InkPhysics

QUESTION WORKBOOK

Star brightness and magnitude

Astrophysics · Year 13

AQA 3.9.2.1, 3.9.2.2 · CIE 25.1.1, 25.1.2, 25.1.3, 25.1.4 · OCR A 5.5.3(a), 5.5.3(b), 5.5.3(c)

20 questions · 56 marks

NAVY SCREEN EDITION

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SECTION A · Warm-up

A1 State which way the apparent magnitude scale runs, and the apparent magnitude of the dimmest stars visible to the naked eye. [2]

A2 Define the parsec, and state its relationship to the light year. [2]

A3 State the brightness ratio corresponding to one step of apparent magnitude, and to five steps, and explain why the scale is built from ratios rather than equal differences. [3]

A4 Define the astronomical unit and the light year. [2]

A5 A star lies exactly 10 pc from Earth. State the relationship between its apparent and absolute magnitudes. [1]

A6 State what is meant by the distance modulus of a star, and what it is used to find. [2]

SECTION B · Standard

B1 Star P has apparent magnitude 2.0 and star Q has apparent magnitude 7.0. Calculate how many times brighter P appears than Q. [2]

B2 Sirius has apparent magnitude -1.5 and lies 2.64 pc from Earth. Calculate its absolute magnitude. [3]

B3 A star has absolute magnitude +0.6 and lies 25 pc away. Calculate its apparent magnitude. [3]

B4 A star's apparent magnitude is 8.5 and its absolute magnitude is 1.0. Calculate its distance in parsecs. [4]

B5 Two stars have the same absolute magnitude. One lies 5.0 pc away, the other 50 pc. Calculate the difference in their apparent magnitudes and the ratio of their apparent brightnesses. [3]

B6 A star radiates a total power (luminosity) of 3.2×10^{28} W. Calculate the radiant flux received by a detector 4.1×10^{17} m away. Assume no light is absorbed on the way. [3]

B7 A pulsating star used as a standard candle has a known luminosity of 7.8×10^{29} W. The radiant flux received from it is 6.2×10^{-13} W m^{-2}. Determine its distance in metres, and in parsecs (1 pc = 3.08×10^{16} m). [4]

B8 Star V appears 16 times brighter than star W. Calculate the difference between their apparent magnitudes. [2]

SECTION C · Stretch

C1 A star lies 42 light years away and has apparent magnitude 5.0. Calculate its distance in parsecs and its absolute magnitude. [4]

C2 The Sun's apparent magnitude is -26.7 and Sirius's is -1.5. Estimate how many times brighter the Sun appears than Sirius. [3]

C3 Explain why apparent magnitude alone cannot tell you how luminous a star really is, and what absolute magnitude does about the problem. [2]

C4 A red dwarf has absolute magnitude +7.5 and lies 3.5 pc from Earth. The naked-eye limit is apparent magnitude +6. Deduce whether the star is visible to the naked eye. [4]

C5 Star T has absolute magnitude −2.0 and lies 250 pc away. Star U has absolute magnitude +1.0 and lies 15 pc away. Deduce which star appears brighter in the night sky. [4]

C6 The mean Earth–Sun distance is 1.50×10^{11} m, and one arcsecond is 1/3600 of a degree. Show that one parsec is about 3.1×10^{16} m. [3]