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, Achemar, EG 129 and Mira.

	Absolute magnitude	Apparent magnitude	Spectral class
Achemar	-3.0	+0.50	В
EG 129	+13.0	+14.0	В
Mira	-3.0	+5.0	м

State which one of the three stars appears brightest from Earth.

111

[3]

131

- Achemor,
- (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.
 - stars differ by ΔM = 16;
 - for $\Delta M = 1$ we have a ratio of luminosities by a factor ≈ 2.51
 - so $\frac{L_A}{L_{ex}} = (2.51)^{16} \approx 2.5 \times 10^6$
- (iii) Show that the distance of the star Achernar from Earth is approximately 50 pc. [2]
 - m M = $5 \log \left(\frac{d}{10}\right) \implies d = 10 \times 10^{\frac{m-M}{5}} \approx 10 \times 10^{\frac{3.5}{5}} \approx 50 \, pc$
- (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]

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

- (d) State and explain which of the stars in the table in (b) is a white dwarf.
 - · it has to be hot star/ a B star
 - · with low luminosity/ high absolute magnitude
 - hence EG129

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