Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Mark Schemes

Q1.

(a) D = 0.305 m ✔

Use of $\theta = \lambda / D$

To give $\lambda = 1.8 \times 10^{-6} \times 0.305$

$= 5.5 \times 10^{-7}$ m ✔

The first mark is for the correct D.
The second mark is for the final answer.
Allow 1 max for one POT error.
Allow ecf for incorrect D unless 5.03 m used.
Award full credit if factor of 1.22 included (to give 4.5×10^{-7} m).

1
1

(b) $M = 3.2 \times 10^{-4} / 1.8 \times 10^{-6}$ ✔

=178

Use of M = fo/fe to give

fe = fo/M = 5.03/178 ✔

= 0.028 m ✔

The first mark is for evidence of use of angular magnification equation.
The second mark is for evidence of the use of the magnification focal lengths equation.
The third is for the final answer. Do not credit 0.03.
Allow ecf for M.
Allow 2 max for one POT error.

1
1
1

(c) Either

Telescope can resolve objects down to 1.8×10^{-6} rad

At 3.0×10^{4} km, this angle is subtended by an object of size 3.0×10^{4} km $\times 1.8 \times 10^{-6}$ rad = 54 m ✔

This is 54/325 = 1/6th size of asteroid ✔

Downloaded from www.merit-minds.com

would not be suitable for viewing detail ✔

OR

Angular size of asteroid = $325/3 \times 10^{7} = 1.1 \times 10^{-5}$ ✔

As $1.1 \times 10^{-5} > 1.8 \times 10^{-6}$ asteroid can be seen / $1.1 \times 10^{-5} / 1.8 \times 10^{-6}$ 6 times minimum angular resolution ✔

Too small for detail to be seen ✔

The first mark is for the calculation.

The second mark is for the comparison. Allow ecf. The angular resolution of the telescope should be quoted.

The third mark is for reaching the judgement.

This mark cannot be given if simple statement that asteroid can be seen.

Condone correct use of sin and tan.

Full credit can also be given if they use magnification and compare angular size with the resolution of the eye.

1
2

[8]

Q2.

(a) Curve with a single peak ✔

Steepest part of LHS steeper than steepest part of RHS ✔

If multiple curves seen all of them must be correct.

Do not condone curves with negative gradient on LHS.

2

(b) Mention of use of peak wavelength ✔

Quoting use of Wien's law and that wavelength is in metres ✔

Use of $\lambda_{max}T = 0.0029$ m K ✔ and mention of temperature in kelvin. ✔

This mark may be awarded for a label on the wavelength axis of the graph. Do not condone biggest or maximum.

If no peak in graph 2 max.

Only the first mark can be awarded if there is a suggestion that 'm' in the equation represents 'milli', or K represents Boltzmann's constant.

Ignore references to Stefan's Law.

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.**

Level	Criteria	QoWC
6 marks	Correct calculations of power output. Comparison of brightness. Leading to similar distance away and therefore binary	The student presents relevant information coherently, employing structure, style and sp&g to render meaning clear. The

Downloaded from www.merit-minds.com

	(or not if supported).	text is legible.
5 marks	There may be an error in the calculations but POT errors can be condoned.	
4	Attempt to calculate power outputs or quantitative analysis of brightness, with some relevant comment. Condone some errors including POT, missing "4" or use of "4/3". Do not condone more serious errors in calculation. If the brightness is the wrong way round (B>A) ignore brightness comparison.	The student presents relevant information and in a way which assists the communication of meaning. The text is legible. Sp&g are sufficiently accurate not to obscure meaning.
3	Only a qualitative response. Reference to r and T suggesting that Power output of A greater than B. This can be seen in an (incorrect) equation. OR straight forward comparison of brightness. (eg A is about twice as bright).	
2	Two aspects of star correct – eg A brighter than B, both appear orange (do not accept red), B redder than A.	The student presents some relevant information in a simple form. The text is usually legible. Sp&g allow meaning to be derived although errors are sometimes obstructive.
1	Only one aspect statement comparing stars correct. eg A brighter than B, both appear orange (do not accept red), B redder than A.	
0	Unsupported evaluation or no relevant analysis	The student's presentation, spelling, punctuation and grammar seriously obstruct understanding.

Stars compared for colour:

Cygnus B will appear more red than Cygnus A as it is cooler

Or both stars orange. (L1)

Ignore calculation of λ_{max} unless linked correctly to colour.

Stars compared for brightness.

Cygnus A will appear (approximately 2 times) brighter than Cygnus B, as the apparent magnitude is approximately 1 less than that of Cygnus B. (L2)

Difference in magnitude = 0.9

ratio in brightness = $2.51^{0.9}$ = 2.3

Distance discussed

Powers compared: (L2)

Using $P=\sigma AT^4$

Gives

Downloaded from www.merit-minds.com

For A: $P = 5.67 \times 10^{-8} \times 4\pi \times (4.7 \times 10^{8})^2 \times 4500^4 = 6.45 \times 10^{25}$W (L2/3)

For B: $P = 5.67 \times 10^{-8} \times 4\pi \times (4.1 \times 10^{8})^2 \times 4100^4 =$

3.38×10^{25}W (L2/3)

*As power output of **A** is about twice that of **B**, and **A** appears about twice as bright, they must both be about the same distance away.(L2/3)*

Evaluation

Being about the same distance away is consistent with idea that they form a binary system. (L2/3)

6

(d) K ticked

1

[12]

Downloaded from www.merit-minds.com