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 2017

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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.

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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 RM Assessor 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

R	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

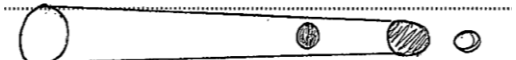
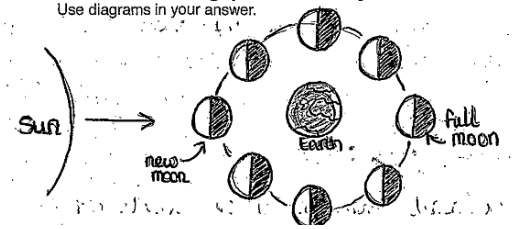
Edinburgh	
Manchester	
Paris	
Southampton	

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		**[Level 3]** Correctly calculates cost of space telescope and compares to land based telescope **and** discusses infra-red absorption in atmosphere **and** considers another factor. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Uses an incomplete calculation, or quotes a number to compare costs of space and mountain telescopes **AND either** discusses infra-red absorption in atmosphere **or** considers another factor. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Compares costs of space and mountain telescopes **or** discusses infra-red absorption in atmosphere **or** considers another factor. 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:** **cost** space telescope: • launch = 80 x 6.5 = 520 million • Add costs = 3500 + 4000 + 520 million = 8020 million ~8000 million land based telescope: • = 1100 million • land based is 6920m cheaper **infra red absorption** • No absorption in space • Dry conditions on mountain minimises absorption **other factor** • Quality of image/data • refraction of atmosphere • no atmospheric pollution or light pollution • cost of maintenance and repairing • uncertainties of space programme • environmental impact • working conditions for employees **Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.**

Question			Answer	Mark	Guidance
2	a*		angles	1	
	b*		Arcs of circle for stars (1) Attempts to show centered on pole star (1) Pole star no line (provide at least one line drawn elsewhere) (1) Arc is 90 degrees (1)	4	
	c*		Planets (1) Backwards (1) stars (1)	3	
	d*		Describes relative position for Sun, Moon and Earth for at least two phases (1) Identifies illuminated part of Moon is due to (reflected) sunlight / part of Moon away from Sun is in shadow/dark (1) Identifies cycle based on Moon's orbit (of Earth**)** / Moon orbits Earth (1)	3	 **allow** e.g as observed ignore other phases around Earth **allow** e.g 'sun lights up the parts we see' All three marking points may be obtained from a diagram **e.g** 

Question			Answer	Mark	Guidance
	e		(27.3/Moon's orbit) is sidereal period i.e. in relation to background stars (1) (29.5/lunar cycle) is period until Moon, Earth and Sun are in same orientation / period until Moon appears the same (phase) to an observer on the Earth (1) Difference because Earth has moved around in its orbit of the Sun / Moon does more than a full orbit. (1)	**3**	**Ignore for all marking** points Earth spinning; angle of Moon orbit; accumulation of daily differences between solar and sidereal day; reference to moon appearing in the same **position** in sky Note no reference to motion required 'Earth orbits the Sun' is insufficient

Question			Answer	Mark	Guidance
3			**[Level 3]** Explains role of reflection **and** refraction **and** diffraction in telescopes. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Explains **two** out of reflection **or** refraction **or** diffraction in telescopes. OR explains one aspect and provides two partial explanations of the other aspects.. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** Explains **one** of reflection **or** refraction **or** diffraction in telescopes OR **two** partial explanation. 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:** **An explanation will include two indicative points from the appropriate section** **refraction** • refraction in lenses / links refraction to lens • lenses bends/brings light to a focus • lens has curved surface • refraction due to change in wave speed/wavelength **reflection** • links reflection to mirrors • mirror as objective • light is reflected to a focus • mirror has curved surface • other mirrors used to reflect image out of telescope tube **diffraction** • diffraction is light spreading out from small gaps/edges • gap about the same as/smaller than wavelength of em radiation/light produces diffraction • need for aperture (much) larger than wavelength • diffraction can be used to produce spectra from stars **Note:** three partial explanations is L2 3marks

					Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.

Question			Answer	Mark	Guidance
4	**a**		one of: Likely to be accepted by scientists / (Interested) scientists are likely to read / Has been checked (by other scientists)	**1**	**Ignore** reliability, accuracy, repeating exp., compare results, another opinion
	b		**[Level 3]** Describes parallax method **and** observed brightness method with reference to known luminosity **and** gives a limitation of each method. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) **[Level 2]** Gives a description of one method **and** a partial description of the other **and** gives a limitation for either method. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) **[Level 1]** A description of a method OR Two partial descriptions of method **or** two limitations OR a partial description of a method **and** a limitation. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) **[Level 0]**	**6**	**This question is targeted at grades up to A** **Indicative scientific points may include:** **Description consists of two indicative points for the method being discussed** **Parallax method** • apparent movement against fixed stars • change over 6 months, opposite sides of orbit • further away smaller parallax (angle) • calculates angle for 8 parsecs = 1/8 = 0.125 arc sec **observed brightness method** • as distance from star increases observed brightness decreases • links temp and size to luminosity • luminosity is measure of stars (intrinsic) brightness • luminosity and observed brightness give distance **limitations** • dust/gases may cause star to appear dimmer • some radiation absorbed by atmosphere

			Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)		making star dimmer • parallax angle/0.125 arcsec very small and difficult to measure **Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.**

Question			Answer	Mark	Guidance
5	a	i	Temperature increases ---------- Pressure increases [1] Volume stays the same [1]	**2**	
		ii	Any Three (increased) energy from the Sun (is absorbed by the gas) As temperature increases/heats up (kinetic) energy/speed of particles (in gas) increases. More / more energetic collisions (between particles and/or container) increase the pressure (The volume cannot increase because) the container/cylinder keeps the same volume	**3**	**ORA** for all points, must be explicit e.g. when moving from light to dark….. **Allow** increased speed of particles increases force/momentum when they collide (with sides of container or other particles)
	b		Converts 50^{o}C increase to 300 K (1) Pressure = 300/250 x 1000 (1) = 1200 (Pa) (1)	**3**	correct numerical answer gains 3 marks allow 200 (Pa) for 2 marks (no conversion)

Question			Answer	Mark	Guidance
6	a	i	Idea of not been observing stars for millions of years (1) Idea of cannot directly measure the mass or temperature (1)	2	 **Allow** cannot weigh a star, cannot get close enough to take temperature
		ii	there is a correlation (1) as one variable increases the other decreases (1) it is not inversely proportional (1) Checks if mass x time = constant (1)	4	'Yes' is insufficient **Allow** 'negative correlation' for first and second marking points For example uses 2 rows from the table to show mass x time not constant OR constant/mass not equal to time OR checks if increase in one is same proportion as decrease in the other
	b	i	(Hydrogen) fusion	1	
		ii	Any 3 Much higher temperature/pressure (1) Fusion happens more quickly (1) Hydrogen used up more quickly (1) Even though more hydrogen in star (1)	3	 **If** 'hydrogen fuses faster' can gain credit for either one of m.p. 2 or 3 but not both. Additional comments may allow both marking points to be gained..

<table>
<tr><td>7</td><td>a</td><td>i</td><td>Re-arrange: mass = e/c^2 (1)

Substitute: mass = $9.9 \times 10^{27} / (3.0 \times 10^8)^2$ (1)

Evaluate: mass = 1.1×10^{11} (kg) (1)

Their answer to 2 sig figs. (1)</td><td>4</td><td>accept for re-arrangement mark also

ecf</td></tr>
<tr><td></td><td></td><td>ii</td><td>2×10^9 (years) x 3.2×10^7 (seconds) x 9.9×10^{27}(watts) (1)

6.3×10^{44} allow 6.336×10^{44} (1)

Joules / J (1)</td><td>3</td><td>Allow kJ/MJ and other energy units</td></tr>
<tr><td></td><td>b</td><td></td><td><table>
<tr><td>The Sun’s line spectra is specific to an element.</td><td></td></tr>
<tr><td>Elements can absorb specific frequencies of light.</td><td>✓</td></tr>
<tr><td>The Luminosity of the Sun depends on the electromagnetic radiation emitted.</td><td></td></tr>
<tr><td>The peak frequency of the Sun’s radiation depends upon the temperature of the Sun.</td><td></td></tr>
<tr><td>The pattern of absorption lines in the Sun’s spectrum is dependent upon the elements present.</td><td>✓</td></tr>
</table></td><td>2</td><td></td></tr>
</table>

* - overlap

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