OCR
RECOGNISING ACHIEVEMENT

SPECIMEN   F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE   **A183/01**

PHYSICS A

Unit A183: Module P7 (Foundation Tier)

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

$$efficiency = \frac{energy\ usefully\ transferred}{total\ energy\ supplied} \times 100\%$$

Explaining Motion

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

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

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

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

Electric Circuits

power = voltage x current

$$resistance = \frac{voltage}{current}$$

$$\frac{voltage\ across\ primary\ coil}{voltage\ across\ secondary\ coil} = \frac{number\ of\ turns\ in\ primary\ coil}{number\ of\ turns\ in\ secondary\ coil}$$

Radioactive Materials

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

Observing the Universe

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

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

speed of recession = Hubble constant x distance

pressure × volume = constant

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

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

energy = mass x [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.

....

....

Sun now

....

....

....
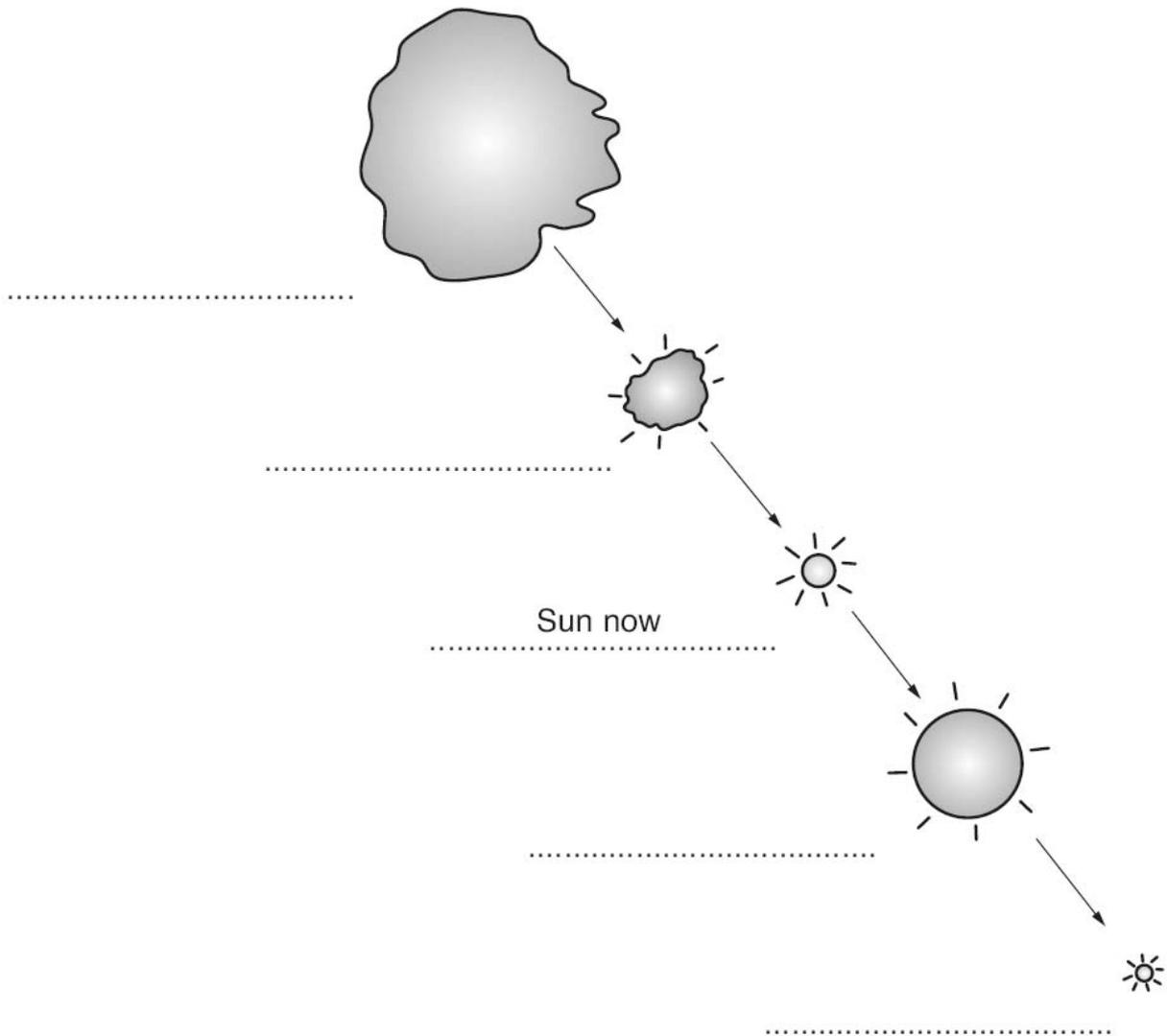
[4]

(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.

....

....

.... **[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.

....

....

....

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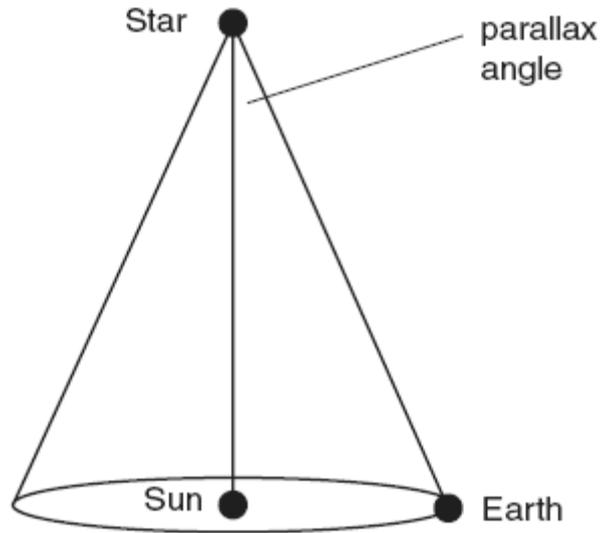
(i) All the stars she measures are more than 1 parsec from the Earth.

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**.

....

....

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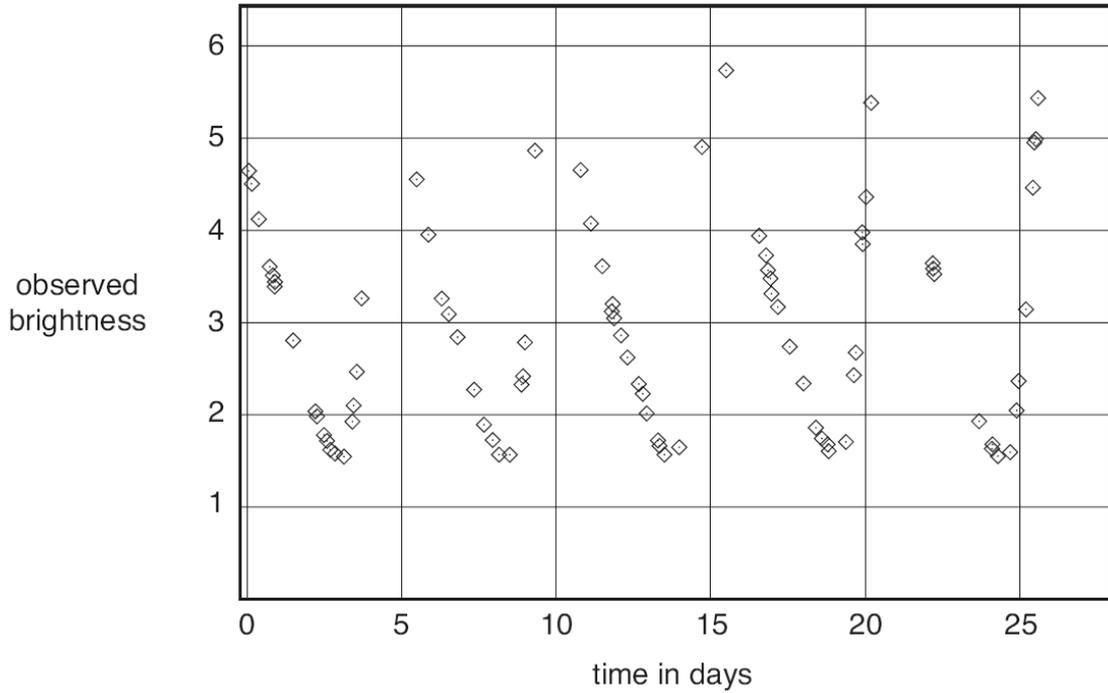
(i) What is the brightness of Delta Cephei at it's dimmest?

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.
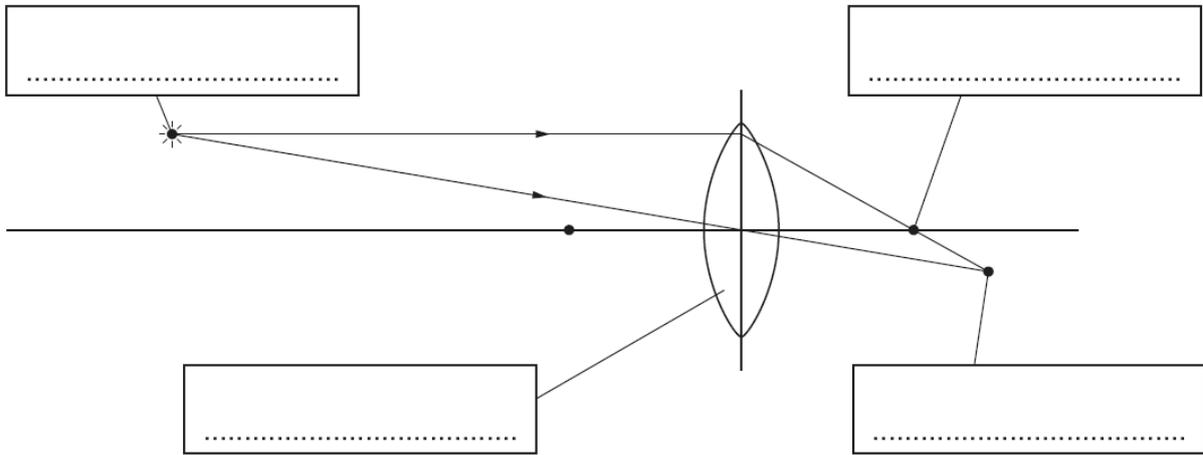
[3]

(b) Three of Billy's lenses are made from the same glass.
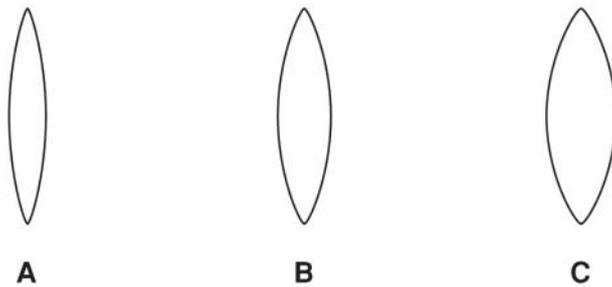
Which lens, **A**, **B**, or **C**, is the most powerful?

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.

....

....

....

....

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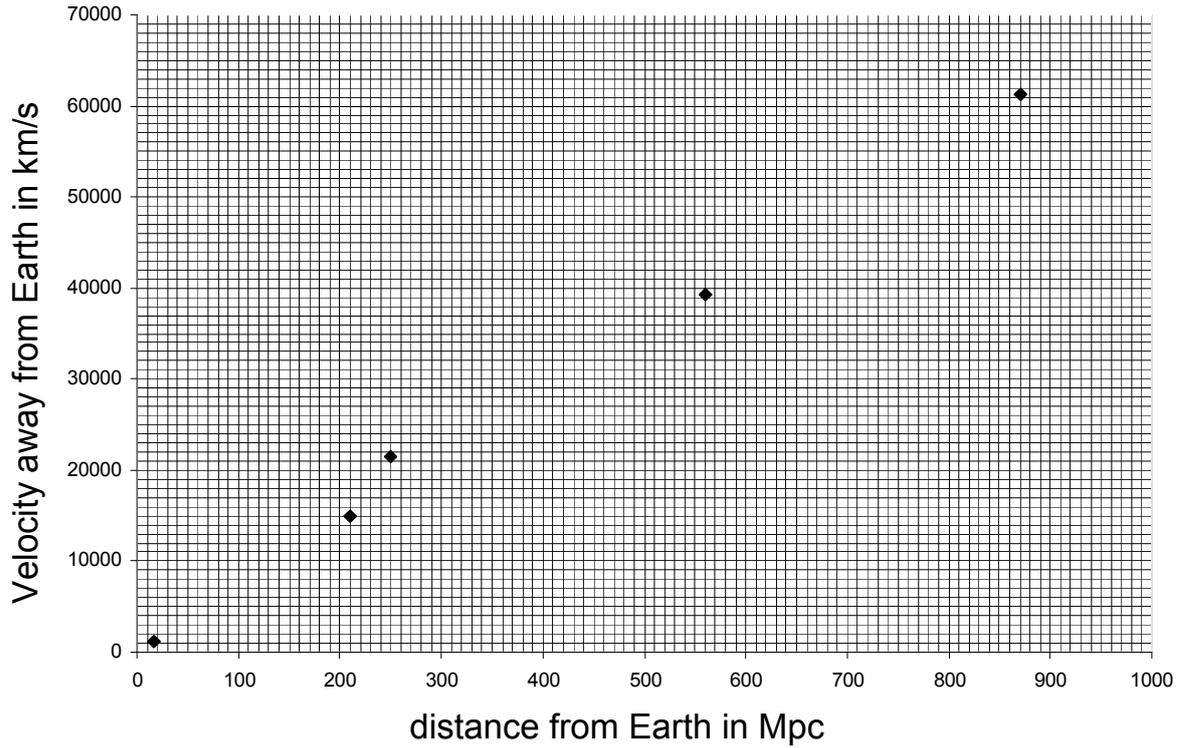
(i) A galaxy has its distance from the Earth measured as 400 Mpc.

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]**

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(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?

....

....

.... **[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.

....

....

....

.... **[2]**

[Total: 10]

[Paper Total: 60]

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE

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SPECIMEN   F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE

PHYSICS A   **A183/01**

Unit A183: Module P7 (Foundation Tier)

MARK SCHEME

Duration: 1 hour

MAXIMUM MARK   60

Guidance for Examiners

> Additional guidance within any mark scheme takes precedence over the following guidance.

1.   Mark strictly to the mark scheme.

2.   Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.

3.   Accept any clear, unambiguous response which is correct, eg mis-spellings if phonetically correct (but check additional guidance).

4.   Abbreviations, annotations and conventions used in the detailed mark scheme:

/	=	alternative and acceptable answers for the same marking point
(1)	=	separates marking points
not/reject	=	answers which are not worthy of credit
ignore	=	statements which are irrelevant - applies to neutral answers
allow/accept	=	answers that can be accepted
(words)	=	words which are not essential to gain credit
<u>words</u>	=	underlined words must be present in answer to score a mark
ecf	=	error carried forward
AW/owtte	=	alternative wording
ORA	=	or reverse argument

       Eg mark scheme shows 'work done in lifting / (change in) gravitational potential energy' (1)
            work done = 0 marks
            work done lifting = 1 mark
            change in potential energy = 0 marks
            gravitational potential energy = 1 mark

5.   Annotations:
       The following annotations are available on SCORIS.

✓	=	correct response
✗	=	incorrect response
bod	=	benefit of the doubt
nbod	=	benefit of the doubt **not** given
ECF	=	error carried forward
^	=	information omitted
I	=	ignore
R	=	reject

6.   If a candidate alters his/her response, examiners should accept the alteration.

7. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

    Eg
    For a one mark question, where ticks in boxes 3 and 4 are required for the mark:

Put ticks (✓) in the two correct boxes.	Put ticks (✓) in the two correct boxes.	Put ticks (✓) in the two correct boxes.
		✗
		✗
✓	✗	✓
✗	✗	✓
This would be worth 0 marks.	This would be worth one mark.	This would be worth one mark.

8. The list principle:
    If a list of responses greater than the number requested is given, work through the list from the beginning. Award one mark for each correct response, ignore any neutral response, and deduct one mark for any incorrect response, eg one which has an error of science. If the number of incorrect responses is equal to or greater than the number of correct responses, no marks are awarded. A neutral response is correct but irrelevant to the question.

9. Marking method for tick boxes:

    Always check the additional guidance.

    If there is a set of boxes, some of which should be ticked and others left empty, then judge the entire set of boxes.
    If there is at least one tick, ignore crosses. If there are no ticks, accept clear, unambiguous indications, eg shading or crosses.
    Credit should be given for each box correctly ticked. If more boxes are ticked than there are correct answers, then deduct one mark for each additional tick. Candidates cannot score less than zero marks.

    Eg If a question requires candidates to identify a city in England, then in the boxes

Edinburgh	
Manchester	
Paris	
Southampton	

    the second and fourth boxes should have ticks (or other clear indication of choice) and the first and third should be blank (or have indication of choice crossed out).

Edinburgh			✓			✓	✓	✓	✓	
Manchester	✓	✗	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	✗		✓		✓	✓		✓	
Score:	2	2	1	1	1	1	0	0	0	NR

10.   Three questions in this paper are marked using a Level of Response (LoR) mark scheme with embedded assessment of the Quality of Written Communication (QWC). When marking with a Level of Response mark scheme:

- Read the question in the question paper, and then the list of relevant points in the 'Additional guidance' column of the mark scheme, to familiarise yourself with the expected science. The relevant points are not to be taken as marking points, but as a summary of the relevant science from the specification.

- Read the level descriptors in the 'Expected answers' column of the mark scheme, starting with Level 3 and working down, to familiarise yourself with the expected levels of response.

- *For a general correlation between quality of science and QWC*: determine the level based upon which level descriptor best describes the answer; you may award either the higher or lower mark within the level depending on the quality of the science and/or the QWC.

- *For high-level science but very poor QWC*: the candidate will be limited to Level 2 by the bad QWC no matter how good the science is; if the QWC is so bad that it prevents communication of the science the candidate cannot score above Level 1.

- *For very poor or totally irrelevant science but perfect QWC*: credit cannot be awarded for QWC alone, no matter how perfect it is; if the science is very poor the candidate will be limited to Level 1; if there is insufficient or no relevant science the answer will be Level 0.

Question			Expected answers	Marks	Additional guidance

1	(a)	(i)	In order left to right –
			
			cloud of gas
			
			   protostar
			
			      (Sun now)
			
			         red giant
			
			            white dwarf
				[4]	

		(ii)	supernova neutron star	[2]	**accept** red supergiant **accept** black hole
	(b)	(i)	hydrogen	[1]	
		(ii)	hydrogen	[1]	
		(iii)	silicon oxygen elements must be larger than helium and smaller than iron	[3]	**accept** carbon or nitrogen
		(iv)	lead / uranium	[1]	
			Total	**[12]**	

Question			Expected answers	Marks	Additional guidance
2	**(a)**		Chile / Hawaii / Australia / Canary Islands	**[1]**	
	(b)	✎	**[Level 3]** A balanced answer which contains all the key astronomical factors, and identifies potential arguments against the location. Location is appropriate and consistent with the astronomical factors. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **[Level 2]** A partial answer which may contain only a limited number of factors or arguments against the location. Location is consistent with factors identified. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **[Level 1]** Answer may be simplistic. Describes a location. An answer which may contain only astronomical factors. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	**[6]**	**relevant points include:** describes a location eg mountain top astronomical factors: • high so less atmospheric interference • away from towns/cities to avoid light pollution • many cloudless nights • low pollution and dry air other factors: • Cost • Environmental impact • Provides employment **note**: some factors may be presented as positive or negative eg provides employment, but remote location makes it hard to get to work **ignore** any references to space telescopes or international relations

Question			Expected answers	Marks	Additional guidance
2	(c)		**who**: government/regulators/politicians **any two from:** **why**: they take into account everybody's views they balance the benefits and costs they are providing the money they make the laws/rules/regulations scientists are **only** one group/ other groups are affected	**[3]**	

Question			Expected answers	Marks	Additional guidance
2	(d)	✎	**[Level 3]** A balanced answer which contains at least 2 arguments both for and against. Conclusion is consistent with the arguments. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **[Level 2]** An answer which may contain only one argument for and against or two or more arguments supporting the conclusion. Conclusion is consistent with arguments. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **[Level 1]** An answer which may contain only one argument and fails to recognise any counter arguments. Conclusion is poorly linked to argument. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	**[6]**	advantage: avoids atmospheric distortion/refraction/absorption/twinkle; different parts of spectrum available; avoids light pollution from cities; no clouds; very dark disadvantage: cost of putting in space; cost/difficulty of maintenance/repair; uncertainty of space programme; **reject** closer to stars
			Total	**[16]**	

Question			Expected answers	Marks	Additional guidance
3	(a)	(i)	2 arc seconds	[1]	
		(ii)	recognises inverse relationship. e.g smaller angle means bigger distance; hence **A** closer than **B**	[2]	
	(b)	(i)	1.5	[1]	**accept** ±0.1
		(ii)	5 days	[2]	**accept** ±1
			Total	[6]	

				Marks	Additional guidance
4	(a)		object focus lens image	[3]	all correct = 3 marks 2/3 correct = 2 marks 1 correct = 1 mark
	(b)		**C** greatest / most curved	[2]	**accept** thickest/fattest/shortest focal length
			Total	[5]	

Question			Expected answers	Marks	Additional guidance
5	(a)		gravity	[1]	**do not accept** 'g force
	(b)		pressure increases because: particles move faster/have more kinetic energy more frequent/energetic collisions between particles particles have increased momentum increased forces during collisions between particles	[2]	**do not accept** 'moves more' or 'vibrates' or just 'more energy' **allow** collisions with 'edge' or 'boundary' **allow** 'more collisions'
	(c)	(i)	Hydrogen → Helium	[2]	**(1)** per correct answer **allow** H and He (symbols must be correct) **ignore** any balancing/additional numbers

Question			Expected answers	Marks	Additional guidance
5	(c)	(ii) ✎	**[Level 3]** Answer correctly describes the processes of energy release in the Sun (hydrogen to helium fusion must be mentioned) and transport and clearly sequences them in the correct order from core to photosphere (then space). All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **[Level 2]** Answer may name some processes rather than describing them, and/or may not make the correct order clear. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **[Level 1]** An incomplete answer, naming some processes without describing them and omitting other processes. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	[6]	**relevant points include:** applies generic knowledge of stellar interiors and processes to specific case of the Sun • energy produced by nuclear fusion, primarily of hydrogen nuclei into helium nuclei / by the fusion of other light elements into heavier elements, in the core of the star then • energy is transported from core to surface / photosphere, by photons of radiation in inner region • and by convection currents in outer region **accept** reference to radiative zone as inner region and convective zone as outer region then • photosphere – electromagnetic radiation / photons , emitted / radiated / travels , into space
			Total	**[11]**	

Question			Expected answers	Marks	Additional guidance
6	(a)		<table><tr><td>statement</td><td>Ryle</td><td>Hoyle</td><td>both</td><td>neither</td></tr><tr><td>In the past ...</td><td>✓</td><td></td><td></td><td></td></tr><tr><td>no pattern</td><td></td><td>✓</td><td></td><td></td></tr><tr><td>stop expanding</td><td></td><td></td><td></td><td>✓</td></tr></table>	[3]	one mark per correct row **accept** any clear and unambiguous response more than one response in any row does not score that row
	(b)	(i)	28,000 ± 1000	[1]	
		(ii)	72 x 1000 72,000	[2]	correct numerical answer gains both marks
	(c)	(i)	better measurements of <u>distance</u> using Cepheid variables	[2]	**allow** better measurement of speed/velocity
		(ii)	distances get larger/increase recognises idea of inverse relationship (from equation)	[2]	
			Total	**[10]**	

Assessment Objectives (AO) Grid

(includes quality of written communication✎)

Question	AO1	AO2	AO3	Total
1(a)(i)	3	1		4
1(a)(ii)	1	1		2
1(b)(i)	1			1
1(b)(ii)	1			1
1(b)(iii)	1	1	1	3
1(b)(iv)		1		1
2(a)	1			1
2(b)✎	4	1	1	6
2(c)	1	2		3
2(d)✎	3	1	2	6
3(a)(i)		1		1
3(a)(ii)		1	1	2
3(b)(i)		1		1
3(b)(ii)		1	1	2
4(a)	2	1		3
4(b)	1	1		2
5(a)	1			1
5(b)		2		2
5(c)(i)	1	1		2
5(c)(ii)✎	4	2		6
6(a)		3		3
6(b)(i)		1		1
6(b)(ii)	1	1		2
6(c)(i)		2		2
6(c)(ii)			2	2
Totals	**26**	**26**	**8**	**60**

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