Astronomy 0113: Exam 1

9-Oct-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 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.

The EXAM is worth a total of 100 marks.

Section A

1. Suppose your mass on Earth is 150 kg. What would be your mass on the surface of the Sun?

   (2 marks)

2. The ecliptic is?

   (2 marks)

3. What is the Right Ascension of the **Autumnal** Equinox?

   (2 marks)

4. At what moon phase or phases does a Lunar eclipse occur?

   (2 marks)

5. Which of the following objects with masses [1 kg, 100 kg, 200 kg] requires the highest velocity to escape from the surface of the Moon?

   (2 marks)

6. Which celestial object moves approximately 1° East each day with respect to the background stars?

   (2 marks)

7. Inside the tropics the Sun passes through the zenith on how many days each year?

   (2 marks)

8. The Sun exerts an attractive force of 1000N on an object. What is the size (magnitude and direction) of the force exerted on the Sun by the object?

   (2 marks)

9. Order the following according to increasing energy:

   Infrared, Gamma rays, Visible, X-rays, Radio, Ultraviolet

   Is the frequency increasing or decreasing along the sequence? Is the wavelength increasing or decreasing along the sequence?

   (3 marks)

10. What is the fundamental reason that every element, molecule and ion shows a unique spectral signature?

    (3 marks)

11. A laser beam is incident on a smooth surface at an angle of 30° to the surface normal. At what angle is the beam reflected? Draw a simple diagram.

    (3 marks)

12. Suppose the solar (tropical) year was exactly 365.2 days. How often should we have a leap year? Explain your reasoning.

    (3 marks)

13. What 2 effects give rise to the seasons? Indicate 1 effect involving the Sun and Earth which is **not** important.

    (3 marks)

14. Which type of telescope suffers from chromatic aberration? What is chromatic aberration?

    (4 marks)

Section B

15. The density of water in c.g.s. units is $1\,\mathrm{gm\,cm^{-3}}$. What is the density of water in S.I. units (i.e. kg, m)?

    (5 marks)

16. Derive the maximum and minimum angular diameter of Mars as viewed from the Earth. The average distance of Mars from the Sun is 1.5 A.U. and the linear diameter of Mars is approximately 0.5 times that of Earth. Assume that the orbits of both Mars and Earth about the Sun are circular, and in the same plane.

    (10 marks)

17. Two children are arguing about the period of the moon. One child says the period is 29.5 days while the other says it is 27.3 days. Comment, defining any relevant terms. (10 marks)

18. Define **ANY TWO** of the following terms, using a diagram where necessary: Synodic period, Retrograde motion, Superior conjunction, Precession.

    (10 marks)

19. Compare the luminosity of Star A (Radius=$3R_{\odot}$, Mass=$1.5M_{\odot}$, $T_{\rm sur} = 4000\,\mathrm{K}$)) with the luminosity of Star B (Radius=$1R_{\odot}$, Mass=$3.0M_{\odot}$, $T_{\rm sur} = 8000\,\mathrm{K}$),

(10 marks)

20. A planet orbits a Star of mass $4\,M_{\odot}$. At closest approach to the star (perihelion) the planet is at 3 A.U., while at its furtherest distance (aphelion) it is at a distance of 5 A.U. What is the shape of its orbit? What is the orbital period of the planet expressed in Earth years?

(10 marks)

21. An electron undergoes a transition from the n=4 to the n=2 level in the hydrogen atom. Is a photon absorbed or emitted? Calculate the energy of the photon, its frequency (in Hz), and its wavelength (in nm). In what part of the spectrum does this wavelength occur?

(10 marks)