Astronomy 0113: Exam 2

7-Nov-1996

In Section A, only the answer need be given unless explicitly stated otherwise. If a justification or definition 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, 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.

Questions may be answered in ANY order provided they are clearly numbered. Leave a few lines between each question in Section A. **Start a new page for each question from Section B.**

The EXAM is worth a total of 100 marks.

Section A [**49 marks**]

1. A star has a distance of 100 pc. What parallax (in arcseconds) would an astronomer measure for the star?

   (2 marks)

2. Star A is at a distance of 5 kpc. An astronomer observing this object detects 1000 photons per second. If the star were moved to 10 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)

3. List 2 valid reasons why astronomers want to put telescopes into space.

   (2 marks)

4. What does "seeing" refer to?

   (2 marks)

5. What is convection?

   (2 marks)

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

   (2 marks)

7. What is a sunspot? (2 (or 3) key points)

   (3 marks)

8. Star A has an apparent magnitude of -2, and star B has an apparent magnitude of 0. Which star is brighter, and by what factor?

   (1+2 marks)

9. What is chromatic aberration, and which type of telescope suffers from it?
(2+1 marks)

10. Two stars have the same temperature but star A is a factor of 100 more luminous than star B. What other facts can be determined from this information?
(1+2 marks)

11. List 3 important physical processes which can influence star formation.
(3 marks)

12. What is the principle difference between normal gas pressure, and pressure due to electron degeneracy?
(3 marks)

13. The Sun's lifetime on the Main Sequence is approximately 10^{10} yrs. If a 0.5 solar mass star has a luminosity 0.1 times that of the Sun, what is the approximate time it will spend on the Main Sequence? Show your logic.
(4 marks)

14. What is helioseismology? Provide a terrestrial analogue.
(3 + 1 marks)

15. An astronomer observes three clusters of Stars. In cluster A only M through G stars are present. In cluster B, M through A stars are seen. Cluster C is seen to contain M through O stars. Which cluster is youngest? Which cluster is oldest? Explain your reasoning.
(1+1+3 marks)

16. An astronomer measures the apparent magnitude of a star, and then obtains a poor quality spectrum of the star. He decides that the star is of type G2V, and deduces its distance to be 1 kpc. What is the name of the method used to deduce the distance?

    Suppose the astronomer obtains a new high quality spectrum which shows that the star is actually of type G2III. Is the distance of the star still 1 kpc? If not is it larger or smaller? Explain your reasoning.
(2+1+3)

Section B [51 marks]

Answer any 3 of the following 4 questions.

17. An astronomer wishes to photograph a large HII region. The HII region is located 1 kpc from Earth and has a linear diameter of 10 pc.

    What is a HII region, and around what type of star is it likely to be found?

    What is the angular size of the HII region?

    If the telescope has a focal length of 10m and diameter of 2 m what would be the linear size of the HII region 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 1 m telescope with a focal ratio of 3?

    NB: If you cannot do a part of this question you may assume an answer (with the correct units) for it. Subsequent answers will be corrected on the basis of the values you used. (17 marks)

18. Compute the main sequence lifetime of the Sun, using the following steps:

    (a) How much energy is liberated when 4 hydrogen atoms are converted into 1 He atom.

    (b) How many hydrogen atoms are there in 1 kg of hydrogen?

    (c) How much energy is liberated per kg of H?

    (d) How many kg's of H are converted to He per second in the Sun?

    (e) Assuming that only 30% of the Sun's mass is available for nuclear burning estimate the Sun's lifetime. For the purposes of this calculation you should assume that the Sun's luminosity does not change over time, the effect of neutrinos can be ignored, and you can assume the Sun is made entirely of H. Is your answer reasonable?

    NB: If you cannot do a part of this question you may assume an answer (with the correct units) for it. Subsequent answers will be corrected on the basis of the values you used. (17 marks)

19. Discuss the evolution of the Sun. I need 12 **substantial** points for full credit to be given. A diagram can be used to assist your discussion. (17 marks)

20. Discuss and compare the three main types of telescopes: Reflecting, Refracting, and Schmidt. You should highlight the differences, and indicate what type of observations they are best suited for. You could also discuss which aberrations, if any, the telescope suffers from and how it is overcome.

    (17 marks)