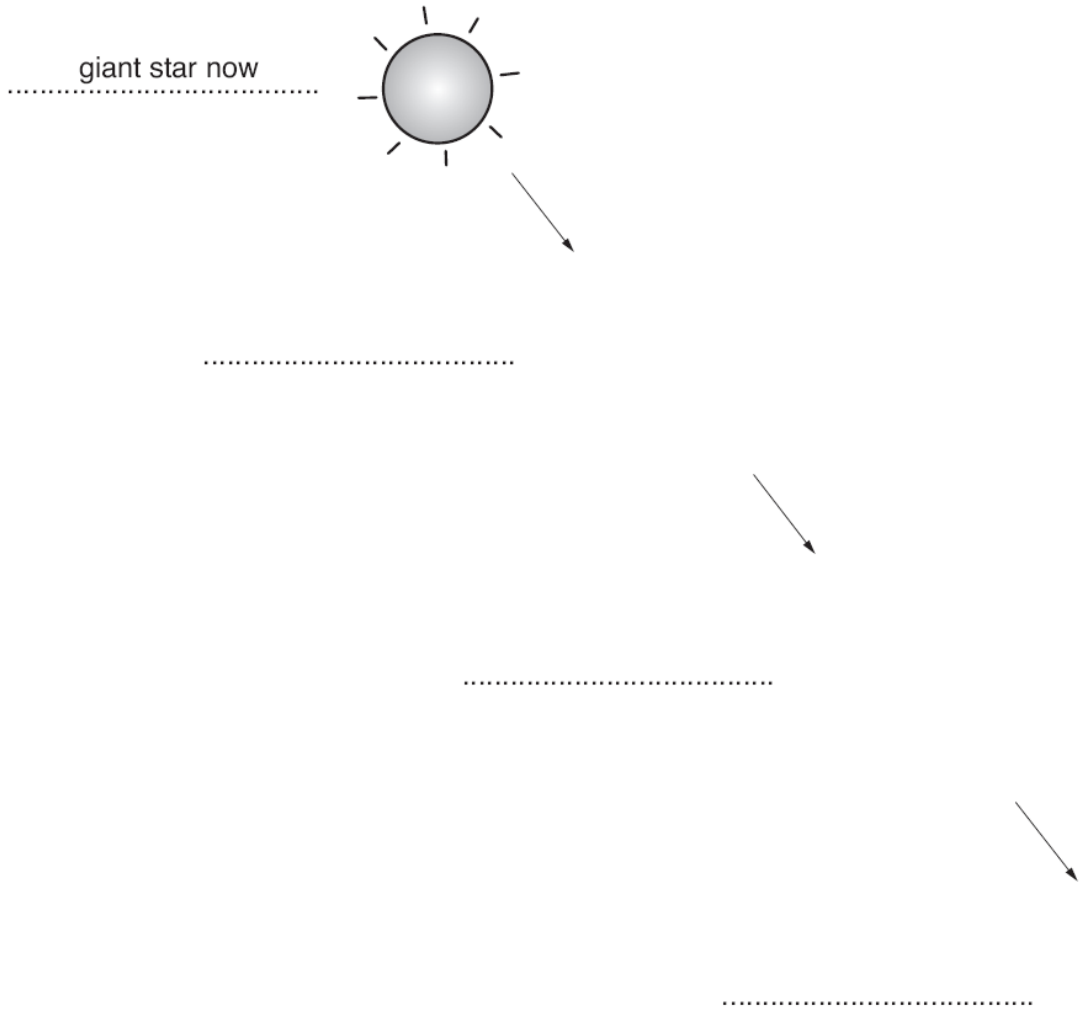
Complete the labels for the different stages on the diagram.

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



[4]

(b) Complete and label a similar diagram for the later stages in the life of a star with very high mass.



[3]

[Total: 7]

4 The Hipparcos telescope satellite has measured the parallax angle of nearby stars very precisely

star	parallax angle in seconds of arc
Barnard's Star	0.549
Tau Ceti	0.274
Epsilon Eridani	0.310
Alpha Canis Majoris (Sirius)	0.379
Alpha Centauri C	0.772
61 Cygni A	0.287

(a) Use the data in the table to answer the following questions.

(i) Which star is closest to the Earth?

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

(ii) Calculate the distance of 61 Cygni A.

distance to 61 Cygni A = ... parsecs **[1]**

(iii) Which star is just over 3 ½ parsecs from the Earth?

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

(b) Write down two advantages of a telescope making its measurements from space, rather than the Earth.

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

[Total: 5]

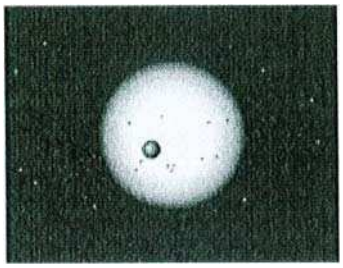
5 Read the newspaper article on evidence for planets.

Extrasolar Planets found?

Some astronomers claim to have found evidence for planets around nearby stars.

The evidence is small variations in brightness of some stars and very small wobbles in the positions of stars.

Some of the results have been published in peer reviewed scientific journals, but only a few have been replicated by other astronomers.



Discuss whether the results should be published in a newspaper or a peer reviewed scientific journal?

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

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

[Total: 6]

6 (a) The Sun takes 24 hours to move once across the sky.

It takes four minutes less time for the Earth to make one complete rotation on it's axis.

Explain why stars take less time to move across the sky than the Sun.

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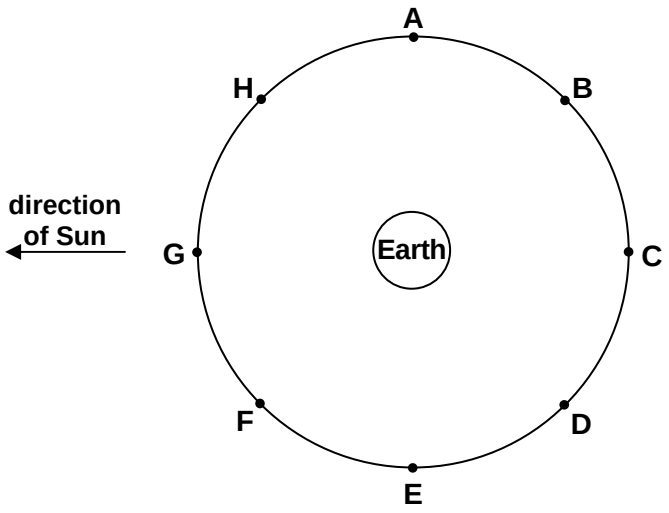
..... **[2]**

(b) The Moon orbits the Earth.

During an orbit it shows different phases.



Sarah sketches the phase of the Moon at three different positions in its orbit.

Complete the table to show the position of the Moon in its orbit, for each phase.

phase of moon	letter of position in orbit
	
	
	

[3]

(c) The moon orbits the Earth approximately once a month.

Solar eclipses occur much less often.

Explain what causes a solar eclipse and why they are so rare.

You may use a diagram to help you answer.

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

[Total: 8]

7 Billy is making a simple telescope.

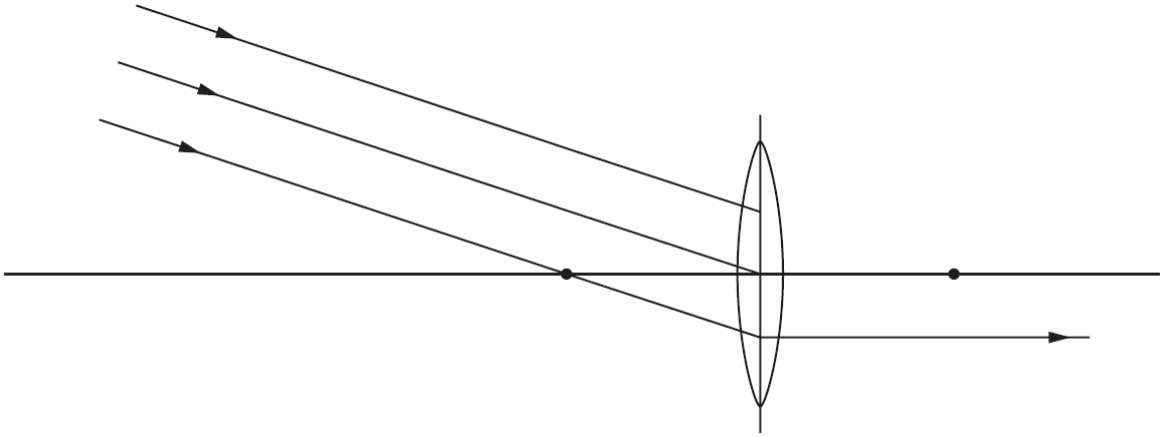
(a) He draws a diagram to show how a lens can produce an image of a distant object.

The focal points of the lens are shown by dots.

He draws three rays coming from the distant object.

Complete the diagram to show how the image is formed.

Label the position of the image on the diagram.



[3]

(b) Billy does some calculations to decide which lenses to use for his telescope.

(i) What is the focal length of a lens with a power 20 dioptres?

You must show your calculation.

focal length = ... m **[2]**

(ii) The lenses he chooses have focal lengths of 0.5m and 0.01m.

What will be the magnification of the telescope?

You must show your calculation.

magnification = ... **[2]**

(iii) Would it be suitable to use two lenses of the same focal length?

Explain your answer.

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

(c) Astronomers want to use the largest telescopes they can. Radio telescopes are much bigger than visible light telescopes.

Explain why large telescopes are needed by astronomers. Your answer should consider both visible light and radio telescopes.

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

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[Total: 14]

[Paper Total: 60]

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