

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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Minjie Lin



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Table of Contents M09 1 A1eng Sp1 Eng Tz1 Xx

1. Understanding the eBook M09 1 A1eng Sp1 Eng Tz1 Xx
 - The Rise of Digital Reading M09 1 A1eng Sp1 Eng Tz1 Xx
 - Advantages of eBooks Over Traditional Books
2. Identifying M09 1 A1eng Sp1 Eng Tz1 Xx
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an M09 1 A1eng Sp1 Eng Tz1 Xx
 - User-Friendly Interface
4. Exploring eBook Recommendations from M09 1 A1eng Sp1 Eng Tz1 Xx
 - Personalized Recommendations
 - M09 1 A1eng Sp1 Eng Tz1 Xx User Reviews and Ratings
 - M09 1 A1eng Sp1 Eng Tz1 Xx and Bestseller Lists
5. Accessing M09 1 A1eng Sp1 Eng Tz1 Xx Free and Paid eBooks
 - M09 1 A1eng Sp1 Eng Tz1 Xx Public Domain eBooks
 - M09 1 A1eng Sp1 Eng Tz1 Xx eBook Subscription Services

- M09 1 A1eng Sp1 Eng Tz1 Xx Budget-Friendly Options
- 6. Navigating M09 1 A1eng Sp1 Eng Tz1 Xx eBook Formats
 - ePub, PDF, MOBI, and More
 - M09 1 A1eng Sp1 Eng Tz1 Xx Compatibility with Devices
 - M09 1 A1eng Sp1 Eng Tz1 Xx Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of M09 1 A1eng Sp1 Eng Tz1 Xx
 - Highlighting and Note-Taking M09 1 A1eng Sp1 Eng Tz1 Xx
 - Interactive Elements M09 1 A1eng Sp1 Eng Tz1 Xx
- 8. Staying Engaged with M09 1 A1eng Sp1 Eng Tz1 Xx
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers M09 1 A1eng Sp1 Eng Tz1 Xx
- 9. Balancing eBooks and Physical Books M09 1 A1eng Sp1 Eng Tz1 Xx
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection M09 1 A1eng Sp1 Eng Tz1 Xx
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine M09 1 A1eng Sp1 Eng Tz1 Xx
 - Setting Reading Goals M09 1 A1eng Sp1 Eng Tz1 Xx
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of M09 1 A1eng Sp1 Eng Tz1 Xx
 - Fact-Checking eBook Content of M09 1 A1eng Sp1 Eng Tz1 Xx
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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