1) How is it that astronomers are able to see parts of the Universe appearing as they were in the past?

2) Converting scientific notation:
   a. Write the following in scientific notation
      i. 4,642
      ii. 70,000
      iii. 34.7
   b. Write the following in scientific notation
      i. 0.254
      ii. 0.0046
      iii. 0.10243
   c. Write out the following in an ordinary string of digits (use commas please!):
      i. 2.543 x 10^6
      ii. 2.0043 x 10^2
      iii. 7.673 x 10^{-4}

3) Like lab: Suppose you wish to construct a scale model of the Solar System. The distance between the Earth and the Sun (astronomical unit, AU) is 1.5 x 10^8 km, and you represent it by 15 km, about the size of a reasonably big city.
   a. What is the scaled distance of the planet Pluto (39.5 AU)? *Hint: use ratios where possible*
   b. The Earth is about 12,800 km in diameter. How large is Earth on your scale? Compare its size with that of a common object.
   c. The Sun’s diameter is about 1.4x10^9 km. How large is it relative to Earth?
   d. The nearest star, Proxima Centauri, is 4.2 light-years away. How far is this in your scale model?
   e. Compare your answer in part (d) with the true distance to the Moon, 3.84 x 10^5 km. Comment on whether this gives you some idea of the enormous distances of even the nearest stars.

4) T/F: When we observe very distant stars and galaxies, we see them as they are at the present time since light travels at the maximum possible speed.

5) T/F: Astronomers gain information about celestial objects by studying many forms of radiation, not just visible light.

6) The distance travelled by light or by an object moving with a constant speed is equal to speed multiplied by __________.

7) If 14 billion years, the approximate age of the Universe, were compressed to 1 year, then on the same scale the Earth (age 4.6 billion years) formed in the month of __________.

8) A light-year is a unit of __________.
9) The process of breaking light down into its component colors creates a(n)
   a. spectrum
   b. image
   c. pulse
   d. hologram

10) Why is electromagnetic radiation so important to astronomers?

11) Describe how the same atoms can sometimes cause emission lines and at other times cause absorption lines.

12) Sketch a Hydrogen atom, showing the nucleus, electrons, and energy levels. Show (with arrows) how the first few Balmer lines arise.

13) How would you respond if someone were to say that we cannot know the composition of distant stars since there is no way to perform experiments on them in terrestrial labs?

14) An iron rod is heated by a welder’s torch. Initially it glows a dull red, then a brighter orange, and finally a very bright white. Discuss this sequence in terms of black-body radiation.

15) Does the Doppler effect depend on the distance between the source of light and the observer? Explain.

16) If one photon has 10 times the frequency of another photon, which photon is the more energy and by what factor? Similarly, answer for the case where the first photon has twice the wavelength of the second.

17) Suppose the peak of a particular star’s spectrum occurs at 6000 Å (1 Å = 10^{-10} m).
   a. Use Wien’s law to calculate the star’s surface temperature.
   b. If this star were a factor of four hotter, at what wavelength would its spectrum peak? In what part of the electromagnetic spectrum is this peak?

18) T/F: When we see other people, our eyes are detecting the visible light that each of us radiates as an approximate “black body” (thermal emitter).

19) T/F: If the surface temperature of Star Zeppo is 2 times that of Star Harpo, then the wavelength at which Star Zeppo’s spectrum peaks is 1/3 the wavelength at which Star Harpo’s spectrum peaks.

20) T/F: The type of spectral feature usually observed from a hot gas with no star behind it along the line of sight is an absorption line.

21) A local radio station broadcasts at 100.3 MHz. What is the approximate wavelength for the signal?
   a. 3000 Å
   b. 30 m
   c. 30 cm
   d. 3 m

22) By observing the ________ of a star or planet, we can determine what kinds of atoms or molecules are present and their relative abundance.

23) Electromagnetic radiation behaves as though it has properties of both ________ and ________.