NAME_____ DATE_____ HOUR_____

Light Problems

Directions: Solve the following problems. Show proper set-up, work, and units for full credit. Box in your final answer.

1. A bright spectrum contains a line with a wavelength of 5.18×10^{-7} m. Determine...

   a. the frequency

$$\lambda = 5.18 \times 10^{-7} \, m$$
$$C = 3.0 \times 10^{8} \, m/s$$
$$V = ?$$

$$\frac{C}{\lambda} = \frac{\lambda \times V}{\lambda} \qquad V = \frac{C}{\lambda} \qquad V = \frac{3.0 \times 10^{8} \, m/s}{5.18 \times 10^{-7} \, m} = \boxed{5.79 \times 10^{14} \, Hz}$$

   b. the energy

$$h = 6.63 \times 10^{-34} \, J \cdot s$$
$$E = h V \qquad E = (6.63 \times 10^{-34} \, J \cdot s)(5.79 \times 10^{14} \, \tfrac{1}{s}) = \boxed{3.84 \times 10^{-19} \, J}$$

2. A photon has an energy of 4.00×10^{-19} J. Find...

   a. the frequency of the radiation

$$E = 4.00 \times 10^{-19} \, J$$
$$V = ?$$
$$h = 6.63 \times 10^{-34} \, J \cdot s$$

$$\frac{E}{h} = \frac{h V}{h} \qquad V = \frac{E}{h}$$
$$V = \frac{4.00 \times 10^{-19} \, J}{6.63 \times 10^{-34} \, J \cdot s} = \boxed{6.03 \times 10^{14} \, Hz}$$

   b. the wavelength of the radiation

$$V = 6.03 \times 10^{14} \, Hz$$
$$C = 3.0 \times 10^{8} \, m/s$$
$$\lambda = ?$$

$$\frac{C}{V} = \frac{V \times \lambda}{V} \qquad \lambda = \frac{C}{V} \qquad \lambda = \frac{3.0 \times 10^{8} \, m/s}{6.03 \times 10^{14} \, \tfrac{1}{s}} = \boxed{4.97 \times 10^{-7} \, m}$$

   c. the region of the electromagnetic spectrum that this radiation represents

Directions: Choose the best answer to each question. Write the letter for that answer on the line provided.

3. __A__ The electromagnetic waves with the shortest wavelengths are _____.
   a. gamma rays   b. X rays   c. radio waves   d. light

4. __A__ The wavelengths of _____ are slightly longer than those of visible light.
   a. infrared radiation   b. X rays   c. ultraviolet radiation   d. gamma rays

5. __C__ Objects containing heat can emit _____.
   a. radio radiation   b. microwaves   c. infrared radiation   d. gamma rays

6. __C__ _____ are the most penetrating kind of electromagnetic radiation.
   a. Radio waves   b. Microwaves   c. Gamma rays   d. Ultraviolet rays   e. X rays

7. __B__ Which color of light in the visible spectrum has the longest wavelength?
   a. yellow   b. red   c. green   d. blue

8. __C__ A quantum of energy is the
   a. frequency of electromagnetic energy given off by an atom.
   b. wavelength of electromagnetic energy gained by an atom.
   c. minimum quantity of energy that can be lost or gained by an atom.
   d. continuous spectrum of energy given off by an atom.

9. __D__ A form of energy that exhibits wave behavior as it travels through space is
   a. microwave radiation.
   b. ultraviolet radiation.
   c. infrared radiation.
   d. All of the above

10. __B__ The process of an atom releasing energy when it moves to a lower energy state is called
   a. absorption.   b. emission.   c. translation.   d. regression.

11. __A__ In the Bohr model of the atom, in which orbit is an electron in its lowest energy state?
     a. in the orbit closest to the nucleus
     b. in the orbit farthest from the nucleus
     c. in the electron cloud
     d. midway between two orbits

Directions: Answer the following questions in the space provided.

12. How are frequency and energy related?

13. What happens when a hydrogen atom absorbs a quantum of energy?

14. Which of the waves shown below has the higher frequency? (The scale is the same for each drawing.) Explain your answer.

Wave A   Wave B
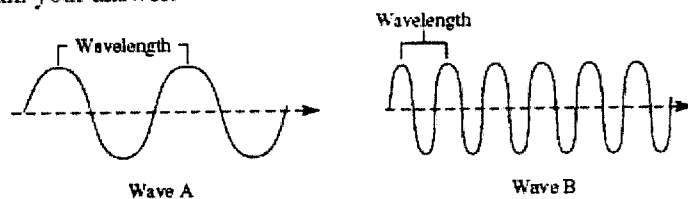
15. How many different photons of radiation were emitted from excited helium atoms to form the spectrum shown below? Explain your answer.

Spectrum for helium