Electron Configuration PRACTICE

Name Key #___

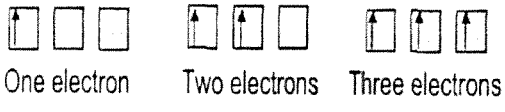
Date_____ Per._____

I. Filling in electrons: Electrons get filled into orbitals individually:

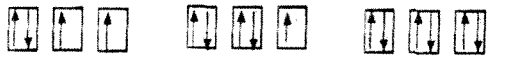
s: 

unoccupied orbital | orbital with 1 electron | orbital with 2 electrons

The Pauli Exclusion Principle!

p: 

One electron | Two electrons | Three electrons



Four electrons | Five electrons | Six electrons

Hund's Rule: fill orbitals singly first, then start pairing!

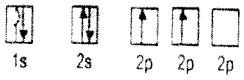
Writing Electronic Configurations

To determine the electron configuration:

1) Find the number of electrons for the element.
2) Fill the electrons in order of the Aufbau Principle.
3) Use Hund's Rule and the Pauli Exclusion Principle for orbital diagrams.

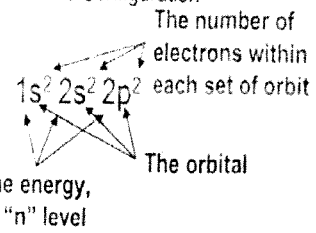
Example: Nitrogen - Element #7 → 7 electrons

Orbital Diagram



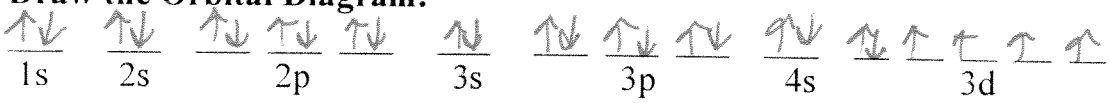
- Each individual orbital gets a "box".
- Electrons are filled into the boxes until the total is reached.

Electronic Configuration



Using Iron with 26 number of e^-

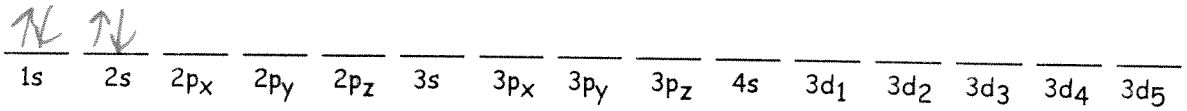
Draw the Orbital Diagram:

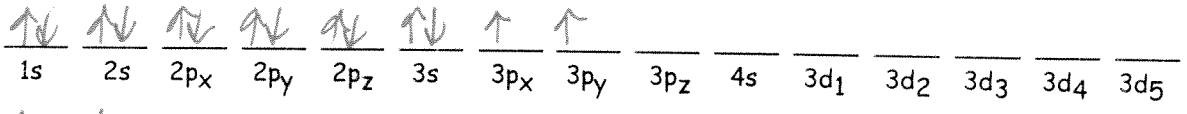


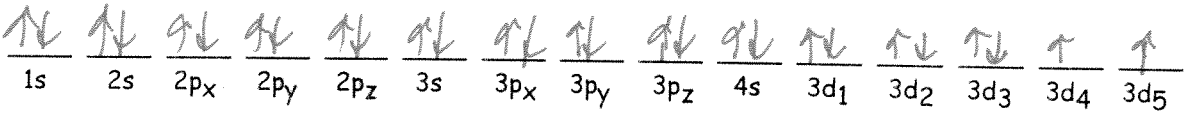
Write the Electron Configuration for Fe:

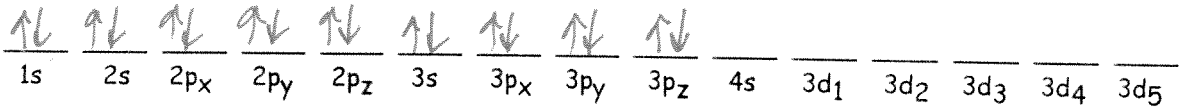
$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^6$

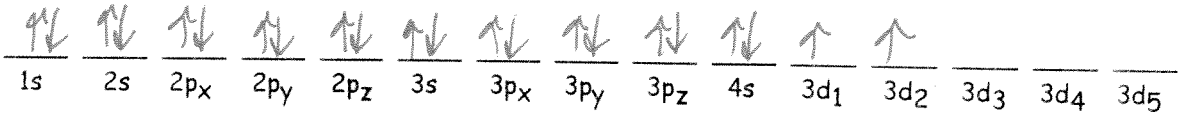
Draw the orbital notation diagrams for the following elements.

1. Be 

2. Si 

3. Ni 

4. Ar 

5. Ti 

Write the electron configuration for the following elements.

6. Si $1s^2\ 2s^2\ 2p^6 3s^2 3p^2$

7. Cr $1s^2\ 2s^2\ 2p^6\ 3s^2 3p^6\ 4s^2\ 3d^4$

8. Mg $1s^2\ 2s^2\ 2p^6\ 3s^2$

Write the noble gas configuration for the following elements.

9. Ca $1s^2\ 2s^2\ 2p^6 3s^2 3p^2\ 4s^2$
   [Ar] $4s^2$

10. Cl $[Ne]\ 3s^2 3p^5$

11. Ag $[Kr]\ 5s^2\ 4d^9$ or $[Kr]\ 5s^1\ 4d^{10}$ ↑ more correct

12. Sn $[Kr]\ 5s^2\ 4d^{10}\ 5p^2$

Electronic Configuration Shorthand

Consider the electronic for Argon and Calcium:

Ar: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$ ← As a noble gas, Argon's orbitals are completely filled.

Ca: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$

[Ar] $4s^2$ ← We can use the "last" noble gas as a shorthand in electronic configurations!

The "core" electrons — The "valence" electrons

Not only are shorthand configurations easier to write, but they identify the valence electrons, which are the electrons that are available for reaction!

Draw the orbital diagrams for the following IONS. This will be the same orbital diagrams as a neutral atom except you've added or subtracted some arrows to represent the electrons that were added or subtracted. See Na for an example.

13. Na^{1+} ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

1s 2s 2p$_x$ 2p$_y$ 2p$_z$ 3s 3p$_x$ 3p$_y$ 3p$_z$ 4s 3d$_1$ 3d$_2$ 3d$_3$ 3d$_4$ 3d$_5$

14. Ca^{2+} ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ___ ___ ___ ___ ___ ___ ___

1s 2s 2p$_x$ 2p$_y$ 2p$_z$ 3s 3p$_x$ 3p$_y$ 3p$_z$ 4s 3d$_1$ 3d$_2$ 3d$_3$ 3d$_4$ 3d$_5$

15. O^{2-} ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

1s 2s 2p$_x$ 2p$_y$ 2p$_z$ 3s 3p$_x$ 3p$_y$ 3p$_z$ 4s 3d$_1$ 3d$_2$ 3d$_3$ 3d$_4$ 3d$_5$

Write the electron configuration for the following IONS.

16. Be^{2+} $1s^2$

17. Li^{1+} $1s^2$

18. F^{1-} $1s^2\ 2s^2 2p^6$

Write the noble gas configuration for the following IONS.

19. Br^{1-} $[Ar]\ 4s^2\ 3d^{10}\ 4p^6$

20. Ba^{2+} $[Xe]$

21. Ag^{1+} $[Kr]\ 5s^2 4d^8$ or $[Kr]\ 4d^{10}$ more correct

Draw Electron Dots
(Valence Electrons = S + P)

1. Fe $1s^2 2s^2 2p^6 3s^2 3p^6 \mathbf{4s^2} 3d^6$

Fe

2. B $1s^2 \mathbf{2s^2 2p^1}$ **B**

3. Cl $1s^2 2s^2 2p^6 \mathbf{3s^2 3p^5}$ **Cl**

Name Key Period ____

Electron Configuration Practice

Brief Instructions

An **electron configuration** is a method of indicating the arrangement of electrons about a nucleus. A typical **electron configuration** consists of numbers, letters, and superscripts with the following format:

1. A number indicates the energy level.
2. A letter indicates the type of orbital; s, p, d, f.
3. A superscript indicates the number of electrons in the orbital. Example: $1s^2$ means that there are two electrons in the 's' orbital of the first energy level. The element is helium.

Configuration Writing Practice

Write an **electron configuration** for each neutral atom. Use only a periodic table, not an aufbau diagram, because that's all you get to use on the test!

1. N $1s^2, 2s^2, 2p^3$
2. P $1s^2, 2s^2, 2p^6, 3s^2, 3p^3$
3. Na $1s^2, 2s^2, 2p^6, 3s^1$
4. Sr $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$
5. Nd $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^2, 4d^{10}, 5p^6, 6s^2, 4f^4$

6. If each orbital can hold a maximum of two electrons, how many electrons can each of the following **sublevels** hold?

a. 2s 2
b. 5p 6
c. 4f 14
d. 3d 10
e. 4d 10

9. What is the shape of an s orbital? spherical
10. How many s orbitals can there be in an energy level? 1
11. How many electrons can occupy an s orbital? 2
12. What is the shape of a p orbital? Dumbbell
13. How many p orbitals can there be in an energy level? 3
14. Which is the lowest energy level that can have an s orbital? 1
15. Which is the lowest energy level that can have a p orbital? 2
16. How many d orbitals can there be in an energy level? 5
17. How many d electrons can there be in an energy level? 10
18. Which is the lowest energy level having d orbitals? 3
19. How many f electrons can there be in an energy level? 14
20. Which is the lowest energy level having f orbitals? 4

Name _____ Period ____

21. For the following elements list the **shorthand electron configuration. The shorthand electron configuration is also called the noble gas configuration.**

a. boron [He] $2s^2, 2p^1$

b. cadmium [Kr] $5s^2 4d^{10}$

c. phosphorus [Ne] $3s^2 3p^3$

d. neon [He] $2s^2, 2p^6$

e. iodine [Kr] $5s^2, 4d^{10}, 5p^5$

What element has the following configuration?

1. $s^2 2s^2 2p^6 3s^2 3p^4$ S
2. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1$ Rb
3. [Kr] $5s^2 4d^{10} 5p^3$ Sb
4. Xe] $6s^2 4f^{14} 5d^6$ Os
5. [Rn] $7s^2$ Ra

Write "valid" or "not valid" next to each electron configuration:

11) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^{10} 4p^5$ Not valid

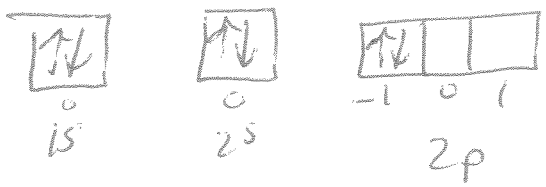
12) $1s^2 2s^2 2p^6 3s^2 3d^5$ Not valid

13) [Ra] $7s^2 5f^8$ not

14) [Kr] $5s^2 4d^{10} 5p^5$ Valid

15) [Xe] not Valid

21. Draw an aufbau diagram for carbon that violates Hund's rule.



Name Key

Practice Test : Electrons

1. How many electrons can fit in –
   a. the first energy level? 2
   b. a 6p orbital? 2
   c. the 3d sublevel? 10
   d. the second energy level? 8
   e. a 2p orbital? 2
   f. the third energy level? 18

2. What are the sublevels in the second energy level? 2 the third energy level? 3
   the fourth energy level? 4

3. What's the difference between the ground state and an excited state of an atom?
   Ground state: Lowest energy
   Excited state: one or more electrons in a higher energy level
   What makes an electron move from the ground state to an excited state? gains energy
   What happens as an electron moves from an excited state back to the ground state? loses energy, returns to GS

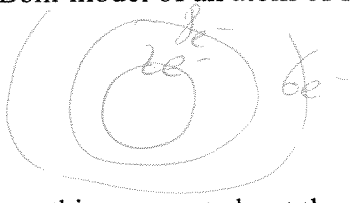
4. What does Hund's rule say? You can't have two electrons in a orbital unless all have one

Draw an aufbau diagram for nitrogen that violates Hund's rule:

5. What does the Pauli Exclusion Principle say?
   Opposite spins (arrows)

Draw an aufbau diagram for beryllium that violates the Pauli Exclusion Principle.

6. Draw a Bohr model of an atom of sulfur.



7. Name something correct about the electrons in the Bohr model.
   exist in Energy levels

Name something incorrect about the electrons in the Bohr model.
   move like Planets

Name _____

8. How many f orbitals are in the third energy level? 0

9. What is the aufbau principle? fill lowest energy level first

Draw an aufbau diagram for oxygen that violates the aufbau principle.

10. Name the sublevel that contains highest energy electrons in an atom of –
    a. magnesium 3s
    b. zinc 3d
    c. platinum 5d
    d. uranium 5f

11. The average distance from the nucleus of a 3s electron in a chlorine atom is smaller than that for a 3p electron. Which orbital is therefore higher in energy? 3p

12. How is the opposite spin of the electrons in an orbital depicted on an aufbau diagram?

opposite points arrow

13. Name the last electron added when writing the configuration for each of these elements:

Zirconium (40) $4d^2$	Bromine (35) $4p^5$	Calcium (20) $4s^2$
Lead (82) $6p^2$	Plutonium (94) $5f^6$	Krypton (36) $4p^6$

14 An orbital of an atom is defined as the most probable location of an electron.

15. Which atom in the ground state has an outermost electron with the most energy?
    (A) Cs (B) Li (C) K (D) Na

16. Explain what each number and letter means in the following notation: $3p^4$

3 = energy level
p = shape (sublevel)
4 = # of electrons

17. a) A 5f sublevel holds a maximum of 14 electrons.

    b) A 2p sublevel holds a maximum of 6 electrons.

18. A 3d orbital holds a maximum of 2 electrons.

19. Name the elements whose electron configurations are:

    a) $1s^2\ 2s^2\ 2p^5$ F

    b) $1s^2\ 2s^2\ 2p^6\ 3s^1$ Na

Name Key Period _____

Electron Practice Quiz

D 1. Which of the following orbitals is furthest from the nucleus?
   a. $2p$
   b. $3p$
   c. $1s$
   d. $4s$

A 2. What would be the highest principal energy level of the electrons in an atom of Iodine-127?
   a. 5
   b. 7
   c. 3
   d. 2

D 3. The letter designations for the first four electron sublevels, with the number of electrons that can be accommodated in each sublevel are:
   a. s:2, p:4, d:6, f:8
   b. s:1, p:3, d:10, f:14
   c. s:1, p:2, d:3, f:4
   d. s:2, p:6, d:10, f:14

D 4. Which is the last electron added for Argon (atomic number 18)?
   a. $3d^8$
   b. $4s^2$
   c. $4p^3$
   d. $3p^6$

P 5. Which element has the electron configuration $[Ar]4s^23d^{10}$?
   a. Ar
   b. Ca
   c. Kr
   d. Zn

A 6. What is the highest occupied subshell in the structure of an atom of arsenic (atomic number 33)?
   a. $4p$
   b. $3s$
   c. $3d$
   d. $3p$

B 7. Which of the following rules requires that each of the p orbitals at a particular energy level receive one electron before any of them can have two electrons?
   a. Aufbau principle
   b. Hund's rule
   c. Pauli exclusion principle
   d. the quantum rule

A 8. What element has the electron configuration of $[Ne]3s^23p^1$?
   a. aluminum
   b. boron
   c. silicon
   d. sodium

B 9. Orbitals hold:
   a. A maximum of one electron each.
   b. A maximum of two electrons each.
   c. The number of electrons in each orbital depends on the energy level.
   d. The number of electrons in each orbital depends on the shape of the orbital.

B 10. The number of orbitals for the d sublevel is
   a. 1
   b. 5
   c. 7
   d. 10

D 11. Compare the maximum number of electrons possible in sublevel $3d$ with the maximum number that could be in sublevel $4d$.
   a. There are more in $3d$.
   b. They are impossible to compare.
   c. There are more in $4d$.
   d. They are the same.

D 12. What element has the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^2$?

a. Argon
b. Carbon
c. Aluminum
d. Silicon

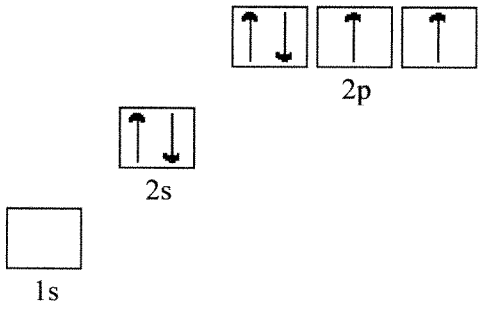
a.

b.

c.

C 13. Which of the diagrams above is the correct orbital notation for the 3d sublevel of the element nickel, (Ni, atomic #28).

C 14. What can you conclude from the figure below?



a. This is a valid orbital diagram.
b. Hund's rule has been violated.
c. The Aufbau principle has been violated.
d. The Pauli exclusion principle has been violated.

C 15. The "up" and "down" arrows in an orbital diagram represent

a. the protons and neutrons in an atom
b. the up quarks and down quarks that make up the protons
c. electrons with opposite spins
d. electrons attracting each other