Astronomy 0113: Exam 2

13-Nov-1995

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 Sections B and C 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, 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 [**34 marks**]

1. Star A has an apparent magnitude of 2, and star B has an apparent magnitude of 7. Which star is brighter, and by what factor?

   (2 marks)

2. The photosphere is?

   (2 marks)

3. A sunspot appears darker than the surrounding photosphere because?

   (2 marks)

4. Around an O star is the H likely to be ionized or neutral? What is the name for this region?

   (2 marks)

5. From what source does a protostar obtain its energy?

   (2 marks)

6. You are given a spectrum of a distant star, and deduce, by comparison with other stars, that is has a spectral type of B2I. What does the I indicate?

   (2 marks)

7. An object has an apparent magnitude of 10 and is at a distance of 10pc. What is its absolute magnitude.

   (2 marks)

8. What is a brown dwarf?

   (2 marks)

9. A star is observed to have a parallax of 10 milli-arcseconds. What is its distance?

(2 marks)

10. What is the positron? What is its mass and charge (in terms of that of the proton, electron, or neutron)?

(2 marks)

11. A nebulosity is seen to have a spectrum similar to that of a nearby star, but it is bluer. The object is a ?. The spectrum is bluer because?

(3 marks)

12. What is the importance of the following equation.

$$\frac{dP}{dr} = -\frac{GM\rho}{r^2}$$

(3 marks)

13. How does the absorption of a photon by dust differ from the scattering of a photon by dust?

(4 marks)

14. Write down the spectral sequence for main sequence stars. Indicate the direction of increasing Temperature, increasing mass, and increasing lifetime.

(4 marks)

Section B [18 marks]

15. Star A suffers no interstellar extinction, has an apparent visual magnitude of 10 and an absolute visual magnitude of -5. What is the distance of Star B which has the same spectral type as star A but suffers 2 magnitudes of visual extinction and has an apparent visual magnitude of 17?

(6 marks)

16. Suppose a star is located at a distance of 3kpc. If the star were moved to a distance of 6kpc, how much more/less energy would an observer on Earth receive? What would be the difference in magnitude between the 2 stars? If the star has an ABSOLUTE magnitude of 6 at 3kpc, what is its ABSOLUTE magnitude at 6kpc?

(6 marks)

17. Indicate why an optical telescope, even if located in space, cannot be used to observe X-rays. How does an X-ray telescope differ from an optical telescope? Illustrate with a diagram.

(6 marks)

Section C [**48 marks**]

Answer only 4 of the following 5 questions.

18. An astronomer wishes to photograph the Orion nebulae. The nebula is located 460 pc from Earth and has a linear diameter of 30 pc.

    What is the angular size of the Orion Nebula?

    If the telescope has a focal ratio ($f_{\#}$) of 5 and diameter of 4 m what would be the linear size of the Orion nebular on a photographic plate at the prime focus?

    Suppose that using such a telescope the astronomer finds that an optimally exposed plate is taken in 60 minutes. How long would the optimal exposure be on a 3 m telescope with a focal ratio of 3?

    (12 marks)

19. A visual binary star has a period of 20 years. What is the sum of the masses of the two stars? Assume the semi-major axis of one star about the other is 2 arcseconds, and the system has a parallax of 0.1 arcseconds.

    Assuming both members of the binary system are visible, how could the individual masses be determined (hint: center of mass)? Draw a diagram.

    (12 marks)

20. In the Sun, energy transport occurs by both convection and radiation? Describe and discuss these 2 methods of energy transport. You should give examples that we are all familiar with. In which part(s) of the Sun is each mechanism dominant? Are there any observations which tell us about these processes in the Sun?

    (12 marks)

21. Define and discuss **ANY TWO** of the following terms, using a diagram where necessary: helioseismology, solar activity cycle, proton-proton chain, solar neutrino experiment.

    (6+6 marks)

22. Define and discuss **ANY TWO** of the following terms, using a diagram where necessary: H-R diagram, spectroscopic binary or eclipsing binary, Schmidt telescope

    (6+6 marks)