

Name of the Student: _____

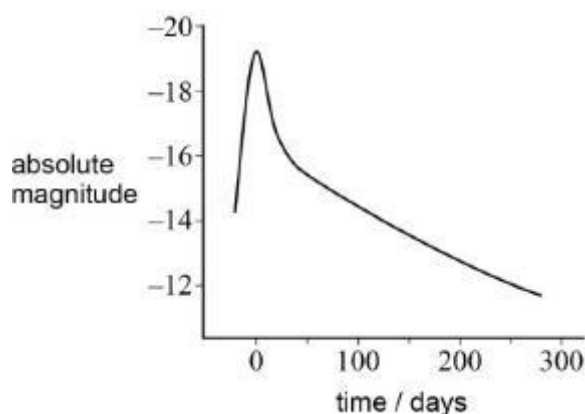
Max. Marks : 24 Marks

Time : 24 Minutes

Mark Schemes

Q1.

(a) D



1

(b) Use of $m - M = 5 \log (d/10)$ to give

$$m = 5 \log(d/10) + m = 5 \log (7.7 \times 10^4) - 19.3$$

Allow -19.0 to -19.5 for M giving $m = 5.4$ to 4.9

MP1 finds apparent magnitude

giving $m = 5.1$ ✓₁

which is brighter than their quoted Hipparcos limit ✓₂

Qualitative comparison of the brightness of their m with 6 leading to a conclusion ✓₃

MP3 comparative statement about answer that relates the 2 brightnesses correctly (allow ecf)

3

[4]**Q2.**

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
- 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]

Q3.

- (a) Quasars are formed around black holes ✓₁
Black hole (at the centre of IC2497) no longer has matter falling into it ✓₂
*MP2 – allow black hole no longer feeding; Black hole no longer active.
 If no mention of black holes no marks can be awarded.*

2

- (b) use of $z = v/c$ to give $v = zc = 0.0516 \times 3.00 \times 10^8$ ✓₁
Accept 2sf in final answer.

3

$$= 1.55 \times 10^7 \text{ m s}^{-1} = 1.55 \times 10^4 \text{ km s}^{-1}$$

use of $v = Hd$

to give $d = \frac{v}{H} \checkmark = \frac{1.55 \times 10^4}{65}$

$$= 238 \checkmark_3 \text{ Mpc} \checkmark_4$$

*Condone Megaparsec, MPC or MPc but **not** Mps OR MpC.
 Unit mark cannot be awarded without an attempt at calculation.
 Allow correct converted unit.
 (eg 782 ✓ Mly ✓; 4.93×10^{10} AU; 7.40×10^{21} m)
 Units other than Mpc can only be awarded if there is a correct
 conversion – but allow ecf.
 (eg AE in calculating Mpc correctly converted to m)*

1

[6]

Q4.

- (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

- (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]