國立中央大學 105 學年度碩士班考試入學試題

所別： 天文研究所 碩士班 不分組(一般生)
天文研究所 碩士班 不分組(在職生)

科目： 天文學

本科考試禁用計算器

＊請在答案卷(卡)內作答

1 Magnitude system

The star A has the apparent magnitude of 8, and the star B has the apparent magnitude of 23. How many times brighter (or fainter) the star A is than the star B? (5 points)

2 Escape velocity of the Sun

Show that the escape velocity from the Sun v_{esc} is expressed as

$$v_{esc} = \sqrt{\frac{2GM_\odot}{R_\odot}},$$

where $M_\odot$ is the mass of the Sun, $R_\odot$ is the radius of the Sun, and G is the gravitational constant. (10 points)

3 Absolute magnitude

The absolute magnitude of a star is the magnitude the star would have if it were at the distance of 10 parsec from the observer. Derive the relation between the apparent magnitude and absolute magnitude of a star

$$m - M = 5 \log d - 5,$$

where m is the apparent magnitude of a star, M is the absolute magnitude of a star, and d is the distance in parsec to the star. (15 points)

4 Surface temperature of a star

Describe a method to measure the surface temperature of a star. (20 points)

5 Size of a white dwarf

Suppose there is a white dwarf which has the luminosity of 0.008 $L_\odot$ and the surface temperature of 17400 K. Give a rough estimate of the radius of this white dwarf in km. Note that the mass, radius and surface temperature of the Sun are 1.99×10^{30} kg, 6.96×10^8 m, and 5800 K, respectively. (25 points)

6 Structure of a star

Consider a small cylindrical element at the distance r from the center of a star. Assume a balance of forces acting on this cylindrical element, and derive the hydrostatic equilibrium equation

$$\frac{dP(r)}{dr} = -\frac{Gm(r)\rho(r)}{r^2},$$

where $P(r)$ is the pressure at the distance r from the center of the star, $m(r)$ is the mass inside the radius r, $\rho(r)$ is the density at the distance r from the center of the star. (25 points)