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 2014

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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	credit alternative wording / or words to that effect
ORA	or reverse argument

Available in scoris to annotate scripts:

BP	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
	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

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.

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 <u>and</u> 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. 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 <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**

d 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	Mark	Guidance
1	a*		these were the (only) planets visible / known about /discovered	1	**Accept** other planets not bright enough **Ignore** references to distance
	b*	i	(24+4)/10 2.8 (AU)	2	**allow** answer in table correct numerical answer gains both marks
		ii	the distance calculated is similar (so it supports law).	1	**Accept** yes with a reference to 2.8 is just sufficient **allow** comment consistent with ecf from bi **allow** anything in range 2.6 – 2.9 to be similar **accept** reverse calculation giving 23.7, but must say this is similar to 24.
		iii	*any 2* observations may be mistakes / wrong check observations (are correct) / confirm results / check predictions greater confidence / more reliable (if observations can be reproduced by others)	2	**Ignore** references to peer review / accuracy / calculations / bias / opinion **Accept** in case he made them up **Ignore** more observations (it is in the stem of the question)

Question			Answer	Mark	Guidance
	c*		EITHER *any 3 from* Uranus - good agreement / numerical comparison Neptune - poor agreement / numerical comparison Pluto - (very) poor agreement / numerical comparison Pluto not a major planet, so should not be included. OR 2 marks for general description with no specific planets mentioned e.g. The results show the further out the less accurate An additional mark may be gained for giving an example as above	3	**Accept** numerical comparison without name
			suitable conclusion (about confidence), **based on discussion** (1)	1	**E.g** The Law doesn't work when the distance is large
	d		a plausible mechanism / (scientific) explanation of link / A theory / a cause	1	**Ignore** idea of more data
			Total	**11**	

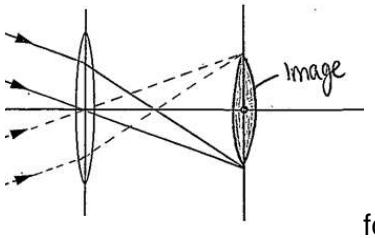
Question			Answer	Mark	Guidance
2*			**[Level 3]** Explains an improvement **and** states aspects of Cepheid Variable distance measurement Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** **EITHER** Explains an improvement due to space telescopes **OR** States two improvements **OR** States an aspect of Cepheid variable distance measurement and states an improvement due to space telescopes **OR** State aspects of Cepheid variable distance measurement Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** **EITHER** States an improvement due to space telescopes **OR** states an aspect of Cepheid variable distance measurement **OR** Explains how distance measurements using parallax or brightness are made 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 C** **Indicative scientific points may include:** **how telescopes in space improve measurements** • increased baseline • lack of atmosphere / light pollution • less light absorbed • improved luminosity measurement • parallax calculations for more distant objects • brightness measurements for more distant objects **Explanation for improvements** • idea that there is less absorption or refraction of light by the atmosphere / less scattering of light by the atmosphere • increased baseline gives bigger/more accurate angle **Cepheid variables** • Cepheids have a period of brightness / pulse / are variable • Cepheids have apparent brightness and luminosity • luminosity is related to the period of the Cepheid • This relationship is used to find distance to more distant Cepheid variables • luminosity is compared with apparent brightness to find distance of the Cepheid • Must know distance to nearby Cepheids **Do not accept** space telescopes are closer to observed stars **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**
			Total	6	

Question			Answer	Mark	Guidance
3	a		1800 ÷ 71; 25(.3521…) Mpc/megaparsec	3	 correct numerical answer gains 2 marks **accept** any number of decimal places, with correct rounding **allow** mpc / MPC
	b		*Any 2* The further away the faster the galaxy's motion idea that space is expanding idea of a big bang / all galaxies started in the same place	2	**Ignore** red shift
	c		Idea of large amount of data/evidence / better quality data fitting the pattern / no contradictory evidence(1) plausible mechanism to explain the relationship/correlation (1)	2	**Ignore** improvements in technology **Accept** the big bang/expanding universe as examples of a mechanism
			Total	**7**	

Question			Answer	Mark	Guidance
4	a		horizontal axis: temperature (1) K or ^{o}C (1) vertical axis: luminosity (1)	3	**Accept** answers on H-R Diagram if answer lines blank or crossed out **do not accept** colour for temperature **accept** ^{o}K or C **ignore** units for luminosity
	b	i	horizontal axis; (1) blue yellow red (1)	2	 blue on left, red on right, yellow should be at least partially between 10000 and 5000. Can gain this mark if colours written on the graph
		ii	Correctly links temperature to (peak) frequency/wavelength (1) Correctly links frequency/wavelength to colour (1)	2	Accept hotness for temperature **allow** 1 mark for correct link between temperature and colour **Accept** correct reference to photon energies Note: higher frequency/temperature is blue lower frequency/temperature is red
	c	i	any star on the main sequence (diagonal line from top left to bottom right as shown by overlay)	1	**accept** more than one main sequence star circled
		ii	spectral lines idea of being unique to an element / matching the hydrogen spectrum	2	**accept** (emission or absorption) spectrum
	d		they have no/zero luminosity/do not emit light / have no colour	1	**allow** no temperature but not low temperature **accept** no brightness **ignore** because they are black **not just** you cannot see them
			Total	**11**	

Question			Answer	Mark	Guidance
5	a		**[Level 3]** Describes or names the post main sequence stages for both low and high mass stars and compares to the other type AND describes physical differences within the star due to mass. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Describes or names at least 4 stages for either low or high mass stars and gives them in the correct order. OR describes physical differences within the star due to mass. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Describes or names at least two of the main stages for a low mass star or for a high mass star OR at least 4 stages if the stars mass is not specified. OR describes a physical effect of mass. 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:** • Low mass about 1 Sun mass, High Mass several solar masses • **Physical differences**: e.g. High mass stars have: higher core temp – higher pressures – higher density - higher luminosity - heavier/more massive nuclei formed - shorter life • Low mass: protostar, main sequence, red giant, white dwarf (accept planetary halo, brown dwarf) • High Mass: protostar, main sequence/supergiant, red (supergiant) giant, supernova, neutron star or black hole **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**

Question			Answer	Mark	Guidance
	b	i	2×10^{25}	1	
		ii	any arrangement of : $E = mc^2$ any arrangement of : $4.5 \times 10^{26} = 5 \times 10^{9}\text{kg} \times (3 \times 10^{8})^2$	1 1	**note:** each stage must be shown
		iii	$3 \times 10^{25} / 5 \times 10^{9}$ 6×10^{15}	2	2 marks for correct numerical answer
			Total	**11**	

Question			Answer	Mark	Guidance
6	a		**for either pair of rays** (the continuous or dotty): ray passes undeviated through centre of lens (1) second ray bends at lens (only) towards the principal axis and crosses the principal axis before the focal point (1) the pair of rays cross in the focal plane (1) **for all rays** labelled extended image based on all 4 correct rays (1)	4	Choose the pair of rays to the benefit of the candidate **Ignore** gaps to the left of the lens  for 4 marks
	b		idea of magnification (1) magnification = focal length of objective/focal length of eyepiece (1)	2	**Ignore** light gathering by objective
	c		**any 2** light not absorbed / less light absorbed can make bigger / support at rear /not just at edges easier to make no chromatic aberration / does not separate colours can use frequencies outside the visible spectrum	2	**Ignore** references to cost **Accept** Can make less heavy. / doesn't sag
			Total	**8**	

Question			Answer	Mark	Guidance
7			**[Level 3]** Considers all sites or all aspects, with **justifications** and **comparisons**, overall conclusion is justified. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Considers some sites or some aspects, may only consider advantages of site chosen. Data is referred to. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Makes a choice with comparative reference to data. 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 B** **Indicative scientific points may include:** • Site **A** best for cloudless nights, high, low humidity and distant from town but local rare species. • Site **B** Far from town low number of cloudless nights low height, high humidity • Site **C** Highest above sea level, fair number of cloudless nights, lowest humidity, quite close to town, few living organisms • Site **D** best for accessibility to services **Possible justifcations** • Height above sea level reduces atmospheric interference • Cloudless nights allow more observation time • High humidity increase absorption and scattering in the atmosphere • Distance to town difficulty of access/labour supply, close to town gives light pollution. • Disruption to local environment may be a problem **accept** Furthest from town less light pollution Note: **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**
			Total	6	

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