AQA A-LEVEL PHYSICS · 7408

PHYSICS



MARK SCHEME

3.9.1 TELESCOPES: RADIO

SCORE	PERCENTAGE
/10	%

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Q1.

(a) (i) largest distance = 2.57 + 1 = 3.57 AU ✓

$3.57 \text{ AU} = 3.57 \times 1.5 \times 10^{11}\text{m}$

$= 5.36 \times 10^{11}\text{(m)}$ ✓

The first mark is for the correct distance in AU.

The second mark is for the correct conversion to metres. Allow c.e.

2

(ii) angle = s / r

$= 5.4 \times 10^{5} / 1.73 \times 10^{11}$ ✓

$= 3.12 \times 10^{-6}$ (rad) ✓

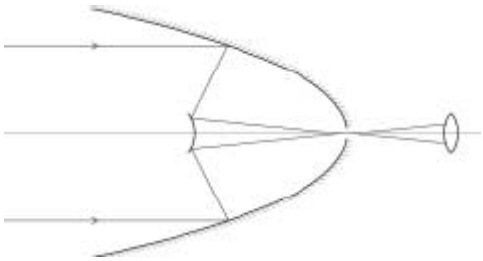
Working needs to be shown for the first mark.

At least two sf needed for final mark.

2

(b) (i) mirrors correct ✓

primary concave, secondary convex. No shading needed
primary mirror should be continuous i.e. not two mirrors
if no hole, evidence can be given by rays passing through
rays correct ✓
rays must cross after the secondary mirror



The lens does not need to be included.

2

(ii) angular resolution $= \lambda / D$ $D = 1 \times 10^{-6} / 3.3 \times 10^{-7}$ ✓

D = 3.0 m 2 sf needed ✓

Allow use of factor of 1.22.

Allow 1 sf if justified by discussion of approximate nature of calculation.

2

(c) minimum angular resolution is better / smaller than the size of the asteroid ✓

The first mark is for qualitative comparison.

details of about 1/10 the angular size of Vesta / 50km can be seen ✓

the second for the quantitative analysis.

2

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[10]

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Q1.

The conversion from AU to metres was correctly carried out by most of the students and this gained them the first mark. A lot fewer students added the 1AU to account for the Earth's orbit, however. The calculation of the subtended angle was carried out successfully by the majority of students. It should be noted that, when a question asks students to "show that" a quantity has a certain value, examiners expect to see evidence of the final calculation. This can be achieved if students write their answer to one more significant figure than the value given.

The ray diagram of the Cassegrain telescope was drawn correctly by the majority of students. Common errors included: the wrong curvature on the secondary mirror; the curvature of the primary mirror making it look like two mirrors rather than one; the rays crossing before reaching the secondary mirror; the rays bending as they leave through the hole in the primary mirror. In the best answers, students drew the primary as one curve with a small gap in its centre, the rays crossed in this gap as they left the telescope and they used a ruler to help draw the rays. The calculation of the diameter proved to be more demanding. Students commonly used the wrong wavelength, or failed to give their answer the 2 significant figures suggested in the data.

In 1(c) students were expected to compare the two values of the angle in 1(aii) and 1(bii). Although many could correctly state that, as the angle subtended by Vesta is larger than the resolution of the telescope, the surface of Vesta could be resolved, fewer went on to discuss what this meant in terms of detail. The best answers stated that details down to about one tenth the diameter of Vesta, or about 50 km, may be resolvable.

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