Work hard. Be nice.

Name: _____ Period: _____

Date: _____ **Hybrid Chemistry Regents Prep** Ms. Hart/Mr. Kuhnau

UNIT 1: All about Atoms

Lesson 1.3: Electrons!

By the end of today, you will have an answer to:

What is electron configuration? How does ground state compare to excited state?

Do Now:

1. According to the wave-mechanical model of the atom, electrons in an atom
   (1) Travel in defined circles
   (2) Are most likely found in an excited state
   (3) Have a positive charge
   (4) Are located in orbitals outside the nucleus

2. What is the total charge of a nucleus of a carbon atom?
   (1) -6 (3) +6
   (2) 0 (4) +12

3. What is the total number of neutrons in an atom of $^{57}_{26}Fe$?
   (1) 26
   (2) 31
   (3) 57
   (4) 83

4. A neutral atom contains 12 neutrons and 11 electrons. The number of protons in this atom is
   (1) 1 (3) 11
   (2) 12 (4) 23

5. Isotopes of an element must have different
   (1) Atomic numbers
   (2) Mass numbers
   (3) Numbers of protons
   (4) Numbers of electrons

6. The atomic mass of an element is the weighted average of
   (1) Number of protons in the isotopes of that element
   (2) Number of neutrons in the isotopes of that element
   (3) Atomic numbers of the naturally occurring isotopes of that element
   (4) Atomic masses of the naturally occurring isotopes of that element.

Base your answers to questions 7 and 8 on the information below.

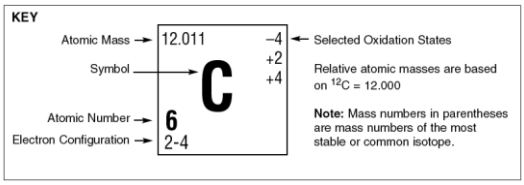
Naturally Occurring Isotopes of Sulfur

Isotope	Atomic Mass (atomic mass units, u)	Natural Abundance (%)
^{32}S	31.97	94.93
^{33}S	32.97	0.76
^{34}S	33.97	4.29
^{36}S	35.97	0.02

7. State, in terms of number of subatomic particles, *one* similarity and *one* different between the atoms of these isotopes of sulfur.

8. In the space below, show a correct numerical setup for calculating the atomic mass of sulfur.

Electron Configuration



WORDS THEY THROW AT YOU:

- Chemically similar
- Energy level
- Absorb
- Emit
- Spectra (singular = spectrum)
- Partially filled
- Stable

KEY POINTS/ NOTES:

Comment [BK1]: In three minutes or less, highlight the following:
Electron configuration for each element is found on the bottom of the box.
The electron configuration is separated into different numbers with each number representing the electrons in that shell.
Each shell can only hold a certain number of electrons. First = 2, Second = 8, Third = 18, etc.
The valence shell is the last shell of the atom. The valence electrons are the last number in the electron configuration. Atoms with the same number of valence electrons have similar properties.
Memory Hint: V is at the end of the alphabet, just as the valence shell is the at the end of the electron configuration.

Example: Which of the following is chemically similar to calcium?

(1) Mg (2) K (3) Mn (4) Zn

Lewis Electron Dot Diagram:

- Only shows the number of valence electrons
- One dot represents one electron

Example:
Phosphorus (P) has an electron configuration of: 2 – 8 – 5
So, Phosphorus has 5 valence electrons.

Lewis dot structure of Phosphorus →
(5 dots representing the 5 valence electrons)

Try this!: Draw a Lewis dot diagram of He and Nitrogen.

He	Nitrogen

Excited State versus Ground State Electrons
Notes:

Comment [BK2]: Explain that normally shells must be filled in order, from the first shell to the last. This is called ground state.
Further relate that there are instances when an atom will gain energy and one or more of the electrons will jump to a higher level. This is called excited state.
Emphasize that excited state can simply be found when the electron configuration shows an incomplete lower shell.

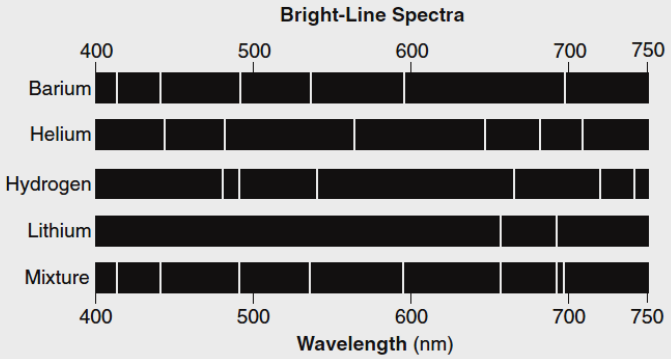
	Ground State	Excited State
High energy or Low energy?		
Electrons further away from nucleus or closer to the nucleus?		
How do you find the electron configuration?		
Example using carbon.		

Comment [BK3]: Highlight that the excited state could have more than one answer. (2-3-1, 1-5, 1-4-1, etc.)

Spectral Lines and Flame Test:

Comment [BK4]: Explain how the excited state is unstable and electrons will always quickly return to the ground state. When they do, light is given off. Each element has a different type of light given off and when it is broken apart, there is a different pattern.

The diagram below represents the bright-line spectra of four elements and a bright-line spectrum produced by a mixture of two of these elements.



Which two elements are in this mixture?

(1) barium and hydrogen
(2) barium and lithium
(3) helium and hydrogen
(4) helium and lithium

PRACTICE:

1. What is the total number of valence electrons in a calcium atom in the ground state?
   (1) 8
   (2) 2
   (3) 18
   (4) 20

2. Which element is most chemically similar to chlorine?
   (1) Ar
   (2) F
   (3) Fr
   (4) S

3. Which symbol represents an atom in the ground state with the most stable valence electron configuration?
   (1) B (3) Li
   (2) O (4) Ne

4. An atom in the ground state has a stable valence electron configuration. This atom could be an atom of
   (1) Al (3) Na
   (2) Cl (4) Ne

5. Magnesium and calcium have similar chemical properties because a magnesium atom and a calcium atom have the same
   (1) atomic number
   (2) mass number
   (3) total number of electron shells
   (4) total number of valence electrons

6. State, in terms of the number of electron shells, why the radius of a strontium atom in the ground state is larger than the radius of a magnesium atom in the ground state.

7. Explain, in terms of atomic structure, why the elements in Group 2 have similar chemical properties.

8. Which electron configuration could represent a strontium atom in an excited state?
   (1) 2–8–18–7–1 (3) 2–8–18–8–1
   (2) 2–8–18–7–3 (4) 2–8–18–8–2

9. Which electron configuration represents an atom in an excited state?
   (1) 2–7 (3) 2–8–1
   (2) 2–6–2 (4) 2–8–8–2

10. An electron in a sodium atom moves from the third shell to the fourth shell. This change is a result of the atom
    (1) absorbing energy (3) gaining an electron
    (2) releasing energy (4) losing an electron

11. Which electron configuration represents an excited state for a potassium atom?
    (1) 2-8-7-1 (3) 2-8-8-1
    (2) 2-8-7-2 (4) 2-8-8-2

12. Which electron configuration represents an atom of aluminum in an excited state?
    (1) 2-7-4
    (2) 2-7-7
    (3) 2-8-3
    (4) 2-8-6

13. Which of the following is a *not* a correct electron configuration for an atom of aluminum-27 in an excited state?
    (1) 2-7-4
    (2) 1-8-4
    (3) 2-7-3-1
    (4) 2-8-3

14. Which electron configuration represents an atom of chlorine in an excited state?
    (1) 2-8-7
    (2) 2-8-8
    (3) 2-8-6-1
    (4) 2-8-7-1

15. Which electron transition represents a gain of energy?
    (1) from 2nd to 3rd shell
    (2) from 2nd to 1st shell
    (3) from 3rd to 2nd shell
    (4) from 3rd to 1st shell

16. In comparison to an atom of $^{19}_{9}F$ in the ground state, an atom of $^{12}_{6}C$ in the ground state has
    (1) three fewer neutrons
    (2) three fewer valence electrons
    (3) three more neutrons
    (4) three more valence electrons

17. An atom has an atomic number of 9, a mass number of 19, and an electron configuration of 2–6–1.
    a) What is the total number of neutrons in this atom?

    b) Explain why the number of electrons in the second and third shells shows that this atom is in an excited state.

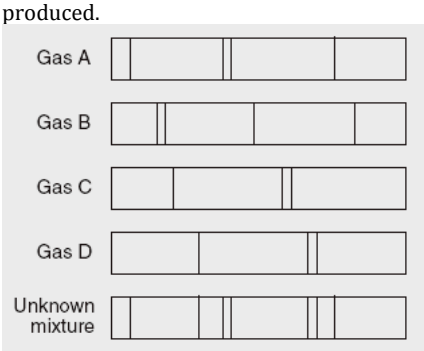
18. The characteristic bright-line spectrum of sodium is produced when its electrons
    (1) return to lower energy levels
    (2) jump to higher energy levels
    (3) are lost by the neutral atoms
    (4) are gained by the neutral atoms

19. During a flame test, ions of a specific metal are heated in the flame of a gas burner. A characteristic color of light is emitted by these ions in the flame when the electrons
    (1) gain energy as they return to lower energy levels
    (2) gain energy as they move to higher energy levels
    (3) emit energy as they return to lower energy levels
    (4) emit energy as they move to higher energy levels

20. The diagram below shows the characteristic spectral line patterns of four elements. Also shown are spectral lines produced by an unknown substance. Which pair of elements is present in the unknown?

(1) lithium and sodium
(2) sodium and hydrogen
(3) lithium and helium
(4) helium and hydrogen

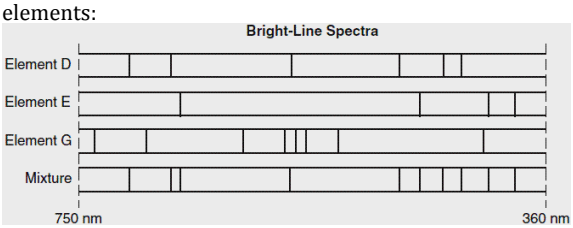
21. Many advertising signs depend on the production of light emissions from gas-filled glass tubes that are subjected to a high-voltage source. When light emissions are passed through a spectroscope, bright-line spectra are produced.



Identify the *two* gases in the unknown mixture.
(1) A and B
(2) A and D
(3) B and C
(4) C and D

22. In a calcium atom in the ground state, the electrons that possess the *least* amount of energy are located in the
(1) first electron shell
(2) second electron shell
(3) third electron shell
(4) fourth electron shell

23. Given the bright-line spectra of three elements and the spectrum of a mixture formed from at least two of these elements:



Which elements are present in this mixture?
(1) *E* and *D*, only
(2) *E* and *G*, only
(3) *D* and *G*, only
(4) *D*, *E*, and *G*