Name of the Student:_____
Max. Marks : 21 Marks **Time : 21 Minutes**

Mark Schemes

Q1.

(a) Tick (✔) only against Tsih

Accept other clear indication (eg x)

1

(b) Temperature:

Attempt to use Wiens Law. ✔
Correct calculation of T for both stars. ✔

Colour:
Links colour to wavelengths produced ✔
Schedar longer wavelengths so 'redder' than Caph ✔
Or
Links temperature to spectral class ✔
Caph F (therefore White), Schedar K (therefore Orange) ✔

For Caph $T = \frac{2.9 \times 10^{-3}}{410 \times 10^{-9}}$ *= 7250 K (6900–7630)*

For Schedar $T = \frac{2.9 \times 10^{-3}}{660 \times 10^{-9}}$ *= 4400 K (3600–5200)*

Allow ecf for incorrect temperatures.
No mark for just stating colours

4

(c) Caph ✔

1

(d) Conversion of distance to parsec (70) ✔
Use of $m - M = 5\log(\frac{d}{10})$
to give $M = m - 5\log(\frac{d}{10})$ ✔
($M = 2.2 - 5\log(\frac{70}{10})$) = –2.0 (–2.025) ✔

1 mark for correct distance conversion
1 mark for re-arranging formula
1 mark for correct answer (min 2 sf)
Ecf for incorrect conversion only if there is an attempt to convert.

3

(e) $R_s \left(= \frac{2GM}{c^2}\right) = \frac{2 \times 6.67 \times 10^{-11} \times 15 \times 1.99 \times 10^{30}}{(3.00 \times 10^8)^2} =$ ✓

4.4×10^4 m ✔

OK to use ≈ instead of = (as in the specification)

Allow ecf for POT error only.

2

[11]

Q2.

(a) It has a known absolute magnitude. ✔

Other wordings are possible. It must be clear that the candidate knows that it is the intrinsic power/brightness that must be known.

1

(b) Peak between −18 and −20 AND axis correct direction ✔

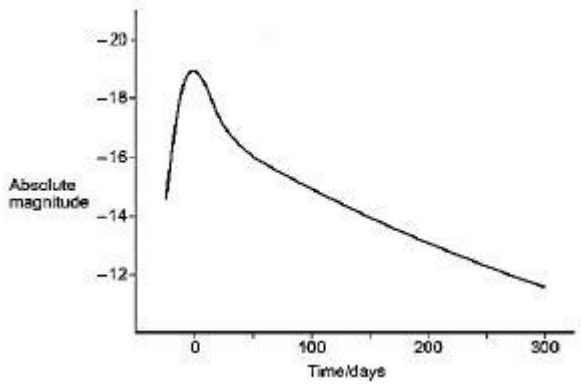
Time scale 40 to 500 days ✔

Lhs steeper than rhs (by eye) ✔

−ve sign essential

Allow magnitude and/or time axes starting at 0

Accept any unit for time which fits with the 40-500 days range. Ideal graph:



3

(c) The mark scheme gives some guidance as to what statements are expected to be seen in a 1 or 2 mark (L1), 3 or 4 mark (L2) and 5 or 6 mark (L3) answer. Guidance provided in section 3.10 of the 'Mark Scheme Instructions' document should be used to assist in marking this question

Mark	Criteria
6	All 3 areas covered with at least two aspects covered in some detail. 6 marks can be awarded even if there is an error and/or parts of one aspect missing.
5	A fair attempt to analyse all 3 areas. If there are several errors or missing parts then 5 marks should be awarded.
4	Two areas successfully discussed, or one discussed and two others covered partially. Whilst there will be 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 which might be made in a good answer.

Data

- Also need z (or red shift).
- Use z value to find velocity ($v = zc$).
- Measure wavelength of spectral lines

2

Graph

- Plot graph of velocity on y-axis vs distance on x-axis.
- v in km/s, distance in Mpc.
- H is gradient of graph.

2

Limitations

- Value of apparent magnitude may be affected by what the light passes through.
- Much variation in the data (there must be specific reasons given e.g. variations between galaxies or random errors in measurement).
- At large distances accelerating universe will affect graph.
- Need data from lots of supernovae

2

[10]