5.4 Review Questions, p. 283

1. Quantum mechanics tells us that a 1s orbital represents the (spherical) region in three-dimensional space around hydrogen's nucleus where its single electron is most likely located rather than a path that the electron follows.

2. A 1s orbital is smaller than a 2s orbital. This tells us that an electron in a 2s orbital possessing energy equal to $n = 2$ is more likely to be located further from the nucleus than an electron in a 1s orbital possessing energy equal to $n = 1$.

3. The first difference is size. Any 3p orbital is larger than any 2p orbital. The "3" tells us that an electron in a 3p orbital possesses more energy than an electron in an orbital that begins with the number "2" such as a 2p orbital. This means that a 3p electron is more likely to be found further from the nucleus

than a 2p electron. The other difference is associated with orientation in space. The lobes of a $2p_x$ orbital are oriented at right angles to the lobes of a $3p_y$ orbital.

4. No p orbital density at the nucleus means that there is no chance of finding the electron at that point in space. Another way of saying this is to say that the amplitude of the electron wave at the nucleus is zero. This is called a node.

5. The maximum number of electrons that can exist in the "n^{th}" energy level is given by $2n^2$. Therefore, the first four energy levels can accommodate a maximum of: 2, 8, 18, and 32 electrons respectively.

6. Hund's rule tells us that that each of those three 3p electrons is in a different equal energy orbital: one in the $3p_x$, one in the $3p_y$, and one electron in the $3p_z$. Hund's rule also tells us that each of those electrons is spinning in the same direction.

7. Use the periodic table to complete the following table:

Atom or Ion	Full Electron Configuration	Core Notation
Ge	$1s^22s^22p^63s^23p^64s^23d^{10}4p^2$	$[Ar]\ 4s^23d^{10}4p^2$
Zn^{2+}	$1s^22s^22p^63s^23p^63d^{10}$	$[Ar]\ 3d^{10}$
Sr	$1s^22s^22p^63s^23p^64s^23d^{10}4p^65s^2$	$[Kr]\ 5s^2$
Br^-	$1s^22s^22p^63s^23p^64s^23d^{10}4p^6$	$[Ar]\ 4s^23d^{10}4p^6$
Sn	$1s^22s^22p^63s^23p^64s^23d^{10}4p^65s^24d^{10}5p^2$	$[Kr]\ 5s^24d^{10}5p^2$
In^{3+}	$1s^22s^22p^63s^23p^64s^23d^{10}4p^64d^{10}$	$[Kr]\ 4d^{10}$

8. (a) Use the periodic table to identify the neutral atoms having the following electron configurations:

Electron Configuration	**Element Name**
[Ne] $3\mathbf{s}^2$	magnesium
[Ar] $4s^2\ 3\mathbf{d}^5$	manganese
[Kr] $5s^2\ 4d^{10}\ 5\mathbf{p}^3$	antimony
[Xe] $6s^2\ 4\mathbf{f}^7$	europium

(b) Each of the four elements in the above table is located in a different position of the periodic table corresponding to a different highest energy sublevel being filled in the elements.
The “s block” is located on the far left side of the periodic table; the “d block” is located in the centre of the table; the “p block” is located on the far right side of the table; the “f block” is located in the bottom region of the periodic table.

9. (a) Each ion possesses 10 electrons.
(b) Electron configuration of all species is given by: $1s^2 2s^2 2p^6$
(c) Neon possesses this configuration and all of the ions achieve a stable valence octet by becoming isoelectronic with neon.

10. (a)

Alkali Metals	**Core Notation**	**# Outer Electrons**	**Halogens**	**Core Notation**	**# Outer Electrons**
lithium	[He] $2s^1$	1	fluorine	[He] $2s^2 2p^5$	7
sodium	[Ne] $3s^1$	1	chlorine	[Ne] $3s^2 3p^5$	7
potassium	[Ar] $4s^1$	1	bromine	[Ar] $4s^2 3d^{10} 4p^5$	7
rubidium	[Kr] $5s^1$	1	iodine	[Kr] $5s^2 4d^{10} 5p^5$	7

(b) All the members of a chemical family demonstrate similar chemical behaviour because they all have the same number of outer or valence electrons.
(c) As we move down a chemical family, the atoms get larger.

11.