Lesson plan: Quantum Numbers

Summary
In this lesson plan, students complete a worksheet answering questions regarding quantum numbers.

Grade Level
High School

NGSS Alignment
This activity will help prepare your students to meet the performance expectations in the following standards:
- **HS-PS1-1**: Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Objectives
By the end of this lesson, students should be able to
- Determine the number of electrons occupying various electron orbitals.
- List the four quantum numbers and what they represent.

Chemistry Topics
This lesson supports students’ understanding of
- Quantum numbers
- Electron configuration

Time
**Teacher Preparation**: 5 minutes
**Lesson**: 30 minutes

Materials
- Student Handout

Safety
- There are no special safety considerations for this activity.

Teacher Notes
- Students will need to be familiar with the concepts of quantum numbers before completing this activity.

FOR THE STUDENT
Lesson

Quantum Numbers

1. Determine the total number of e⁻ that can occupy the following:
   a. One s orbital
   b. Three p orbitals
   c. Five d orbitals
   d. Seven f orbitals
2. Determine how many e⁻ can have the following quantum numbers:
   a. \( n=3, \ l=0 \)
b. \( n=3, \ l=1 \)
   c. \( n=3, \ l=2, \ m_l=-1 \)
   d. \( n=5, \ l=0, \ m_l=-2, \ m_s=-1/2 \)

3. How many \( e^- \) can exist in all of the \( n=5 \) orbitals?
4. How many possible orbitals are there for \( n=4 \)?
5. Figure out the \( n \) and \( l \) values for the following orbitals:
   a. 2s
   b. 7s
   c. 6p
   d. 5d
   e. 4f

6. State all of the four quantum numbers, their names and explain what they represent.
7. What are the \( m_l \) values for a \( d \) orbital?
8. What is the lowest value of \( n \) for which a \( d \) subshell can occur?
9. A single subshell orbital can contain how many \( e^- \)?
10. Fluorine commonly has an oxidation state of -1. Draw orbital diagrams, with quantum numbers \( l \) and \( m_l \) labeled, of both the neutral atom and the most common oxidation state.