

V. Atomic Structure Answers

0. As far as we are concerned in this course, 99.99% of the matter in the universe is composed of three subatomic particles. What are the names and charges of these particles? Where in the atom do these particles exist?

proton: symbol is p^+ and charge is +1	Exist in nucleus (small space at the center of the atom)
neutron: symbol is n and charge is 0	Exist in nucleus (small space at the center of the atom)
electron: symbol is e^- and charge is -1	Move rapidly in orbitals around the outside of atom

1. Given the elemental symbol X shown below, what do Z, M, C, and H stand for?

Z is called the atomic number. $Z =$ the number of p^+ .

M is called the mass number. $M =$ the number of p^+ plus the number of n .

C is the net charge. $C =$ the sum of the charge of the p^+ plus the charge of the e^- .

H is the number of atoms of this element present in a molecule or compound ion. (Ex.: One carbon atom and two oxygen atoms are present in CO_2 .)



2. How many p^+ , n , and e^- are present in each of the following, and would you expect the indicated material to be stable? (See Supplemental Information part of the web page for a Periodic Table.)

	p^+	n	e^-	stable? (answers re. only e^- stability)
${}^6\text{Li}$	<u>3</u>	<u>3</u>	<u>3</u>	<u>not nearly as stable as Li^+</u>
${}^{81}\text{Br}^-$	<u>35</u>	<u>46</u>	<u>36</u>	<u>Yes, much more so than Br^0</u>
${}^{196}\text{Pt}$	<u>78</u>	<u>118</u>	<u>78</u>	<u>Yes, but you might not know this.</u>
${}^{41}\text{Ar}$	<u>18</u>	<u>23</u>	<u>18</u>	<u>Yes! It's an inert gas!</u>
${}^{90}\text{Sr}^{2+}$	<u>38</u>	<u>52</u>	<u>36</u>	<u>Yes, much more so than Sr^0</u>

3. Describe the number, shape, and relative size of:

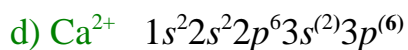
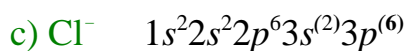
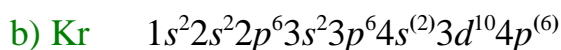
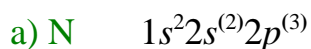
a) $4s$ atomic orbitals There is one s orbital per principle quantum number. (Ex.: only one $1s$ orbital, only one $2s$ orbital, etc.) s orbitals have one spherical lobe per orbital. $4s$ orbitals have a larger radius than $3s$ orbitals, but a smaller radius than $5s$ orbitals.

b) **3p atomic orbitals** There are three *p* orbitals per principle quantum number. (Ex.: Three *2p* orbitals, *etc.*) *p* orbitals have two compressed drop shaped lobes per orbital. *3p* orbitals are larger than *2p* orbitals, *etc.*.

4. Define the term *valence electron*.

The e^- occupying the outermost *s* and *p* orbitals are referred to as valence e^- . These are the e^- that are lost or gained during ion formation or shared during covalent bond formation.

5. Write electron configurations for and circle the valence electrons in:



6. Comment on the electronic stability of 5a)-d).

a) N Nitrogen atoms are quite unstable because they do not have a full valence shell.

b) Kr Krypton atoms are quite stable because they do have a full valence shell.

c) Cl^- Chloride ions are quite stable because they do have a full valence shell.

d) Ca^{2+} Calcium ions are quite stable because they do have a full valence shell.