

**Option E — Astrophysics****E1. This question is about stars.**

(a) Distinguish between apparent magnitude and absolute magnitude.

[2]

- *apparent magnitude is a measure of how bright a star appears from Earth;*
- *absolute magnitude is a measure of how bright a star would appear from a distance of 10 pc;*

(b) The table gives information on three stars, Achernar, EG 129 and Mira.

	Absolute magnitude	Apparent magnitude	Spectral class
Achernar	−3.0	+0.50	B
EG 129	+13.0	+14.0	B
Mira	−3.0	+5.0	M

(i) State which **one** of the three stars appears brightest from Earth.

[1]

- *Achernar;*

(ii) Estimate the ratio  $\frac{L_A}{L_E}$  where  $L_A$  is the luminosity of Achernar and  $L_E$  is the luminosity of EG 129.

[3]

- *stars differ by  $\Delta M = 16$ ;*
- *for  $\Delta M = 1$  we have a ratio of luminosities by a factor = 2.51*
- *so  $\frac{L_A}{L_E} = (2.51)^{16} = 2.5 \times 10^6$*

(iii) Show that the distance of the star Achernar from Earth is approximately 50 pc.

[2]

$$\bullet \ m - M = 5 \log \left( \frac{d}{10} \right) \implies d = 10 \times 10^{\frac{m-M}{5}} = 10 \times 10^{\frac{1.5}{5}} = 50 \text{ pc}$$

(c) The surface temperature of Mira is 5 times lower than that of Achernar. Estimate the ratio  $\frac{R_M}{R_A}$  where  $R_M$  is the radius of Mira and  $R_A$  is the radius of Achernar.

[3]

$$\bullet \ \frac{L_M}{L_A} = \frac{\sigma 4\pi R_M^2 T^4}{\sigma 4\pi R_A^2 (5T)^4} = 1 \implies \frac{R_M}{R_A} = 25$$

(d) State and explain which of the stars in the table in (b) is a white dwarf.

[3]

- *it has to be hot star/ a B star*
- *with low luminosity/ high absolute magnitude*
- *hence EG129*

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