Multiple Choice. In the blanks provided before each question write the letter for the phrase that best answers the question or completes the thought and fill in the corresponding area on the computer graded sheets with a number 2 lead pencil.

A 1. The number of waves passing the observer per second is:
   A. the frequency (in Hertz)  
   B. the period (in seconds)  
   C. the wavelength (in Angstroms)  
   D. the energy (in milliWatts)  
   E. the amplitude (in nanometers)

A 2. What is the resolving power of the telescope?
   A. The ability to distinguish adjacent objects in the sky  
   B. The ability to detect very faint objects  
   C. The ability to collect a lot of light  
   D. The ability to make distant objects appear closer  
   E. The ability to separate light into its component colors

D 3. What are two advantages of large telescopes over smaller ones?
   A. Large scopes are easier to mount and control than small ones.  
   B. Large telescopes give higher magnification and are easier to build.  
   C. Large scopes have a larger field of view and sharper focus.  
   D. Large telescope have better resolution and collect more light.  
   E. Large scopes are not subject to atmospheric turbulence and opacity like smaller ones.

B 4. It is dusk and the moon is just setting. What is the moons phase?
   A. Last quarter  
   B. New  
   C. First quarter  
   D. Waxing gibbous  
   E. Full

B 5. On the vernal equinox, you will experience:
   A. The shortest day of the year  
   B. Equal hours of day and night  
   C. The longest day of the year  
   D. Both A and B  
   E. Both B and C
6. The spectrum of the Sun appears as:
   A. A rainbow, but with some dark lines mixed in.
   B. An unbroken rainbow of colors.
   C. A rainbow with some bright lines on top of the continuum.
   D. A series of bright, colored lines.
   E. A very red shifted rainbow due to the expansion of the universe.

From the list below, find the best matches for the phrases that follow.
A. neutrinos  B. protons  C. photons  D. electrons  E. neutrons

7. The particles of the radiation field that can be absorbed or emitted when an atom shifts between two of its allowed orbits

8. The negatively charged particles

9. The neutral particles that insulate the charged particles in the nucleus from each other

10. The particles in the nucleus that give an element its identity

11. Radio dishes are large in order to:
   A. Give greater magnification.
   B. Detect shorter waves than optical telescopes for superior resolution.
   C. Attract funding from NASA and the NSF.
   D. Increase the range of waves they can collect.
   E. Increase their angular resolution and collect the very weak radio photons.

12. Which statement about the day is FALSE?
   A. Normal timekeeping is based on the solar day.
   B. The sidereal day is four minutes longer due to our revolution around the Sun.
   C. The solar day is based on consecutive noon transits of the Sun.
   D. The sidereal day is based on the Earth’s rotation alone.
   E. Relative to the stars, the Earth spins in 23 hours, 56 minutes.

13. A planet orbits a distant 1 solar mass star with a perihelion distance of 3 AU and an aphelion distance of 5 AU. The semi-major axis of the planet is:
   A. 2.5 AU  B. 5 AU
   C. 8 AU  D. 4 AU
   E. 3 AU

14. If a light source is approaching you, you will observe:
   A. That all of its spectral lines have become shorter in wavelength.
   B. That its light has become much bluer in color.
   C. An apparent red shift of its spectral lines.
   D. That the speed of its photons have increased.
   E. That the amplitude of its waves have increased.
15. Which of the following is not a form of electromagnetic radiation?
   A. Radio waves
   B. X-rays
   C. Electrons
   D. Sunlight
   E. Gamma-rays

16. Summer in the southern hemisphere occurs in December, January and February because:
   A. There are fewer solar eclipses then, resulting in more sunlight received.
   B. The Earth moves more slowly around the Sun then, allowing it to absorb more sunlight.
   C. The Sun’s light hits that hemisphere most directly then.
   D. The Earth experiences retrograde motion then.
   E. The Earth is closest to the Sun then.

From the list of scientists, find the best matches for the phrases that follow.
   A. Kirchoff
   B. Galileo
   C. Newton
   D. Einstein
   E. Bohr

17. Discovered the three laws dealing with the creation of various types of spectra.
18. First observed the moons around Jupiter.
19. Got the Nobel Prize for the photoelectric effect and the nature of electron orbitals.
20. Devised the first successful model of the hydrogen atom.
21. Determined the physical reason behind Kepler’s laws.

22. Using Newton’s version of Kepler’s 3rd law, what do we need to know to determine the mass of the Sun?
   A. The Earth’s mass and circumference.
   B. The exact timings of the transits of Venus and its diameter.
   C. Its density as found by spectroscopy.
   D. Its temperature as found by Wien’s Law.
   E. The size of the A.U. and exact length of the year.

23. A mountain top is an especially good site for infrared telescopes since:
   A. There you are closer to celestial objects.
   B. You are above most of the carbon dioxide and water vapor in the atmosphere.
   C. Less air above means better seeing in many cases.
   D. The cold weather helps the sensitivity of infrared detectors.
   E. All of the above are factors.

24. Which of the following describes parallax?
   A. It is a method for determining the distance to a nearby star.
   B. It was first observed by Galileo with his new telescope.
   C. It is only applicable to objects within the solar system.
   D. It is best measured over exactly one year intervals.
   E. All of the above.
25. The Ptolemaic model probably persisted for all these reasons EXCEPT:
   A. It used perfect circles, which appealed to geometry.
   B. It was consistent with the doctrines of the Catholic Church.
   C. It explain why stellar parallax was not observed by the Greeks.
   D. It had the authority of Aristotle behind it.
   E. It accounted well for Galileo’s observations of the phase cycle of Venus.

26. Modern scientific theories are NOT:
   A. Perfect.
   B. Simple.
   C. Testable.
   D. Elegant.
   E. Continuously tested.

27. A solar eclipse can only happen during a:
   A. Full moon.
   B. Perihelion passage of the Sun.
   C. New moon.
   D. Solstice.
   E. First quarter moon.

28. A photon with energy 5eV is emitted by the hypothetical atom in Figure 1. It must result from the de-excitation of an electron between:
   A. n=1 and n=3 states
   B. n=1 and n=4 states
   C. n=2 and n=4 states
   D. n=2 and n=3 states
   E. n=1 and n=2 states

29. The diameter of the Earth is about 6400 km. That is equivalent to:
   A. 6.4 x 10^6 m
   B. 6.4 x 10^{11} m
   C. 6.4 x 10^9 m
   D. 6.4 x 10^8 m
   E. 6.4 x 10^5 m
30. The Orion Nebula, M-42, is a hot, thin cloud of glowing gas, so its spectrum is:
   A. A continuum, strongest in the color red.
   B. A continuum, but with both bright and dark lines mixed in.
   C. A few dark line in the continuum.
   D. A few bright lines against a dark background.
   E. Not in the visible portion of the spectrum.

31. Why are most large telescopes reflectors, not refractors?
   A. Large lenses deform under their own weight, but mirrors can be supported.
   B. Large mirrors need only one optical surface, achromats four surfaces to grind.
   C. Large, very clear lenses are harder to cast than more tolerant mirror blanks.
   D. Reflectors do not suffer from chromatic aberration like refractors do.
   E. All of the above are correct.

From the list below, find the best matches for the phrases that follow.
A. Ecliptic  B. Eclipse  C. Eccentricity  D. Ellipse  E. Equinoxes

32. A “flattened” circle
33. When one body prevents sunlight from falling on another body
34. A number indicating the degree of flattening of an ellipse
35. The two times in the year when the sun appears to be overhead at noon at the equator
36. The path the sun appears to take across the sky

From the list of terms below, find the best matches for the phrases that follow.
A. Celestial Equator  B. Horizon  C. Declination  D. Zenith  E. Celestial North Pole

37. Extension of the Earth’s equator on to the sky
38. Analog of the Earth’s North Pole projected on to the sky
39. Point directly overhead
40. Angular unit of measure on the sky, equivalent to latitude on the Earth

True/False: In the blanks provided before each question write whether the following statements are True (T) or False (F). Fill in A for True and B for False on your score sheet.

41. As a blackbody gets hotter, it appears redder as its peak wavelength gets longer.
42. Measuring the parallax of a star tells you whether its moving towards or away from us.
43. Even the Hubble Space Telescope’s resolution is greatly enhanced by adaptive optics.
44. Kepler’s second law notes that a planet should move fastest at perihelion.
45. A light year is the time for light to cross the Earth’s orbit.
46. Due to our atmospheres ozone layer, ultraviolet astronomy must be done from space.
Photon A has a wavelength of 200nm and Photon B has a wavelength of 700nm. Indicate whether the following statements about these photons are True (T) or False (F).

F 47. Photon A is moving faster than Photon B.
T 48. Photon A is more energetic than Photon B.
T 49. Photon A has a greater frequency than Photon B.
F 50. Photon A is redder than Photon B.