OCR
Oxford Cambridge and RSA

GCSE

Physics A

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

General Certificate of Secondary Education

Mark Scheme for June 2015

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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.

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	alternative wording
ORA	or reverse argument

Available in scoris to annotate scripts

	indicate uncertainty or ambiguity
	benefit of doubt
	contradiction
	incorrect response
	error carried forward
	draw attention to particular part of candidate's response
	draw attention to particular part of candidate's response
	draw attention to particular part of candidate's response
	no benefit of doubt
	reject
	correct response
	draw attention to particular part of candidate's response
	information omitted

Subject-specific Marking Instructions

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

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 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 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 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, e.g. 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.

E.g. 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 <u>should be blank</u> (or have indication of choice crossed out).

Edinburgh			✓			✓	✓	✓	✓	
Manchester	✓	×	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	×		✓		✓	✓		✓	
Score:	**2**	**2**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**NR**

MARK SCHEME:

Question			Answer	Mark	Guidance
1*	a		to replicate/repeat results / gain confidence in results/ confirm the results / results are reliable/ more evidence / to see if they had made a mistake.	1	**ignore** to work out an average / to see if results were reproducible/ accuracy of results
	b		idea of using another telescope	1	**not** optical telescope
	c	i	<u>an advantage</u> [1] e.g. they may provide new knowledge /intrinsically interesting / we want to know / show we are not hostile / possibility of trade / communicate <u>a disadvantage</u> [1] e.g. they may be hostile / want to use the Earth / want to visit / waste of money/resources / very long travel time for signal An explicit conclusion consistent with advantage/disadvantage [1]	3	**accept** provides evidence for/confirms/ proves extra-terrestrial life. **accept** specific cultural references – e.g. assimilation into a Borg collective **accept** yes/no/don't know if fits with advantages/disadvantages
		ii	None	1	
	iii	iii	planets (around other stars)/extra solar planets / planets in other solar systems / planets similar to Earth [1]	1	**accept** this answer in the space for 1cii if no response
	d		<u>supernova (1)</u> any **one** from (1); (from a) super giant / very massive star idea of remnant/core/left over not massive enough to form a black hole	2	 **not just** giant / massive **e.g.** formed after a supernova for 2 marks
				9	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td>2*</td><td>a</td><td></td><td>Canary Islands Chile</td><td>2</td><td></td></tr>
<tr><td></td><td>b</td><td></td><td>[Level 3]
Gives two advantages and two disadvantages and suggests an appropriate alternative location with justification
Quality of written communication does not impede communication of the science at this level.
(5 – 6 marks)

[Level 2]
Gives three advantages and/or disadvantages and suggests an appropriate alternative location
Quality of written communication partly impedes communication of the science at this level.
(3 – 4 marks)

[Level 1]
Gives two of an advantage, a disadvantage, an appropriate alternative location
Quality of written communication impedes communication of the science at this level.
(1 – 2 marks)

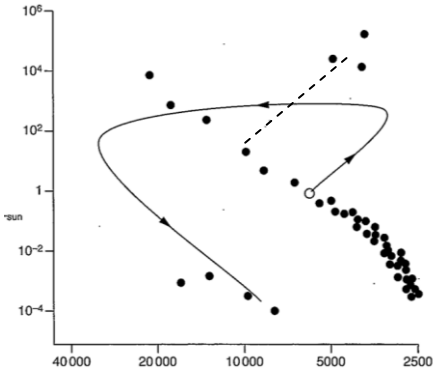
[Level 0]
Insufficient or irrelevant science. Answer not worthy of credit.
(0 marks)</td><td>6</td><td>This question is targeted at grades up to C
Indicative scientific points may include:
advantages
• low atmospheric pollution
• less scattering of light
• low light pollution
• dry air/less humid
• frequent cloudless nights/above the clouds
• less absorption due to atmosphere
• less refraction due to atmosphere
• darker skies give more contrast
• image/seeing is clearer/less blurred/less distorted
disadvantages
• some absorption due to atmosphere
• some refraction due to atmosphere
• some parts of em spectrum absorbed by atmosphere
• difficult working conditions e.g. access to services / altitude sickness
• poor transport links
• lack of local labour availability
• high cost / difficult to build environmental impact
Appropriate alternative locations:
<table>
<tr><th>Location</th><th>justification</th></tr>
<tr><td>space/orbital</td><td>because less interference from atmosphere / can detect e.g gamma / x-ray / uv / (far)IR / microwave</td></tr>
<tr><td>underground for neutrinos</td><td>reduces interference</td></tr>
<tr><td>deserts</td><td>space for very large radio arrays / avoids radio/em interference (from man-made sources) / dry air argument</td></tr>
<tr><td colspan="2">ignore – the idea of isolated locations (is in the stem of the question)
ignore as a justification space telescopes are closer to observed stars</td></tr>
</table>
</td></tr>
</table>

Question			Answer	Mark	Guidance
3	a		sensible scale [1] correctly labelled x-axis (D) including units [1] correctly labelled y-axis (T) including units [1] simple smooth curve through plotted points, must include 0,0 and 1,1 [1]	4	Allows points to cover greater than a third of the graph paper for x and y axes. If axes swapped allow 1 mark if both are correctly labelled with units. **Do not accept** straight line
	b	i	(yes) straight line / constant gradient/rate [1] through origin [1] OR one doubles the other doubles / x=y for all values / y=kx [2]	2	These each gain 2 marks
	b	ii	$D^3 = 1.95$ value of T^2 from graph = 1.95 or calculated from D^3 T = 1.39(…) or 1.4(0)	3	allow correct numerical answer gains 3 marks
	c	i	142 / 142.2(4) 142 / 141.6(1) [1] both to 3 sig figs OR both to two decimal places [1]	2	**Do not accept** 142.00 for 1st marking point
		ii	Use of Saturn data from table [1] e.g. 868 ≈ 870 / 868÷870 ≈ 1 / $9.54^3 \div 29.5^2 \approx 1$ **This mark can only awarded if the first marking point is awarded:** Explicit comparison to Kepler's relationship: [1] e.g.it fits ratio/relationships/gradient / is the same as the other planet(s) / Therefore/so it fits (relationship)	2	

Question			Answer	Mark	Guidance
	d		there is a correlation / correlation described [1] might be something else causing both changes / a plausible mechanism/explanation is also needed [1]	2	e.g. as distance increases, time decreases **accep**t reverse arguments e.g. they don't orbit the same object.
4	**a**		**[Level 3]** *Correct description of three methods **and** both links considered*. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** *Describes two methods **and** one link considered.* Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** *Correctly describes one method **or** one link considered*. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	**6**	**This question is targeted at grades up to A** **Indicative scientific points may include:** **parallax** • apparent movement against fixed stars • change over 6 months, opposite sides of orbit • greater distance smaller parallax (angle) **Cepheid variable** • luminosity linked to period • luminosity and apparent brightness give distance **Hubble law** • Distant galaxies moving faster • Velocity of recession = H_o x distance • Greater redshift gives greater velocity **Link** • Hubble law depends on Cepheid variable distances • Cepheid variable (distances) depends on parallax distances **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td>5</td><td>a</td><td></td><td>starts further to left/higher on main sequence [1]

moves up and to right above sun track [1]

line stops in supergiant region/ top right. [1]</td><td>3</td><td>Arrows are not needed, but if drawn may contradict.
If all correct except the direction of arrow, allow 1 mark.
 
</td></tr>
<tr><td></td><td>b</td><td></td><td>Helium

carbon

iron</td><td>3</td><td>ecf. allow helium if hydrogen in first space</td></tr>
<tr><td></td><td>c</td><td>i</td><td><table>
<tr><td>electrons fuse with protons to emit energy</td><td></td></tr>
<tr><td>electrons moves between energy levels in an atom</td><td>✓</td></tr>
<tr><td>photons turn into electrons in atoms</td><td></td></tr>
<tr><td>a photon of a specific energy is emitted</td><td>✓</td></tr>
<tr><td>the energy of the photon determines the frequency of the photon</td><td>✓</td></tr>
<tr><td>the colour of the electron depends upon the photon</td><td></td></tr>
<tr><td>an atom is ionised when an electron is removed</td><td></td></tr>
</table></td><td>3</td><td></td></tr>
<tr><td></td><td></td><td>ii</td><td>5 8</td><td>2</td><td>1 mark for each</td></tr>
</table>

Question			Answer	Mark	Guidance
	d	i	photons / radiation convection (currents)	2	**do not accept** light
		ii	Photosphere	1	
		iii	5778 – 273 [1] 5505	2	allow 1 mark for 6051 correct numerical answer gains full marks

Question			Answer	Mark	Guidance
6			**[Level 3]** *Gives mathematical relationships, **and** explains how gravity results in decreased volume which increases the pressure and results in increasing temperature **and** gives conditions for fusion*. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** *Explains how gravity results in decreased volume which increases the pressure and results in increasing temperature **and** gives a condition for fusion*. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** *Any 2 from Comments on temp, pressure and volume changes **or** describes the contraction of a protostar under gravity **or** gives condition for fusion*. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grades up to A*** **Indicative scientific points may include:** Gaseous behaviour: **at level 3** • pressure α temperature/ P/T=constant • pressure α 1/volume / PV=constant • **at level 2** • temperature increase as pressure increase • pressure increase as volume decrease. **at level 1** • reference to changes without specific links between pressure, temp and volume • incorrect relationships between pressure, temp and volume conditions for fusion • high temp • high pressure • hydrogen/protons must be forced together / overcome repulsion / more frequent/energetic collisions formation of protostar • gravitational collapse / gas cloud particles attracted to centre of cloud • allow temperature increases with smaller volume **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**

* - overlap

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