

Name of the Student: \_\_\_\_\_

Max. Marks : 27 Marks

Time : 27 Minutes

Mark Schemes

**Q1.**

- (a)
- $n$
- changes by 4 units, 2 units, 1 unit for each change in 100 nm ✓

OR

this is not half-life behaviour because graph has false origin for  $n$ 

OR

the magnitude of  $n$  does not halve every interval

1

- (b) Sensible long (
- $> 8$
- cm) tangent drawn, correct read-off for points from triangle at least half length of line and readings taken ✓

Substitution correct ✓

 $(-)(1.5 \pm 0.2) \times 10^4$  and  $\text{m}^{-1}$  ✓*Condone power of ten error in first two marks*

3

- (c) Column heading correct ✓

All calculations correct ✓

appropriate (3) sfs ✓

$1 / \lambda^2 / 10^{-12}$ $\text{m}^{-2}$
11.1
8.16
6.25
4.94
4.00
3.31

Accept if calculated in  $\text{nm}^{-2}$  instead of  $\text{m}^{-2}$

$11.1 \times 10^6 \text{ nm}^{-2}$  etc

Units as follows:  $1/\lambda^2 / \text{m}^{-2}$ . Alternative acceptable labelling includes  $1/\lambda^2 (\text{m}^{-2})$ ,  $1/\lambda^2$  in  $\text{m}^{-2}$ . The  $10^{-12}$  can be in the body of the table or at top of column.

3

- (d) Graph axes labelled correctly and sensible axes ✓

Plots correct to within half a square ✓

Best-fit line by eye ✓

*Suitably large graph scale (do not award if scale on axis could have been doubled) Scale must be sensible divisions which can be easily read. eg scales in multiples of 3, 6, 7, 9 etc are unsatisfactory.*

*2<sup>nd</sup> mark is independent mark i.e. if candidates have used an unsuitable scale they can still achieve marks for accurately plotting the points.*

*The line of best fit should have an approximately equal distribution of points on either side of the line.*

*Check bottom 3 plots.*

3

- (e) Intercept correct to within half a square ✓

[1.6014]

1

- (f) The value of refractive index at infinite / very long wavelength ✓

1

- (g) states that  $\log n = \log c + d \log \lambda$  ✓

plot  $\log n$  versus  $\log \lambda$  ✓

$d$  is the gradient of the graph ✓

3

[15]

## Q2.

- (a) Spectral class A ✓

1

The temperature range for A class is 7500 K to 11 000 K ✓

1

- (b) Lowest value of apparent magnitude indicates the brightest star. ✓

1

Vega has the lowest apparent magnitude (so is brightest) ✓

1

- (c) Closest of three stars is Altair ✓

1

Using  $m - M = 5 \log (d / 10)$

To give  $0.77 - 2.21 = -1.44$ ✓

1

And  $d = 5.2 \text{ pc}$ ✓

*Allow ce for calculation of wrong star*

1

(d) Deneb is the largest✓

*No mark for unsupported answer*

1

It has approximately the same temperature, but has a much brighter absolute magnitude and therefore greater power output✓

1

To have a much greater power output for a similar temperature, it must have a greater area✓

As  $P = \sigma AT^4$

1

*Allow alternative:*

*from position on HR diagram, from T and M,*

*Altair and Vega are main sequence stars*

*Deneb is a giant star*

*so Deneb largest.*

(e) Using  $\lambda_{\text{max}} T = 0.0029$

1

To give  $\lambda_{\text{max}} = 0.0029 / 7700$ ✓

$= 3.8 \times 10^{-7} \text{ m}$ ✓

1

[12]