Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

Mark Schemes

Q1.

Mark	Criteria
6	All 3 areas covered in some detail. 6 marks can be awarded even if there is an error and/or parts of one aspect missing.
5	All 3 areas covered at least 2 in detail. Whilst there will be gaps, there should only be an occasional error.
4	Two areas successfully discussed, or one discussed and two others covered partially. Whilst there will be several gaps, there should only be an occasional error.
3	One area discussed and one discussed partially, or all three covered partially. There are likely to be several errors and omissions in the discussion.
2	Only one area discussed or makes a partial attempt at two areas.
1	None of the three areas covered without significant error.
0	No relevant analysis.

Examples of points made in a good answer

Overall shape

• Overall curve is a black body spectrum

• Links λ_{max} to temperature

• Continuous spectrum emitted by star

Absorption lines

• Dips are due to absorption

• Light of particular wavelengths absorbed by gases in outer layers

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• And re-emitted in random directions

• Leaving dark lines

• E.g. Balmer lines are produced by hydrogen

The hydrogen must be excited to the $n = 2$ state

Choice of star

• Miaplacidus (class A)

• Temperature calculated (~9000 K)

• temperature is class A

OR

• Miaplacidus (class A)

• Absorption lines are Hydrogen (Balmer) lines

• strong Hydrogen/Balmer absorption lines seen in class A but not in class K

AO1 - 4
AO3 - 2

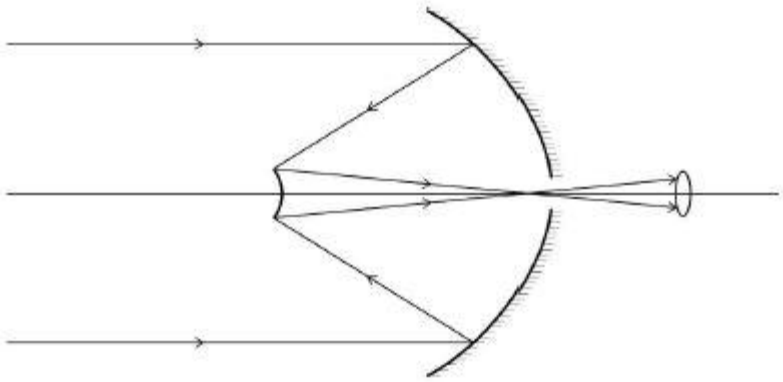
[6]

Q2.

(a) Diagram of Cassegrain telescope with

both mirrors correct ✔

two rays correct ✔



The first mark is for a concave primary mirror and convex secondary.

Condone lack of shading. Hole in primary can be inferred from rays passing through.

Primary must not look like two mirrors.

Condone flat secondary if labelled convex. Do not condone if concave.

The second mark is for the two rays, initially parallel to the principal axis, reflecting from the primary mirror to the secondary, and then crossing on the principal axis after secondary and before passing through primary. Condone crossing after primary if before a lens.

Ignore arrows on rays. No lens needed; ignore rays after lens if drawn.

Poorly drawn rays, eg curved, loses mark.

2

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(b) Resolution = $\frac{450 \times 10^{-9}}{}$ = 2.14×10^{-6} (rad) ✔

Smallest detail = $2.14 \times 10^{-6} \times 12.5 \times 10^{6} = 27$ m ✔

Sensible comment about comparison and decision made ✔

For MP2 student may find angle subtended by 1 km crater (8.0×10^{-5} rad) then compare angles for MP3

MP3 for example 27 m is 1/40th of crater.

3

(c) Collecting power ∝ area ✔

$$\text{Ratio} = {2.4^2}/{.21^2} = 130$$

OR calculates both areas and states Hubble is much bigger ✔

MP1 is for student showing they know dependence on area. Condone collecting power $\propto d^2$ if it is clear that d is diameter.

MP2 for clear comparison

2

(d) At least 2 clear comparisons made ✔ ✔
Decision made about which telescope, justified in terms of the impact of at least one comparison on the image (likely to be reflecting).✔

Problems of refractors:

Can suffer spherical aberration and chromatic aberration.

Reflecting are lighter. Reflecting are shorter. Mirrors do not suffer from chromatic aberration.

Problems of reflectors:

Spider/secondary mirror block some of the light/reduce image brightness/cause diffraction effects.

Ignore discussion of cost/difficulty of construction/air trapped in refracting telescope.

3

[10]

Q3.

(a) Rayleigh criterion identifies the minimum subtended angle between two objects whose (images) can be resolved. ✔$_1$

(Minimum angle is when) the central maximum of (the diffraction pattern of light from) one object coincides with the first minimum of (the diffraction pattern) of the second object. ✔$_2$

2

(b) Telescope is detecting U-V/wavelengths smaller than visible light ✔$_1$

1

Which is absorbed by (ozone in) the atmosphere so must be in space ✔$_2$

Explains why U-V light gives better resolution ✔$_3$

MP3 needs ref to λ/D or good detail about diffraction.

2

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(c) Quantitative comparison of collecting power or resolution ✔1

Arecibo brighter image or more detail ✔2

Links spherical aberration to detail of image ✔3

e.g. Collecting power $\frac{305^2}{76^2}$ *= 16 times brighter*
or calculation of resolutions
There is no absolute conclusion
- Image from Arecibo will be brighter
- Lovell likely to be better detail because no spherical aberration
No mention of the effect of shape – MAX 2

3

[8]

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