1. Which type of electromagnetic radiation has the shortest wavelength?
   A) red light
   B) x rays
   C) microwaves
   D) gamma rays
   E) blue light

2. What is the wavelength of a photon having a frequency of 4.50×10^{14} Hz? ($c = 3.00 \times 10^8$ m/s)
   A) 667 nm
   B) 1.50×10^{-3} nm
   C) 4.42×10^{-31} nm
   D) 0.0895 nm
   E) 2.98×10^{-10} nm

3. What is the energy of a photon of electromagnetic radiation with a wavelength of 877.4 nm?
   ($c = 3.00 \times 10^8$ m/s, $h = 6.63 \times 10^{-34}$ J·s)
   A) 2.16×10^{-19} J
   B) 5.82×10^{-40} J
   C) 2.16×10^{-28} J
   D) 3.42×10^{14} J
   E) 1.94×10^{-39} J

4. Which of the following is/are correct postulates of Bohr's theory of the hydrogen atom?
   1. The energy of an electron in an atom is quantized (i.e. only specific energy values are possible).
   2. The principal quantum number (n), specifies each unique energy level.
   3. An electron transition from a lower energy level to a higher energy level results in an emission of a photon of light.
   A) 1 only
   B) 2 only
   C) 3 only
   D) 1 and 2
   E) 1, 2, and 3

5. List all the orbitals when n = 4.

6. Give the formula that relates the number of possible values of m_l to the value of l.

7. Which of the following subshells cannot exist: (a) 1p; (b) 4f; (c) 2d; (d) 5p; (e) 3f? Why not?

8. List all possible values of m_l for each of the indicated subshells. What role does the principal quantum number n play in determining your answer?

Subshell	Values of m_l
(a) 4s	
(b) 2p	
(c) 3d	
(d) 5f	

9. Which of the following sets of quantum numbers (n, l, ml, ms) refers to a 3d orbital?
   A) 2 1 0 + 1/2
   B) 5 4 3 + 1/2
   C) 4 2 1 − 1/2
   D) 4 3 1 − 1/2
   E) 3 2 1 − 1/2

10. An orbital with the quantum numbers: n = 3, l = 0, m_l = 0, may be found in which subshell?
   A) 3f
   B) 3d
   C) 3p
   D) 3g
   E) 3s