5. C Think of visual analogies to help you remember the shapes of the *s*, *p*, and *d* orbitals. For example, the *p* orbital might remind you of barbells. Sketch a diagram to show your analogies.

6. T/I Agree or disagree with the following analogy, and support your opinion: An electron in an orbital is like a fly trapped in a glass jar.

7. A Label each of the following sets of quantum numbers as *allowed* or *not allowed*. Identify the problem for each of the *not allowed* sets.

a. $n = 2, l = 2, m_l = 0$ not $l = 1$

b. $n = 2, l = 0, m_l = -1$ not $m_l = 0$

c. $n = 4, l = 0, m_l = 0$ yes, allowed

d. $n = 2, l = 3, m_l = -1$ not, $l = 1$ or 2

8. T/I How many of each of the following types of orbitals are there in an atom?

a. 3*s* 1 **b.** 7*f* 7 **c.** 4*p* 3 **d.** 7*d* 5 **e.** 2*s* 1 **f.** *s* infinite

9. T/I How many sets of quantum numbers are possible for a 3*p* orbital? List them. (3) (3,1,-1) (3,1,0) (3,1,1)

10. T/I What is wrong with each set of quantum numbers? Change one number to give an allowed set.

a. $n = 0, l = 1, m_l = 0$ $n = 1$

b. $n = 3, l = 2, m_l = -3$ $m_l = -2, 0, -1, 1, 2$

8 gives $2n^2 = 128$."

a. State two problems with this reasoning.

b. How many energy levels are there for a given atom?

14. K/U If the $n = 1$ energy level is shown in a diagram as a sphere, what does this sphere represent?

15. K/U What is the Pauli exclusion principle and what consequence does it have in terms of quantum numbers?

16. T/I Is it possible for a hydrogen atom's one electron to have the following quantum numbers: $n = 2, l = 0, m_l = 0, m_s = +\frac{1}{2}$? Explain your answer.

17. K/U How does $n = 2$ compare with $n = 1$ in terms of its size and the energy of an electron moving in its volume?

18. T/I What is the greatest number of electrons possible in each of the following energy levels?

a. $n = 1$ 2 **b.** $n = 2$ 8 **c.** $n = 3$ 18 **d.** $n = 4$ 32

19. K/U Explain why there are $(2l + 1)$ values for m_l for any given value of l.

20. A Given the information that an electron is associated with $l = 0$, can you tell what the value of n is? Explain your answer.

Practice Problems

1. For the quantum number $n = 3$, what values of l are allowed, what values of m_l are possible, and how many orbitals are there? $l = 0, 1, 2$ $m_l = -2, -1, 0, 1, 2$ 9 orbitals

2. If $n = 5$ and $l = 2$, what orbital type is this, what are the possible values for m_l, and how many orbitals are there? 5d, $m_l = -2, -1, 0, 1, 2$ 5 orbitals

3. What are the n, l, and possible m_l values for the following orbital types?

a. 2*s* $n = 2$ $l = 0$ $m_l = 0$

b. 3*p* $n = 3$ $l = 1$ $m_l = -1, 0, 1$

c. 5*d* $n = 5$ $l = 2$ $m_l = -2, -1, 0, 1, 2$

d. 4*f* $n = 4$ $l = 3$ $m_l = -3, -2, -1, 0, 1, 2, 3$

4. What orbital type can be described by the following sets of quantum numbers?

a. $n = 2, l = 0, m_l = 0$ 2s

b. $n = 5, l = 3, m_l = -2$ 5f

5. How many orbitals are associated with each of the following types?

a. 1*s* 1 **b.** 5*f* 7 **c.** 4*f* 7 **d.** 2*p* 3

6. What sets of quantum numbers are possible for a 4*d* orbital? List them. (4,2,-2) (4,2,-1) (4,2,0) (4,2,1) (4,2,2)

7. What is one possible value for the missing number in each of the following sets?

a. $n = 3, l = 1, m_l = ?$ $m_l = -1, 0, 1$

b. $n = 2, l = ?, m_l = -3$ none possible

8. Write two possible sets of quantum numbers for a 6*p* orbital. (6,1,0) (6,1,-1) (6,1,1)

9. The following sets of quantum numbers are not allowed. Identify the problem and change one number to give an allowed set.

a. $n = 1, l = 2, m_l = -2$ (n = 3)

b. $n = 4, l = 1, m_l = -2$ (-1)

10. Label each of the following sets of quantum numbers as *allowed* or *not allowed*. Identify the problem for each of the *not allowed* sets.

a. $n = 3, l = 2, m_l = 0$ allowed

b. $n = 1, l = 1, m_l = -1$ (2) not

c. $n = 0, l = 0, m_l = 0$ (1) not

d. $n = 5, l = 1, m_l = 3$ (1) not