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

Mark Schemes

Q1.

(a) (i) Spectral class axis correct: OBAFGKM ✔

Ignore bunching of labels.

Do not condone letters beyond O and M

1

(ii) Main sequence correct ✔

Dwarf and giant stars correct ✔

Bands not lines.

Main sequence must have correct curvature

LHS must be above -5 and RHS below 10 on abs mag scale.

Dwarfs in bottom left quadrant, below abs mag 5, not touch Main sequence.

Giants in top right quadrant, can extend left, above abs mag 0, not touch Main sequence.

2

(b) (i) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should apply a 'best-fit' approach to the marking. The candidate's writing should be legible and the spelling, punctuation and grammar should be sufficiently accurate for the meaning to be clear. The candidates answer should be assessed holistically. The answer will be assigned to one of 3 levels according to the following general criteria:

Higher Level (5 or 6 marks)

The information conveyed by the answer is clearly organised, logical and coherent using appropriate specialist vocabulary correctly. The form and style of writing is appropriate to answer the question. Appearance: Student gives a coherent description the relative brightness and of the three stars, linked to their apparent magnitude.

For 6 marks, they go on to describe the colour of each star related to the temperature and spectral class

Spectrum: The student further describes the spectrum of each of the three stars in terms of the major absorption lines, again related to the spectral class from their temperatures.

Position on HR. There is some discussion of the position of the stars. For example it is pointed out that 41 Arieti cannot be a dwarf star as it is too large.

Intermediate Level (3 or 4 marks)

The information conveyed by the answer may be less well organised and not fully coherent.

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There is less use of specialist vocabulary, or specialist vocabulary may be used incorrectly. The form and style of writing is less appropriate.

Appearance: Student gives a coherent description the relative brightness and of the three stars, linked to their apparent magnitude.

Spectrum: There may be some less accurate comparison of colour based on temperature **or** description of the spectra of the stars.

Position: There is some attempt to discuss the position of the stars on the HR diagram.

Low Level (1 or 2 marks)

The information conveyed by the answer is poorly organised and may not be relevant or coherent. There is little correct use of specialist vocabulary. The form and style of writing may be only partly appropriate.

Appearance: The apparent magnitude scale is identified as the one that indicates brightness, but it may be interpreted the wrong way round by the student.

Incorrectly, there may be some reference to how big the stars appear based on the radius. References to colour may be missing altogether.

Spectrum: little or no relevant detail related to the spectrum of each star is given.

Position: on the HR diagram: there may be no attempt.

Summary of relevant information about each star

Property	**41 Arieti**	**Sharatan**	**Hamal**
Brightness	Dimmest	Middle	Brightest
Colour	Blue	Blue / white	Orange / red
Spectra class	He and H B	H and ionised metals A	Neutral metals K
type of star	Main sequence Not dwarf.	Main sequence	Main sequence
Position on HR	Top left	Middle / left	Middle / right

extra information

Answers that suggest that the size of the stars can be compared visually are unlikely to be awarded marks in the top half of a band.

max 6

(ii) d = 66 /3.26 = 20 pc ✔
Use of m-M = 5 log (d/10)
To give 2 – M = 5 log (20/10) ✔
M = 2 – 1.5 = 0.5 ✔

The first mark is for the conversion of d into parsec

Allow CE for two marks.

If M and m wrong way round, treat as physics error: only the first mark can be awarded

The second mark is the correct substitution

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The third mark is for the final answer; allow 0.46 to 0.5; no sf penalty

3

(iii) 41 Arietis has the largest radius and temperature, ✔
and therefore the greatest power output / brightest abs mag / greatest intrinsic brightness (ref to $P = \sigma AT^4$) ✔
But appears dimmest in the sky (as it has the greatest apparent magnitude.) so 41 Arietis must be furthest away. ✔

No mark for an unsupported answer.

Allow area for radius

The first two marks can be awarded for a correct calculation of the power of 41 Arietis.

3

[15]

Q2.

(a) Star much brighter than reflected light from planet ✓

Or

Planet very small and distant – subtends very small angle compared to resolution of telescopes

1

(b) Planet and star orbit around common centre of mass that means the star moves towards/away from Earth as planet orbits ✓

1

Causes shift in wavelength of light received from star ✓

1

(c) Light curve showing constant value with dip ✓

1

When planet passes in front of star (as seen from Earth), some of the light from star is absorbed and therefore the amount of light reaching Earth reduced ✓

1

Apparent magnitude is a measure of the amount of light reaching Earth from the star ✓

1

[6]

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