OCR
RECOGNISING ACHIEVEMENT

GCSE

Physics A

General Certificate of Secondary Education

Unit **A183/02:** Unit 3 – Module P7 (Higher Tier)

Mark Scheme for June 2013

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

1. **Annotations**

Used in the detailed Mark Scheme:

Annotation	**Meaning**
/	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
words	underlined words must be present in answer to score a mark
ecf	error carried forward
AW/owtte	credit alternative wording / or words to that effect
ORA	or reverse argument

Available in scoris to annotate scripts:

	correct response
	incorrect response
BOD	benefit of doubt
NBOD	no benefit of doubt
ECF	error carried forward
0 , L1 , L2 , L3	indicate level awarded for a question marked by level of response
^	information omitted
CON	contradiction
R	reject

	indicate uncertainty or ambiguity
	draw attention to particular part of candidate's response

2. **ADDITIONAL OBJECTS:** You **must** assess and annotate the additional objects for each script you mark. Where credit is awarded, appropriate annotation must be used. If no credit is to be awarded for the additional object, please use annotation as agreed at the SSU.

3. Subject-specific Marking Instructions

a. Accept any clear, unambiguous response (including mis-spellings of scientific terms if they are *phonetically* correct, but always check the guidance column for exclusions).

b. 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.

e.g. for a one-mark question where ticks in the third and fourth boxes are required for the mark:

This would be worth 1 mark.

This would be worth 0 marks.

This would be worth 1 mark.

c. 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, e.g. 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.

d. Marking method for tick-box questions:

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 and other markings. If there are no ticks, accept clear, unambiguous indications, e.g. shading or crosses. Credit should be given according to the instructions given in the guidance column for the question. 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.

e.g. if a question requires candidates to identify cities in England:

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**

e. For answers marked by levels of response:
i. **Read through the whole answer from start to finish**
ii. **Decide the level** that **best fits** the answer – match the quality of the answer to the closest level descriptor
iii. **To determine the mark within the level**, consider the following:

Descriptor	Award mark
A good match to the level descriptor	The higher mark in the level
Just matches the level descriptor	The lower mark in the level

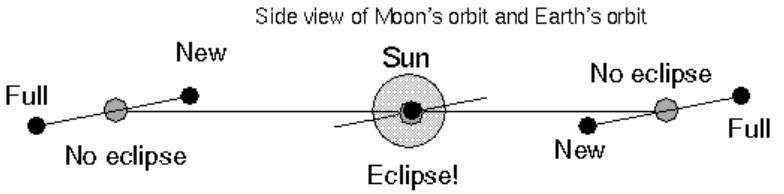
iv. Use the **L1**, **L2**, **L3** annotations in Scoris to show your decision; do not use ticks.

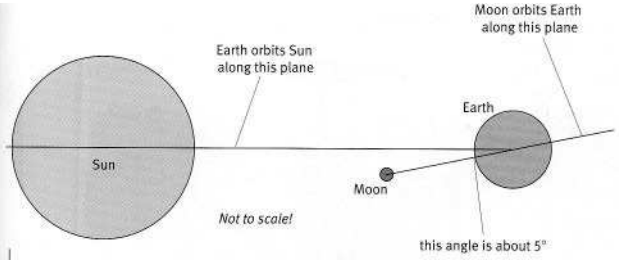
Quality of Written Communication skills assessed in 6-mark extended writing questions include:

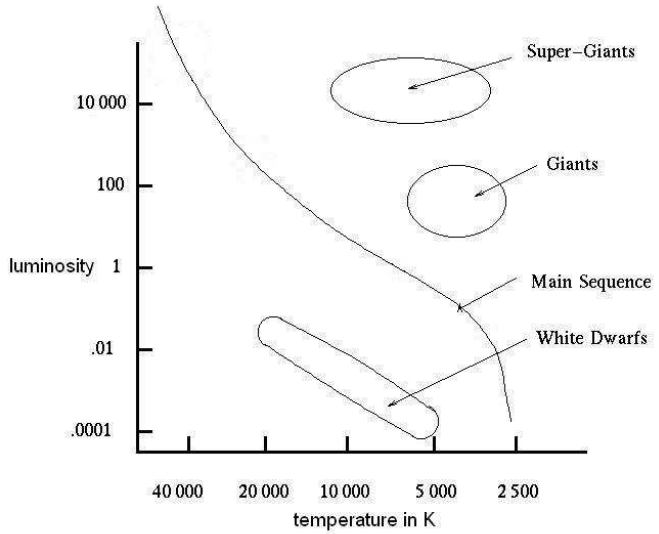
- appropriate use of correct scientific terms
- spelling, punctuation and grammar
- developing a structured, persuasive argument
- selecting and using evidence to support an argument
- considering different sides of a debate in a balanced way
- logical sequencing.

Question			Answer	Marks	Guidance
1	(a)		speed (1) wavelength (1) frequency (1)	3	**allow** wavelength for one mark in first gap as long as wavelength is not used in the second gap.
	(b)	(i)	objective **B** (1) eyepiece **D** (1)	2	
		(ii)	(focal length of objective / focal length of eyepiece) =1000/20 (1) 50 (1)	2	**allow** ecf from (b)(i)
	(c)		they are made from different materials / that refract differently / different density	1	**ignore** any reference to shape and size
	(d)		**any two from:** edge of lens shaped like a prism /acts like a prism ; colours spread like a prism/prism forms a spectrum/colours disperse ; different wavelengths/colours change speed differently ; different wavelengths/frequencies refract/bend through different angles ; different colours focus at different points	2	all points may be shown on a labelled diagram e.g. standard prism dispersion = 2 marks. Ignore order of colours. If spectrum from lens, allow one mark if spectrum produced near edge/rim.

Question			Answer	Marks	Guidance
1	(e)		**any three from:** diffraction (affects images) ; radio waves have long(er) wavelengths (than visible light) ; aperture must be bigger than wavelength ; the nearer the aperture size to the wavelength the more diffraction	3	 **accept** diffraction when aperture/hole/gap is the same size as the wavelength
			Total	**13**	

Question			Answer	Marks	Guidance
2			**Level 3 (5–6 marks)** Explains an eclipse and mentions tilt and/or planes of orbits. Successfully relates this to frequency of eclipses. Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** Explains an eclipse with further detail (e.g. tilt and/or planes of orbits OR Partial eclipses / only limited size of shadow on Earth). But not successfully related to frequency. Quality of written communication partly impedes communication of the science at this level. **Level 1 (1–2 marks)** Explains an eclipse and positions of Moon, Earth and Sun but not frequency. Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted at grades up to A*** **All marks can be scored EITHER with a diagram OR with a written answer OR a combination of both.** **Indicative scientific points for level:** • **Level 1** • Moon orbits the Earth • sometimes Moon between Sun and the Earth • Moon blocks sunlight / is opaque • shadow reaches the Earth • **Level 2** • Moon is the same apparent size as the sun • total / full eclipse seen within shadow region • partial eclipse seen just outside main shadow zone (penumbra) • Moon's orbit at an angle to the Earth's orbit • **Level 3** • on most occasions Moon is above or below plane of Earth's orbit / ecliptic. hence no eclipse • only when the moon is in plane of Earth's orbit AND between Sun and Earth does the eclipse occur.  Earth-Moon system at three points in their orbit around the Sun. Usually the Moon is above or below the ecliptic at the new or full phase, but twice a year it crosses the ecliptic when it is behind or in front of the Earth to produce an eclipse! *continued on next page…*

Question			Answer	Marks	Guidance
					…continued from previous page  **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**
			Total	**6**	

Question			Answer	Marks	Guidance
3	(a)			4	**accept** red/blue supergiants **accept** red giants
	(b)		X on main sequence line in a horizontal line with 1 on the vertical axis	1	by eye **accept** any unambiguous symbol
	(c)		arrow points below horizontal (1) arrow points to the right (1)	2	arrow should relate to the star
			Total	**7**	

Question			Answer	Marks	Guidance
4			**Level 3 (5–6 marks)** Describes the Curtis-Shapley debate AND describes the changing data which showed Curtis to have the correct interpretation Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** Describes the debate AND gives an example of data they used **OR** Describes debate AND gives an example of their interpretations **OR** Gives an example of their interpretations AND gives and example of the data the used Quality of written communication partly impedes communication of the science at this level. **Level 1 (1–2 marks)** Attempts to describe the Curtis-Shapley debate **OR** gives an example of either Curtis and / or Shapley's interpretation **OR** gives an example of the data that was used in the debate Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted at grades up to C** **Indicative scientific points may include:** **The debate** • Disagreement about (spiral) nebulae / fuzzy objects in the sky • Shapley – gas clouds • Curtis – systems of stars **ignore** If Shapley and Curtis are reversed or not named. If response indicates debate between 'Curtis-Shapley' and Hubble, limit to Level 1. **Allow** Position of Sun in galaxy / Curtis has Sun at centre of galaxy / Shapley has Sun at edge **The data** • Both agreed distance to nebulae *(Andromeda)* was very large / greater than any other star • Hubble provided new distance measurement / evidence from Cepheid variables • Curtis – (Hubble's method showed) distance to nebulae much too large to be inside the galaxy **The interpretations** • Shapley – the nebulae are inside the Milky Way / The Universe is one big galaxy • Curtis – the systems of stars are outside the Milky Way / Universe has more than one galaxy **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**
			Total	**6**	

Question			Answer	Marks	Guidance
5	(a)		20900 20000	1	both required **allow** 20916 or 21000 for Bootes
	(b)		**any four from:** galaxies spread out from big bang / galaxies in the same place at big bang / universe is expanding ; galaxies have travelled different distances ; all galaxies have travelled for the same time ; the further away a galaxy the greater its (recessional) velocity / speed ; calculation suggests age is greater than 14000 / is 20000 million years ago (ie gives different time) ; speed may not have been constant / galaxies have slowed down so time consistent with idea of 14000 million years ; slow down due to gravity / difficult to measure speeds / distances accurately	4	**ignore** references to 'dark energy'
			Total	**5**	

Question			Answer	Marks	Guidance
6	(a)		(3400) – 273 (1) 3127 (1)	2	**allow** 1 mark for 3673 (ie adds 273)
	(b)		**any two from:** (Sun fuses) hydrogen ; Hydrogen less positive OR Helium more positive ; Hydrogen less energy needed/easier to bring together **OR** Helium more energy needed/harder to bring together ; Higher energy linked to higher temperature needed for fusion / ORA	2	
	(c)		carbon [ ] hydrogen [✓] iron [✓] nitrogen [ ] oxygen [ ]	2	
	(d)		blue giant [ ] main sequence [ ] proto star [ ] supernova [ ] white dwarf [✓]	1	
			Total	**7**	

Question			Answer	Marks	Guidance
7			**Level 3 (5–6 marks)** Considers at least 2 advantages and 1 disadvantage OR 1 advantage and 2 disadvantages of ground or space based telescopes. Provide a balanced conclusion considering the effects of adaptive optics. Some conclusion is required level 3. Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** Gives at least 1 advantage AND 1 disadvantage of ground or space based telescopes. Draws a conclusion consistent with the advantage and disadvantage. Quality of written communication partly impedes communication of the science at this level. **Level 1 (1–2 marks)** Describes EITHER an advantage OR a disadvantage of ground or space based telescopes. Gives a conclusion, which may be unsupported. Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted at grades up to A** **Indicative scientific points may include:** **advantages for space based:** (vice versa for Earth based): • Provides clear/better/higher resolution images • avoids absorption and refraction effects of the atmosphere • clear skies/no clouds • No light pollution • Can use parts of e.m. spectrum absorbed by atmosphere. • Can see whole celestial sphere **disadvantages for space based** (vice versa for Earth based): • Cost argument, • difficult to maintain and repair, • environmental cost of space travel • uncertainties of space program. **conclusion:** Ground based is now better due to adaptive optics however advantage limited as no other factors are affected. **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**
			Total	**6**	

Question			Answer	Marks	Guidance
8	(a)	(i)	Substitution: energy = 3.90×10^{26} (1) Rearrange: $m = E/c^2$ OR $m = 3.90 \times 10^{26} / (3 \times 10^8)^2$ (1) 4.3×10^9 (kg/s) (1)	3	3 marks for correct answer
		(ii)	time = $60 \times 60 \times 24 \times 365.25 \times 10^{10} = 3.2 \times 10^{17}$ seconds (1) time x answer to (ai) 1.4×10^{27} kg (1)	2	**allow** 365 days which gives 3.15×10^{17} Ecf from a(i) **accept** correct answer which when rounded is 1.4 or ecf
	(b)	(i)	2	1	
		(ii)	idea of conserving charge	1	
			Total	**7**	

Question			Answer	Marks	Guidance
9	(a)		The time taken for the moon to return to the same position in the sky. [ ] 24 hours. [ ] The time taken for a star to return to the same position in the sky. [✓] The time for the sun to return to the same position in the sky. [ ]	1	
	(b)		**any two from:** Angle ; Two (co-ordinates/values/angle) needed (may be implied by further detail) ; Reference to celestial sphere / declination / ascension	2	e.g. 'use declination and ascension' is 2 marks for 2nd and 3rd marking points. **accept** azimuth and altitude for declination and ascension
			Total	**3**	

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