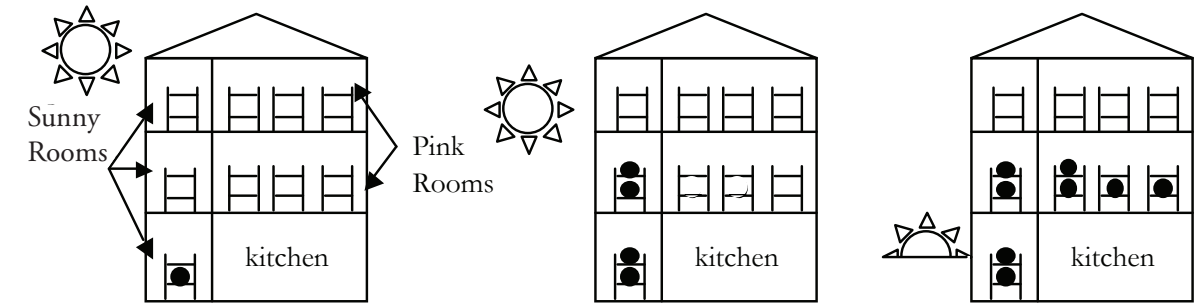
NS F4 Electron Configuration *ANSWERS*

What is the electron structure in an atom?

The electron structure of an atom is very important. Scientists use the electronic structure of atoms to predict bonding in molecules, the charge(s) an atom might have, and the physical properties of elements. In order for scientists to describe the electron structure in an atom, they give the electrons "addresses." Just like your address might include your house number, street, city, and state, an electron's "address" has multiple parts. In this activity, you will learn how the electrons fill up the available spaces in an atom and how their "addresses" or configurations are assigned.

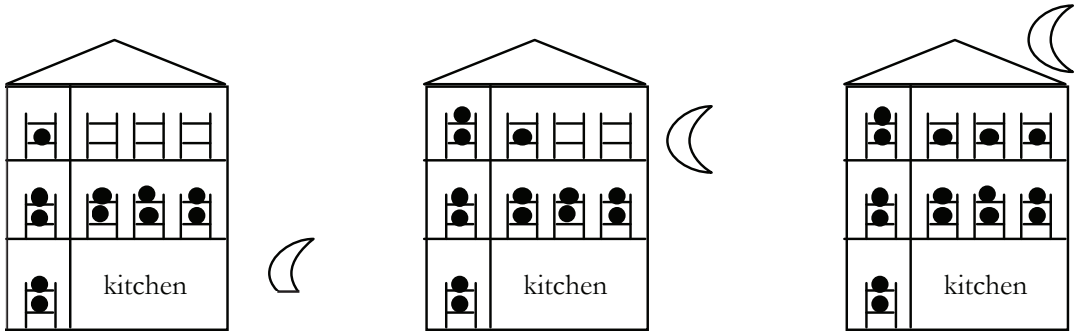
The Boarding House



Time: 1:00 pm — Manager's Code: $1s^1$

3:00 pm — $1s^2\ 2s^2$

5:00 pm — $1s^2\ 2s^2\ 2p^4$



Time: 7:00 pm — Manager's Code: $1s^2\ 2s^2\ 2p^6\ 3s^1$

9:00 pm — $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$

11:00 pm — $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$

1. Examine the boarding house diagrams above. Choosing from the lettered list to the left (below), match the meaning of each symbol (as used in the diagrams and configurations above) with the correct description in the list to the right (below). Write the letter of each symbol on the line to the left of each description.

a. ●

b. ⊟

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

b. ⊟ Bunk bed for boarders

c. $1s^2\ 2s^2\ 2p^6\ 3s^1$ Manager's code for the number of boarders in the house, and their room assignments

a. ● Boarder

2. Refer to the diagram above.

a. How many boarders were in the boarding house at 5:00 pm? 8 boarders at 5pm

b. What two ways could you have used to determine your answer for part a.?

By **counting the 8 circles** or **adding up the exponents** in the manager's code $1s^2\ 2s^2\ 2p^4$

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3. Examine each diagram in Model 1, and the corresponding manager's code. Using the 5:00 pm manager's code shown below, underline the floor numbers in red, circle the types of rooms in green, and draw a box around the number of borders in yellow.

$1s^2\ \ 2s^2\ 2p^4$

4. The manager of the boarding house has some very strict rules on how beds will be rented out for the night. Examine the diagrams in Model 1 and the statements below to determine the phrase that best describes the manager's set of rules. Draw a line through the ~~incorrect answers~~ in the underlined portion of the sentence, so that the sentence is a correct statement.

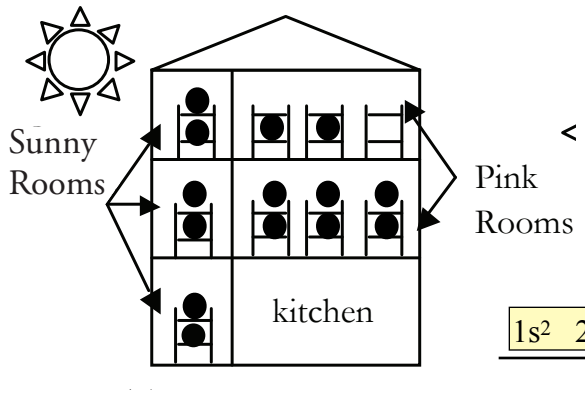
   a. The boarding house will rent out beds on the (1st, ~~2nd, 3rd, any~~) floor first.

   b. Boarders are only allowed to double up in a bunk in a room when (~~there is an even number of boarders in the room,~~ all bottom bunks are occupied).

   c. The next floor of rooms will be opened for boarders only when (~~half of the bunks, at least one of the rooms,~~ all of the bunks) on the floor below are occupied.

   d. The pink room on a floor will be opened for boarders only when (~~all of the lower bunks in the sunny room on that floor are occupied,~~ all of the bunks in the sunny room on that floor are occupied, ~~the sunny room on that floor is open~~).

5. Finish filling in the boarding house diagram below, to represents the sleeping situation when 14 boarders are present, and then write the managers code on the line to the right of the diagram.



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

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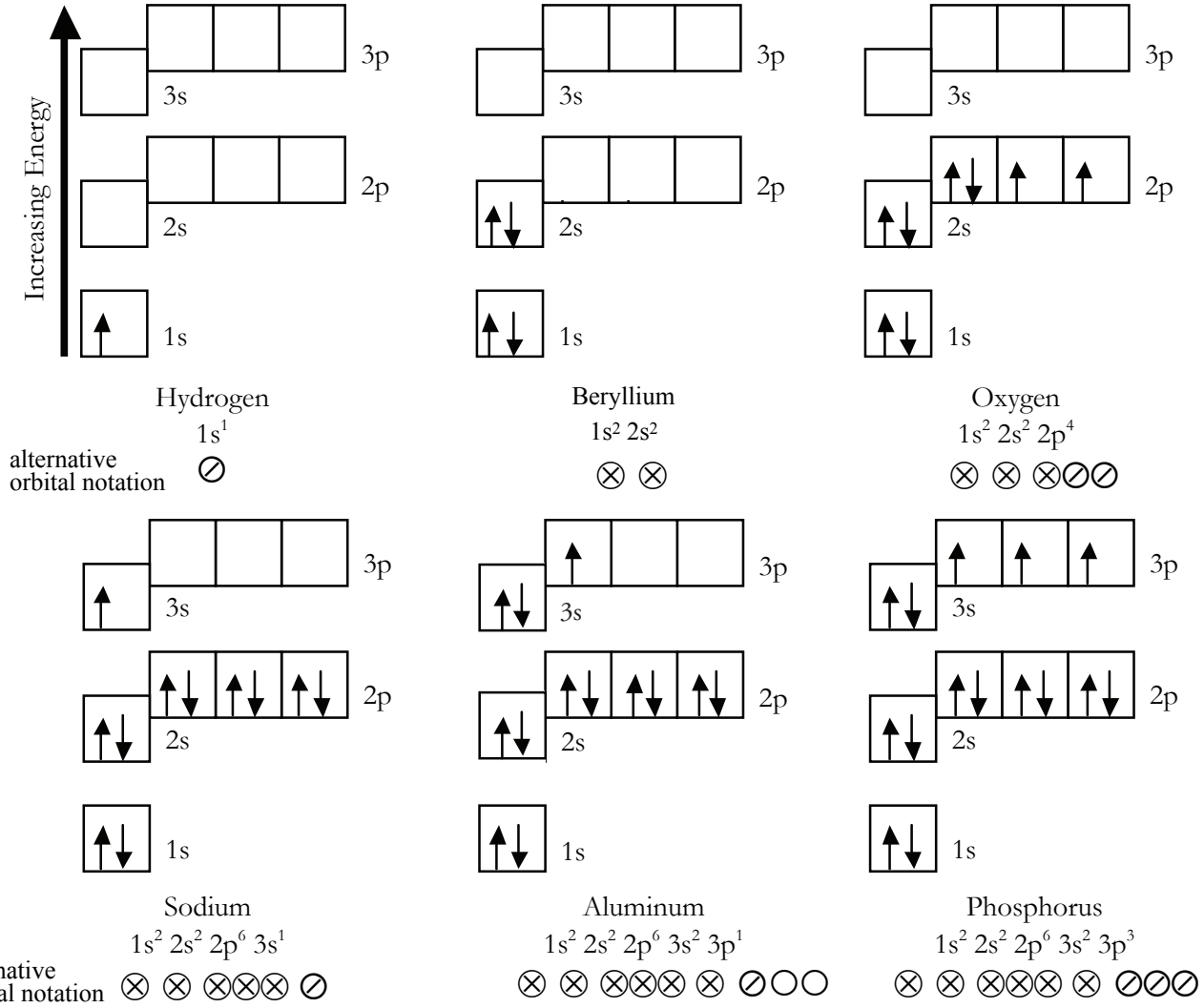
Ground State Orbital Diagrams and Electron Configurations

Compare the ground state orbital diagrams below to the boarding house diagrams on page 1.
Compare the electron configurations below to the manger's code, also on page 1.



6. Examine the orbital diagrams and electron configurations as shown above. Choosing from the lettered list to the left (below), match the meaning of each symbol (as used in the diagrams and configurations above) with the correct description in the list to the right (below). Write the letter of each symbol on the line to the left of each description.

a. $1s^2\ \ 2s^2\ 2p^4$

b. ☐

c. ↑

d. ↑ ↓

e. ☐☐☐

c. __↑____ Single electron (individual boarder)

d. __↑ ↓__ Pair of electrons with opposite spins (boarders in a bunk bed together)

b. __☐__ Atomic orbital (room in boarding house)

a. $1s^2\ \ 2s^2\ 2p^4$ Electron configuration (manager's code)

e. ☐☐☐ Sublevel, set of orbitals having equivalent energy (rooms with the same name in boarding house)

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7. Consider the orbital diagram for oxygen on the previous page 3.
   a. How many electrons are present in the orbital diagram? 8
   b. Checking the periodic table, is your answer to part (a) is the correct number of electrons for oxygen? yes

8. Examine the electron configuration for oxygen, as compared with the corresponding 5:00 pm manager's code shown below. Underline the energy levels in red, circle the sublevels in green, and draw a box around the number of electrons in yellow.

$1s^2\ 2s^2\ 2p^4$

9. The lowest potential energy arrangement of electrons in an atom is called the ground state. Ground state electron configurations can be predicted by a strict set of rules known as the **Aufbau Principle** ("aufbau"means filling up). Examine the diagrams on page 3 and the statements below to determine the phrase that best describes each rule. Draw a line through the ~~incorrect answers~~ in the underlined portion of the sentence, so that the sentence is a correct statement.

   a. Based on where a single electron is placed, the lowest potential energy electron in an atom is found in the (1st, ~~2nd, 3rd, any~~) sublevel.

   b. Electrons will pair up in an orbital only when (~~there is an even number of electrons in the sublevel,~~ all the orbitals in the same sublevel have one electron).

   c. Electrons can begin to occupy energy levels with the next highest integer designation only after (~~half of the orbitals, at least one of the orbitals,~~ all of the orbitals) on the energy level below are occupied.

   d. Electrons will occupy a p-orbital only after (~~the previous s-orbital is half full,~~ the previous s-orbital is completely full, ~~the previous s-orbital is empty~~).

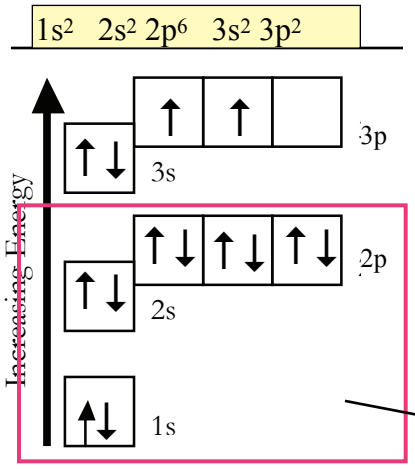
10. The **Pauli Exclusion Principle** describes the restriction on the placement of electrons into the same orbital. The Pauli exclusion principle can be expressed as: "If two electrons occupy the same orbital, they must have (~~the same spin~~ opposite spin)."

11. **Hund's Rule** describes how electrons are distributed among orbitals of the same sublevel when there is more than one way to distribute them. Hund's rule consists of two important ideas.

   a. Electrons will pair up in an orbital only when (~~there is an even number of electrons in the sublevel,~~ all the orbitals in the same sublevel have one electron).

   b. When single electrons occupy different orbitals of the same sublevel, (they all have the same spin, ~~they all have different spins, their spins are random~~).

12. Finish filling in the orbital diagram for silicon AND write the electron configuration on the line above the diagram.



13. Put a box around all the electrons in the orbital diagram you filled in that would represent the electrons of the neon atom.

14. On the line below, to the right of the [Ne], write the electron configuration for all of the electrons in the diagram that you did NOT put a box around.

[Ne] $3s^2\ 3p^2$

You have just written the **condensed** electron configuration for silicon.

Fill in this alternative orbital notation