

Practice Problems Chapter 6

1. Answer the following questions:

(a) Without using quantum numbers, describe the differences between the shells, subshells, and orbitals of an atom.

According to the chemistry etext, the **shells** of an atom can be thought of concentric circles radiating out from the nucleus.

shell: set of orbitals in the same energy level

subshell: set of orbitals in the same energy level and same shape (s, p, d, or f)

orbital: can hold up to 2 electrons

(b) How do the quantum numbers of the shells, subshells, and orbitals of an atom differ?

shell: set of orbitals with same n

subshell: set of orbitals in an atom with the same values of n and l

orbital: shape defined by l quantum number

2. State the Heisenberg uncertainty principle. Describe briefly what the principle implies.

The Heisenberg uncertainty principle states that the velocity and position of an object cannot be determined at the same moment accurately. The mathematical expression for Heisenberg uncertainty principle can be written as

**HEISENBERG'S UNCERTAINTY PRINCIPLE
FOR MOMENTUM AND POSITION**

$$\Delta x \Delta p \geq \hbar/2$$

UNCERTAINTY IN POSITION
MULTIPLIED BY UNCERTAINTY
IN MOMENTUM...

...MUST BE
GREATER THAN
OR EQUAL TO...

...THE REDUCED
PLANCK'S
CONSTANT DIVIDED
BY 2

This equation tells us that when the uncertainty in position is multiplied by the uncertainty in momentum its value cannot be greater than the reduced Planck's constant divided by two. The equation above also applies to several other variables, most notably energy and time, it can also be adapted to any suitable pairs of operators in a system.

3. Write a set of quantum numbers for each of the electrons with an n of 3 in a Sc atom.

$$[NE] = 3s^2 3p^6 3d^1 4s^2$$

Broken down below in the table

$N = 3$

n	l	m_l	m_s
3	0	0	$\pm \frac{1}{2}$
3	1	-1, 0, 1	$\pm \frac{1}{2}$ -
3	2	-2, -1, 0, 1, 2 Most likely -1	$\pm \frac{1}{2}$ +

4. Based on their positions in the periodic table, predict which has the smallest first ionization energy: Li, Cs, N, F, I.

Based on their positions in the periodic table Cs has the smallest first ionization energy due to it being on the left side.