29:50 Stars, Galaxies, and the Universe
First Hour Exam
October 6, 2010
Form A

There are 32 questions. Read through each question and all the answers before choosing. Budget your time. No whining.

Walk with Ursus!

1. We can classify stars according to their spectral class and their location on the Hertzsprung Russell diagram. To which class does the Sun belong?
   (a) K0III
   (b) O3V
   (c) M5I
   (d) G2V ∗
   (e) G6III

2. Stars can also be classified according to concentrations or regions on the Hertzsprung Russell diagram. On this basis, the Sun is a
   (a) Main Sequence star∗
   (b) white dwarf star
   (c) Giant star
   (d) Supergiant star
   (e) Cepheid variable

3. It is the day of the vernal equinox. What is the azimuth angle of the Sun when it rises?
   (a) 0°
   (b) 90° ∗
   (c) 135°
   (d) 180°
   (e) 270°

4. Physically, what is the nature of light?
   (a) high energy, charged particles emitted by atomic nuclei
   (b) ripples in the geometry of spacetime
   (c) concentrated clumps of electric charge
   (d) strings in higher dimensional space-time
   (e) a wave of electric and magnetic fields ∗

5. The most basic way to determine the temperature of a star is
   (a) measuring its apparent magnitude
   (b) measuring the wavelength at which it is brightest ∗
   (c) measuring the absolute magnitude
   (d) measuring its distance from Earth
   (e) observing which elements are present via absorption lines

6. Let's say you are given a number which is the difference between the apparent magnitude and the absolute magnitude of a star. What does that do for you?
   (a) It tells you the distance to the star. ∗
   (b) It tells you the surface temperature the star.
   (c) It tells you the age of the star.
   (d) It tells you the chemical composition of the star.
   (e) It tells you the wavelength at which the star is brightest.

7. The *ecliptic* is defined as
   (a) the path across the sky the Sun makes from rising to setting
   (b) the path of the Sun against the background stars during the year ∗
   (c) a great circle formed on the sky by the five brightest stars
   (d) the point straight overhead on the celestial sphere
   (e) the point on the celestial sphere to which the Earth's rotation axis points

8. The *zenith* is defined as
   (a) the path across the sky the Sun makes from rising to setting
   (b) the path of the Sun against the background stars
   (c) a great circle formed on the sky by the five brightest stars
   (d) the point straight overhead on the celestial sphere ∗
   (e) the point on the celestial sphere to which the Earth's rotation axis points

9. A unit which is convenient and commonly used to express distances in the solar system is the
   (a) parsec
   (b) astronomical unit ∗
   (c) kilometer
   (d) Angstrom
   (e) Fermi

10. A unit which is convenient and commonly used to express distances between the stars is the
    (a) parsec ∗
    (b) astronomical unit

(c) kilometer
(d) Angstrom
(e) Fermi

11. What element makes up most of the mass of the Sun?
(a) hydrogen ∗
(b) helium
(c) lithium
(d) carbon
(e) silicon

12. Imagine that a star produces energy by nuclear fusion of helium nuclei. Such stars do exist. What would the temperature of that star have to be, relative to the central temperature of the Sun?
(a) core temperature of absolute zero
(b) core temperature lower than that of the Sun
(c) core temperature the same as the Sun
(d) core temperature higher than that of the Sun ∗
(e) core temperature equal to that of the Earth's atmosphere at sea level.

13. It is the day of the summer solstice. What's the day of the year.
(a) December 22
(b) June 22 ∗
(c) March 22
(d) September 22
(e) October 16

14. There are two days of the year when the Sun is on the celestial equator. These two days are
(a) December 22 and June 22
(b) October 16 and May 16
(c) March 22 and December 22
(d) September 22 and June 22
(e) March 22 and September 22 ∗

15. Every month, we see a different group of stars (constellations, which are different in different cultures) halfway up the western sky as soon as it gets dark in the evening. What is the astronomical basis of this phenomenon?
(a) the revolution of the Earth around the Sun ∗
(b) the rotation of the Earth on its axis
(c) the rotation of the Sun on its axis

(d) the motion of the solar system through the Milky Way galaxy
(e) the oscillations of the distance between the Earth and the Sun

16. We are now at the beginning of October. The Sun sets earlier, and rises later than it did at the beginning of the semester. It is getting colder. These basic (and important) phenomena have an astronomical origin. The astronomical basis is
(a) the 1.7 % eccentricity of the Earths' orbit
(b) gravitational perturbations of the Moon on the Earth
(c) annual changes in the distance between the Earth and the Sun
(d) the 23.5 degree tilt of the Earth's rotation axis relative to the plane of the ecliptic *
(e) variations of the Sun's luminosity with a period of one year

17. What is the definition of the meridian?
(a) an imaginary line on the sky, defined by the declination = 0 degrees
(b) an imaginary point on the sky where the Sun ceases its motion against the background stars for a period of 6 weeks
(c) an imaginary line on the sky, running from due north, through the zenith, to due south *
(d) an imaginary point on the celestial sphere which we see as straight overhead
(e) an imaginary line of the sky, defined by the right ascension = 0 hours

18. Which of the following planets is most similar to the Earth in mass and diameter?
(a) Venus *
(b) Jupiter
(c) Saturn
(d) Uranus
(e) Mercury

19. One of the following planets below is much more massive than the Earth, larger in diameter, and much further from the Sun. Which one is it?
(a) Mars
(b) Venus
(c) Jupiter *
(d) Mercury
(e) the Moon

20. In class very recently, I discussed a major new discovery in astronomy that made the newspapers. What was this discovery?
(a) discovery of the most massive black hole known
(b) a planet similar to the Earth orbiting a nearby red dwarf star *
(c) evidence in the rotation curves of galaxies that Dark Energies exists

(d) strong observational evidence that the star Betelgeuse is ready to produce a supernova
(e) desiccated bodies of dead aliens from 3.75 billion years ago in the Hellas Basin of Mars

21. You look up and see a star shining in the night sky. How long ago was the light that you are now seeing radiated from the surface of the star? Stars are obviously at range of distances. Only one of the values below is right for many (but not all) stars. Pick it.
(a) 2 - 30 hours
(b) 10 - 100 years *
(c) 1 - 8 months
(d) 5 - 70 million years
(e) 4.5 to 50 billion years

22. Consider the 100 or so stars which are closest to the Sun, and presumably typical of those elsewhere in the galaxy. What type of star is it most likely to be?
(a) red dwarf *
(b) red giant
(c) white dwarf
(d) spectral class G main sequence star
(e) spectral class O main sequence star

23. What is the astronomical technical term used to express the total power output of a star?
(a) parallax
(b) apparent magnitude
(c) spectral class
(d) luminosity *
(e) bolometric correction

24. Below are listed data for a number of stars. Pick the star that would appear as a bright star to the naked eye. For the other stars, they might appear bright or faint to the naked eye. For one star, it is certain that it would be bright.
(a) star A: apparent magnitude = 5.2
(b) star B: apparent magnitude = 0.5 *
(c) star C: absolute magnitude = -2.0
(d) star D: absolute magnitude = 5.7
(e) star E: wavelength of peak brightness = 480 nanometers

25. During the night, the stars rise in the east and move from east to west. This phenomenon is due to
(a) the revolution of the Earth about the Sun.
(b) the motion of the Sun through the nearby stars of the Milky Way.
(c) a flow of stars through the inner solar system.

(d) the rotation of the Earth on its axis. ∗
(e) precession of the Earth's rotation axis.

26. You look up in the night sky and see the planet Jupiter, the planet Mars, and the Moon very close together. You know that they are located in or close to one of the following. Which is it?
(a) the ecliptic ∗
(b) the celestial equator
(c) the zenith
(d) the north celestial pole
(e) the constellation of Hercules

27. Let's assume that you go out in space to a distance of 10 parsecs. You look back at the Sun. How bright would it appear to you?
(a) About a factor of 5 fainter than it now appears
(b) About as bright as the light from the full moon
(c) About as bright as the stars Vega and Arcturus
(d) About as bright as the faintest stars we can see with the naked eye. ∗
(e) Far to faint to be seen without a large telescope.

28. Imagine looking at a globular star cluster like M13 in a large telescope, or at a picture of it taken with a large telescope. You can see many of the stars in M13. Without additional information or measurements, what properties of these stars could you determine?
(a) their absolute magnitudes
(b) not the absolute magnitudes, but differences in the absolute magnitudes ∗
(c) the spectral types of the stars
(d) the distances
(e) the ages of the stars

29. A solid, opaque object can be heated to different temperatures. What happens to the light emitted by this object as the temperature increases?
(a) The spectrum changes from a continuous spectrum to an emission line spectrum
(b) The object becomes bluer, and stays at the same brightness.
(c) The power radiated in infrared radiation increasingly dominates that emitted at ultraviolet wavelengths.
(d) The object gets brighter and the light shifts to shorter wavelengths. ∗
(e) The object gets brighter and the light shifts to longer wavelengths.

30. You measure or estimate the apparent magnitude of a star. What piece of information do you need to determine its absolute magnitude?
(a) distance ∗

(b) spectral type
(c) space velocity
(d) age
(e) constellation in which it is located

31. Which celestial object has been prominent in the early evening sky, straight overhead (at the *zenith*)?
(a) the planet Mars
(b) the planet Venus
(c) the star Antares
(d) the Andromeda galaxy
(e) the star Vega ∗

32. Your social life has become a disaster! Recently, all of your so-called friends avoid you like a leper! Despondent, you enter the Hillcrest dining room to eat by yourself when you notice a group of *Space Aliens* eating together at a table on the north wall, engaged in lively conversation. You join them. They say that from their home planet their star appears as a big, fuzzy red light rather than the sharp, unpleasantly bright disk of our Sun. Their home planet is at distance of 100 astronomical units from their star, but the surface of their planet is warm and comfortable, and there are lakes and oceans. As you hear them talk, you realize you know where they come from. They are from a planet around
(a) 18 Scorpii, the solar twin
(b) Epsilon Eridani, a main sequence star that is cooler than the Sun
(c) Vega, a main sequence star that is hotter than the Sun
(d) Antares, a red supergiant ∗
(e) UV Ceti, a red dwarf, or spectral class M main sequence star