Astronomy 0113: Exam 2

11-Nov-1996

Please write clearly. Marks will be deducted for untidy work. Questions may be done in any order but they **must be labelled clearly**. Leave a few lines between each question. The marks for each question are indicated.

In Section A, only the answer need be given unless explicitly stated otherwise. If a justification is needed, it need only be a few lines long.

Questions in Section B require a longer answer, and are worth more. A simple answer for these questions will **NOT** suffice — **you must indicate your reasoning**. All working must be shown, symbols should be defined, and units must be provided for the final answer. Partial marks will be awarded for incomplete or incorrect answers. If you feel that your answer is incorrect because you may have made some mistake, indicate why you think this.

The EXAM is worth a total of 100 marks.

Section A [40 marks]

1. A H II region shows what type of spectrum? (1 or 2 words)

   (2 marks)

2. In astronomical jargon, which of the following elements (H, Fe, Ni, O, He, C, N) are "metals" ?

   (2 marks)

3. A star has an ABSOLUTE magnitude of 5, and lies at a distance of 10 kpc. If the star were moved to 1 kpc, what would be its absolute magnitude?

   (2 marks)

4. A star is observed to have a parallax of 0.050 arcseconds. What is its distance?

   (2 marks)

5. Star A is at a distance of 3 kpc. An astronomer observing this object detects 100 photons per second. If the star were moved to 1 kpc from Earth, how many photons per second would the astronomer detect with exactly the same telescope and instrumentation? Ignore the effects of interstellar extinction. (2 marks)

6. A White Dwarf obtains its energy from what source?

   (2 marks)

7. Which is the most abundant element in our galaxy (and the Universe), and what fraction (by mass) does it constitute?

   (1+2 marks)

8. Star A has an apparent magnitude of 3, and star B has an apparent magnitude of 0. Which star is brighter, and by what factor?

   (1+2 marks)

9. The Sun's lifetime on the main sequence is approximately 10^{10} yrs. If a 10 solar mass star has a luminosity 1000 times that of the Sun, what is the approximate time it will spend on the main sequence?

(3 marks)

10. Two stars are known to be IDENTICAL, and are at the same distance. One star, however, appears fainter when observed from the Earth. In a few lines, explain this apparent inconsistency.

(3 marks)

11. An astronomer wishes to study that region of the Sun which is interior to the photosphere and extends down to the core. Which observational technique can he/she use? Provide a terrestrial analogue.

(2 + 2 marks)

12. Draw a light curve for an object which varies sinusoidally by a factor of 2 with a period of 4 days. The axes must be clearly labelled, and at least 2 periods of variation must be shown.

(4 marks)

13. List 3 differences between the terrestrial and the Jovian planets. Clearly identify which planets belong to which class. (4 marks)

14. An invisible object in a NEWLY formed binary system is inferred to have a mass of 0.01 times the mass of the Sun. Can this object be a "normal" star? If not, why not? What do we call such objects?

(1+2+1 marks)

Section B [60 marks]

15. A 1.5 solar mass neutron star has a radius of approximately 10 km. Give a lower limit to the pressure at the center of the neutron star.

(6 marks)

16. A main sequence star has a surface temperature of 8000 K and an apparent visual magnitude of 10. Using the supplied H-R diagram, estimate the star's distance. What is the name of this method of distance determination? If the star suffered 5 magnitudes of visual extinction, how would your answer change?

(10 marks)

17. Draw the spectrum of a star which has a continuous spectrum in which 1 absorption line and 1 emission line are present. The emission line occurs at a longer wavelength than the absorption line. The diagram should use at LEAST 1/2 a page, and the axes must be clearly labelled. On the same diagram draw the same spectrum but for a star which is suffering a large amount of interstellar extinction. Explain (in 1 to 2 sentences) why this latter spectrum differs from that obtained if the star were receding from us at high velocity.

(10 marks)

18. Contrast the evolution of a low mass star with the evolution of a high mass star.

(17 marks)

19. Draw a LARGE diagram showing the structure of the Sun, labelling all important regions. Provide a concise discussion on each region. The discussion might include such things as temperature, size, energy transport mechanism, energy production, density etc.

(17 marks)