

# 普通天文學 二〇一五年春 期中考

2015.04.23 Thursday 10:10~11:50

## Useful constants and quantities

Solar mass:  $2 \times 10^{30}$  kg; AU:  $1.5 \times 10^{11}$  m; Gravitational constant G:  $6.7 \times 10^{-11}$  N m<sup>2</sup>/kg<sup>2</sup>;  
parsec:  $3 \times 10^{16}$  m; Planck constant h:  $6.6 \times 10^{-34}$  J s; speed of light c:  $3 \times 10^8$  m/s

### 一、解釋下列名詞 (3% each)

- (1) brown dwarf; (2) limb darkening; (3) eclipsing binary; (4) Maunder diagram;  
(5) instability strip; (6) horizontal branch; (7) proton-proton reaction;  
(8) interstellar reddening; (9) Population I star; (10) H II region

### 二、問答題：

1. Sirius, the brightest star in the night sky, has an apparent magnitude of  $-1.46$ , and an annual parallax of  $0.38$  arcseconds per year. [Hint:  $\log_{10}(0.38) = -0.42$ ] (a) What is its distance from us in unit of parsec? (b) What is the absolute magnitude of Sirius? (10%)
2. A star can be classified into one of the stellar spectral types of O, B, A, F, G, K, M, L, or T.  
(a) How does one tell which spectral type a particular star has? (b) What physical quantity does the spectral type sequence correspond to? (c) What is the spectral type of our Sun? (d) What is the luminosity class of the Sun? (20%)
3. (a) Draw a Hertzsprung-Russell diagram. Clearly label and explain the physical quantity associated with each axis. (b) Draw the main sequence and mark where the Sun is in the diagram. (c) The Sun is estimated to be 5 billion years old. How is this known? (d) From our knowledge of the stellar evolution, the young Sun should be fainter by 30% than the current luminosity. Explain the physical reason of this inference. (20%)
4. (a) What is the energy source of the Sun as a main-sequence star? State one piece of observational evidence to support your answer. (b) Stars like our Sun, after their main-sequence phase in evolution, will engage in an explosive event in their cores, called the "*helium flash*". Explain what a helium flash is, and why such an event occurs only in the core of a star with mass greater than about  $0.5 M_{\odot}$  and less than about  $2.25 M_{\odot}$ . (20%)