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# ONLINE STUDY RESOURCE

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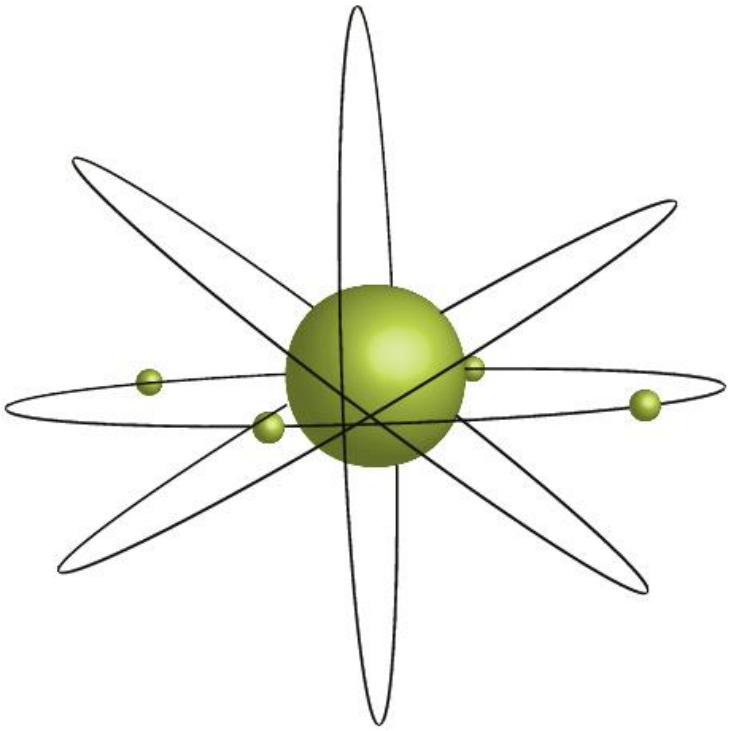
# 100 Common Questions About The Periodic Table.

# A Study Guide.



Second Edition.

José Barreto

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# About this book

This ebook was written with the purpose of helping students to understand the common concepts related with the periodic table.

# How to use this book

-The book is divided into 7 sections, each one referring to a different topic related to the periodic table.

- Section 1. Atomic model
- Section 2. Electron configuration
- Section 3. Atomic and ionic radius
- Section 4. Learning the periodic table
- Section 5. Reactions and miscellaneous
- Section 6. Atomic number, mass number, isotopes
- Section 7. Electronegativity

-Try to find the answer for each question by yourself before reading the answer; compare your answer with the answer provided in the book.

-Use the links provided through the text to find additional information related to the topic that is discussed.

-Use the periodic table provided at the end of the book to solve the questions and understand the answers.

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# Section 1. Atomic model

**1. How does the Bohr model relate to the periodic table?**

Bohr model describes the atom as a nucleus surrounded by electrons that moves in defined orbits. Each of this orbits posses a certain level of energy and can only hold a certain number of electrons. Using this model it was possible to understand and predict many properties of the elements in the periodic table. One of these properties was the size of the atoms. Elements size decrease moving from the left to the right and increases moving down in the periodic table. The trends of atomic size in a period can be explained in terms of the electrons filling the same orbit when increasing their number. The atoms size does not increase, but more protons (as the atomic number increases) are pulling the electrons towards the nucleus making the atoms smaller. Atoms only becomes bigger when a new shell is added, thus the size increases going down a group where new shells are added.

Another property predicted with this model was the reactivity of some elements. Using the shell model it was possible to explain why the noble gases are not reactive. This happens because their outer orbits are full of electrons.

**2. How does the structure of the atom relate to the atom's position in the periodic table?**

In the actual model, it is considered that the atom consists of a nucleus, containing protons and neutrons, and electrons which are located around the atom. The property that varies among the elements in the periodic table and gives them their particular order, in which they are arranged, is the atomic number. The atomic number is the number of protons present in the nucleus of an atom of a given element. For any element, the atomic number is a natural number, 1, 2, 3, etcetera. As elements are classified according to their atomic number, they can be arranged in increasing order of atomic number, starting from 1 to 120 or more. Thus the atoms position on the periodic table depends on their atomic number or the number of protons present in the nucleus, which is directly related with the structure of the atoms and their identity.

**3. Why would any element that will eventually be produced or discovered be located in the lower end of the periodic table?**

As elements can only have entire atomic numbers and there have been discovered or produced around 116 elements, any new element discovered or produced can only have a higher atomic number than the 116 already known elements. This would locate any new element at the lower end of the periodic table.

**4. Which of the following particles are found in the nucleus of an atom.**

A. Electrons, only

B. Neutrons, only

C. Protons and electrons

D. Protons and neutrons

*Answer*: D. Protons and neutrons. An atom nucleus consists of protons and neutrons whereas electrons are located in orbitals around the nucleus.

**5. What is the structure of an atom and what makes each element different from the others?**

An atom consists of three particles, protons, electrons and neutrons. Protons and neutrons form the nucleus of the atom whereas electrons surround the nucleus and are located in different orbitals. Each of the elements on the periodic table differs from one to another in the number of protons that they possess in their nucleus (atomic number).

**6. Can you divide any element's atom?**

In theory yes, you can divide any elements atom. This process is usually carried by nuclear fission, a process which consists of either a nuclear reaction or a radioactive decay that forms smaller atoms and/or neutrons and photons. This process also liberates and incredible amount of energy.

**7. Why aren't electrons included in the calculation of mass number?**

The mass of an electron ($9.11 \times 10^{-31}$ kg) is negligible compared with the mass of protons ($1.66 \times 10^{-27}$ kg) and neutrons ($1.67 \times 10^{-27}$ kg), thus its value is excluded from the calculations of mass numbers.

**8. How do I find how many protons, electrons and neutrons are in an element?**

You can refer to the periodic table to find the number of protons of an atom. In the periodic table the number of protons of any element corresponds to its atomic number. On a neutral atom, the number of protons should be equal to the number of electrons. In case of ions of an element you should add or subtract the charge of the element ion to the atomic number of the element. The number of neutrons depends on the isotope of the element you are referring to. This number can be found from the mass number of the element by subtracting it atomic number: *mass number – atomic number*.

**9. According to Dalton's atomic model, can atoms be destroyed or created? According to the law of conservation of mass, is mass conserved after a chemical reaction? Does Dalton's model support the law of conservation of mass?**

One of the principles of Dalton's atomic theory is that atoms cannot be destroyed nor created. This has been proved to be false in modern times. The law of conservation of mass states that the mass of an isolated system will remain constant over time, thus mass cannot be created nor destroyed. In a chemical reaction the total mass of the system should remain constant, or in other words, the mass of the products should be the same as the mass of the reactants. Dalton's model does support the law of conservation of mass, as in a chemical reaction atoms cannot be destroyed or created and the mass of the system should remain constant after the reaction. Also according to his theory, atoms cannot change their mass and only combine with other atoms to form compounds.

**10. The _____ is a particle that has one unit of positive charge.**

A. Proton
B. Photon
C. Electron
D. Nucleus

*Answer*: A. Proton. A proton is a particle with one unit of positive charge.

**11. The _____ is a particle that has one unit of negative charge.**

A. Proton
B. Positron
C. Electron

D. Nucleus

*Answer*: C. Electron. An electron is a particle with one unit of positive charge.

**12. A(n) _____ cannot be broken down into anything simpler by means of chemical reactions.**

A. Gas
B. Substance
C. Element
D. Solid

*Answer*: C. Element. An atom of an element cannot be broken down into simpler things using chemical reactions.

**13. An atom can be considered the smallest unit of an element that retains the _____ of that element.**

A. Shape
B. Mass
C. Texture
D. Properties

*Answer*: D. Properties. An atom of an element retains the properties of that element.

**14. In the model of an atom what type of particle has no electrical charge?**

A. Proton
B. Neutron
C. Electron
D. Nucleus

*Answer*: B. Neutron. A neutron does not possess any electrical charge.

**15. What did each of the following men contribute to the atomic theory?**

A) John Dalton
B) Joseph Thomson
C) Albert Einstein
D) Niels Bohr
E) Ernest Rutherford

A) Dalton was the first to establish and atomic theory, he postulated the following statements:

- Elements are made of small particles called atoms.

- Atoms of a given element are identical in size, mass, and other properties; atoms of different elements differ in their size, mass, and other properties.

- Atoms cannot be subdivided, created, or destroyed.

- Atoms of different elements combine in simple whole-number ratios to form chemical compounds.

- In chemical reactions, atoms are combined, separated, or rearranged.

B) Thomson is considered to being the scientist who discovered electrons and isotopes. Also he contributed to the development of an atomic model in which electrons were positioned in an sphere of positive matter by electrostatic forces.

C) Einstein contributed by giving the idea that atoms can be converted into energy leading to the development of the atomic bomb and atomic energy. This is derived from his famous equation, E $mc^2$ which related the energy of an atom with its mass.

D) Bohr refined Rutherford's model of the atom by introducing quantum principles. Basically he described the atom as a central positive core surrounded by electrons that were positioned in well defined orbits around the nucleus. Each of those orbits would be able to have a limited number of electrons and have an associated energy level.

E) Rutherford proposed a model of the atom derived from his work bombarding gold foil with radioactive particles. With this experiment he concluded that most of the mass of an atom must be located in its centre in a small nucleus and the rest of the atom would be empty space.

# Section 2. Electron configuration

*Use the following video as a guide to easily write electron configurations of neutral atoms:*

http://youtu.be/UAS3h_YSoeg

**1. What would be the atomic number of the element that would have an electron found in the 3th sublevel?**

The question is referring to the neutral element that has one electron in any of the orbitals that belong to the sublevel 3: 3s, 3p, 3d, 3f. Thus using an electron configuration chart we can construct the electron configuration on an element with ONE electron in the sublevel 3: $1s^2$ $2s^2$ $2p^6$ $3s^1$. If we now sum the number of electrons in the atom: 2 + 2 + 6 + 1 = 11, we can obtain the number of protons assuming the atom is neutral. Remember that the number of electrons in a neutral atom is equal to the number of protons (atomic number), thus the number of protons and the atomic number of this element is 11 (Sodium, Na).

**2. What would be the full electron configuration of an atom with one electron in the 4th sublevel? Describe this element in terms of protons, electrons, mass number, and other properties that can be inferred from the periodic table.**

The question is referring to the neutral element that has one electron in any of the orbitals that belong to the sublevel 4: 4s, 4p, 4d, 4f. Thus using an electron configuration chart we can construct the electron configuration on an element with ONE electron in the sublevel 4: $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ $4s^1$. If we now sum the number of electrons in the atom: 2 + 2 + 6 + 2 + 6 + 1 = 19, we can obtain the number of protons assuming the atom is neutral. Remember that the number of electrons in a neutral atom is equal to the number of protons (atomic number), thus the number of protons and the atomic number of this element is 19 (Potassium, K). The number of neutrons should be equal to the number of protons in nothing else have been stated, thus the atom has 19 neutrons. We now can calculate the value of the mass number of the atom that should be the sum of protons and neutrons: 19 + 19 = 38. In terms of reactivity, we can infer from the electron configuration that potassium tend to donate one electron when participates in a reaction in order to complete 8 electrons in its valence shield: $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ $4s^1$ (K) → $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ ($K^{+1}$). $K^{+1}$ is the common ionic form of potassium and due to its tendency to donate electrons, mostly forms ionic compounds with non-metal ions like $Cl^{-1}$, $F^{-1}$, etcetera. You can do a similar analysis for any atom.

**3. A non-metal has the outer subshell nearly filled with electrons or mostly empty?**

A non-metal is going to have the outer subshell nearly filled with electrons. If we analyse the electron configuration of the non-metals (the elements at the right hand side of the periodic table) we will find out that all of them will have the p level mostly filled with electrons, for example, oxygen is a non-metal and its electron configuration (obtained using the electron configuration chart at the end of the book) corresponds to: $1s^2\ 2s^2\ 2p^4$. The outer subshell of oxygen is 2p, as this subshell should contain 6 electrons to be totally filled we can say that by missing only two electrons the outer subshell of oxygen is nearly full. This also applies to the outer shell 2s 2p: following the octet rule this shell should contain 8 electrons, in the case of oxygen it contains 6 (2 from s + 2 from p) thus being nearly full. This rationalization applies for any of the non-metals in the periodic table.

**4. Does a filled subshell can allow an atom to achieve greater stability?**

Yes, atoms will acquire a more stable configuration after one of their subshells is completely filled with electrons.

**5. What can be the total number of energy levels of an element located in Period 3?**

A. 0

B. 1

C. 3

D. 9

*Answer*: C. 3. An atom located in the third period of the periodic table would have an electron configuration between $1s^2\ 2s^2\ 2p^6\ 3s^1$ and $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$. The highest energy level is 3 as can be seen from the electron configurations.

**6. Write the electron configuration of iodine, in regular notation, and in noble-gas notation.**

To obtain the electron configuration of Iodine we must first find its atomic number in the periodic table. The atomic number of Iodine is 53. Once we have found the atomic number, we can construct the electron configuration in regular notation: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^5$. Once we have written the configuration in regular notation we can obtain the noble-gas notation by using the first noble gas below iodine (krypton, 36) to abbreviate the first orbitals:

Kr (36) = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6$. Thus the noble-gas notation of Iodine should be the one of Krypton plus the rest of the orbitals to complete 53 electrons: [Kr] $5s^2\ 4d^{10}\ 5p^5$.

**7. Write all possible sets of quantum numbers (n, l, ml, and ms) for an electron located in the 3th energy level in the d-subshell.**

To answer this question you must understand the meaning of each of the quantum numbers, n, l, ml and ms.

n = 3. n is the principal quantum number and describes the energy of the electron. Because the electron is located in the third level of energy thus its value is 3.

l = 2. l is the azimuthal quantum number and describes the angular momentum of the electron. l is usually represented by a letter, s, p, d, f, etc. l have the following values: s = 0, p = 1, d = 2 and f = 3. Because the electron is located in d subshell, l should be 2.

ml, = -2, -1, 0, 1, 2. ml is the magnetic quantum number and describes the magnetic moment of the electron. An electron located in a d subshell can have the values: -2, -1, 0, 1, 2.

ms = +1/2, -1/2. ms represents the spin quantum number of the electron and can have two values, +1/2, -1/2.

**8. What is the correct ground state electron configuration for the element that contains 23 protons?**

A. $4s^2\ 3d^{10}\ 5s^2\ 4p^4$
B. $1s^2\ 2s^2\ 3s^2\ 4s^2\ 2p^6\ 3p^6\ 5p^3$
C. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^3$
D. $1s^2\ 2s^2\ 2p^6\ 3p^6\ 3s^2\ 3d^3\ 4s^2$

*Answer:* C. To answer this question you will need to build the electron configuration for the element with atomic number 23. You can do this using the electron configuration chart provided at the end of the book. The correct electron configuration is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^3$. Other options do not follow the Aufbau rule for filling electron orbitals.

**9. What is the meaning of electron configuration of an atom?**

The electron configuration of an atom represents the distribution of electrons of an atom in atomic orbitals.

**10. How many electrons can be present in an atom having three principal energy levels?**

An atom having three principal energy levels should have the following electron configuration: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$. Thus the maximum number of electrons that can have is 18 and the minimum 11. These atoms correspond to period 3 in the periodic table.

**11. Isoelectronic species are atoms that possess similar electron configurations. Which of the following ions are isoelectronic?**

**A. $Li^+$, $H^-$, He**

**B. $Ca^{2+}$, Ne, $S^{2-}$**

To answer this question you will need to build the electron configuration for each of the ions listed above. You can do this using the electron configuration chart provided at the end of the book. Below is shown what you should obtain for each ion. Remember that ions are charge negatively or positively therefore additional electrons should be added or subtracted of the electron configuration for the neutral atom.

A. Neutral atom: $Li^{0:}\ 1s^2\ 2s^1$; charged atom: $Li^+$: $\mathbf{1s^2}$, an electron has been subtracted.

A. Neutral atom: $H^0$: $1s^1$; charged atom: $H^-$: $\mathbf{1s^2}$, an electron has been added.

A. Neutral atom: He: $\mathbf{1s^2}$.

Comparing the three ions all of them have the same electron configuration: $\mathbf{1s^2}$ thus they are considered isoelectronic.

B. Neutral atom: $Ca^0$: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$; charged atom: $Ca^{2+}$: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$, a couple of electrons has been subtracted.

B. Neutral atom: $Ne^0$: $1s^2\ 2s^2\ 2p^6$.

B. Neutral atom: $S^0$: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$; charged atom: $S^{2-}$: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$, a couple of electrons has been added.

Comparing the three ions none of them have the same electron configuration thus they are not considered isoelectronic.

**12. Write a ground state electron configuration for each neutral atom listed below. Ground state means that all of the lowest possible energy levels (up to the proper number of electrons for the element) are filled.**

A. K

B. Pb

C. Sc

D. Ra

E. O

F. Ag

G. Ru

H. Ce

I. I

J. F

To answer this question you will need to build the electron configuration for each of the atoms listed above. You can do this using the electron configuration chart provided at the end of the book and using the atomic number of each element.

A. K $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$

B. Pb $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f^{14}\ 5d^{10}\ 6p^2$

C. Sc $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^1$

D. Ra $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f^{14}\ 5d^{10}\ 6p^6\ 7s^2$

E. O $1s^2\ 2s^2\ 2p^4$

F. Ag $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^9$

G. Ru $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^6$

H. Ce $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f^2$

I. I $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^5$

J. F $1s^2\ 2s^2\ 2p^5$

**13. Write a ground state electron configuration for these ions. Ions can gain or lose electrons so remember that a positive ion (cation) has less number of electrons than its neutral form whereas a negative ion (anion) has more electrons than its neutral form.**

**Example: $C^{4+}$ is a cation thus has 4 electrons *less* than its neutral form $C^0$. If $C^0$ has 6 electrons and its configuration is $1s^2\ 2s^2\ 2p^2$, then $C^{4+}$ should have only two electrons; thus its electron configuration would be $1s^2$.**

A. $O^{2-}$

B. $Fe^{3+}$

C. $Br^{-1}$

D. $Ni^{2+}$

E. K+

F. $Cu^{2+}$

G. $F^{1-}$

H. $Ca^{2+}$

To answer this question you will need to build the electron configuration for each of the ions listed above. You can do this using the electron configuration chart provided at the end of the book. You also need to have in account the charge of the atom to sum or subtract electrons accordingly.

A. $O^{2-}\ 1s^2\ 2s^2\ 2p^6$

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

C. $Br^{-1}\ 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6$

D. $Ni^{2+}\ 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^6$

E. K+ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

F. $Cu^{2+}\ 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^7$

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

H. $Ca^{2+}\ 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$

**14. Choose 3 possible elements or ions that may represent the following electron configurations**

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

B. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6$

C. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}$

D. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2$

E. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^4$

F. [Ar] $4s^1$

G. [Ar] $4s^2\ 3d^5$

H. [Ne] $3s^2$

I. [Ne] $3s^2 3p^4$

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

In order to solve this problem, we should first count the number of electrons given by the electronic configuration of the atom; for A, the number of electrons is 21. After determining the number of electrons we can use a periodic table to look for the element with atomic number 21: Scandium, $Sc^0$. This is the first possible answer. Now we can look for an element around scandium with an oxidation state of 1+, 2+ or more than can have the same electron configuration. For example, we can choose Vanadium (II), $V^{2+}$ and Chromium (III), $Cr^{3+}$, as they possess the electron configuration: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^1$. You can also choose elements with negative charges if they are close to the neutral element in the periodic table, represented by that electron configuration. Use the periodic table at the end of the book with charges to determine the oxidation states of the elements.

A. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^1$ **$Sc^0$, $V^{2+}$, $Cr^{3+}$**

B. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6$ **$Kr^0$, $Br^{1-}$, $Rb^{1+}$**

C. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}$ **$Zn^0$, $Ge^{2+}$, $As^{3+}$**

D. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2$ **$Sr^0$, $Nb^{3+}$; only these 2 options exist.**

E. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^4$ **$Mo^0$, $Rh^{3+}$, $Pd^{4+}$**

F. [Ar] $4s^1$ **$K^0$, $Ti^{3+}$, $V^{4+}$**

G. [Ar] $4s^2$ $3d^5$ **$Mn^0$, $Co^{2+}$, $Ni^{3+}$**

H. [Ne] $3s^2$ **$Mg^0$, $Si^{2+}$, $P^{3+}$**

I. [Ne] $3s^2 3p^4$ **$S^0$, $Cl^{1+}$; only these 2 options exist.**

J. [Kr] $5s^2$ $4d^{10}$ $5p^2$ **$Zr^0$, only this option exists.**

**15. What's the difference between an atom in its ground state and in an excited state?**

An atom in its ground state will be at its minimum energy level, an excited state is any energy level higher or any state with higher energy than the ground state.

**16. What would be the most likely charge of an ion formed from an atom with the following electron configuration: $1s^2$ $2s^2$ $2p^5$?**

A. +1

B. -1

C. +3

D. -3

*Answer*: B. -1. An atom with this electron configuration would require only 1 electron to complete its valence layer (according to the octet rule) by filling the 2p subshell. Thus the ion formed after accepting 1 electron must be -1. This is the case for the halogens: fluorine, chlorine, bromine and iodine.

**17. How many electrons can occupy an s orbital?**

s orbitals can be only occupied by 2 electrons according to the rules of quantum mechanics.

**18. List the exceptions to the octet rule.**

There are 3 types of exceptions to the octet rule:

1. Molecules that do not have enough electrons to achieve the octet. These molecules are generally composed of Beryllium, Boron and Aluminium, Be, B and Al respectively.

Atoms like hydrogen and helium do not have a minimum of 8 electrons although they can form stable species.
2. Elements located in the third period and below can accommodate more than an octet of electrons. The most common atoms following this are phosphorous and sulphur.
3. Free radicals. These are atoms with unpaired electrons that clearly violate the octet rule.

# Section 3. Atomic and ionic radius

### 1. How can we determine the atomic radius and ionic radius using a periodic table?

There are many periodic tables that include the atomic and ionic radius of the elements, although they are more likely found in table of atomic radius or ionic radius. At this link you can find a complete table of atomic and ionic radius for all the elements: http://materias.qi.fcen.uba.ar/file.php/16/Tablas/Radios_atomicos_e_ionicos.pdf.

### 2. Describe the periodic trends in atomic radius in the periodic table.

Atoms get bigger as you go down the groups. This is a consequence of the increasing number of electrons in the atoms. In terms of the periods, the atomic radius increases across the periods, from left to right. This decrease is due to the increase in the nuclear charge as the number of protons in each atom increases. As electrons (negatively charged) are attracted to protons (positively charged), the increase in the number of protons from one atom to the next one in a period causes an increase attraction of electrons from the outer shell of an atom towards the nucleus.

### 3. Which of the following is the largest ion?

A. $Cl^-$
B. $S^{2-}$
C. $Na^+$
D. $F^-$

*Answer*: B. $S^{2-}$. To solve this problem we can use a periodic table with ionic radius, like the one provided at the following link: http://wikis.lawrence.edu/download/attachments/295332/table10-9.jpg. We can infer how the charge of an atom will affect it atomic radius (to obtain its ionic radius). If electrons are added to the atom the radius will tend to increase whereas if electrons are removed from the atom, the radius will tend to decrease. Sodium, Na, is bigger than any of the other elements listed above but when an electron is removed its radius reduces notably forming $Na^+$, see image. While Chlorine $Cl^0$ and fluorine $F^0$ will increase their atomic radius because of the addition of one electron to form $Cl^{-1}$ and $F^{-1}$, the addition of 2 electrons to sulfur to form $S^{2-}$ from $S^0$ will have a greatest effect on the size of the ion; this is enough to obtain a bigger ion. Thus we can infer that the biggest ion will be sulfur because of the addition of 2 electrons to its valence shell.

### 4. If the atomic radius increases moving down a group on the periodic table what happens to the number of electrons when moving down a group?

The number of electrons also increases going down a group and this is the cause for the increase in the atomic radius of the elements when going down a group.

# Section 4. Learning the periodic table

### 1. How to memorize the periodic table?

Memorizing the periodic table can be fun; you can do it by either memorizing a song or playing puzzle games. Visit the following links for periodic table songs and games:

http://www.youtube.com/watch?v=zGM-wSKFBpo

http://www.youtube.com/watch?v=uJGrwWOWt3Q

http://www.youtube.com/watch?v=Apr7MdbHGQo&feature=related

### 2. How are elements grouped on the periodic table?

Elements are ordered in the periodic table according to their atomic number. They are grouped in groups and periods. A group is a vertical column in the table being 18 groups. Elements ordered in each group have common physical or chemical characteristics and properties of its outermost electron shells. Thus elements in the same group exhibit similar trends in reactivity.

### 3. What are the common features of each row in the periodic table?

The rows in the periodic table are called periods. Elements of the same period have the same number of electron shells.

### 4. What are the common features of each column in the periodic table?

Columns in the periodic table are called groups. The groups in the periodic table contain many common features for the elements belonging to each group. A common feature shared by most of the elements in a group is their oxidation state. This also gives very similar chemical and physical properties to the elements in a group.

### 5. How do we use the periodic table to predict which elements have similar properties?

We can use the periodic table to infer common characteristics of elements that are grouped within the table. In the simplest division, the table divide the elements into metals (left hand

side), metalloids and non-metals (right hand side). The table is also divided in groups. Each of the groups in the periodic table has elements with similar characteristics, for example the oxidation state. Many properties of an element can be inferred by comparison with an element located in the same group. This is very important to predict reactivity patterns in chemical reactions, for example.

**6. What properties are used to classify the elements?**

Elements are usually classified as metals, non-metals and metalloids. In this sense elements are classified according to properties such as malleability, ductility, thermal and electrical conductivity, strength, opacity and luster. Elements can also be classified according to the group they belong in the periodic table. This classification gives differences in properties such as reactivity.

**7. Where are nonmetals located on the periodic table?**

Nonmetals are the elements located in the right hand side of the periodic table. This group of elements includes carbon, nitrogen, phosphorous, oxygen, sulfur, selenium, the halogens and the noble gases. Some of their properties are their poor conductivity of heat and electricity; they are dull and brittle when they are solids; they have a high electronegativity and form acidic oxides.

**8.Transition metals are located in the middle of the periodic table. Which of the following statements about them is incorrect?**

A. They have similar properties to each other and form alloys.

B. Transition elements located higher in the periodic table are more reactive than those lower in the periodic table.

C. They dissolve in water to form alkaline solutions.

D. They are used in fireworks because they produce bright colours when they burn.

*Answer:* B. Transition elements located higher in the periodic table are more reactive than those lower in the periodic table. This statement is incorrect because reactivity of metals tend to increase moving down the periodic table as a consequence of their increasing number of electrons which are located far away from the nucleus and are less attracted to it.

**9. Alkali metals are located on the left of the periodic table. Which of the following statements is correct for these elements?**

A. They are found in the Earth's crust as metal nuggets.

B. Those elements located higher in the periodic table are generally more reactive than those lower in the table.

C. They dissolve in water to form alkaline solutions.

D. They are not very reactive because their outer electron shell is full.

*Answer*: C. They dissolve in water to form alkaline solutions. They react with water forming the respective metal hydroxide and releasing hydrogen gas ($H_2$). The reaction is as follows:

$2M_{(s)} + 2H_2O \rightarrow 2MOH_{(aq)} + H_{2(g)}$.

Due to their reactive nature, they are usually found in the earth as minerals not metal nuggets. Their reactivity increases going down the periodic table and are very reactive with non-metals because its outer electron shell is not full, they last energy level is $ns^1$ which means they can donate an electron in a reaction to acquire a more stable configuration thus making them very reactive.

**10. If element 116 is produced, its properties should resemble the properties of:**

A. Cesium, atomic number 55

B. Polonium, atomic number 84

C. Radon, atomic number 86

D. The element with atomic number 115

*Answer*: B. Polonium, atomic number 84. Remember that elements in the same group on the periodic table have similar properties. Looking to the periodic table, element 116, flerovium, would be located below Polonium thus resembling its properties.

**11. Can you name the noble gases?**

The noble gases are: Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr), Xenon (Xe) and Radon (Rn).

**12. How do you find out which element has a higher or lower reactivity?**

The reactivity of the elements depends on whether they are metals or non-metals. For the metals, reactivity increase going down a group and decreases when moving to the right in a period. In the case of non-metals, reactivity decreases going down a group and increases going from left to right in the periodic table.

You can derive both conclusions from the properties of the elements, like atomic radius and electronegativity. In the case of the metals, when the atomic radius increases, their capacity to donate electrons to participate in reactions increases, thus increasing their reactivity. In the case of non-metals, when their electronegativity increases, their capacity to attract electrons towards them increases, thus increasing their reactivity.

**13. In the modern periodic table, elements are arranged according to increasing _____ .**

A. Atomic Number
B. Atomic mass
C. Date of discovery
D. Electrical conductivity

*Answer*: A. Atomic number. Elements are arranged according to their atomic number. The atomic number of an element is equal to its number of protons, being an entire number.

**14. Which group in the periodic table contains an element that can form a blue compound with sulfate?**

Copper is the metal that more often form blue complexes. When it is charged as 2+, $Cu^{2+}$, it forms a copper salt with sulphate that is blue. Copper belong to group 11 in the periodic table.

**15. When moving down a group on the periodic table which two atomic properties follow the same trend?**

Only atomic and ionic radius increases when going down a group in the periodic table, other properties such as electronegativity and the ionization energy decreases moving down in a group.

**16. Is 118 the absolute limit to the atomic number of elements?**

It has been suggested that the highest possible atomic number might be 130. There is still a great controversy on this statement. For a complete discussion on this topic follow this link: http://en.wikipedia.org/wiki/Periodic_ta…

**17. Which of the following elements is a non-metal?**

A. Aluminum
B. Gold
C. Carbon
D. Tin

*Answer*: C. Carbon. Carbon is located in the right hand side of the periodic table and has none of the properties of metals like high conductivity, ductility and malleability.

**18. Which element shown here is the least metallic?**

A. Zinc

B. Iron

C. Cadmium

D. Silver

*Answer*: A. Zinc. Zinc is the less metallic element among this four, as is closer to the non-metals in the periodic table.

**19. Which of the following elements is a metalloid?**

A. Oxygen

B. Silicon

C. Chlorine

D. Argon

*Answer*: B. Silicon. Silicon has properties that are between those of metals and non-metals (metalloid). Metalloids can be distinguished in a periodic table as they are forming a diagonal between the metals and the non-metals.

**20. Which of the following is a noble gas?**

A. Carbon Dioxide

B. Boron

C. Oxygen

D. Helium

*Answer*: D. Helium. Noble gases are simple elements not molecules thus carbon dioxide cannot be a noble gas as is a molecule not an element. Noble gases are located in group 18 at the left hand side of the periodic table and the first of the noble gases is Helium.

**21. Which of the following pairs of elements could possibly be found in the same group on the periodic table?**

A. A forms a $2^+$ ion, B is an alkaline earth metal.

B. A is a noble gas, B forms a $1^-$ ion.

C. A has 3 valence electrons, B is a halogen.

D. A forms a $2^-$ ion, B has the atomic number 12.

*Answer*: A. A forms a $2^+$ ion, B is an alkaline earth metal. Alkaline earth metals have a charge of $2^+$ thereby A can be an alkaline earth metal. In the case of answer B, noble gases do not form $1^-$ ions. In answer C, halogens have 7 valence electrons therefore they cannot be in the same group as an atom with 3 valence electrons. In the case of D, B is carbon and carbon usually forms ions with 4+ charges not 2+.

**22. How is the periodic table used in chemistry?**

The periodic table contains all the information required by a chemist in order to find the properties of elements and how those properties affects the reactivity of the different substances, atoms or molecules in different environments. The periodic table is a necessary tool for any chemist as it serves as a guide to use in a daily basis.

**23. Do all the elements from the periodic table exist on earth?**

No, there are many elements that have been produced by man and cannot be found on earth. This is due to their instability which impedes them to exist in stable forms on earth. The human made elements are the ones with higher atomic number (like Flerovium, 114); they can only be synthesized in a laboratory and their half time lives are in the order of pico or nanoseconds or even less.

**24. Have all the elements been discovered?**

No, hypothetically we could create a huge number of elements with atomic numbers bigger than 120. Although these, the stability of elements with that size remains a problem and their synthesis, isolation and characterization is very difficult. For sure some other elements will be discovered/prepared in the future.

**25. In the periodic table, the most active nonmetals will be found in the:**

A. Upper Right

B. Upper Left

C. Lower Right

D. Lower Left

*Answer:* A. Upper Right. The reactivity of the non-metals increase according to their electronegativity, thus being the nonmetal elements on the upper right of the table the ones more reactive. Check the electronegativity trends for the elements to have a clear view of their reactivity.

**26. From its position in the periodic table, one would predict that the element Potassium, K, has the following property**

A. Is more active than lithium

B. Participate in chemical reactions by taking electrons from other elements

C. Would react with elements like oxygen or iodine to form covalent compounds

D. Has less attraction for its outer electron than does rubidium

*Answer:* A. Is more active than lithium. Potassium and Lithium belong to the same group in the periodic table. Reactivity tends to increase when you go down on a group in the case of metals, as it becomes easier for an atom to lose electrons when they become bigger. Other answers, like B, C or D are incorrect. Potassium do not participate in chemical reactions by taking electrons from other elements, the opposite, it usually gives electrons when participating in a reaction. Potassium also would not react with elements like oxygen or iodine to form covalent compounds, it forms ionic compounds sue to its facility to donate electrons instead of sharing them. Also potassium and rubidium has similar attraction for their outer electron.

**27. Why do the fourth and fifth periods contain 18 elements, rather than 8 as do the second and third periods or only 2 as the first period?**

This depends on the electron configuration of the atoms located on those periods. The first two elements have only an s orbital in their first energy level, whereas the second and third periods are made of elements containing s and p orbitals in their second and third energy level; these are only 8 elements per period. The fourth and fifth periods contain electrons in their d orbitals and we can find 18 elements for each period.

# Section 5. Reactions and miscellaneous

**1. List the colorless gases on the periodic table.**

Most of the gases in the periodic table are colorless, this includes the noble gases, He, Ne, Ar, Kr, Xe and Rn. Also molecules like $O_2$, $F_2$ and $N_2$ are colorless.

**2. What is the difference between an element, a compound and a mixture?**

An element is a single entity, a pure chemical substance consisting of one type of atom. A compound is made from different elements that are chemically bounded whereas a mixture is made of different substances that can be separated by physical methods. For example, Oxygen is an element; it has unique properties that define it. Sugar is a compound, is made from 3 elements chemically bonded, oxygen, hydrogen and carbon. Water and salt are a mixture, they are substances not chemically bonded that can be separated by physical methods, like evaporation.

**3. What is the relationship between an atom and a molecule?**

Molecules are composed of atoms. Atoms join together through chemical bonds to form bigger structures called molecules.

**4. What is the relationship between an atom and an element?**

An atom is a single unit of an element. The atom is the basic unit of matter. An element is a single entity, a pure chemical substance consisting of one type of atom.

**5. What is the relationship between a molecule and a compound?**

A molecule represents a simple unit of a compound. A compound is a substance made from many molecules of the same type.

**6. How do we look at a periodic table to predict which atoms will easily bond together?**

Generally speaking, atoms on the left hand side (metals) of the periodic table will tend to react with atoms in the right hand side (non-metals) to for ionic compounds. For example, potassium will react with chlorine to form a salt: KCl. Besides this, non-metals can react also within themselves to form covalent compounds. For example nitrogen reacts with oxygen to form $NO_2$, a covalent compound. Metals generally speaking do not react between themselves to form any kind of compound (except in special occasions out of the discussion in this book).

**7. Are nonmetals more likely to form cations or anions?**

Nonmetals are more likely to form anions. This is because they have the tendency to accept electrons when participating in a chemical bond, to complete its valence electrons following the octet rule. Because non-metals have their p-orbitals partially filled they require a few electrons to complete their valence shield. For example, oxygen ($1s^2\ 2s^2\ 2p^4$) will require only 2 electrons to complete its valence ($1s^2\ 2s^2\ 2p^6$) instead of donating its 6 electrons in the second energy level.

**8. From the following countries which one is not represented on the periodic table?**

A. United States

B. India

C. France

D. Germany

*Answer*: A. United States. Some elements in the periodic table are named after a person, an object or a country. This is the case of Francium, in honor to France, Germanium in honor to Germany and Indium in honor to India. There is not an element representing United States.

**9. X forms a compound with an element Y from Group VIA. The compound will most likely have the formula:**

A. $X_5Y_3$

B. XY

C. $X_3Y_6$

D. $X_3Y_2$

E. $X_2Y_3$

*Answer*: E. XY. First you will have to find out which elements belong to group VIA in the periodic table. As you can see at the periodic table at end of the book, group VIA corresponds to group 16 in the modern IUPAC notation for groups.

The elements that belong to this group are the oxygen family, O, S, Se, Te, Po and Lv. These elements have an electron configuration of their outer shell consisting of $ns^2\ np^4$. From this you can infer that the most common oxidation state of these elements is -2 as they require 2 electrons to complete their valence shell. Thus Y has to be $Y^{-2}$. In all the possible answers the molecule is neutral as doesn't have any charge. In the case of answer A, $X_5Y_3$, the oxidation state of X and Y corresponds to +3 and -5 respectively. In case of B the oxidation state of X and Y corresponds to +1 and -1 respectively. In case of C the oxidation state of X and Y corresponds to +2 and -1 respectively. In case of D the oxidation state of X and Y corresponds to +2 and -3 respectively. In case of E the oxidation state of X and Y corresponds to +3 and -2 respectively. Thus E is the correct answer as Y has an oxidation state of -2. B can be another possible answer as X could have an oxidation state of +2 and Y -2 instead of +1 and -1 respectively.

**10. The element chlorine (atomic number 17) will tend to:**

A. Lose electron(s) to become a positive ion.

B. Lose electron(s) to become a negative ion.

C. Gain electron(s) to become a positive ion.

D. Gain electron(s) to become a negative ion.

*Answer*: D. Gain electron(s) to become a negative ion. You can write the electron configuration of the atom in order to find its valence electrons, use the electron configuration chart at the end of the book to build electron configurations. For Chlorine the electron configuration will be: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$. According to the octet rule Chlorine will need 1 electron in order to fill the energy level 3 to be $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$. This mean that chloride has a tendency to acquire electrons instead of donate and because electrons are negatively charged the atom will become negative therefore chlorine will gain an electron to become negative, $Cl^{-1}$.

**11. The element Lithium has an atomic number of 3, it will tend to:**

A. Lose electron(s) to become a positive Ion.

B. Lose electron(s) to become a negative Ion.

C. Gain electron(s) to become a positive Ion.

D. Gain electron(s) to become a negative ion.

*Answer*: A. Lose electron(s) to become a positive ion. You can write the electron configuration of the atom in order to find its valence electrons, use the electron configuration chart at the end of the book to build electron configurations. For Lithium the electron configuration will be: $1s^2$ $2s^1$. In this case according to the octet rule Lithium will need to lose 1 electron to be $1s^2$ which is the configuration of the nearest noble gas (He). This mean that Lithium has a tendency to donate electrons instead of acquire and the atom will become positive as is losing electrons, therefore lithium will lose an electron to become positive, $Li^{+1}$.

**12. Metallic atoms will generally:**

A. Lose electron(s) to become a positive ion.

B. Lose electron(s) to become a negative ion.

C. Gain electron(s) to become a positive ion.

D. Gain electron(s) to become a negative ion.

*Answer*: A. Lose electron(s) to become a positive ion. Metallic atoms tend to lose electrons to become positive ions in order to acquire the electron configuration of the nearest noble gas.

**13. Non-Metallic atoms will generally:**

A. Lose electron(s) to become a positive ion.

B. Lose electron(s) to become a negative ion.

C. Gain electron(s) to become a positive ion.

D. Gain electron(s) to become a negative ion.

*Answer*: D. Gain electron(s) to become a negative ion. Non-metallic atoms tend to gain electrons to become negative ions in order to acquire the electron configuration of the nearest noble gas.

**14. Will Beryllium tend to lose or gain electrons? What is its Oxidation state?**

Beryllium will tend to lose electrons. Following the octet rule and looking at the electron configuration of this element ($1s^2$ $2s^2$) we can infer that beryllium would need to donate its two

electrons in its second energy level to acquire the more stable configuration of Helium ($1s^2$). Its oxidation state is 2+ due to its tendency to donate these two electrons.

**15. Will Oxygen tend to lose or gain electrons? What is its Oxidation state?**

Oxygen will tend to gain electrons. Following the octet rule and looking at the electron configuration of this element ($1s^2\ 2s^2\ 2p^4$), we can derive that oxygen only need two electrons to complete its valence shield (to be like Neon, $1s^2\ 2s^2\ 2p^6$) and will be more likely able to gain electron than to lose them. Therefore his common oxidation state should be $2^-$.

**16. Which chloride compound shows the greatest covalent bond character?**

A. LiCl

B. $SCl_2$

C. $AlCl_3$

D. $MgCl_2$

*Answer*: B. $SCl_2$. To answer this question we should compare the difference in electronegativity of each of the atoms in the molecules. In order to be considered a covalent compound, the molecule should posses a small difference in electronegativity. The difference in electronegativity between Li and Cl on LiCl is very high thus making it an ionic compound. The same applies for $MgCl_2$ and $AlCl_3$. The smallest difference in electronegativity of the atoms occurs between S and Cl.

**17. Compared to an atom of potassium, an atom of calcium has?**

A. Larger radius and lower reactivity

B. Larger radius and higher reactivity

C. Smaller radius and lower reactivity

D. Smaller radius and higher reactivity

*Answer*: C. Smaller radius and lower reactivity. Potassium and calcium are in the same period. Potassium has a larger radius than calcium because calcium has more protons that attracts it electrons stronger than potassium, thus reducing the size of the calcium atoms. Calcium is less

reactive because of the same reason, as it attracts its outer electron strongly, it is more difficult to be donated in a reaction than the one of potassium.

**18. What elements are described by properties such as luster, conductivity, and flexibility?**

A. Metals

B. Nonmetals

C. Gases

D. Plasma

*Answer*: A. Metals. Properties such as luster, conductivity and flexibility are characteristic of metals. This is due to the arrangement of metal atoms in their solid state. Metallic atoms are usually bond together by metallic bonds. When metallic atoms bond together they form networks where atoms are closely packed and electrons can easily "travel" across this network and are said to be delocalized. This property accounts for many of the physical properties of metals, such as malleability, ductility, thermal and electrical conductivity, strength, opacity and luster.

**19. What element is this? Is an element located in period 3 in the periodic table. The oxide of the Metal reacts with both acids and alkalis to form a solution of salt.**

Aluminium. It is the only metal in period 3 that forms an amphoteric oxide. Amphoteric oxides react with both acids and bases.

**20. Describe the periodic trend in the first ionization energies that can be found in the periodic table.**

Ionization energy is the energy required to remove electrons from atoms or ions. Ionization becomes greater moving up and to the right of the periodic table. This is due to a decrease in the atomic radius of the atoms which follows the opposite trend, as the atomic radius decreases it becomes more difficult to remove an electron that is closer to the positively charged nucleus, thus requiring more energy to ionize the atom.

**21. Why there is a change in ionisation from H to Li down the group in periodic table?**

Going down a group in the periodic table the ionization energy decreases, this is a consequence of the increase in the atomic radius of atoms, which cause that electrons locate far away from the nucleus making easy its removal.

**22. Why does it take more energy to remove an electron from $Al^+$ than from Al?**

In all cases the energy required to remove an electron from the outer shell of an atom will be less than the one required to remove an electron located in one of the inner layers of the atom. In $Al^+$, one electron has been removed with certain energy from $Al^0$. Because the next electron is closer to the nucleus, and thus attracted strongly, removing it will require a lot more energy than the first electron. This applies to any positive ion compared to its neutral form.

# Section 6. Atomic number, mass number, isotopes

**1. How many protons, neutrons and electrons does Sulfur-35 ( S-35) has?**

The notation S-35 is referring to an atom of sulphur with a mass number of 35. The mass number is the atomic number plus the number of neutrons of an element for a determined isotope. In this case the mass number of Sulfur-35 consists of the sum of its atomic number (16) and the number of neutrons of this isotope. Knowing the atomic number of S from the periodic table, we can calculate the number of neutrons in this atom, $35 = 16 + x$, so $x = 35\text{-}16 = 19$. As the atomic number is the number of protons on an element's atom, 16 will be the number of protons of S. Assuming S-35 is a neutral atom, the number of electrons must be equal to the number of protons, thus sulfur-35 possesses 16 electrons. The answer then is, 16 protons, 19 neutrons and 16 electrons.

**2. An ion contains 19 protons, 20 neutrons, and 18 electrons. What is the symbol of the ion?**

A. $S^{2-}$

B. $Cl^{-}$

C. $K^{+}$

D. $Ca^{2+}$

*Answer*: C. $K^{+}$. To solve this exercise you will need to use a periodic table to look for the atomic number and the name of the elements, use the table provided at the end of the book. This type of question can be solved knowing that the atomic number defines which element we are talking about. As the atomic number is the number of protons in an atom, in this case we can infer that the atom should have an atomic number of 19 as it has 19 protons. Looking at the periodic table we can easily fin potassium as the element with 19 protons. A positive ion of potassium, $K^{+}$ should have the atomic number minus one electrons, this is, 19 – 1 = 18 electrons, which matches the statement in the question.

**3. The atomic number tells you the number of _____ in one atom of an element. It also tells you the number of _____ in a neutral atom of that element. The atomic number gives you identity" of an element as well as its location in the periodic table No two different elements will have the _____ atomic number.**

The atomic number tells you the number of protons in one atom of an element. It also tells you the number of electrons in a neutral atom of that element. The atomic number gives you identity of an element as well as its location in the periodic table. No two different elements will have the same atomic number.

**4. The mass number of an element is the total number of protons and neutrons in the _____of an atom.**

*Answer*: nucleus. The mass number of an element is the total number of protons and neutrons in the nucleus of an atom.

**5. Give the symbol and number of electrons in a neutral atom of:**

A. Uranium

B. Chlorine

C. Boron

D. Iodine

*Answer*: To solve this exercise you will need to use a periodic table to look for the atomic number and the name of the elements, use the table provided at the end of the book. Remember that the number of electrons in a neutral atom is the same as its atomic number.

A. U, 92

B. Cl, 17

C. B, 5

D. I, 53

**6. Name the element that is most likely to have the following number of particles.**

A. 53 protons, 74 neutrons _____

B. 3 electrons (neutral atoms) _____

C. 20 protons _____

D. 86 electrons, 125 neutrons, 82 protons _____

E. 1 proton, 2 neutrons _____

*Answer*: To solve this exercise you will need to use a periodic table to look for the atomic number and the name of the elements, use the table provided at the end of the book.

A. 53 protons, 74 neutrons. As the number of protons for an element is constant and is equal to the atomic number of the element we simply locate the element 53 in the periodic table, Iodine (I). The number of neutrons should not be used in this case as the identity of the element depends on its atomic number (number of protons).

B. 3 electrons. A neutral atom has the same number of electrons and protons thus this element should have 3 protons which corresponds to the atomic number, thus the atom is Lithium, Li.

C. 20 protons. Look for the element with atomic number 20, Calcium, Ca.

D. 86 electrons, 125 neutrons, 82 protons. Looking at the number of protons (82) we can say that the element is Lead, Pb. The number of neutrons should not be used in this case as the identity of the element depends on its atomic number (number of protons). Because the number of electrons in this case is higher than the number of protons the lead atom must be charged with 4 electrons thus the complete answer is $Pb^{-4}$.

E. 1 proton, 2 neutrons. Hydrogen has an atomic number of 1 and one of its isotopes, deuterium, possess 2 neutrons. Thus the element is hydrogen.

**7. The atomic and mass numbers for four different elements are given in the following table. Which two can be considered to be isotopes?**

| Atom | Atomic Number | Mass Number |
|---|---|---|
| | | |
| **A** | **100** | **257** |
| **B** | **101** | **257** |
| **C** | **101** | **260** |
| **D** | **103** | **259** |

A. A and B
B. B and C
C. B and D
D. C and D

*Answer*: B. B and C. Isotopes are considered atoms of the same element having different number of neutrons in their nucleus. If we consider that two of the atoms in the table should be from the same element to be considered isotopes, we must select them according to their atomic number, as isotopes must possess the same atomic number. In this case, atoms B and C follow this rule. They are atoms from the same element according to their atomic number, but they differ in their number of neutrons, according to their mass number; atom B has 257-101 = 156 neutrons, whereas atom C has 260-101 = 159 neutrons.

**8. How many protons neutrons and electrons are present in isotopes?**

In isotopes of neutral atoms, the number of neutrons is the one that varies while the number of electrons and protons remain constant. For example, hydrogen has three isotopes, $^{1}H$, $^{2}H$ and $^{3}H$. In this case the number of protons is the same for the 3 isotopes having only 1 proton each. As we are assuming these are neutral atoms the number of electrons must be equal to the number of protons thus being 1 electron for each atom. What varies then is the number of neutrons that each atom posses, remember that the superscript before the symbol of the element represents the mass number of the atom which corresponds to the sum of protons and neutrons in that atom. For $^{1}H$ the mass number is 1 and as we know the number of protons is 1, we can infer that the atom has 0 neutrons. In the case of $^{2}H$ the atom has 1 proton and 1 neutron and finally in the case of $^{3}H$, the atom has 1 proton and 2 neutrons.

# Section 7. Electronegativity

**1. Which of these elements on the periodic table has the highest electronegativity?**

A. Lithium

B. Fluorine

C. Rubidium

D. Iodine

*Answer*: B. Fluorine. Fluorine is the element in the periodic table that has the highest electronegativity according to Pauling scale. You can easily find this using a periodic table understanding what the trends in electronegativity for the elements that are in the same group or period.

**2. What is the electronegativity value for the noble gases?**

There are different methods used to determine the electronegativity values of the elements in the periodic table. The most popular, is the one developed by Linus Pauling, who also proposed the concept of electronegativity. To determine the electronegativity of an atom using Pauling's method, one must have in account how it takes part in the formation of covalent bonds with other atoms. As Noble gases are not reactive and most usually do not form molecules, it was assumed that their electronegativity value could not be calculated, thus is generally ignored in many chemistry books.

Another scale, developed by Allen, includes the values of electronegativity for the noble gases, as the method of calculation of this property of atoms does not depend on the formation of molecules. In this scale Neon posses the biggest electronegativity in the periodic table, instead of Fluorine.

**3. What is the difference between electronegativity and electron affinity?**

Electronegativity refers to the ability of an atom to attract electrons towards it whereas electron affinity refers to the amount of energy released when an electron is added to an atom or molecule in order to obtain an anion.

**4. Why electronegativity decreases as you move down the table and increases as you move across the table?**

Across the periods of the periodic table, the elements increase their electronegativity. This is due to the increase on the number of charges in the nucleus, which attracts the electrons more strongly. In respect to the groups, electronegativity decreases when you go down in a group. This happens because the electrons locate farer away from the nucleus as the atomic radius increases. For a definition of electronegativity and a periodic table chart showing the electronegativity trends visit.

**5. What general trends in electronegativity occur in the periodic table?**

A. Electronegativity increases from left to right across a period and down a group.

B. Electronegativity decreases from left to right across a period and down a group.

C. Electronegativity increases from left to right across a period and decreases down a group.

D. Electronegativity increases from left to right across a period. For the elements of one group electronegativity values are approximately equal.

*Answer*: C. Electronegativity increases from left to right across a period and decreases down a group. Across the periods of the periodic table, the elements increase their electronegativity. This is due to the increase on the number of charges in the nucleus, which attracts the electrons more strongly. In respect to the groups, electronegativity decreases when you go down in a group. This happens because the electrons locate farer away from the nucleus as the atomic radius increases. For a definition of electronegativity and a periodic table chart showing the electronegativity trends visit.

END

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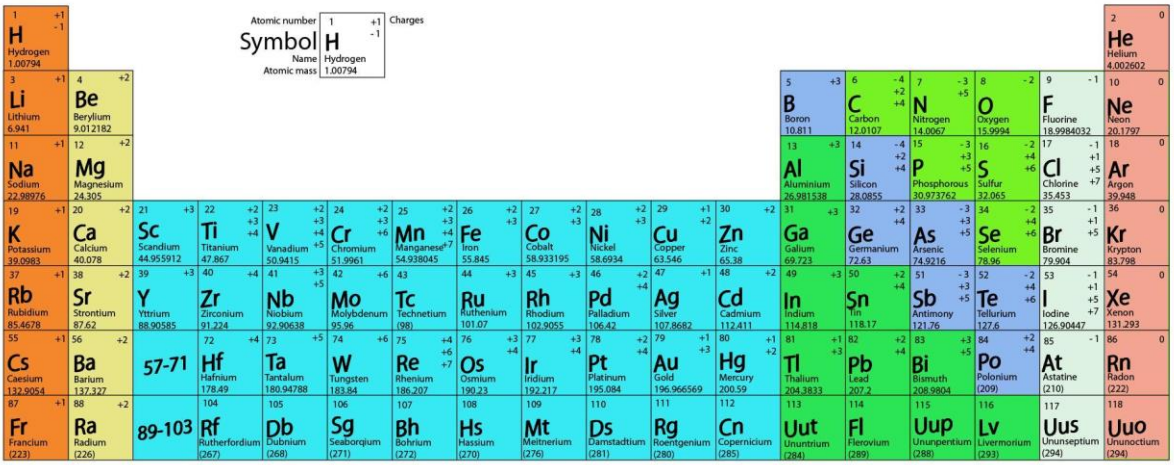


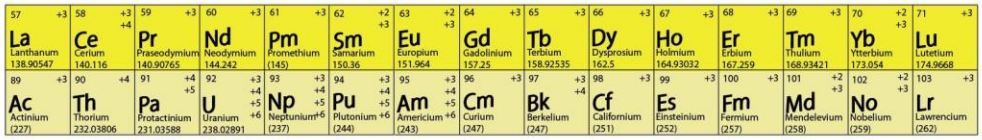

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