國立中央大學104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)　科目：天文學　共 1 頁 第 1 頁
天文研究所碩士班 不分組(在職生)

本科考試禁用計算器　　＊請在答案卷（卡）內作答

參考用

(1) (10 points)
At present,
(a) (2 points) what is the radius of the Sun in meters?
(b) (2 points) what is the mass of the Sun in kilograms?
(c) (2 points) what is the luminosity of the Sun in Watts?
(d) (2 points) what is the temperature of the photosphere of the Sun in Kelvin?
(e) (2 points) what is the main nuclear reaction at the core of the Sun?

(2) (20 points)
There are two types of orbital periods of a planet revolving around the Sun: sidereal period P and synodic period S. A sidereal period is the time the planet takes to make one orbit around the Sun with respect to distance stars, while a synodic period is the time it takes to return to the same configuration with the Sun and Earth (e.g., Earth, Sun and Planet lie on a straight line). The orbital sidereal period of Earth T around the Sun is one year.
(a) (10 points) Assuming circular orbits for the planets and the Earth, derive the formula expressing S in terms of P and T for inferior planets, and the one for superior planets. State clear your derivation. (Note that inferior/superior planets are planets whose orbits lie inside/outside the orbit of the Earth.)
(b) (4 points) Find the approximate synodic period (in years) of Venus if its sidereal period is 0.6 year, and an asteroid if its sidereal period is 5 years.
(c) (6 points) With the help of a diagram showing the orbits of Mars and Earth, explain the retrograde motion (westward motion) of Mars.

(3) (15 points)
Exoplanets or extra-solar planets are planets revolving around stars other than the Sun. Describe in detail three exoplanet detection methods.

(4) (25 points)
(a) (5 points) How can you measure the surface temperature of a star? State clear your reason(s) and assumption(s).
(b) (5 points) If the star is about 100 to 200 parsecs away, describe in detail the method you use to measure its distance from Earth.
(c) (5 points) What is the relation between (i) brightness, luminosity and distance? (ii) apparent magnitude, absolute magnitude and distance? and (iii) apparent magnitude, luminosity and distance?
(d) (5 points) Describe your method of estimating the size of the star provided you know its apparent magnitude, distance from Earth and surface temperature.
(e) (5 points) Can you estimate the mass of the star with the information above? If yes, describe the method of estimation. If not, suggest what kind of (extra) observation(s) do you need.

(5) (20 points)
Astronomers claim that Milky Way is a barred spiral galaxy, and our Solar system is 8 to 8.5 kpc from the Galactic center.
(a) (5 points) Draw a diagram indicating the characteristics of a barred spiral galaxy.
(b) (5 points) How do astronomers know Milky Way has the characteristics of a spiral galaxy? and how do they know our Solar system is not at the center of the galaxy?
(c) (10 points) Besides stars, Milky Way has interstellar gas. Describe in detail the different phases of the interstellar gas (e.g., physical characteristics, components, distribution, etc.).

(6) (10 points)
In March 2014, there was a big news about the detection of gravitational waves from the early universe by the BICEP2 (Background Imaging of Cosmic Extragalactic Polarization 2) experiment. Describe as much as you can on this detection. (For example, you can discuss the experiment itself, its result, the controversy it generated, etc.)