

Solution

Physics 214

Problem 3 Electronic states in atoms

Week 7

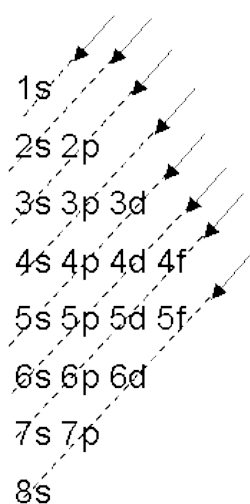
- a) There are about 100 different atomic elements. Pretend for the moment that life is simple and that E always increases as you increase n , the principal quantum number. **How many atomic elements can be constructed using $n \leq 4$** , following the rule that you fill up the lowest states first? (Hint: use s , p , d , and f orbitals and complete the table below.)

n	l	Name of orbital	Possible m_l values	# of electrons that can fit in the orbital (including spin)
1	0	1s	0	2
2	0	2s	0	2
	1	2p	-1, 0, 1	6
3	0	3s	0	2
	1	3p	-1, 0, 1	6
	2	3d	-2, -1, 0, 1, 2	(5)(2) = 10
4		4s	0	2
		4p	-1, 0, 1	6
		4d	-2, -1, 0, 1, 2	10
		4f	-3, -2, -1, 0, 1, 2, 3	14

Total: 60

- b) Life is actually not so simple (because the electrons interact with each other). The figure below gives a mnemonic for determining the electronic configuration of atoms. Electrons are added by proceeding along the arrows shown.

Krypton is a noble gas with $Z = 36$. Find its electronic configuration (e.g., $1s^2 2s^2 2p^6 \dots$)



Just proceed along the arrows until you have 36 electrons (the sum of the “exponents”):

$$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 = \text{krypton}$$