

## The Quantum Mechanical Model of the Atom Worksheet

- Which of the following statements about orbitals is false?
  - Orbitals are distributed in space around the nucleus.
  - Orbitals are regions in which electrons are likely to be found.
  - Orbitals show the path of the electron.
  - Orbitals are part of one model for atomic structure.
- Name the elements that correspond to each of the following electron configurations. (Assume all are neutral atoms.)
  - $1s^2 2s^2 2p^1$
  - $1s^2 2s^2$
  - $1s^2 2s^2 2p^6 3s^2 3p^2$
- What is the frequency of electromagnetic radiation emitted when the electrons of one mole of hydrogen atoms change from the 4s orbital to the 1s orbital?
- Write the electron configurations for the following elements: arsenic, krypton, bromine, and phosphorus.
- Write the electron configurations for Be, Mg, Ca, and Sr. What is the similarity in the configurations of the outermost electrons of these elements?
- Write the electron configurations for Sc, Ti, Ni, and Zn. Which sublevel is changing in these configurations?
- For each of the following electron configurations of neutral atoms, determine the name of the element listed and determine if the configuration as written is the ground state or an excited state:  
 $1s^2 2s^2 2p^6$   
 $1s^2 2s^2 2p^5 3s^2$   
 $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3$   
 $1s^2 2s^2 2p^6 3s^2 5s^1$
- For each of the following electron configurations of neutral atoms, determine if the configuration as written is the ground state, an excited state, or if it is an impossible configuration:  
N:  $1s^2 2s^2 2p^3$   
Na:  $1s^2 2s^2 2p^6 4s^1$   
Ne:  $1s^2 2s^3 2p^5$   
V:  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^2 4p^1$
- Write the electron configurations for elements 37, 38, and 39 (rubidium, strontium, and yttrium).

# Electron Configuration Practice Worksheet

In the space below, write the full (unabbreviated) electron configurations of the following elements:

- 1) sodium \_\_\_\_\_
- 2) iron \_\_\_\_\_
- 3) bromine \_\_\_\_\_
- 4) barium \_\_\_\_\_
- 5) neptunium \_\_\_\_\_

In the space below, write the Noble Gas (abbreviated) electron configurations of the following elements:

- 6) cobalt \_\_\_\_\_
- 7) silver \_\_\_\_\_
- 8) tellurium \_\_\_\_\_
- 9) radium \_\_\_\_\_
- 10) lawrencium \_\_\_\_\_

Determine what elements are denoted by the following electron configurations:

- 11)  $1s^2 2s^2 2p^6 3s^2 3p^4$  \_\_\_\_\_
- 12)  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1$  \_\_\_\_\_
- 13)  $[\text{Kr}] 5s^2 4d^{10} 5p^3$  \_\_\_\_\_
- 14)  $[\text{Xe}] 6s^2 4f^{14} 5d^6$  \_\_\_\_\_
- 15)  $[\text{Rn}] 7s^2 5f^{11}$  \_\_\_\_\_

Determine which of the following electron configurations are not valid: State which rule has been violated.

- 16)  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^{10} 4p^5$  \_\_\_\_\_
- 17)  $1s^2 2s^2 2p^6 3s^3 3d^5$  \_\_\_\_\_
- 18)  $[\text{Ra}] 7s^2 5f^8$  \_\_\_\_\_
- 19)  $[\text{Kr}] 5s^2 4d^{10} 5p^5$  \_\_\_\_\_
- 20)  $[\text{Xe}]$  \_\_\_\_\_

## The Quantum Mechanical Model of the Atom Worksheet - ANSWERS

1. Which of the following statements about orbitals is false?
- Orbitals are distributed in space around the nucleus.
  - Orbitals are regions in which electrons are likely to be found.
  - Orbitals show the path of the electron.
  - Orbitals are part of one model for atomic structure.
2. Name the elements that correspond to each of the following electron configurations.  
(Assume all are neutral atoms.)

- $1s^2 2s^2 2p^1$                       **Boron**
- $1s^2 2s^2$                               **Beryllium**
- $1s^2 2s^2 2p^6 3s^2 3p^2$               **Silicon**

3. What is the frequency of electromagnetic radiation emitted when the electrons of one mole of hydrogen atoms change from the 4s orbital to the 1s orbital?

$$E_{transition} = \left( \frac{-1312}{n_f^2} \right) - \left( \frac{-1312}{n_i^2} \right)$$

$$E_{transition} = \left( \frac{-1312}{1^2} \right) - \left( \frac{-1312}{4^2} \right)$$

$$E_{transition} = -1312 + \left( \frac{1312}{16} \right)$$

$$E_{transition} = -1230 \text{ kJ/mol}$$

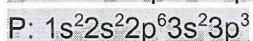
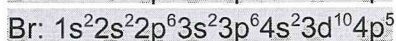
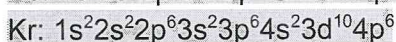
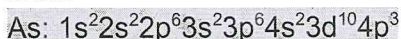
$$E = hfN_A$$

$$f = \frac{E}{hN_A}$$

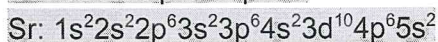
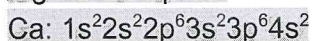
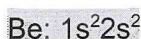
$$f = \frac{1230}{(6.63 \times 10^{-37})(6.022 \times 10^{23})}$$

$$f = 3.08 \times 10^{15} \text{ Hz}$$

4. Write the electron configurations for the following elements: arsenic, krypton, bromine, and phosphorus.



5. Write the electron configurations for Be, Mg, Ca, and Sr. What is the similarity in the configurations of the outermost electrons of these elements?



All of these elements have the outermost electrons located in an s orbital.

6. Write the electron configurations for Sc, Ti, Ni, and Zn. Which sublevel is changing in these configurations?

Sc:  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^1$

Ti:  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^2$

Ni:  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^8$

Zn:  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10}$

The d sublevel is changing in these electron configurations.

7. For each of the following electron configurations of neutral atoms, determine the name of the element listed and determine if the configuration as written is the ground state or an excited state:

$1s^2 2s^2 2p^6$

Neon - ground state

$1s^2 2s^2 2p^5 3s^2$

Sodium - excited state

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

Vanadium - ground state

$1s^2 2s^2 2p^6 3s^2 5s^1$

Aluminum - excited state

8. For each of the following electron configurations of neutral atoms, determine if the configuration as written is the ground state, an excited state, or if it is an impossible configuration:

N:  $1s^2 2s^2 2p^3$

Ground state

Na:  $1s^2 2s^2 2p^6 4s^1$

Excited state

Ne:  $1s^2 2s^3 2p^5$

Impossible configuration - too many electrons in the 2s

V:  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^2 4p^1$

Excited state

9. Write the electron configurations for elements 37, 38, and 39 (rubidium, strontium, and yttrium).

Rb:  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1$

Sr:  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2$

Y:  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^1$