# GCSE

# Physics A

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

General Certificate of Secondary Education

# Mark Scheme for June 2016

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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 RM Assessor to annotate scripts

| | |
|---|---|
| ? | indicate uncertainty or ambiguity |
| BOD | benefit of doubt |
| CON | contradiction |
| ✖ | incorrect response |
| ECF | 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 |
| NBOD | 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 | i | background/fixed stars [1]<br><br>star (to be measured) [1]<br><br><br>Earth / planet / satellite / observer / eye [1]<br><br>Sun [1] | 4 | **Accept** distant stars<br><br>**accep**t closer star<br>**Not** Sun<br><br>**Not** Moon<br><br>**Ignore** star |
| | | ii | Clear indication of half the angle subtended by the Earth's orbit | 1 | **accept** equivalent angles e.g. the angle between a vertical line through the Earth and the adjacent light ray. |
| | b | | 1÷0.71<br><br>1.4<br><br>Parsec / pc | 3 | <br><br>correct numerical answer which rounds to 1.4 gains 2 marks<br><br>**ignore** megaparsec/Mpc |
| | | | **Total** | 8 | |

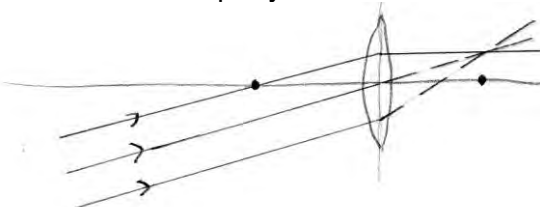| Question | | | Answer | Mark | Guidance |
|---|---|---|---|---|---|
| 2* | a | | idea of spreading cost [1]<br><br>idea of sharing expertise / more scientists [1] | 2 | **Accept** more/sharing resources for 1 mark, if no other mark scored<br><br><br>**Ignore** expertise in analysing results |
| | b | i | idea of non-scientists e.g. politicians/bureaucrats/administrators/officials/ head of ESA/Governments/EU. | 1 | **Ignore** engineers/NASA or ESA unqualified. |

| Question | | | Answer | Mark | Guidance |
|---|---|---|---|---|---|
| | | ii | **[Level 3]**<br>States 3 advantages and 3 disadvantages. Quality of written communication does not impede communication of the science at this level.<br><br>(5 – 6 marks)<br><br>**[Level 2]**<br>States 2 advantages and 2 disadvantages. 3 and 0 = 3 marks. Quality of written communication partly impedes communication of the science at this level.<br><br>(3 – 4 marks)<br><br>**[Level 1]**<br>States an advantage and a disadvantage. Quality of written communication impedes communication of the science at this level.<br><br>(1 – 2 marks)<br><br>**[Level 0]**<br>Insufficient or irrelevant science. Answer not worthy of credit.<br><br>(0 marks) | 6 | **This question is targeted at grades up to C**<br><br>**Indicative scientific points may include:**<br>**advantages**<br>• no atmospheric pollution<br>• no light pollution<br>• avoids atmospheric refraction<br>• avoids atmospheric absorption<br>• all parts of em spectrum available<br>• new discoveries<br>• shows beauty of science<br>• collect more accurate/detailed data<br>• national prestige<br>• international cooperation<br>• encourage support for science<br>• clearer image<br><br>**disadvantages**<br>• cost of setting up<br>• cost of maintenance<br>• cost of repair<br>• money could be used for better purposes e.g. hospitals etc.<br>• pollution during take off<br>• risk of accident during take off<br>• very hazardous for astronauts<br>• difficult working conditions (to maintain/repair/upgrade)<br><br>**Ignore** incorrect statements<br><br>**Do not accept** space telescopes are closer to observed stars<br><br>**Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.** |
| | | | **Total** | 9 | |

| Question | | | Answer | Mark | Guidance |
|---|---|---|---|---|---|
| **3** | a | i | EITHER<br>• Light speed slows down (as it enters lens);<br>• (Hence) decrease in wavelength;<br>• Light changes direction towards normal;<br>OR<br>• Light speeds up (as it leaves lens);<br>• (Hence) increase in wavelength;<br>• Light changes direction away from normal;<br>OR<br>• Sides of the lens are not parallel;<br>• Speed in the lens not same as in air;<br>• Wavelength different in lens; | 3 | Unless specified, assume that light is passing into the lens.<br><br>**Ignore** colours<br>**Not** frequency changes (negate wavelength marks)<br><br><br><br><br><br>**Allow** wavelength changes and speed changes for 1 mark if no other marks scored |
| | | ii | ray through centre of lens continues straight to intersect top ray<br><br>bottom ray bends in lens then continues as straight line to intercept of central and top ray<br><br><br><br>image labelled at intercept of all three rays; | 1<br><br><br>1<br><br><br><br>1 | **Ignore** any additional rays constructed for the top ray.<br><br><br><br><br><br><br><br>**Accept** an extended image to the principal axis |
| | b | i | **W** | 1 | |
| | | ii | **W**<br><br>It is the most powerful lens/ has the shortest focal length/ will give the most magnification | 1<br><br>1 | **Allow** even if **W** not chosen<br>allow correct argument based on idea that some lens are too large for the eye. |

| Question | | | Answer | Mark | Guidance |
|---|---|---|---|---|---|
| | | iii | **Z** | 1 | **Allow** 2nd two marking points even if Z not chosen |
| | | | It has the largest area / biggest diameter | 1 | **Accept** largest aperture |
| | | | to collect the most/more light | 1 | |
| | | iv | No mark for 'yes' or 'no' | | |
| | | | Has the highest magnification  (June is correct) | 1 | **Accept** deduction that W and Y are best using points below |
| | | | Correct reason for highest magnification e.g. longest focal length & shortest focal length / or calculation of **all** pairings | 1 | |
| | | | Magnification is not 300 OR is 30 (June is incorrect) | 1 | |
| | | | Shows a calculation of magnification. i.e 1.5/0.05 (= 30) | 1 | |
| | | | **Total** | **16** | |

| Question | | | Answer | Mark | Guidance |
|---|---|---|---|---|---|
| **4** | **a** | | Mean of   = (165 +180 + 160 + 175) / 4 = 170 light years [1]<br><br>These are at similar distances / the other stars are all at very different distances [1] | 2 | **Accept** 170 for the first mark |
| | **b** | | 20 light years [1]<br><br><br><br>The range/spread of the stars (gives  the approximate depth of the cloud) [1] | 2 | **allow** ecf from (a) for wrong choice of stars Provided stars clearly identified in part (a) e.g.<br>all stars (331.25 mean) = 1000 lt years |
| | | | **Total** | **4** | |

| Question | Answer | Mark | Guidance |
|---|---|---|---|
| 5 | **[Level 3]**<br>Explain how to find Cepheid variable AND how to use Cepheid variable distance to find galaxy distance AND how to use galaxy distance to find Hubble constant. Quality of written communication does not impede communication of the science at this level.<br>(5 – 6 marks)<br><br>**[Level 2]**<br>Gives at least **two** of: explain how to find Cepheid variable (may contain errors) OR how to use Cepheid variable distance to find galaxy distance OR how to use galaxy distance to find Hubble constant. 3 partial explanations gains 3 marks. Quality of written communication partly impedes communication of the science at this level.<br>(3 – 4 marks)<br><br>**[Level 1]**<br>Attempts to explain how to find Cepheid variable (may contain errors) OR how to use Cepheid variable distance to find galaxy distance OR how to use galaxy distance to find Hubble constant. 2 partial explanations gains 2 marks. Quality of written communication impedes communication of the science at this level.<br>(1 – 2 marks)<br><br>**[Level 0]**<br>Insufficient or irrelevant science. Answer not worthy of credit.<br>(0 marks) | 6 | **This question is targeted at grades up to A\***<br><br>**Indicative scientific points may include:**<br><br>**Cepheid variable distance**<br>• (measure) period (use graph to find luminosity)<br>• Idea of observed /apparent brightness<br>• use brightness and luminosity to find distance<br><br>**galaxy distance**<br>• find Cepheid variable in galaxy<br>• distance to galaxy = distance to Cepheid variable<br><br>**Hubble constant**<br>• measure speed of recession (allow redshift)<br>• use recession and distance to calculate Hubble constant / gives rearranged equation for H<br><br>**Note** all statements are expected for a complete explanation. 1 statement is a partial explanation.<br><br>**Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.** |
| | **Total** | 6 | |

| Question | | | Answer | Mark | Guidance |
|---|---|---|---|---|---|
| **6** | a | | Fusion<br><br>Hydrogen<br><br>To Helium | 3 | **Maximum 2 marks** if refers to atoms rather than nuclei.. |
| | b | i | $M = E/c^2$<br><br>M = 4.3 x 10$^{-12}$ ÷ (3 x 10$^8$)$^2$<br><br>4.8 x 10$^{-29}$ | 3 | **Accept** correct substitution into $E=mc^2$ and then correct rearrangement.<br><br>correct numerical answer gains 3 marks<br><br>**allow** any answer that rounds to 4.8 x 10$^{-29}$ |
| | | ii | 3.9 x 10$^{26}$ ÷ 4.3 x 10$^{-12}$<br><br>9.1 x 10$^{37}$ | 2 | correct numerical answer gains 2 marks<br>**allow** any answer that rounds to 9.1 x 10$^{37}$ |
| | c | | Produced in core / transferred towards surface of the Sun<br><br>radiation **and** convection (within the Sun)<br><br>Radiated/emits photons/radiation/light from surface/photosphere of the Sun. | 3 | **Accept** radiative and convective zones |
| | | | **Total** | 11 | |

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| Question | Answer | Mark | Guidance |
|---|---|---|---|
| 7 | **[Level 3]**<br>Correctly explains Star **and** Sun **and** Moon.  Quality of written communication does not impede communication of the science at this level.<br>(5 – 6 marks)<br><br>**[Level 2]**<br>Correctly explains **two** of Star **or** Sun **or** Moon.  If 1 explanation and 2 partial explanations or 3 partial explanations then 3 marks.<br>Quality of written communication partly impedes communication of the science at this level.<br>(3 – 4 marks)<br><br>**[Level 1]**<br>Correctly explains **one** of Star **or** Sun **or** Moon'. If 2 partial explanations then 2 marks. Quality of written communication impedes communication of the science at this level.<br>(1 – 2 marks)<br><br>**[Level 0]**<br>Insufficient or irrelevant science. Answer not worthy of credit.<br>(0 marks) | 6 | **This question is targeted at grades up to B**<br><br>points may be made on diagrams<br><br>**Indicative scientific points may include:**<br><br>**Stars** (Sidereal day)<br>• Shorter than solar day (by about 4 minutes)/23 hr 56 min<br>• Stars fixed with respect to solar system/Earth<br>• (Sidereal day) is time for one rotation of the Earth/360°<br><br>**Sun** (Solar day)<br>• Time for Sun to return to same position in sky<br>• 24 hours<br>• As **Earth** rotates it also moves in orbit around Sun.<br>• Extra time (4 minutes) for the extra rotation needed.<br><br>**Moon**<br>• Time longer than solar day / About 24 hr 49 minutes.<br>• As Earth rotates **Moon** orbits the Earth<br>• It takes time (approx. 50 minutes) to catch up with the Moon which has moved around its orbit.<br><br>**Note:** Explain requires two bullet points from the section<br><br>**Accept** diagrams illustrating any of these points.<br><br>**Use the L1, L2, L3 annotations in RM Assessor; do not use ticks.** |
| **Total** | | 6 | |

* - overlap

**OCR (Oxford Cambridge and RSA Examinations)**
**1 Hills Road**
**Cambridge**
**CB1 2EU**

**OCR Customer Contact Centre**

**Education and Learning**
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

**www.ocr.org.uk**

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