Astronomy 0113: Exam 1

7-Oct-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, 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 90 marks.

Section A

1. Which celestial object moves approximately 13° East each day with respect to the background stars?

   (2 marks)

2. Suppose your weight on Earth is 50 kg. What would be your weight on a planet with twice the surface gravity of Earth?

   (2 marks)

3. A gas cloud has a linear diameter of 1AU, and is located at 1pc from the Earth. What is its angular diameter?

   (2 marks)

4. Three objects with the following masses [10 kg, 70 kg, 90 kg] are put into orbit about the Earth at the same altitude. Which object requires the highest orbital velocity?

   (2 marks)

5. The moon is observed to set about 1 hour after sunset. What moon phase is it?

   (2 marks)

6. Which of the following photons has the lowest energy? Infrared, radio, x-ray, visible, ultraviolet.

   (2 marks)

7. It is the winter solstice. At what latitude (or latitudes) will the Sun be at the zenith at noon?

   (2 marks)

8. In 1 or 2 sentences, explain why glass can split a beam of light into its component colors.

(3 marks)

9. A planet is located very close to the full moon. The planet is either Venus or Jupiter. Which planet is it, and why?

(1+2 marks)

10. Explain clearly what is WRONG with the following statement? "The teacher pointed out the planet Jupiter. It was located about 15 degrees from the North celestial pole."

(3 marks)

11. What does Sidereal refer to? Give an example.

(2+2 marks)

12. An emission line in a celestial object, A, is found to lie 1 nm to the red (i.e, to longer wavelengths) of its laboratory wavelength. In another celestial object B, the line is found to lie 2 nm to the red. Are the objects moving to or away from us? Which object is moving faster, and what is the ratio of their velocities?

(1+1+2 marks)

13. A laser beam, in air, is incident on a smooth transparent piece of glass which has a uniform thickness of 1 inch. Show the refracted beams of light, being careful to correctly illustrate their direction of travel. Explain why you have drawn the beam in the manner you have. (2+3 marks)

Section B

14. In SI units, the gravitational constant has the numerical value $6.626 \times 10^{-11}\ \mathrm{N\,m^2\,kg^{-2}}$. What is its value in cgs units? Recall that $1\,\mathrm{N} = 1\ \mathrm{kg\,m\,s^{-2}}$. You must show your working! (6 marks)

15. A comet orbiting the Sun in a circular orbit has a period of 300 years. What is its average distance from the Sun?

(6 marks)

16. Compute the escape velocity, in km/s, of a 100 kg object from the surface of the Sun. What is the escape velocity of an object with a mass of 200 kg?

(5+2 marks)

17. Star A has the following parameters: Radius=$3R_\odot$, Mass=$1.5M_\odot$, $\mathrm{T_{sur}} = 16,000\,\mathrm{K}$. Star B has a radius of $12R_\odot$ and a Mass of $3M_\odot$. What surface temperature does Star B have to have so that its luminosity is the same as that of Star A?

(10 marks)

18. An electron undergoes a transition from the n=1 to the n=3 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)

19. 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.

(15 marks)