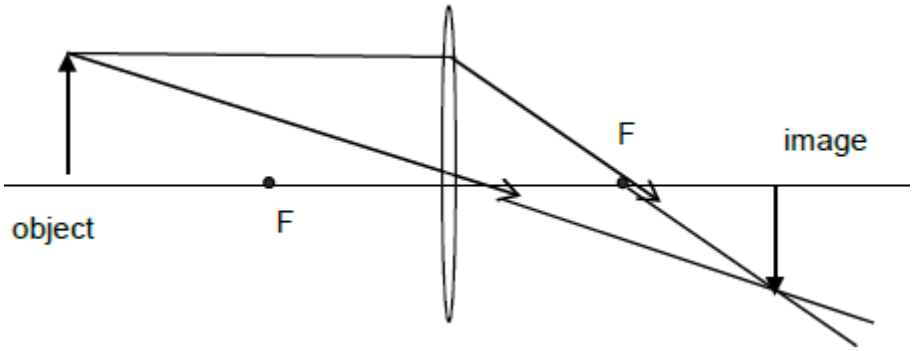
Name of the Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Mark Schemes

Q1.

(a)



Arrows are not essential
Condone only one focus if it is the one used for the construction ray.
Construction ray must have focus labelled to get the mark.
Lose the second mark if the image is same size or magnified
Image line is needed for second mark.

One construction ray correct ✓

Other construction ray to form diminished image ✓

(The parallel construction ray must pass through a labelled F)

Object, image labelled correctly. ✓

3

(b) u = 128 cm

Allow c.e. for incorrect v

v = 200 − 128 = 72 cm ✓

Condone u and v the wrong way round.

Use of 1 / f = 1 / u + 1 / v

To give 1 / f = 1 /128 + 1 / 72

f = 46 cm ✓

2

(c) Objective.

No credit for unsupported answer.

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As M = fo / fe, for magnification fo > fe

As telescope length = fo + fe, lens must be objective (so that telescope not too long.) ✓

2

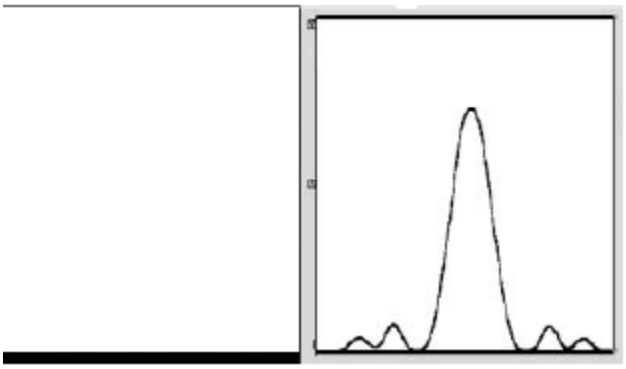
[7]

Q2.

(a) (i) central maximum at least twice the height of adjacent maxima ✓

Allow graph to be above angle axis

Subsequent narrower maxima ✓



Any further maxima should not get bigger.

2

(ii) Two sources will be (just) resolved if the central maximum of the diffraction pattern of one coincides ✓

Central max and first min may be labelled on diagram in ai

with the first minimum of the other. ✓

If they use the term 1st maximum it must be clear that it is the central maximum

Second mark is for correct part of the second diffraction pattern.

Clearly labelled diagram can get both marks.

2

(b) Use of $Rs = 2GM/c^2$

*Allow ce for **one** from:*

missing out million; missing out mass of Sun; square in equation, but no square of speed of light in calculation

to give $Rs = 2 \times 6.67 \times 10^{-11} \times 4.1 \times 10^{6} \times 2 \times 10^{30} / (3 \times 10^{8})^2$ ✓

$= 1.2 \times 10^{10}$m ✓

2sf ✓

Sf mark stands alone but must be a number (not just stated 2 sf)

3

(c) (i) use of $\theta = \lambda/D$

The first mark is for calculating the wavelength

to give $\theta = (3 \times 10^{8} / 230 \times 10^{9})$ ✓ $/ 5000 \times 10^{3}$

$= 2.6 \times 10^{-10}$ (rad) ✓

The second mark is for the use of the equation to give the final answer

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Allow c.e. for an a.e. in the first mark.

If frequency used treat as p.e. – no marks

2

(ii) use of $s = r\theta$

First mark is for the angle subtended (5.12×10^{-11})

to give $\theta = 5 \times 1.2 \times 10^{10} / (25\,000 \times 9.46 \times 10^{15})$ ✓

$= 2.5 \times 10^{-10}$ (rad) ✓

Second mark is for showing that this is 5 × answer to c(i).

which is (approximately) the answer to ci

Alternatives:

Calculate size of object that could just be resolved at this distance, and showing that this is 5 × radius of black hole.

2

[11]

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