QUANTUM NUMBERS WORKSHEET KEY

1. Write the 14 sets of quantum numbers that describe the 14 electrons of silicon, Si.

1,0,0,+½ and −½ **2,0,0, +½ and −½**
2,1,1, +½ and −½ **2,1,0, +½ and −½** **2,1,-1, +½ and −½**
3, 0, 0,+½ and −½ **3,1,1,+½** **3,1,0,+½**

2. Indicate the maximum number of electrons in an atom that can have as part of their set of four quantum numbers for each of the following.

a. n = 3 **18**
b. n = 4, l = 2 **10**
c. n = 2, l = 2 **0**
d. n = 4, l = 3, m_l = −1, ms = +½ **1**
e. n = 3, l = 1, m_l = +2 **0**
f. n = 6, l = 3, m_l = −3 **2**

3. Sketch the general shape of the orbitals that are described by the following sets of quantum numbers.

a. 1,0,0 **Sphere See text.**
b. 2,1,1 **Dumbbell See text.**
c. 3,2,2 **Double dumbbell or dumbell and donut See text.**

CHEMISTRY 151 - QUANTUM NUMBERS KEY

1. Write the quantum numbers associated with each of the following.

a. the fifth principle energy level **n = 5**
b. the 6s sublevel **n = 6, l = 0**
c. an orbital on the 3d sublevel **n = 3, l = 2, m_l = +2**
d. the first electron added to the 4f sublevel **n = 4, l = 3, m_l = +3, ms = +½**

2. Indicate the maximum number of electrons in an atom that can have as part of their set of four quantum numbers.

a. n = 8 **128**
b. n = 2, l =1 **6**
c. n = 4, l = 3, m_l = 2 **2**
d. n = 7, l = 1, m_l = 2, m_s = −½ **0**
e. n = 6, l = 0, m_l = 0, m_s = +½ **1**
f. n = 4, l = 2, m_l = −3 **0**
g. n = 8, l = 2 **10**

3. With reference to quantum numbers, explain why the 4f sublevel can hold a maximum of 14 electrons.

The 4f sublevel has the quantum numbers n = 4 and l = 3. When l = 3, ml can only be +3, +2, +1, 0, −1, −2, and −3. Thus there are seven orbitals for the 4f sublevel. Each orbital can have electrons with +½ and −½ for m_s. Thus there are two electrons per orbital. Seven orbitals with two electrons per orbital leads to 14 electrons in the 4f sublevel.

4. Write each of the sets of four quantum numbers that describe the 23 electrons of the ground state of vanadium, V.

1,0,0, +½ and −½ **2,0,0, +½ and −½**
2,1, 1, +½ and −½ **2,1,0, +½ and −½** **2,1,−1, +½ and −½**
3,0,0, +½ and −½ **3,1,1, +½ and −½** **3,1,0, +½ and −½** **3,1,−1, +½ and −½**
4,0,0,+ ½ and −½ **3,2,2, +½** **3,2,1, +½** **3,2,0, +½**