Chapter 4 – 5
Practice Exam

Directions: Construct the electron configuration for each element given.

1. $^{16}_8$O

2. $^{63}_{29}$Cu

Directions: Solve the following half-life problems. Show all work. Circle your answer.

3. You discover a charcoal pit on Newfoundland and wonder if it is from the Vikings landing. So you take a 1 kg sample and find that there is 0.78 kg of Carbon-14 left in the sample. How old is the sample? Remember the half-life of Carbon-14 is 5730 years.

4. You find a 200 g sample of Potassium-46, $^{46}_{19}$K, which has a half-life of 105 seconds. How long will it take for the sample to decay to 36 g?

5. A scientist asks you to find out how much of radioactive substance will still be around after 6 hours. The sample started with 100 g and is Lead-196, $^{196}_{82}$Pb with a half-life of 37 minutes.
6. How much time elapses before 90\% of the radioactivity of a sample of $^{72}$As disappears? The half-life of $^{72}$As is 26 hours.

Directions: Solve the following problems. Show all work. Circle your answer.

7. Cicadas produce a sound that has a frequency of 123 Hz. What is the wavelength of this sound in air? The speed of sound in air is 343 m/s.

8. Old cordless phones use a 900 MHz frequency and can be operated up to 60 m from their base. What is the wavelength of this electromagnetic wave? How many wavelengths can fit between your ear and a base 60 m away?

9. A new antiterrorist technique detects the differences in electromagnetic waves emitted by humans and by weapons made of metal, plastic, or ceramic. One possible range of wavelengths used with this technique is from 2.0 mm to 5.0 mm. Calculate the associated range of frequencies.

10. The U.S. Army’s loudest loudspeaker is almost 17 m across and is transported on a special trailer. The sound is produced by an electromagnetic coil that can generate a minimum frequency of 10.0 Hz. What is the wavelength of these electromagnetic waves?
Directions: Solve each problem. Show your work. Circle your answer.

11. Free-electron lasers can be used to produce a beam of light with variable wavelength. Because the laser can produce light with wavelengths as long as infrared waves or as short as X-rays, its potential applications are much greater than for a laser that can produce light of only one wavelength. If such a laser produces photons of energies ranging from 1.034 eV to 620.6 eV, what is the minimum and the maximum wavelengths corresponding to these photons?

12. In 1974, IBM researchers announced that X-rays with a wavelength of only 0.154 nm had been guided through a “light pipe” similar to optic fibers used for visible and near-infrared light. Calculate the energy of one of these X-ray photons.

13. Wireless “cable” television uses radio waves having frequencies close to 28 GHz to transmit images. Find the energy of a photon at this frequency.

14. Of the various types of light emitted by objects in space, the radio signals emitted by cold hydrogen atoms in regions of space that are located between stars are among the most common and important. These signals occur when the “spin” angular momentum of an electron in a hydrogen atom changes orientation with respect to the “spin” angular momentum of the atom’s proton. The energy of this transition is equal to a fraction of an electron-volt, and the photon emitted has a very low frequency. Given that the wavelength of these radio signals is 21.0 cm, calculate the frequency and the energy (both in joules and in electron-volts) of the photons.
Directions: Solve each problem. Show your work. Circle your answer.

15. The intensity of light from a reading lamp is 300 millilumens at a distance of 0.5 m. The lamp is moved to a distance of 1.5 m. What is the intensity of the lamp?

16. The exposure from an x-ray tube operated at 80 kVp, 300 mAs is 300 mR at 30 cm. What is the exposure at 70 cm?

17. For a given technique, the x-ray intensity at 0.75 m is 375 mR. What is the intensity when the subject is 2.25 m away?

18. For a given technique, the x-ray intensity at 1 m is 450 mR. How far must the subject be to have an intensity of 20 mR?