

الهيكل وفق Term 3 Review General Science



تم تحميل هذا الملف من موقع المناهج الإماراتية

موقع المناهج ← المناهج الإماراتية ← الصف العاشر العام ← علوم ← الفصل الثالث ← ملفات متنوعة ← الملف

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منهج انجليزي | ملخصات وتقارير | مذكرات وبنوك | الامتحان النهائي | للمدرس

المزيد من مادة
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التواصل الاجتماعي بحسب الصف العاشر العام



صفحة المناهج
الإماراتية على
فيسبوك

الرياضيات

اللغة الانجليزية

اللغة العربية

التربية الاسلامية

المواد على تلغرام

المزيد من الملفات بحسب الصف العاشر العام والمادة علوم في الفصل الثالث

الهيكل وفق Term 3 Review General Science

1

تجميع هيكل عاشر عام علوم

2

شرح تطبيقات على قانون حفظ الكتلة والتعادل الكهربائي للذرة مع أسئلة وفق الهيكل

3

تجميع العلوم المتكاملة وفق الهيكل 2026

4

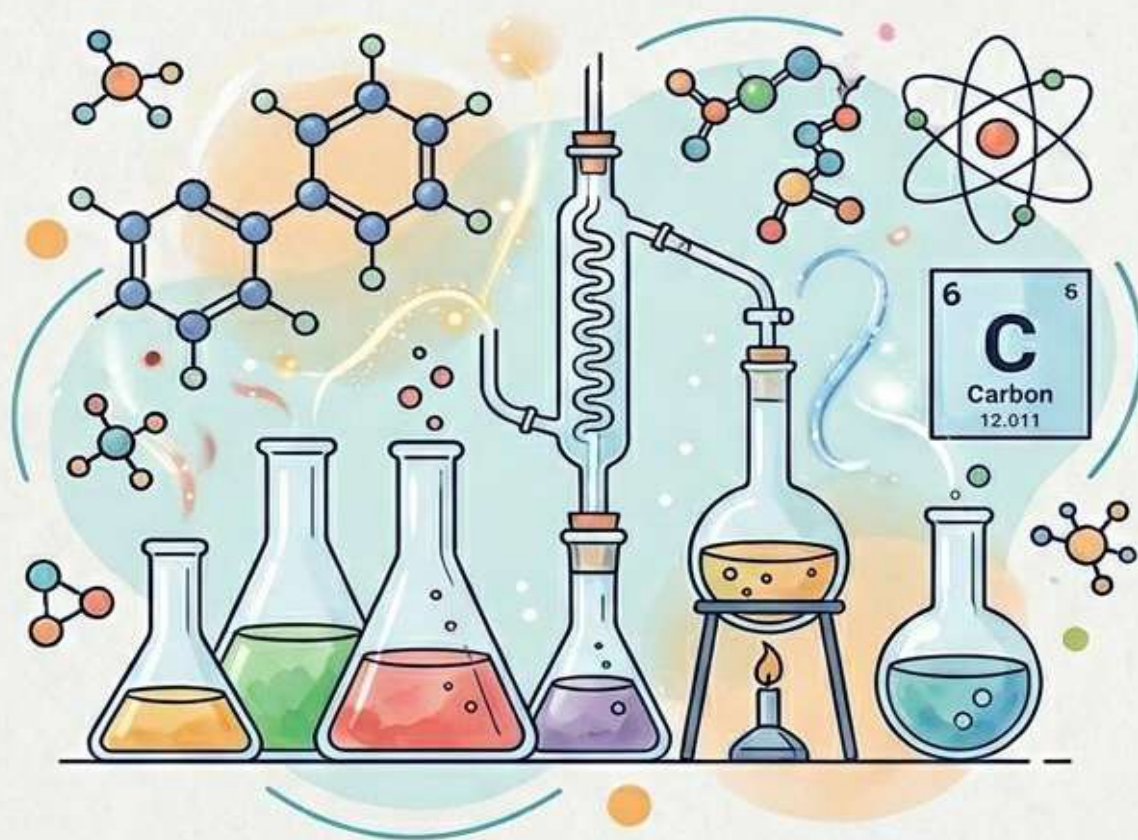
ملزمة جميع دروس ووحدات الفصل الثالث منهج انسباير Inspire

5

TERM 3 REVIEW

GRADE 10

GENERAL SCIENCE



DONE BY:
MS BAYAN ALMALLAH

ACADEMIC YEAR 2025-2026

Keywords & their Arabic meanings

Basic Chemistry & Atomic Structure

English Term	Arabic Meaning	English Term	Arabic Meaning
Atom	ذرة	Proton	بروتون
Element	عنصر	Neutron	نيترون
Ion	أيون	Electron	إلكترون
Conservation of mass	حفظ الكتلة		

Nuclear Chemistry & Radiation

English Term	Arabic Meaning	English Term	Arabic Meaning
Radioactivity	النشاط الإشعاعي	Nuclear equation	معادلة نووية
Radiation	الإشعاع	Beta radiation	إشعاع بيتا
Nuclear reaction	تفاعل نووي	Beta particle	جسيم بيتا
Radioactive decay	التحلل الإشعاعي	Gamma radiation	إشعاع غاما
Alpha radiation	إشعاع ألفا	Gamma ray	أشعة غاما
Alpha particle	جسيم ألفا	Nuclear stability	الاستقرار النووي

Quantum Model & Electron Configuration

English Term	Arabic Meaning	English Term	Arabic Meaning
Bohr's Model	نموذج بور	Aufbau principle	مبدأ أوفباو (البناء التصاعدي)
Quantum Number (n)	(n) عدد الكم	Pauli exclusion principle	مبدأ استبعاد باولي
Ground State	الحالة المستقرة (الأرضية)	Hund's rule	قاعدة هوند
Excited State	الحالة المثارة	Atomic orbital	المجال الذري (المدار)
Circular Orbits	مدارات دائرية	Electron-dot structure	التمثيل النقطي (بنية لويس)
Energy Levels	مستويات الطاقة	Aufbau diagram	مخطط أوفباو

English Term	Arabic Meaning	English Term	Arabic Meaning
Quantized Energy	طاقة مكممة (محددة)	Orbital diagram	مخطط مستويات الطاقة
Atomic Emission Spectrum	طيف الانبعاث الذري	Electron configuration notation	ترميز التوزيع الإلكتروني
Discontinuous	غير متصل (منفصل)	Noble-gas notation	ترميز الغاز الخامل
Electron configuration	التوزيع الإلكتروني	Valence electrons	إلكترونات التكافؤ
Ground-state electron config.	التوزيع في الحالة المستقرة		

The Periodic Table & Periodic Trends

English Term	Arabic Meaning	English Term	Arabic Meaning
Modern Periodic Table	الجدول الدوري الحديث	Transition metals	الفلزات الانتقالية

English Term	Arabic Meaning	English Term	Arabic Meaning
Atomic number	العدد الذري	Inner transition metals	الفلزات الانتقالية الداخلية
Mass number	العدد الكتلي	Lanthanide series	سلسلة اللانثانيدات
Atomic mass	الكتلة الذرية	Actinide series	سلسلة الأكتينيدات
Atomic mass unit	وحدة الكتل الذرية	Nonmetals	اللافلزات
Isotope	نظير	Halogens	الهالوجينات
Groups (or families)	المجموعات (العائلات)	Noble gases	الغازات النبيلة (الخاملة)
Periods	الدورات	Metalloids (semimetals)	أشباه الفلزات
Representative elements	العناصر الممثلة	Ionic radius	النصف القطر الأيوني
Transition elements	العناصر الانتقالية	Atomic radius	النصف القطر الذري
Metals	الفلزات	Ionization energy	طاقة التأين
Alkali Metals	الفلزات القلوية	Electronegativity	الكهروسالبية
Alkaline Earth Metals	الفلزات القلوية الترابية	Octet rule	القاعدة الثمانية

Elements Properties & Characteristics

English Term	Arabic Meaning	English Term	Arabic Meaning
Shiny	لامع	Conductor	موصل
Dull	باهت / غير لامع	Insulator	عازل
Malleable	قابل للطرق	Poor	رديء / ضعيف
Ductile	قابل للسحب		

1

SCI.4.4.01.091.02 Apply the Law of conservation of mass

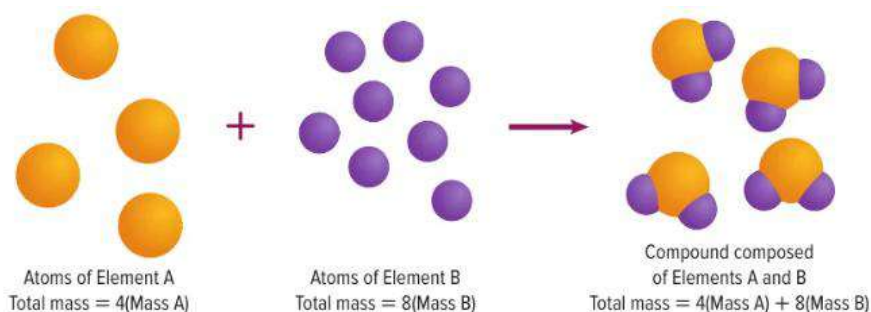


Figure 3 When atoms of two or more elements combine to form a compound, the number of atoms of each element is conserved. Thus, the mass is conserved as well.

Conservation of mass

The law of conservation of mass states that mass is conserved in any process. Dalton's atomic theory explains that the conservation of mass in chemical reactions is the result of the rearrangement of atoms during the reaction. They are not created or destroyed. The formation of a compound by combining elements is shown in **Figure 3**. Notice that the mass ratio for the compound consists of 1 atom of element A and 2 atoms of element B, a 1:2 ratio. The total number of atoms of each element is the same before and after the reaction.

Dalton's convincing experimental evidence and clear explanation of the composition of compounds, and conservation of mass, led to the general acceptance of his atomic theory. However, not all of Dalton's theory was accurate. As our understanding of atoms evolved, new information was learned, leading to the revision and improvement of Dalton's atomic theory by later scientists.

2

SCI.4.4.01.090.02 Explain why atoms are electrically neutral

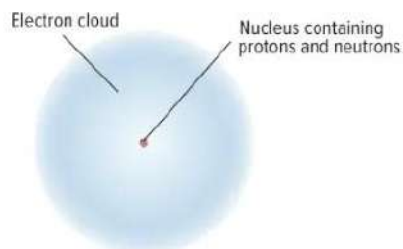


Figure 14 Atoms are composed of a nucleus containing protons and neutrons, and surrounded by a cloud of electrons.

Table 3 Properties of Subatomic Particles

Particle	Symbol	Relative Electric Charge	Relative Mass	Actual Mass (g)
Electron	e ⁻	1-	$\frac{1}{1840}$	9.11×10^{-28}
Proton	p	1+	1	1.673×10^{-24}
Neutron	n	0	1	1.675×10^{-24}

Most of an atom consists of fast-moving electrons traveling through empty space around the nucleus. The electrons are held within the atom by their attraction to the positively charged nucleus. The nucleus, which is composed of neutral neutrons (hydrogen's single-proton nucleus is an exception) and positively charged protons, contains more than 99.97% of an atom's mass. It occupies only about one ten-thousandth of the volume of the atom. Because an atom is electrically neutral, the number of protons in the nucleus equals the number of electrons around the nucleus. The typical atom is shown in **Figure 14**, and the properties of the subatomic particles are summarized in **Table 3**.

3	
	SCI.4.4.01.084.16 Define the neutron

neutron. A **neutron** is a subatomic particle that has a mass nearly equal to that of a proton, but carries no electric charge.

4	
	SCI.4.4.01.090.07 Calculate for a neutral atom, given the mass number and atomic number, the number of subatomic particles

6	
	SCI.4.4.01.090.09 Determine the atomic number, mass number, and subatomic particles for different isotopes

Atomic number

$$\begin{aligned}\text{atomic number} &= \text{number of protons} \\ &= \text{number of electrons}\end{aligned}$$

The atomic number of an atom equals its number of protons and its number of electrons.

Mass number

$$\text{mass number} = \text{atomic number} + \text{number of neutrons}$$

The mass number of an atom is the sum of its atomic number and its number of neutrons.

	Potassium-39	Potassium-40	Potassium-41
Protons	19	19	19
Neutrons	20	21	22
Electrons	19	19	19

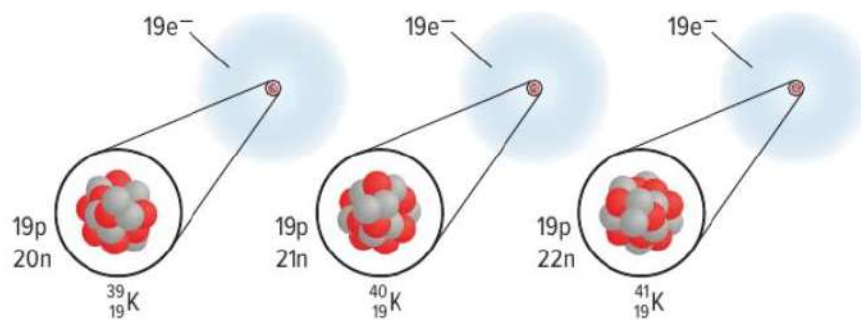


Figure 17 Potassium has three naturally occurring isotopes, potassium-39, potassium-40, and potassium 41. The table lists the number of protons, neutrons, and electrons in each potassium isotope.

EXAMPLE Problem 1

ATOMIC NUMBER Complete the following table.
Composition of Several Elements

	Element	Atomic Number	Protons	Electrons
a.	Pb	82		
b.			8	
c.				30

1 ANALYZE THE PROBLEM

Apply the relationship among atomic number, number of protons, and number of electrons to complete most of the table. Then, use the periodic table to identify the element.

Known

- a. element = Pb, atomic number = 82
- b. number of protons = 8
- c. number of electrons = 30

Unknown

- a. number of protons (N_p), number of electrons (N_e) = ?
- b. element, atomic number (Z), N_e = ?
- c. element, Z , N_p = ?

2 SOLVE FOR THE UNKNOWN

- a. number of protons = atomic number

$$N_p = 82$$

number of electrons = number of protons

$$N_e = 82$$

The number of protons and the number of electrons is 82.

Apply the atomic-number relationship.

Substitute atomic number = 82.

- b. atomic number = number of protons

$$Z = 8$$

number of electrons = number of protons

$$N_e = 8$$

The atomic number and the number of electrons is 8.

The element is oxygen (O).

Apply the atomic-number relationship.

Substitute number of protons = 8.

Consult the periodic table to identify the element.

- c. number of protons = number of electrons

$$N_p = 30$$

atomic number = number of protons

$$Z = 30$$

The atomic number and the number of protons is 30.

The element is zinc (Zn).

Apply the atomic-number relationship.

Substitute number of electrons = 30.

Consult the periodic table to identify the element.

3 EVALUATE THE ANSWER

The answers agree with atomic numbers and element symbols given in the periodic table.

EXAMPLE Problem 2

USE ATOMIC NUMBER AND MASS NUMBER A chemistry laboratory has analyzed the composition of isotopes of several elements. The composition data is given in the table below. Determine the number of protons, electrons, and neutrons in the isotope of neon. Name the isotope and give its symbol.

Isotope Composition Data

	Element	Atomic Number	Mass Number
a.	Neon	10	22
b.	Calcium	20	46
c.	Oxygen	8	17
d.	Iron	26	57
e.	Zinc	30	64
f.	Mercury	80	204

1 ANALYZE THE PROBLEM

You are given some data for neon in the table. The symbol for neon can be found on the periodic table. From the atomic number, the number of protons and electrons in the isotope are known. The number of neutrons in the isotope can be found by subtracting the atomic number from the mass number.

Known

element: neon

atomic number = 10

mass number = 22

Unknown

number of protons (N_p), electrons (N_e), and neutrons (N_n) = ?

name of isotope = ?

symbol for isotope = ?

2 SOLVE FOR THE UNKNOWN

number of protons = atomic number = 10

number of electrons = atomic number = 10

number of neutrons = mass number – atomic number

$$N_n = 22 - 10 = 12$$

The name of the isotope is neon-22.

The symbol for the isotope is ${}^{22}_{10}\text{Ne}$.

Apply the atomic number relationship.

Use the atomic number and the mass number to calculate the number of neutrons.

Substitute mass number = 22 and atomic number = 10

Use the element name and mass number to write the isotope's name.

Use the chemical symbol, mass number, and atomic number to write out the isotope in symbolic notation form.

3 EVALUATE THE ANSWER

The relationships among number of electrons, protons, and neutrons have been applied correctly. The isotope's name and symbol are in the correct format. Refer to the Elements Handbook to learn more about neon.

Isotopes and Mass Number

All atoms of an element have the same number of protons and electrons, but the number of neutrons might differ. For example, there are three types of potassium atoms that occur naturally and all three types contain 19 protons and 19 electrons. However, one type of potassium atom contains 20 neutrons, another 21 neutrons, and still another 22 neutrons. Atoms with the same number of protons but different numbers of neutrons are called **isotopes**.

Mass of isotopes While isotopes that contain more neutrons have a greater mass, all isotopes of an atom have the same chemical behavior. The **mass number** identifies each isotope of an element and is the sum of the atomic number (or number of protons) and neutrons in the nucleus.

For example, copper has two isotopes. The isotope with 29 protons and 34 neutrons has a mass number of 63 ($29 + 34 = 63$), and is called copper-63 (also written ^{63}Cu or Cu-63). The isotope with 29 protons and 36 neutrons is called copper-65. Chemists often write out isotopes using a notation shown in **Figure 16**.

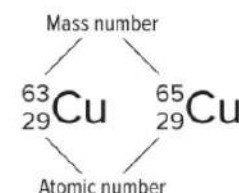


Figure 16 Cu is the chemical symbol for copper. Copper, which was used to make this Chinese gong, is composed of 69.2% copper-63 and 30.8% copper-65.

EXAMPLE Problem 3

CALCULATE ATOMIC MASS Given the data in the table, calculate the atomic mass of unknown Element X. Then, identify the unknown element, which is used medically to treat some mental disorders.

1 ANALYZE THE PROBLEM

Calculate the atomic mass and use the periodic table to confirm.

Known

^6X : mass = 6.015 amu
abundance = 7.59% = 0.0759

^7X : mass = 7.016 amu
abundance = 92.41% = 0.9241

Unknown

atomic mass of X = ? amu

element X = ?

Isotope Abundance for Element X

Isotope	Mass (amu)	Percent Abundance
^6X	6.015	7.59%
^7X	7.016	92.41%

EXAMPLE Problem 3 (Continued)**2 SOLVE FOR THE UNKNOWN**

^6X : mass contribution = (mass)(percent abundance)
 mass contribution = (6.015 amu)(0.0759) = 0.4565 amu

Calculate ^6X 's contribution.
 Substitute mass = 6.015 amu
 and abundance = 0.0759.

^7X : mass contribution = (mass)(percent abundance)
 mass contribution = (7.016 amu)(0.9241) = 6.483 amu

Calculate ^7X 's contribution.
 Substitute mass = 7.016 amu
 and abundance = 0.9241.

atomic mass of X = (0.4565 amu + 6.483 amu) = **6.939 amu**

Total the mass contributions to
 find the atomic mass.

The **element** with a mass nearest 6.939 amu is **lithium (Li)**.

Identify the element using the
 periodic table.

3 EVALUATE THE ANSWER

The result agrees with the atomic mass given in the periodic table. The isotope masses have four significant figures, so the atomic mass needs to have four significant figures.

Mass of Atoms

Recall from **Table 3** that the masses of both protons and neutrons are approximately 1.67×10^{-24} g. While this is a small mass, the mass of an electron is even smaller—only about 1/1840 that of a proton or a neutron.

Table 4 Masses of Subatomic Particles

Particle	Mass (amu)
Electron	0.000549
Proton	1.007276
Neutron	1.008665

Atomic mass unit Because these extremely small masses expressed in scientific notation are difficult to work with, chemists have developed a method of measuring the mass of an atom relative to the mass of a specific atomic standard. That standard is the carbon-12 atom. Scientists assigned the carbon-12 atom a mass of exactly 12 atomic mass units. Thus, one **atomic mass unit (amu)** is defined as one-twelfth the mass of a carbon-12 atom. Although a mass of 1 amu is nearly equal to the mass of a single proton or a single neutron, it is important to realize that the values are slightly different. **Table 4** gives the masses of the subatomic particles in terms of amu.

Atomic mass Because an atom's mass depends mainly on the number of protons and neutrons it contains, and because protons and neutrons have masses close to 1 amu, you might expect the atomic mass of an element to always be nearly a whole number. However, this is often not the case. The explanation involves how atomic mass is defined. The **atomic mass** of an element is the weighted average mass of the isotopes of that element. Because isotopes have different masses, the weighted average is not a whole number. The calculation of the atomic mass of chlorine is illustrated in **Figure 18**.

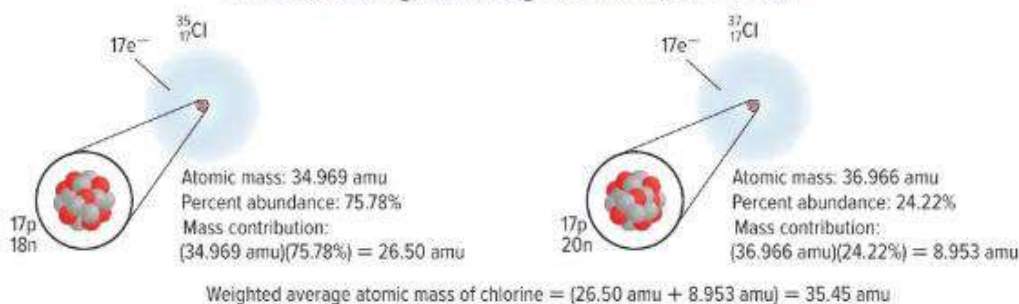
Calculate the Weighted Average Atomic Mass of Chlorine

Figure 18 To calculate the weighted average atomic mass of chlorine, you first need to calculate the mass contribution of each isotope.

5	Investigate nuclear radiation while illustrating the characteristics of the alpha, beta particles and gamma rays in terms of mass, ability to penetrate and impact on humans.
9	CHM.5.1.03.007Investigate the different types of spontaneous radioactive decay, with their characteristics and the changes that accompanied in terms of atomic and mass numbers

Radioactivity

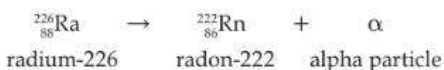
Nuclear reactions In the late 1890s, scientists noticed that some substances spontaneously emitted radiation in a process they named **radioactivity**. The rays and particles emitted by the radioactive material were called **radiation**. Scientists discovered that radioactive atoms undergo changes that can alter their identities. A reaction that involves a change in an atom's nucleus is called a **nuclear reaction**. Prior to this discovery, it was not known that a reaction could result in the formation of a new element. Radioactive atoms emit radiation because their nuclei are unstable. Unstable systems, whether they are atoms or people doing handstands, as shown in **Figure 20**, gain stability by losing energy.

Radioactive decay Unstable nuclei lose energy by emitting radiation in a spontaneous process called **radioactive decay**. Unstable atoms undergo radioactive decay until they form stable atoms, often of a different element. An atom can lose energy and reach a stable state when emitting radiation.

Types of Radiation

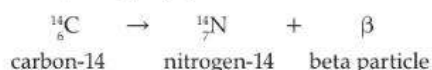
Scientists began researching radioactivity in the late 1800s. By directing radiation from a radioactive source between two electrically charged plates, scientists were able to identify three different types of radiation based on their electric charge. As shown in **Figure 21**, radiation was deflected toward the negative plate, the positive plate, or not at all.

Alpha radiation The radiation that was deflected toward the negatively charged plate was named **alpha radiation**. It is made up of alpha particles. An **alpha particle** contains two protons and two neutrons, and thus has a 2+ charge, which explains why alpha particles are attracted to the negatively charged plate as shown in **Figure 21**. An alpha particle is equivalent to a helium-4 nucleus and is represented by ${}^4_2\text{He}$ or α . The alpha decay of radioactive radium-226 into radon-222 is shown below.



Note that a new element, radon (Rn), is created as a result of the alpha decay of the unstable radium-226 nucleus. The type of equation shown above is known as a **nuclear equation**. It shows the atomic numbers and mass numbers of the particles involved. Note that in a nuclear equation, although elements are not conserved, the total number of protons plus neutrons is conserved.

Beta radiation The radiation that was deflected toward the positively charged plate was named **beta radiation**. This radiation consists of fast-moving beta particles. Each **beta particle** is an electron with a 1- charge. The negative charge of the beta particle explains why it is attracted to the positively charged plate shown in **Figure 21**. Beta particles are represented by the symbol β or e^- . The beta decay of carbon-14 into nitrogen-14 is shown below. The beta decay of unstable carbon-14 results in the formation of the new element, nitrogen (N).



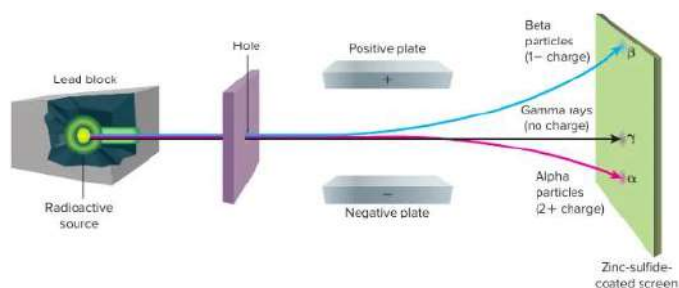
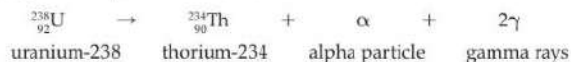


Figure 21 An electric field will deflect radiation in different directions, depending on the electric charge of the radiation.

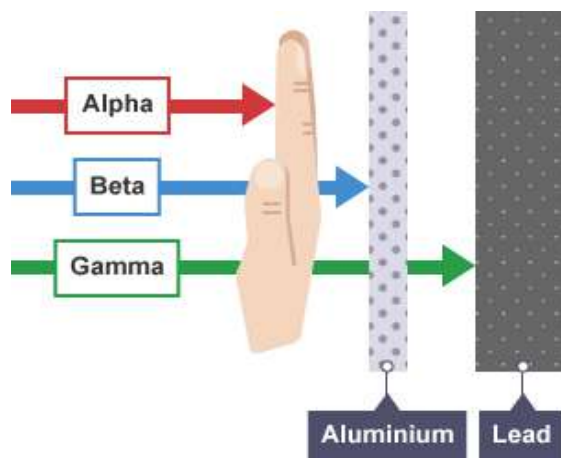
Gamma radiation The third common type of radiation is called gamma radiation, or gamma rays. A **gamma ray** is high-energy radiation that has no mass and is denoted by the symbol γ . Gamma rays are neutral, and so are not deflected by electric or magnetic fields. They often accompany alpha and beta radiation, and account for most of the energy lost during radioactive decay. For example, gamma rays accompany the decay of uranium-238.

Table 5 Characteristics of Radiation

	Alpha	Beta	Gamma
Symbol	${}^4_2\text{He}$ or α	e^- or β	γ
Mass (amu)	4	$\frac{1}{1840}$	0
Mass (kg)	6.65×10^{-27}	9.11×10^{-31}	0
Charge	2+	1-	0



Because gamma rays are massless, the emission of gamma rays by themselves cannot result in the formation of a new element. **Table 5** summarizes the characteristics of alpha, beta, and gamma radiation.



Bohr's Model of the Atom

The dual wave-particle model of light accounted for several previously unexplainable phenomena, but scientists still did not understand the relationships among atomic structure, electrons, and atomic emission spectra. Recall that hydrogen's atomic emission spectrum is discontinuous; that is, it is made up of only certain frequencies of light. Why are the atomic emission spectra of elements discontinuous rather than continuous? Niels Bohr, a Danish physicist working in Rutherford's laboratory in 1913, proposed a quantum model for the hydrogen atom that seemed to answer this question. Bohr's model also correctly predicted the frequencies of the lines in hydrogen's atomic emission spectrum.

Energy states of hydrogen

Building on Planck's and Einstein's concepts of quantized energy, Bohr proposed that the hydrogen atom has only certain allowable energy states, as illustrated in Figure 10. The lowest allowable energy state of an atom is called its **ground state**. When an atom gains energy, it is said to be in an excited state.

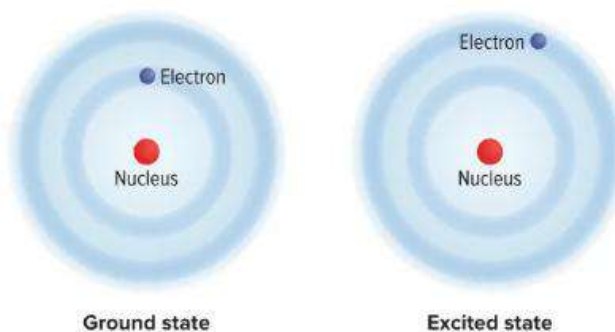


Figure 10 The figure shows an atom that has one electron. Note that the illustration is not to scale. In its ground state, the electron is associated with the lowest energy level. When the atom is in an excited state, the electron is associated with a higher energy level.

Table 1 Bohr's Description of the Hydrogen Atom

Bohr's Atomic Orbit	Quantum Number	Orbit Radius (nm)	Corresponding Atomic Energy Level	Relative Energy
First	$n = 1$	0.0529	1	E_1
Second	$n = 2$	0.212	2	$E_2 = 4E_1$
Third	$n = 3$	0.476	3	$E_3 = 9E_1$
Fourth	$n = 4$	0.846	4	$E_4 = 16E_1$
Fifth	$n = 5$	1.32	5	$E_5 = 25E_1$
Sixth	$n = 6$	1.90	6	$E_6 = 36E_1$
Seventh	$n = 7$	2.59	7	$E_7 = 49E_1$

Bohr suggested that the electron in a hydrogen atom moves around the nucleus in only certain allowed circular orbits. The smaller the electron's orbit, the lower the atom's energy state, or energy level. Conversely, the larger the electron's orbit, the higher the atom's energy state, or energy level. Bohr assigned a number, n , called a **quantum number**, to each orbit. He also calculated the radius of each orbit. Table 1 shows data for the first seven energy levels of a hydrogen atom according to Bohr's model.

The aufbau principle

The **aufbau principle** states that each electron occupies the lowest energy orbital available. Therefore, your first step in determining an element's ground-state electron configuration is learning the sequence of atomic orbitals from lowest energy to highest energy. This sequence, known as an aufbau diagram, is shown in **Figure 18**. In the diagram, each box represents an atomic orbital.

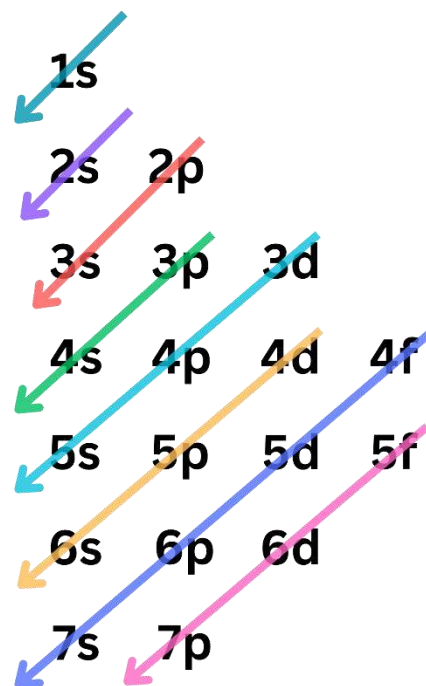


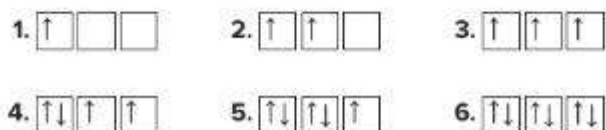
Table 3 Features of the Aufbau Diagram

Feature	Example
All orbitals related to an energy sublevel are of equal energy.	All three 2p orbitals are of equal energy.
In a multi-electron atom, the energy sublevels within a principal energy level have different energies.	The three 2p orbitals are of higher energy than the 2s orbital.
In order of increasing energy, the sequence of energy sublevels within a principal energy level is s, p, d, and f.	If $n = 4$, then the sequence of energy sublevels is 4s, 4p, 4d, and 4f.
Orbitals related to energy sublevels within one principal energy level can overlap orbitals related to energy sublevels within another principal level.	The orbital related to the atom's 4s sublevel has a lower energy than the five orbitals related to the 3d sublevel.

Table 3 summarizes several features of the aufbau diagram. Although the aufbau principle describes the sequence in which orbitals are filled with electrons, it is important to know that atoms are not built up electron by electron.

Hund's rule

The fact that negatively charged electrons repel each other affects the distribution of electrons in equal-energy orbitals. **Hund's rule** states that single electrons with the same spin must occupy each equal-energy orbital before additional electrons with opposite spins can occupy the same orbitals. For example, the boxes below show the sequence in which six electrons occupy the three 2p orbitals. One electron enters each of the orbitals before a second electron enters any of the orbitals.



13	CHM.5.3.01.004.01 Calculate the number of representative particles present in given moles of an element (atomic or molecular) or a compound and vice versa, conversion of a given mass to particles
----	---

15	CHM.5.1.01.002.03 Relate the principal quantum number to the total number of orbitals of the principal energy levels and the number of orbitals in sub-energy levels
----	--

Table 2 Hydrogen's First Four Principal Energy Levels

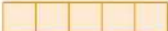
Principal Quantum Number (n)	Sublevels (Types of Orbitals) Present	Number of Orbitals Related to Sublevel	Total Number of Orbitals Related to Principal Energy Level (n^2)
1	s	1	1
2	s p	1 3	4
3	s p d	1 3 5	9
4	s p d f	1 3 5 7	16

Hydrogen's first four principal energy levels, sublevels, and related atomic orbitals are summarized in **Table 2**. Note that the number of orbitals related to each sublevel is always an odd number, and that the maximum number of orbitals related to each principal energy level equals n^2 .

At any given time, the electron in a hydrogen atom can occupy just one orbital. You can think of the other orbitals as unoccupied spaces—spaces available should the atom's energy increase or decrease.

Table 5 Electron Configurations for Elements 11–18

Element	Atomic Number	Complete Electron Configuration	Electron Configuration Using Noble Gas
Sodium	11	$1s^2 2s^2 2p^6 3s^1$	$[\text{Ne}]3s^1$
Magnesium	12	$1s^2 2s^2 2p^6 3s^2$	$[\text{Ne}]3s^2$
Aluminum	13	$1s^2 2s^2 2p^6 3s^2 3p^1$	$[\text{Ne}]3s^2 3p^1$
Silicon	14	$1s^2 2s^2 2p^6 3s^2 3p^2$	$[\text{Ne}]3s^2 3p^2$
Phosphorus	15	$1s^2 2s^2 2p^6 3s^2 3p^3$	$[\text{Ne}]3s^2 3p^3$
Sulfur	16	$1s^2 2s^2 2p^6 3s^2 3p^4$	$[\text{Ne}]3s^2 3p^4$
Chlorine	17	$1s^2 2s^2 2p^6 3s^2 3p^5$	$[\text{Ne}]3s^2 3p^5$
Argon	18	$1s^2 2s^2 2p^6 3s^2 3p^6$	$[\text{Ne}]3s^2 3p^6$ or $[\text{Ar}]$

f  14 electronsd  10 electronsp  6 electronss  2 electrons

Electron-dot structures

Because valence electrons are involved in forming chemical bonds, chemists often represent them visually using a simple shorthand method, called electron-dot structure. An atom's

electron-dot structure consists of the element's symbol, which represents the atomic nucleus and inner-level electrons, surrounded by dots representing all of the atom's valence electrons. In writing an atom's electron-dot structure, dots representing valence electrons are placed one at a time on the four sides of the symbol (they may be placed in any sequence) and then paired up until all are shown. Table 6 shows examples for the second period.

Table 6 Electron Configurations and Dot Structures

Element	Atomic Number	Electron Configuration	Electron-Dot Structure
Lithium	3	$1s^2 2s^1$	Li·
Beryllium	4	$1s^2 2s^2$	·Be·
Boron	5	$1s^2 2s^2 2p^1$	·B·
Carbon	6	$1s^2 2s^2 2p^2$	·C·
Nitrogen	7	$1s^2 2s^2 2p^3$	·N·
Oxygen	8	$1s^2 2s^2 2p^4$	·O·
Fluorine	9	$1s^2 2s^2 2p^5$	·F·
Neon	10	$1s^2 2s^2 2p^6$	·Ne·

EXAMPLE Problem 3

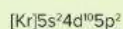
ELECTRON-DOT STRUCTURES Some toothpastes contain stannous fluoride, a compound of tin and fluorine. What is tin's electron-dot structure?

1 ANALYZE THE PROBLEM

Consult the periodic table to determine the total number of electrons in a tin atom. Write out tin's electron configuration, and determine its number of valence electrons. Then use the rules for electron-dot structures to draw the electron-dot structure for tin.

2 SOLVE FOR THE UNKNOWN

Tin has an atomic number of 50. Thus, a tin atom has 50 electrons.



Write out tin's electron configuration using noble-gas notation. The closest noble gas is Kr.

The two 5s and the two 5p electrons (the electrons in the orbitals related to the atom's highest principal energy level) represent tin's four valence electrons. Draw the four valence electrons around tin's chemical symbol (Sn) to show tin's electron-dot structure.



17

CHM.5.1.01.004.07 Explain why the properties of the elements in the same group are similar

Valence electrons

Recall that electrons in the highest principal energy level of an atom are called valence electrons. Each of the group 1 elements has one valence electron. The group 1 elements have similar chemical properties because they have the same number of valence electrons. This is one of the most important relationships in chemistry: atoms in the same group have similar chemical properties because they have the same number of valence electrons. Each group 1 element has a valence electron configuration of s^1 . Each group 2 element has a valence electron configuration of s^2 . Groups 1, 2, and 13 to 18 all have their own valence electron configurations.

Table 3 Electron Configuration for the Group 1 Elements

Period 1	hydrogen	$1s^1$	$1s^1$
Period 2	lithium	$1s^2 2s^1$	$[\text{He}]2s^1$
Period 3	sodium	$1s^2 2s^2 2p^6 3s^1$	$[\text{Ne}]3s^1$
Period 4	potassium	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$	$[\text{Ar}]4s^1$

18

CHM.5.1.01.010.03 Describe the general properties of alkaline earth metals and their uses

Alkaline Earth Metals The **alkaline earth metals** are in group 2. They are also highly reactive. Calcium (Ca) and magnesium (Mg), two minerals important for your health, are examples of alkaline earth metals. Because magnesium is strong and relatively light, it is used in applications in which strength and low mass are important, as shown in **Figure 6**.



Figure 6 Because magnesium is light and strong, it is often used in the production of safety devices such as these carabiners used by climbers.

19	CHM.5.1.01.008.02 Use the electron configuration notation, orbital notation, and noble gas notation of an element (Z 1 - 36) to identify the location of an element in the periodic table (period, group and block)
----	---

EXAMPLE Problem 1

ELECTRON CONFIGURATION AND THE PERIODIC TABLE Strontium, which is used to produce red fireworks, has an electron configuration of $[\text{Kr}]5s^2$. Without using the periodic table, determine the group, period, and block of strontium.

1 ANALYZE THE PROBLEM

You are given the electron configuration of strontium.

Known

Electron configuration = $[\text{Kr}]5s^2$

Unknown

Group = ?

Period = ?

Block = ?

2 SOLVE FOR THE UNKNOWN

The s^2 indicates that strontium's valence electrons fill the s sublevel. Thus, strontium is in **group 2** of the **s-block**.

The 5 in $5s^2$ indicates that strontium is in **period 5**.

For representative elements, the number of valence electrons can indicate the group number.

The number of the highest energy level indicates the period number.

3 EVALUATE THE ANSWER

The relationships between electron configuration and position on the periodic table have been correctly applied.

20	CHM.5.1.01.004 Explore the location of elements in the periodic table based on their electron configuration and predict their chemical and physical properties
----	--

25	CHM.5.1.02.001.02 Determine the number of valence electrons in atoms
----	--

Valence Electrons

Only certain electrons, called valence electrons, determine the chemical properties of an element. **Valence electrons** are defined as electrons in the atom's outermost orbitals—generally those orbitals associated with the atom's highest principal energy level. For example, a sulfur atom contains 16 electrons, only six of which occupy the outermost 3s and 3p orbitals, as shown by sulfur's electron configuration, $[\text{Ne}]3s^23p^4$. Sulfur has six valence electrons. Similarly, although a cesium atom has 55 electrons, it has just one valence electron, the 6s electron shown in cesium's electron configuration, $[\text{Xe}]6s^1$.

1	2	13	14	15	16	17	18
1 H·							He·
2 Li·	Be·						
3 Na·	Mg·	B·	C·	N·	O·	F·	Ne·
4 K·	Ca·	Al·	Si·	P·	S·	Cl·	Ar·
5 Rb·	Sr·	Ga·	Ge·	As·	Se·	Br·	Kr·
6 Cs·	Ba·	In·	Sn·	Sb·	Te·	I·	Xe·
		Tl·	Pb·	Bi·	Po·		Rn·

Figure 8 The figure shows the electron-dot structure of most representative elements.

Observe How does the number of valence electrons vary within a group?

Valence electrons and period

The energy level of an element's valence electrons indicates the period on the periodic table in which it is found. For example, lithium's valence electron is in the second energy level and lithium is found in period 2. Now look at gallium, with its electron configuration of $[\text{Ar}]4s^23d^{10}4p^1$. Gallium's valence electrons are in the fourth energy level, and gallium is found in the fourth period.

Valence electrons of the representative elements

Elements in group 1 have one valence electron; group 2 elements have two valence electrons. Group 13 elements have three valence electrons, group 14 elements have four, and so on. The noble gases in group 18 each have eight valence electrons, with the exception of helium, which has only two valence electrons. **Figure 8** shows how the electron-dot structures you studied previously illustrate the connection between group number and number of valence electrons. Notice that the number of valence electrons for the elements in groups 13 to 18 is ten less than their group number.

21

CHM.5.1.01.009.06 Explain the periodic trend of atomic radii across a period and down a group

Atomic Radius

For metals such as sodium, the atomic radius is defined as half the distance between adjacent nuclei in a crystal of the element, as shown in **Figure 11**. For elements that commonly occur as molecules, such as many nonmetals, the atomic radius is defined as half the distance between nuclei of identical atoms that are chemically bonded together. The atomic radius of a nonmetal diatomic hydrogen molecule (H_2) is shown in **Figure 11**.

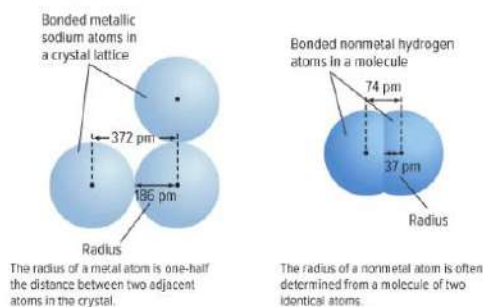


Figure 11 Atomic radii depend on the type of bonds that atoms form.

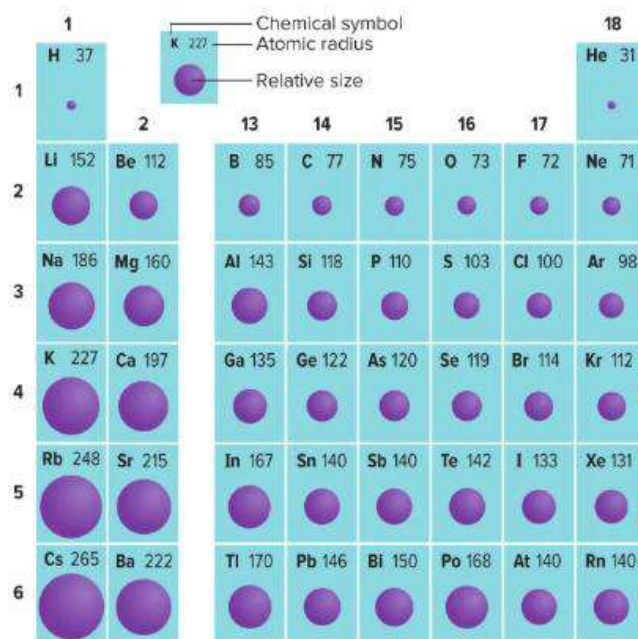


Figure 12 The atomic radii of the representative elements, given in picometers (10^{-12} m), vary as you move from left to right within a period and down a group.

Infer why the atomic radii increase as you move down a group.

Trends within periods

In general, there is a decrease in atomic radii as you move from left to right across a period. This trend is illustrated in **Figure 12**. It is caused by the increasing positive charge in the nucleus and the fact that the principal energy level within a period remains the same. Each successive element has one additional proton and electron, and each additional electron is added to orbitals corresponding to the same principal energy level. Moving across a period, no additional electrons come between the valence electrons and the nucleus. Thus, the valence electrons are not shielded from the increased nuclear charge, which pulls the outermost electrons closer to the nucleus.

Trends within groups

Atomic radii generally increase as you move down a group on the periodic table. The nuclear charge increases, and electrons are added to orbitals corresponding to successively higher principal energy levels. However, the increased nuclear charge does not pull the outer electrons toward the nucleus to make the atom smaller as you might expect. Why does the increased nuclear charge not make the atom smaller?

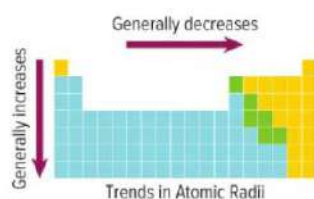


Figure 13 Atomic radii generally decrease from left to right in a period and generally increase as you move down a group.

Moving down a group, the outermost orbital increases in size along with the increasing principal energy level; thus, the atom becomes larger. The larger orbital means that the outer electrons are farther from the nucleus. This increased distance offsets the pull of the increased nuclear charge. Also, as additional orbitals between the nucleus and the outer electrons are occupied, these electrons shield the outer electrons from the nucleus. **Figure 13** summarizes the group and period trends.

EXAMPLE Problem 2

ELECTRON CONFIGURATION AND THE PERIODIC TABLE Which has the largest atomic radius: carbon (C), fluorine (F), beryllium (Be), or lithium (Li)? Answer without referring to **Figure 12**. Explain your answer in terms of trends in atomic radii.

1 ANALYZE THE PROBLEM

You are given four elements. First, determine the groups and periods the elements occupy. Then apply the general trends in atomic radii to determine which has the largest atomic radius.

2 SOLVE FOR THE UNKNOWN

From the periodic table, all the elements are found to be in period 2. *Determine the periods.*

Ordering the elements from left-to-right across the period yields:
Li, Be, C, and F.

The first element in period 2, lithium, has the largest radius.

Apply the trend of decreasing radii across a period.

3 EVALUATE THE ANSWER

The period trend in atomic radii has been correctly applied. Checking radii values in **Figure 12** verifies the answer.

Electronegativity

The **electronegativity** of an element indicates the relative ability of its atoms to attract electrons in a chemical bond. As shown in **Figure 19**, on the next page, electronegativity generally decreases as you move down a group. **Figure 19** also indicates that electronegativity generally increases as you move from left to right across a period. Fluorine is the most electronegative element, with a value of 3.98, meaning it attracts electrons more strongly than any other element in a chemical bond. Cesium and francium are the least electronegative elements, with values of 0.79 and 0.70, respectively. In a chemical bond, the atom with the greater electronegativity more strongly attracts the bond's electrons. Note that because the noble gases form very few compounds, they do not have electronegativity values.

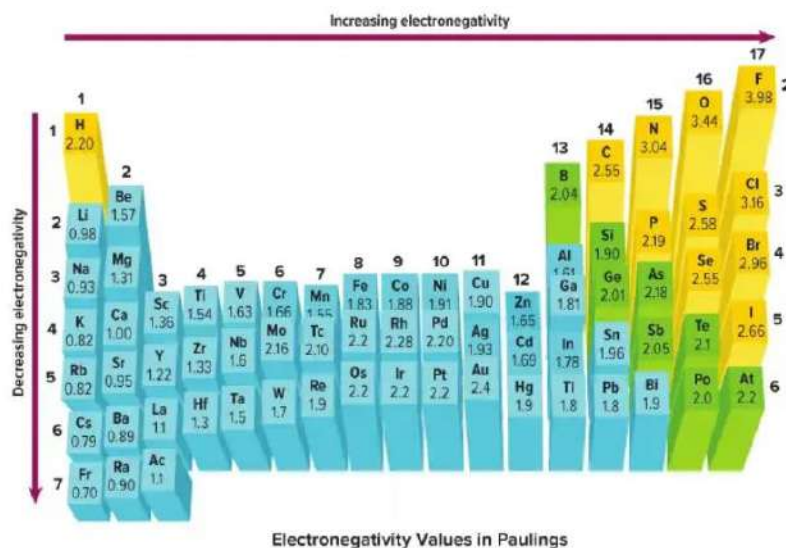


Figure 19 The electronegativity values for most of the elements are shown. The values are given in Paulings, a unit named after American scientist Linus Pauling (1901–1994).

Infer why electronegativity values are not listed for the noble gases.

23

CHM.5.1.01.009.10 Explain the trend of first ionization energy across a period (Exceptions between Groups 2 & 3 and 5 & 6 are included), and down a group of the periodic table

Trends within periods

As shown in **Figure 17** and by the values in **Table 5**, first ionization energies generally increase as you move from left to right across a period. The increased nuclear charge of each successive element produces an increased hold on the valence electrons.

Trends within groups

First ionization energies generally decrease as you move down a group. This decrease in energy occurs because atomic size increases as you move down the group. Less energy is required to remove the valence electrons farther from the nucleus. **Figure 18** summarizes the group and period trends in first ionization energies.

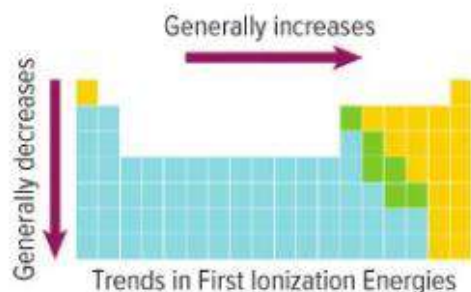


Figure 18 Ionization energies generally increase from left to right in a period and generally decrease as you move down a group.

Ionic Radius

Atoms can gain or lose one or more electrons to form ions. Because electrons are negatively charged, atoms that gain or lose electrons acquire a net charge. Thus, an **ion** is an atom or a bonded group of atoms that has a positive or negative charge.

You will learn more about ions later, but for now, consider how the formation of an ion affects the size of an atom.

Losing electrons

When atoms lose electrons and form positively charged ions, they always become smaller. The reason is twofold. The electron lost from the atom will almost always be a valence electron. The loss of a valence electron can leave a completely empty outer orbital, which results in a smaller radius. Furthermore, the electrostatic repulsion between the now-fewer number of remaining electrons decreases.

As a result, they experience a greater nuclear charge allowing these remaining electrons to be pulled closer to the positively charged nucleus.

Figure 14a illustrates how the radius of sodium decreases when sodium atoms form positive ions. The outer orbital of the sodium atom is unoccupied in the sodium ion, so the sodium ion is much smaller than the sodium atom.

Gaining electrons

When atoms gain electrons and form negatively charged ions, they become larger. The addition of an electron to an atom increases the electrostatic repulsion between the atom's outer electrons, forcing them to move farther apart. The increased distance between the outer electrons results in a larger radius.

Figure 14b shows how the radius of chlorine increases when chlorine atoms form negative ions. Adding an electron to a chlorine atom increases the electrostatic repulsion among its valence electrons. The increased repulsion causes the electrons to move farther apart and results in the radius of a chloride ion being almost twice as large as that of a chlorine atom.

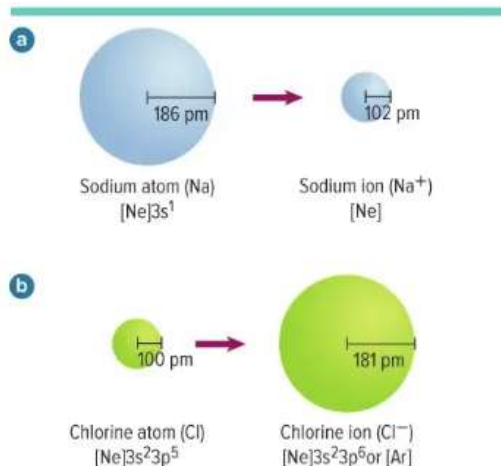
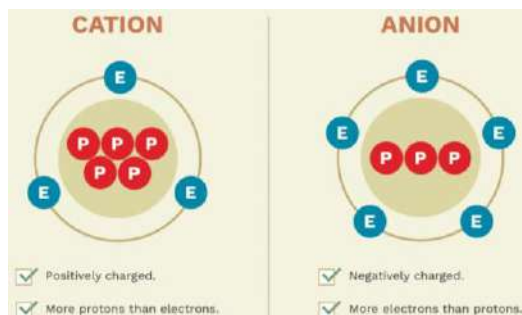


Figure 14 The size of atoms varies greatly when they form ions.

- Positive ions are smaller than the neutral atoms from which they form.
- Negative ions are larger than the neutral atoms from which they form.



Practice Questions

Which of the following is correct regarding the ions shown in the two figures below?

أي مما يأتي صحيح فيما يتعلق بالأيونات الموضحة في الشكلين أدناه؟



Learning Outcomes Covered

- CHM.5.1.01.009

a.

Chlorine atom gains an electron, electrostatic repulsion between the atom's outer electrons increases, the ion size increases

تكتسب ذرة الكلور إلكترونًا فيزيد التنافر الإلكترونياتيكي بين الإلكترونات الخارجية للذرة فيزداد حجم الأيون

b.

Sodium atom gains an electron, electrostatic repulsion between the atom's outer electrons increases, the ion size increases

تكتسب ذرة الصوديوم إلكترونًا فيزيد التنافر الإلكترونياتيكي بين الإلكترونات الخارجية للذرة فيزداد حجم الأيون

c.

Chlorine atom loses an electron, electrostatic repulsion between the atom's outer electrons decreases, the ion size decreases

تفقد ذرة الكلور إلكترونًا فيقل التنافر الإلكترونياتيكي بين الإلكترونات الخارجية للذرة فيقل حجم الأيون

d.

Sodium atom loses an electron, electrostatic repulsion between the atom's outer electrons increases, the ion size increases

تفقد ذرة الصوديوم إلكترونًا فيزيد التنافر الإلكترونياتيكي بين الإلكترونات الخارجية للذرة فيزداد حجم الأيون

Determine the period and group of an element which has the electron configuration shown below.

حدد الدورة والمجموعة لعنصر له الترتيب الإلكتروني أدناه.



الدورة **4** Period

المجموعة **15** Group

Which of the following is **correct** regarding

أي مما يأتي **صحيح** فيما يتعلق بالأيون **الموجب**؟

positive ion?

Learning Outcomes Covered

◦ CHM.5.1.02.022

a.

A neutral atom loses one or more valence
electrons, and this requires gain of energy

تفقد الذرة المتعادلة إلكترونًا أو أكثر من إلكترونات التكافؤ
ويتطلب ذلك اكتساب الذرة طاقة

b.

A neutral atom gains one or more valence
electrons, and this requires gain of energy

تكتسب الذرة المتعادلة إلكترونًا أو أكثر من إلكترونات التكافؤ
ويتطلب ذلك اكتساب الذرة طاقة

c.

A neutral atom loses one or more valence
electrons, and energy released

تفقد الذرة المتعادلة إلكترونًا أو أكثر من إلكترونات التكافؤ
وتتحرر طاقة

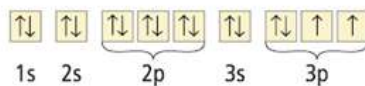
d.

A neutral atom gains one or more valence
electrons, and energy released

تكتسب الذرة المتعادلة إلكترونًا أو أكثر من إلكترونات التكافؤ
وتتحرر طاقة

The figure below shows the orbital notation of sulfur. أي مما يأتي صحيح؟ يوضح الشكل أدناه ترميز الفلك لعنصر الكبريت.

Which of the following is **correct**?



Learning Outcomes Covered

- CHM.5.1.02.022

a.

Sulfur atom loses two electrons, and positive

تفقد ذرة الكبريت إلكترونين وتكون أيونًا موجبًا S^{2+}

ion S^{2+} is formed

b.

Sulfur atom gains two electrons, and negative

تكتسب ذرة الكبريت إلكترونين وتكون أيونًا سالبًا S^{2-}

ion S^{2-} is formed

c.

Sulfur atom loses two electrons, and negative

تفقد ذرة الكبريت إلكترونين وتكون أيونًا سالبًا S^{2-}

ion S^{2-} is formed

d.

Sulfur atom gains two electrons, and positive

تكتسب ذرة الكبريت إلكترونين وتكون أيونًا موجبًا S^{2+}

ion S^{2+} is formed

Scientists created this robot that looks and swims like a real fish, its body is made of a silicon resin. What type of elements does silicon belong to?

أنشأ العلماء هذا الروبوت الذي يُشبه السمكة وتم صناعة هيكله من راتنجات السيليكون. ما نوع العناصر التي ينتمي إليها السيليكون؟



Learning Outcomes Covered

o CHM.5.1.01.008

a.

Transition metals

الفلزات الانتقالية

b.

Metalloids

أشباه الفلزات

c.

Noble gases

الغازات النبيلة

d.

Nonmetals

اللافلزات

What explains the increase in the first ionization energy when moving from left to right across a period?

ما الذي يُفسر الزيادة في طاقة التأين الأولى عند الانتقال من اليسار إلى اليمين خلال أي دورة؟

Learning Outcomes Covered

o CHM.5.1.01.009

a.

Increasing the positive charge of nucleus

زيادة الشحنة الموجبة للنواة

b.

Increasing the number of energy levels

زيادة عدد مستويات الطاقة

c.

Increasing the number of valence electrons

زيادة عدد إلكترونات التكافؤ

d.

The increased distance between the outer electrons and the nucleus

زيادة المسافة بين الإلكترونات الخارجية والنواة

What is the **correct** ascending order of the following elements according to their electronegativity values?

(All the elements are in the same group)

ما الترتيب التصاعدي **الصحيح** للعناصر التالية تبعاً لقيم السالبية

الكهربائية لكل منها؟

(جميع العناصر تقع في نفس المجموعة)

Te	O	Se	S	رسم العنصر Element symbol
52	8	34	16	العدد الذري Atomic number

Learning Outcomes Covered

- o CHM.5.1.01.009

a.

(Lowest) S → Se → O → Te (highest) (الأقل) هو S ← O ← Se ← Te (الأعلى)

b.

(Lowest) Se → S → Te → O (highest) (الأقل) هو Se ← S ← Te ← O (الأعلى)

c.

(Lowest) Te → O → Se → S (highest) (الأقل) هو Te ← O ← Se ← S (الأعلى)

d.

(Lowest) Te → Se → S → O (highest) (الأقل) هو Te ← Se ← S ← O (الأعلى)

The atomic number of zinc equals 30, and its electron

configuration is $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10}$

Which of the following is the Pseudo-noble gas

configuration for this element's ion?

العدد الذري للخارصين يُساوي 30 وله الترتيب الإلكتروني

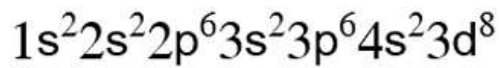
التالي $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10}$

أي مما يأتي هو ترتيب الغاز شبه النبيل لأيون هذا العنصر؟

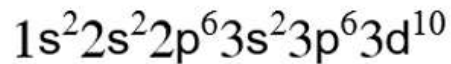
Learning Outcomes Covered

- CHM.5.1.02.022

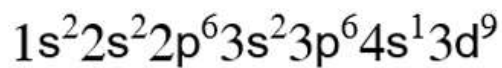
a.



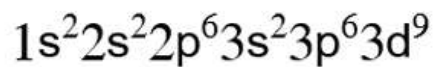
b.



c.



d.



What is the sublevel that can hold a total of 6 electrons?

ما تحت المستوى الذي يتسع لعدد 6 إلكترون؟

Learning Outcomes Covered

- CHM.5.1.01.008

a.

s

b.

p

c.

d

d.

f

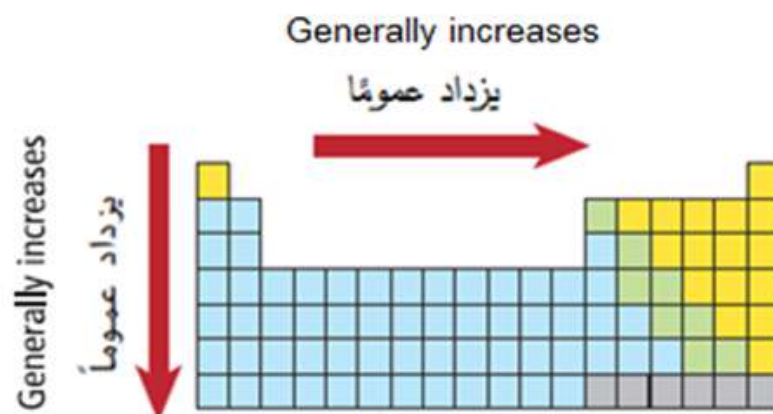
Which of the following figures shows the trends of the atomic radius through both a period and a group?

أي الأشكال التالية يوضح اتجاهات نصف القطر الذري خلال كل من الدورة والمجموعة؟

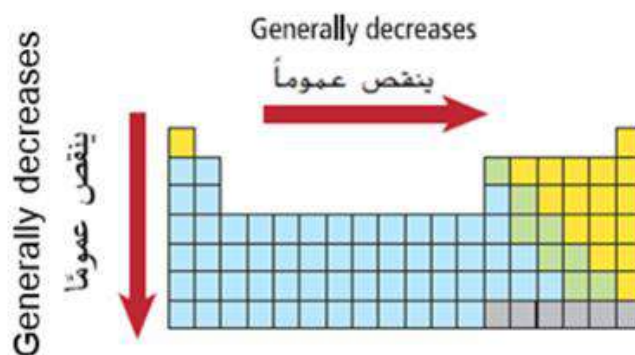
Learning Outcomes Covered

◦ CHM.5.1.01.009

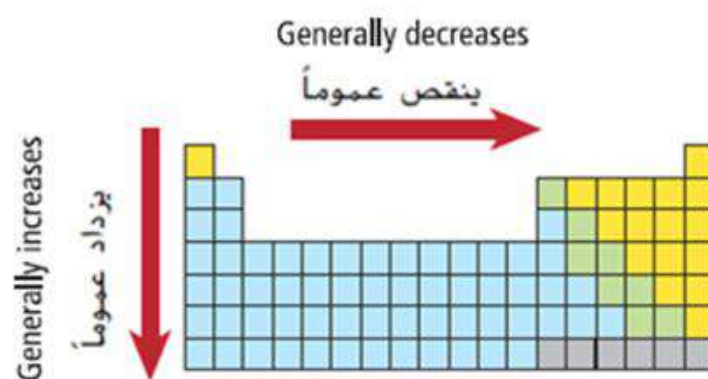
a.



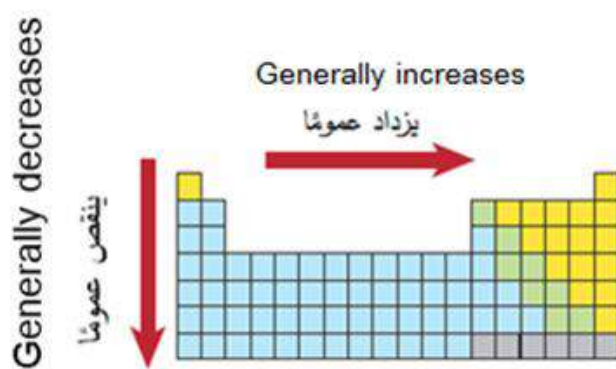
b.



c.

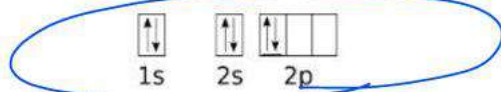
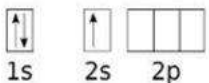
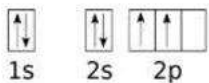
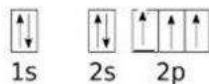


d.



What is called the state of the atom when it gains energy according to Bohr's model?	ماذا تسمى الحالة التي تكون الذرة فيها عندما تكتسب طاقة وفق نموذج بور؟
A. Ground state	A. الحالة الأرضية
B. Excited state	B. الحالة المستثارة
C. Inert state	C. الحالة الخاملة
D. Radiation-emitting state	D. حالة انبعاث الإشعاع

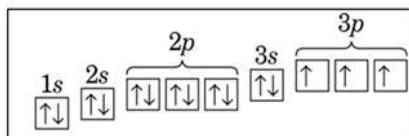
Which of the following orbital diagrams violates Hund's rule? أي من أشكال مخططات الأفلاك التالية تخالف قاعدة هوند؟



Which of the following is true related to the orbital diagrams below?

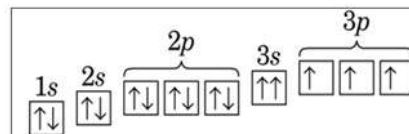
أي مما يأتي صحيح فيما يتعلق بمخططات الأفلاك أدناه؟

Matches all electron configuration principles



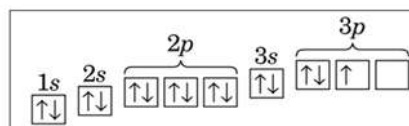
يتطابق مع كل قواعد الترتيب الإلكتروني

Matches Pauli exclusion principle



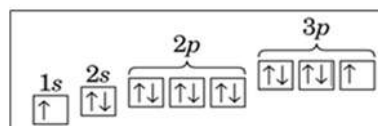
يتطابق مع مبدأ باولي للاستبعاد

Matches Hund's rule



يتطابق مع قاعدة هوند

Matches aufbau principle

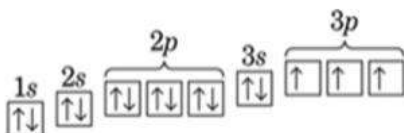


يتطابق مع مبدأ أوفباو

Which of the following is true related to the orbital diagrams below?

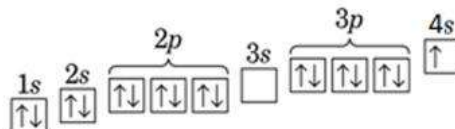
أي مما يأتي صحيح فيما يتعلق بمخططات الأفلاك أدناه؟

Matches Hund's rule



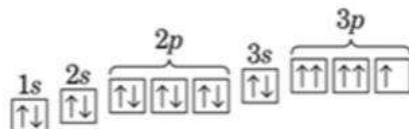
يتطابق مع قاعدة هوند

Matches Aufbau principle



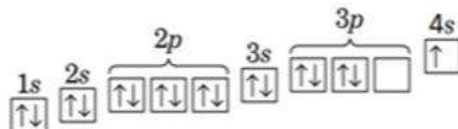
يتطابق مع مبدأ أوفباو

Matches Pauli exclusion principle



يتطابق مع مبدأ باولي للاستبعاد

Matches all electron configuration principles



يتطابق مع كل قواعد الترتيب الإلكتروني

APPLICATIONS

8. Without using the periodic table, determine the group, period, and block of an atom with the following electron configurations.

a. $[\text{Ne}]3s^2$

b. $[\text{He}]2s^2$

c. $[\text{Kr}]5s^24d^{10}5p^5$

9. What are the symbols for the elements with the following valence electron configurations?

a. s^2d^1 (All group 3)

b. s^2p^3 (All group 15)

c. s^2p^6 (All group 18 except helium)

10. Challenge Write the electron configuration of the following elements.

a. the group 2 element in the fourth period

c. the noble gas in the fifth period

b. the group 12 element in the fourth period

d. the group 16 element in the second period

8-a. group 2
Period 3
block s

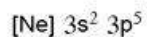
8-b. group 2
Period 2
block s

8-c. group 17
Period 5
block p

10-a. $[\text{Ar}]4s^2$
10-b. $[\text{Ar}]4s^23d^{10}$
10-c. $[\text{Xe}]$
10-d. $[\text{He}]2s^22p^4$

What is the period, group, and block for an element with the following electron configuration?

ما الدورة والمجموعة والمجمع التي ينتمي إليها العنصر ذو الترتيب الإلكتروني التالي؟



المجموعة Group	الدورة Period	المجمع Block
2	2	s

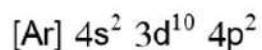
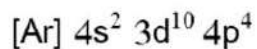
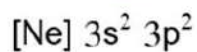
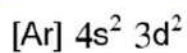
المجموعة Group	الدورة Period	المجمع Block
17	6	p

المجموعة Group	الدورة Period	المجمع Block
15	3	p

المجموعة Group	الدورة Period	المجمع Block
17	3	p

Which of the following arrangement represents an element in group 4, period 4 and block d?

أي الترتيبات التالية تمثل عنصر يقع في المجموعة 4 والدورة 4 والمجمع d؟



Which of the following table represents an atom with the following electron configuration: $[\text{Ne}] 3s^2 3p^1$

أي من الجداول التالية يُعبّر عن ذرّة لها التوزيع الإلكتروني التالي:
 $[\text{Ne}] 3s^2 3p^1$

المجموع block	المجموعة group	الدورة period
s	3	1

المجموع block	المجموعة group	الدورة period
p	3	3

المجموع block	المجموعة group	الدورة period
s	3	3

المجموع block	المجموعة group	الدورة period
p	13	3

Where is located the element with the electron configuration $[\text{Kr}] 5s^2 4d^{10} 5p^2$ in the periodic table?

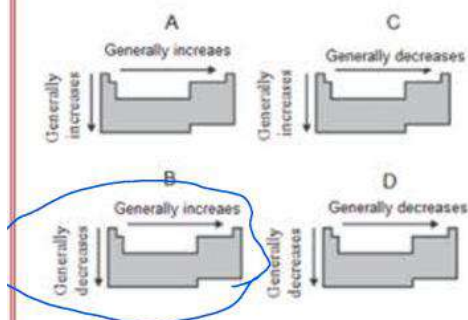
- A – Period 5 and group 2
- B – Period 5 and group 12
- C – Period 5 and group 14
- D – Period 5 and group 4

أين يقع العنصر ذو الترتيب الإلكتروني $[\text{Kr}] 5s^2 4d^{10} 5p^2$

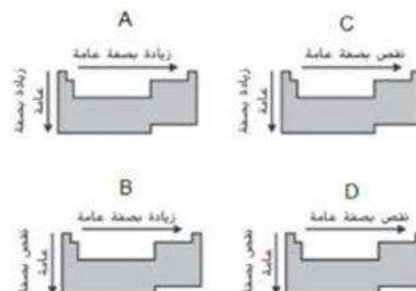
في الجدول الدوري؟

- A – في الدورة 5 والمجموعة 2
- B – في الدورة 5 والمجموعة 12
- C – في الدورة 5 والمجموعة 14
- D – في الدورة 5 والمجموعة 4

Which of the following diagrams represents the ionization energy trend of the periodic table elements across periods and groups?



أي المخططات التالية يُمكن تدرّج طاقة التأين الكهربائية في كل من الدورة والمجموعة لعناصر الجدول الدوري؟



Which of the following ions has the **largest** ionic radius?

A – O^{2-}

B – N^{3-}

C – Li^+

D – F^-

Ion symbol	Li^+	N^{3-}	O^{2-}	F^-
Element group number	1	15	16	17

أي من الأيونات التالية له أكبر نصف قطر أيوني؟

O^{2-} – A

N^{3-} – B

Li^+ – C

F^- – D

رمز الأيون	Li^+	N^{3-}	O^{2-}	F^-
رقم مجموعة العنصر	1	15	16	17

Which is the correct ascending order of the atomic radius for the period 4 elements shown in the table below?

ما الترتيب التصاعدي الصحيح حسب نصف القطر الذري لكل من عناصر الدورة الرابعة المبينة في الجدول أدناه؟

K Ca Ga Ge
19 → 20 → 31 → 32

Element symbol	K	Ga	Ge	Ca
رمز العنصر	K	Ga	Ge	Ca
Atomic number	19	31	32	20
العدد الذري	19	31	32	20

A. (lowest) Ga → Ge → Ca → K (highest)

A. (الأقل) K ← Ca ← Ge ← Ga (الأكثر)

B. (lowest) Ge → Ga → Ca → K (highest)

B. (الأقل) K ← Ca ← Ga ← Ge (الأكثر)

C. (lowest) K → Ca → Ga → Ge (highest)

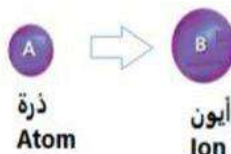
C. (الأقل) Ge ← Ga ← Ca ← K (الأكثر)

D. (lowest) Ca → Ga → Ge → K (highest)

D. (الأقل) K ← Ge ← Ga ← Ca (الأكثر)

Using the figure below, if **A** represents an atom and **B** represents an ion of the same element
Which of the following statements is **TRUE**?

مستخدمًا الشكل أدناه، إذا كان **A** يرمز لذرة و **B** يرمز لأيون لنفس العنصر
أي العبارات التالية **صحيحة** ؟



- A. The ion is positive as the ionic diameter becomes larger when an electron is lost
- B. The ion is negative as the ionic diameter becomes larger when an electron is gain**
- C. The ion is negative as the ionic diameter becomes smaller due the decrease in the electrostatic repulsion
- D. The ion is positive as the ionic diameter becomes larger due the increase in the electrostatic repulsion

- A. الأيون موجب حيث أصبح القطر الأيوني أكبر عند فقدان الإلكترون
- B. الأيون سالب حيث أصبح القطر الأيوني أكبر عند اكتساب الإلكترون
- C. الأيون سالب حيث أصبح القطر الأيوني أصغر بسبب انخفاض قوى التنافر الإلكتروني
- D. الأيون موجب حيث أصبح القطر الأيوني أكبر بسبب زيادة قوى التنافر الإلكتروني

Which of the following is true regarding electronegativity in the periodic table?

أي مما يأتي صحيح فيما يتعلق بالسالبية الكهربائية في الجدول الدوري؟

PERIODIC TABLE OF ELEMENTS																		2			
1 H																	2 He				
3 Li	4 Be															5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg															13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr				
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe				
55 Cs	56 Ba	57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu					
87 Fr	88 Ra	89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr					

Electronegativity increases as we move down a group

تزداد السالبية الكهربائية عند الانتقال في المجموعة من أعلى إلى أسفل

Fluorine (F) is the least electronegative element

الفلور (F) هو العنصر الأقل سالبية كهربائية

Cesium (Cs) is the most electronegative element

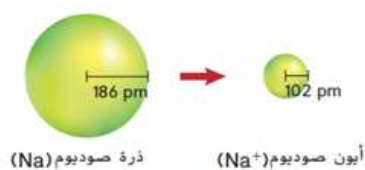
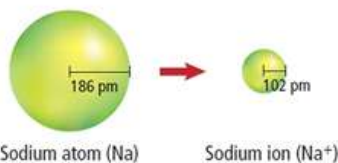
السيوم (Cs) هو العنصر الأعلى سالبية كهربائية

Electronegativity increases as we move from left to right across a period

تزداد السالبية الكهربائية عند الانتقال في أي دورة من اليسار إلى اليمين

Why sodium ion Na^+ is smaller than its atom Na?

لماذا يكون حجم الأيون Na^+ أصغر من حجم ذرته Na ؟



I	Outer orbital is left completely empty.	ترك مستوى الطاقة الأخير خالياً تماماً	I
II	The effective nuclear charge increases for the remaining electrons	زيادة تأثير شحنة النواة في الإلكترونات المتبقية	II
III	Increase in number of energy levels	زيادة عدد مستويات الطاقة	III

II only

II فقط

I and II

II و I

I only

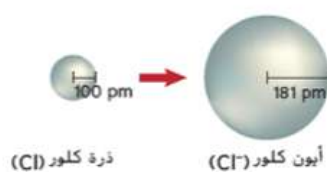
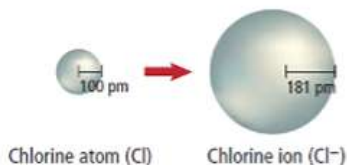
I فقط

II and III

III و II

Why Cl^- ion is bigger than its atom Cl?

لماذا يكون حجم الأيون Cl^- أكبر من حجم ذرته Cl ؟



I.	The electrostatic repulsion between the atom's outer electrons increases	زيادة التنافر الإلكتروستاتيكي بين الإلكترونات الخارجية للذرة	.I
II.	The electronic cloud is stretched outward	تمدد السحابة الإلكترونية للخارج	.II
III.	The electrostatic repulsion between the atom's outer electrons decreases	انخفاض التنافر الإلكتروستاتيكي بين الإلكترونات الخارجية للذرة	.III

II only

II فقط

I only

I فقط

I and II

II و I

II and III

III و II

Which one of the following elements have the highest electronegativity?

أي من العناصر التالية لها أعلى سالبية كهربائية؟

PERIODIC TABLE OF ELEMENTS

S

Si

P

Al

Why the difference between 1st and 2nd Ionization Energy for lithium is the highest in period 2 elements?

لماذا يكون الفرق بين طاقة التأين الأولى والثانية لعنصر الليثيوم هو

الأعلى بين عناصر الدورة الثانية؟

Element	1 st Ionization Energy (KJ/mol)	2 nd Ionization Energy (KJ/mol)	Difference between 1 st and 2 nd I.E.
العنصر	طاقة التأين الأولى (KJ/mol)	طاقة التأين الثانية (KJ/mol)	الفرق بين طاقة التأين الأولى والثانية
Li	520	7300	6780
Be	900	1760	860
B	800	2430	1630
C	1090	2350	1260
N	1400	2860	1460
O	1310	3390	2080
F	1680	3370	1690
Ne	2080	3950	1870

Because the effect of lithium nucleus on electrons is the weakest among period 2 elements

لأن تأثير شحنة نواة الليثيوم على الإلكترونات يكون هو الأضعف بين عناصر الدورة الثانية

Because the energy required for each successive ionization always increases

لأن الطاقة اللازمة لكل عملية تأين تالية تزيد دوماً

Because lithium easily forms the common lithium 2+ ion but is unlikely to form a lithium 1+ ion.

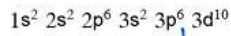
لأن الليثيوم يُشكل أيون الليثيوم 2+ الشائع بسهولة لكن لا يحتمل أن يُشكل أيون الليثيوم 1+.

Because the atom holds onto their inner core electrons much more strongly than they hold onto their valence electrons.

لأن الذرة تتمسك بالإلكترونات الأساسية الداخلية بقوة شديدة تفوق تمسكها بالإلكترونات التكافؤ

Which of the ions below has the following
electron configuration?

أي من الأيونات أدناه له الترتيب الإلكتروني التالي؟



$$28 + 2 = 30$$

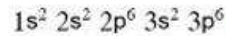
1																	18	
1	H																	He
2	Li	Be											B	C	N	O	F	Ne
3	Na	Mg											Al	Si	P	S	Cl	Ar
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
6	Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7	Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og



Which of the ions below has the following
electron configuration?

أي من الأيونات أدناه له الترتيب

الإلكتروني التالي؟



$$21 - 3 = 18$$

PERIODIC TABLE OF ELEMENTS																		19				
1																	2					
3	H																	He				
4																						
5	Li	Be															B	C	N	O	F	Ne
6																						
7	Na	Mg											Al	Si	P	S	Cl	Ar				
8																						
9	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr				
10																						
11	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe				
12																						
13	Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn				
14																						
15	Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og				
16																						



Describe how ions (cations and anions) form to fulfill the octet rule

يصف تكون الأيونات (كاتيون - أنيون) للوصول إلى الترتيب الإلكتروني المستقر

The Group 13 elements of the periodic table tend to lose valence electrons to attain a stable outer electron configuration and form ions.

What is the charge of the formed ions?

تميل عناصر المجموعة 13 من الجدول الدوري إلى فقدان الإلكترونات التكافؤ للوصول إلى الترتيب الإلكتروني الخارجي المستقر مكونةً أيونات.

ما شحنة الأيونات المتكونة؟

+2

0

-3

+3

What is the pseudo-noble gas configuration for Cd atom when it loses $2e^-$?

(Cd: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10}$)

ما الترتيب الإلكتروني للغاز شبه النبيل لذرة الكاديوم Cd عندما تفقد $2e^-$ ؟

(Cd: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10}$)

[Kr] $4d^{10}$

[Ar] $4s^2 3d^{10} 4p^6$

[Kr] $5s^2 4d^8$

[Ar] $4d^{10}$

The electronic configuration of sulfur atom (S) is

$1s^2 2s^2 2p^6 3s^2 3p^4$. What is the electron configuration

of the ion formed by this atom?

الترتيب الإلكتروني لذرة الكبريت (S) هو $1s^2 2s^2 2p^6 3s^2 3p^4$. ما

الترتيب الإلكتروني للأيون الذي تكوّنهُ هذه الذرة؟

A	B	C	D
$1s^2 2s^2 2p^6 3s^2 3p^6$	$1s^2 2s^2 2p^6 3s^2 3p^5$	$1s^2 2s^2 2p^6 3s^2 3p^3$	$1s^2 2s^2 2p^6 3s^2$

How the atoms of group 15 elements become stable?

- A – By losing two electrons
- B – By gaining two electrons
- C – By losing 3 electrons
- D – By gaining 3 electrons

كيف تستقر ذرات عناصر المجموعة 15؟

- A – بفقدان إلكترونين
- B – باكتساب إلكترونين
- C – بفقدان 3 إلكترونات
- D – باكتساب 3 إلكترونات

Which of the following is **incorrect** regarding the basic features of the modern periodic table?

أي مما يأتي **غير** صحيح فيما يتعلق بالميزات الأساسية للجدول الدوري الحديث؟

-- لا يوجد تعليق لهذا السؤال --

Elements in the modern periodic table are arranged in ascending order of atomic mass

ترتب العناصر في الجدول الدوري الحديث تصاعديًا حسب الكتلة الذرية

The elements in the periodic table are arranged in seven horizontal periods in which a trend of properties appears

ترتب العناصر في الجدول الدوري في سبع دورات أفقية يظهر فيها تدرج في الخواص

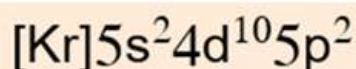
Metals occupy the left and center of the periodic table and are good conductors of heat and electricity and are characterized by their luster

تشغل الفلزات يسار ووسط الجدول الدوري وهي جيدة التوصيل للحرارة والكهرباء وتمتاز باللمعان

Group 17 consists of chemically active elements called halogens

تتألف المجموعة 17 من عناصر نشطة كيميائيًا يُطلق عليها الهالوجينات

What period, group and block does the element with the following electron configuration belong to? ما الدورة والمجموعة والمجمع التي ينتمي إليها العنصر ذو الترتيب الإلكتروني التالي؟



المجمع Block	المجموعة Group	الدورة Period	
d	14	5	A
p	14	5	B
d	4	4	C
p	4	4	D

Which of the following correctly describes the first ionization energy trend across both the period and the group and the explanation of this trend?

أي مما يأتي يصف بشكل صحيح تدرج طاقة التأين الأولى خلال كل من الدورة والمجموعة وتفسير هذا التدرج؟

First ionization energies generally decrease as you move from left to right across any period due to the increasing nuclear charge

تقل طاقات التأين الأولى عند الانتقال من اليسار إلى اليمين خلال أي دورة بسبب شحنة النواة المتزايدة

First ionization energies generally increase as you move from left to right across a period due to the increasing nuclear charge

تزداد طاقات التأين الأولى عند الانتقال من اليسار إلى اليمين خلال أي دورة بسبب شحنة النواة المتزايدة

First ionization energies generally decrease as you move down a group because the atomic size decreases

تقل طاقات التأين الأولى عند الانتقال لأسفل خلال أي مجموعة بسبب نقص الحجم الذري

First ionization energies generally increase as you move down a group because the atomic size increases

تزداد طاقات التأين الأولى عند الانتقال لأسفل خلال أي مجموعة بسبب زيادة الحجم الذري

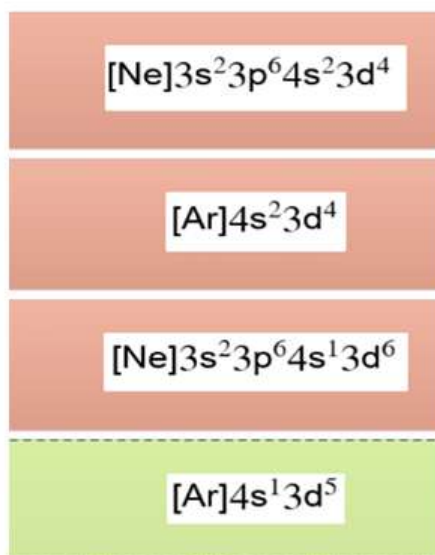
What is the electronic configuration of the element chromium (**Cr**) in the ground state by the noble gas notation?

Atomic number of chromium = 24

ما الترتيب الإلكتروني لعنصر الكروم (**Cr**) في الحالة المستقرة

باستخدام ترميز الغاز النبيل؟

العدد الذري للكروم = 24



Which of the electronic configurations below **does not** agree with Aufbau principle?

أي من الترتيبات الإلكترونية أدناه **لا** يتفق مع مبدأ أوفباو؟



1. In Bohr's model of the hydrogen atom, electrons revolve around the nucleus in:

- a) Elliptical orbits
- b) Fixed circular orbits with quantized energy
- c) Random orbits
- d) Parabolic paths

3. The ground state of the hydrogen atom corresponds to:

- a) $n=0$
- b) $n=1$
- c) $n=2$
- d) $n=3$

4. An excited state of an atom means:

- a) The electron has been removed completely
- b) The electron is in the lowest possible orbit
- c) The electron is in a higher orbit than the ground state
- d) The nucleus gains energy

13. When an electron jumps from higher orbit to a lower orbit, it:

- a) Absorbs energy
- b) Emits energy in the form of photons
- c) Remains unchanged
- d) Loses a proton

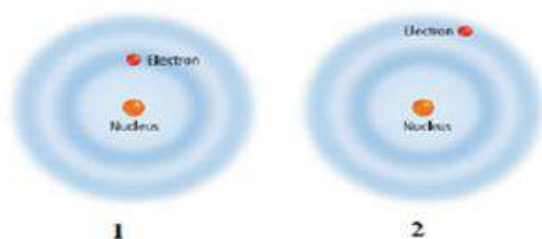
Which one of the following sublevels maximum fits up to 10 electrons?

أي من المستويات الفرعية التالية يتسع بأقصى حد لعشر إلكترونات؟

p
s
f
d

Regarding the figure below, which of the following is

correct?



A	Figure 2 represents the lowest allowable energy state of an atom
B	Figure 1 represents the excited state of the atom
C	The atom gains energy until it reaches figure 1
D	The atom gains energy until it reaches figure 2

Which of the following statements is **correct?**

A	Principal energy level 3 consists of three sublevels, they are 3s, 3p and 3f
B	Principal energy level 3 consists of three sublevels, they are 3s, 3p and 3d
C	Principal energy level 2 consists of two sublevels, they are 2s, 2d
D	Principal energy level 2 consists of two sublevels, they are 2s, 2f

Practice :

Q4: Write valence electron for each electron configuration :

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

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

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

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

Q5: Match each element with its electron dot-structure :

Element	Electron-dot Structure
$1s^2 2s^2 2p^6 3s^1$	
$1s^2 2s^2 2p^2$	
$1s^2 2s^2 2p^6 3s^2 3p^1$	
$1s^2 2s^2 2p^6$	

Why do elements in the same group have similar chemical properties?

لماذا تتشابه العناصر الموجودة في المجموعة نفسها في الخواص الكيميائية؟

Because they have the same number of valence electrons	☐ لأن لها عدد إلكترونات التكافؤ نفسه
Because they have the same mass number	☐ لأن لها العدد الكتلي نفسه
Because they have the same atomic number	☐ لأن لها العدد الذري نفسه
Because they have the same number of isotopes	☐ لأن لها عدد النظائر نفسه

13. Which of the following correctly orders the atomic radii from largest to smallest?

- a) $\text{Li} > \text{Na} > \text{K} > \text{Rb}$
- b) $\text{Rb} > \text{K} > \text{Na} > \text{Li}$
- c) $\text{Na} > \text{K} > \text{Rb} > \text{Li}$
- d) $\text{Li} > \text{K} > \text{Rb} > \text{Na}$

Which of the following figures shows the trends of the atomic radius through both a period and a group?

A	C
B	D

Which of the following is **correct** regarding

أي مما يأتي **صحيح** فيما يتعلق بالأيون **السالب**؟

negative ion?

A neutral atom loses one or more valence electrons, and this requires energy	تفقد الذرة المتعادلة إلكترونًا أو أكثر من إلكترونات التكافؤ ويتطلب ذلك طاقة
A neutral atom gains one or more valence electrons, and this requires energy	تكتسب الذرة المتعادلة إلكترونًا أو أكثر من إلكترونات التكافؤ ويتطلب ذلك طاقة
A neutral atom loses one or more valence electrons, and energy released	تفقد الذرة المتعادلة إلكترونًا أو أكثر من إلكترونات التكافؤ وتتحلل طاقة
A neutral atom gains one or more valence electrons, and energy released	تكتسب الذرة المتعادلة إلكترونًا أو أكثر من إلكترونات التكافؤ وتتحلل طاقة

Which of the following is **correct** regarding

أي مما يأتي **صحيح** فيما يتعلق بالأيون **الموجب**؟

positive ion?

A	A neutral atom loses one or more valence electrons, and this requires gain of energy	C	A neutral atom loses one or more valence electrons, and energy released
B	A neutral atom gains one or more valence electrons, and this requires gain of energy	D	A neutral atom gains one or more valence electrons, and energy released

How the atoms of group **15** elements become stable?

A – By losing two electrons

B – By gaining two electrons

C – By losing 3 electrons

D – By gaining 3 electrons

Objective-1

Q1. What does the Law of Conservation of Mass state?

- A) Mass can be created
- B) Mass is neither created nor destroyed
- C) Mass is lost as heat
- D) Mass changes in a reaction

Q2. If 10g of substance A reacts completely with 5g of substance B, what is the total mass of the products?

- A) 5g
- B) 10g
- C) 15g
- D) 50g

Q3. Why must chemical equations be balanced?

- A) To change the products
- B) To show that mass is conserved
- C) To make it look neat
- D) To change the states of matter

Q4. In a closed system, a physical change occurs. What happens to the total mass?

- A) It increases
- B) It decreases
- C) It remains exactly the same
- D) It doubles

Q5. Which of the following is always conserved in a chemical reaction?

- A) Volume of gases
- B) Number of molecules
- C) Total mass
- D) Color

Objective-2

Q1. Why is an atom considered electrically neutral?

- A) It has no particles
- B) Protons and electrons are equal
- C) Neutrons block the charge
- D) Electrons have no charge

Q2. What is the electrical charge of a proton?

- A) +1
- B) -1
- C) 0
- D) +2

Q3. What is the electrical charge of an electron?

- A) +1
- B) -1
- C) 0
- D) -2

Q4. If a neutral atom has 6 protons, how many electrons must it have?

- A) 0
- B) 3
- C) 6
- D) 12

Q5. Which two particles must be equal in number for an atom to be neutral?

- A) Protons and neutrons
- B) Neutrons and electrons
- C) Protons and electrons
- D) Nucleus and empty space

Objective-3

Q1. Where is the neutron located in an atom?

- A) Electron cloud
- B) Nucleus
- C) Outside the atom
- D) Energy levels

Q2. What is the electrical charge of a neutron?

- A) +1
- B) -1
- C) Neutral (0)
- D) +2

Q3. What is the approximate mass of a neutron?

- A) 0 amu
- B) 1 amu
- C) 2 amu
- D) 0.0005 amu

Q4. Which particles make up the dense nucleus of an atom?

- A) Protons and electrons
- B) Electrons and neutrons
- C) Protons and neutrons
- D) Only protons

Q5. Which subatomic particle has no effect on the charge of the atom?

- A) Proton
- B) Electron
- C) Neutron
- D) Ion

Objective-4

Q1. An atom has an atomic number of 11 and a mass number of 23. How many protons does it have?

- A) 11
- B) 12
- C) 23
- D) 34

Q2. How many neutrons are in an atom with a mass number of 14 and an atomic number of 6?

- A) 6
- B) 8
- C) 14
- D) 20

Q3. How many electrons are in a neutral atom of Oxygen (Atomic Number = 8)?

- A) 4
- B) 8
- C) 16
- D) 24

Q4. If an atom has 15 protons and 16 neutrons, what is its mass number?

- A) 1
- B) 15
- C) 16
- D) 31

Q5. Which value tells you the exact number of protons in an atom?

- A) Mass number
- B) Neutron count
- C) Atomic number
- D) Atomic weight

Objective-5

Q1. Which type of radiation has the highest penetrating power?

- A) Alpha
- B) Beta
- C) Gamma
- D) X-ray

Q2. What is an alpha particle identical to?

- A) A helium nucleus
- B) An electron
- C) A photon
- D) A hydrogen atom

Q3. Which type of radiation is easily stopped by a single piece of paper?

- A) Alpha
- B) Beta
- C) Gamma
- D) Neutron

Q4. What charge does a beta particle carry?

- A) +2
- B) +1
- C) 0
- D) -1

Q5. Which of the following has NO mass and NO electrical charge?

- A) Alpha particle
- B) Beta particle
- C) Gamma ray
- D) Proton

Objective-6

Q1. Isotopes of an element have different numbers of which particle?

- A) Protons
- B) Electrons
- C) Neutrons
- D) Nuclei

Q2. Carbon-12 and Carbon-14 differ in their:

- A) Atomic number
- B) Number of protons
- C) Mass number
- D) Electron count

Q3. How many neutrons are in Hydrogen-3 (Tritium) if its atomic number is 1?

- A) 1
- B) 2
- C) 3
- D) 4

Q4. Do isotopes of the same element always have the same atomic number?

- A) Yes, always
- B) No, never
- C) Only in solids
- D) Only if radioactive

Q5. An isotope of Uranium has an atomic number of 92 and a mass number of 235. How many protons does it have?

- A) 92
- B) 143
- C) 235
- D) 327

Objective-7

Q1. Why do isotopes of an element react chemically the exact same way?

- A) They have the same mass
- B) They have the same number of neutrons
- C) They have the same number of electrons
- D) They have no charge

Q2. Which subatomic particle is primarily responsible for chemical behavior?

- A) Proton
- B) Neutron
- C) Electron
- D) Quark

Q3. Do isotopes have the same electron configuration?

- A) Yes
- B) No
- C) Only some of them
- D) Only if heated

Q4. What physical property differs between isotopes of the same element?

- A) Chemical reactivity
- B) Number of electrons
- C) Mass
- D) Atomic number

Q5. If Oxygen-16 reacts with hydrogen to form water, how will Oxygen-18 react?

- A) It will explode
- B) It will also form water
- C) It will not react
- D) It will form acid

Objective-8

Q1. What standard reference atom is used to define the atomic mass unit (amu)?

- A) Hydrogen-1
- B) Oxygen-16
- C) Carbon-12
- D) Nitrogen-14

Q2. 1 amu is defined as what fraction of a Carbon-12 atom?

- A) $1/2$
- B) $1/6$
- C) $1/10$
- D) $1/12$

Q3. Which of the following particles has a mass of approximately 1 amu?

- A) Electron
- B) Proton
- C) Photon
- D) Gamma ray

Q4. Why do scientists use amu instead of grams to measure atomic mass?

- A) Grams are too small
- B) Grams are too large and inconvenient
- C) Amu is metric
- D) Atoms don't have true mass

Q5. The mass of an electron measured in amu is closest to:

- A) 1 amu
- B) 2 amu
- C) 0 amu
- D) 12 amu

Objective-9

Q1. What happens to the mass number of a nucleus during alpha decay?

- A) Decreases by 2
- B) Decreases by 4
- C) Increases by 1
- D) Stays the same

Q2. What happens to the atomic number of a nucleus during beta decay?

- A) Decreases by 2
- B) Increases by 1
- C) Decreases by 1
- D) Stays the same

Q3. Which type of decay does not change the atomic or mass number at all?

- A) Alpha
- B) Beta
- C) Gamma
- D) Positron

Q4. Uranium-238 (Atomic number 92) undergoes alpha decay. What is the new atomic number?

- A) 90
- B) 91
- C) 93
- D) 94

Q5. Carbon-14 (Atomic number 6) undergoes beta decay. What is the new atomic number?

- A) 4
- B) 5
- C) 6
- D) 7

Objective-10

Q1. According to Bohr's model, how do electrons move?

- A) In random clouds
- B) In fixed circular orbits
- C) In straight lines
- D) They do not move

Q2. What happens when an electron drops from a higher energy orbit to a lower one?

- A) It gains mass
- B) It emits a photon of light
- C) It becomes a proton
- D) It stops moving

Q3. Which specific element was Bohr's model primarily based upon?

- A) Helium
- B) Oxygen
- C) Carbon
- D) Hydrogen

Q4. The lowest possible energy state of an electron in Bohr's model is called the:

- A) Excited state
- B) Ground state
- C) Quantum state
- D) Vacuum state

Q5. In Bohr's model, the energy levels of electrons are:

- A) Continuous
- B) Random
- C) Quantized (fixed amounts)
- D) Infinite

Objective-11

Q1. What is the main rule of the Aufbau principle?

- A) Electrons repel each other
- B) Electrons fill lowest energy levels first
- C) Electrons pair up immediately
- D) Orbitals hold 8 electrons

Q2. According to the Aufbau principle, which orbital is filled first?

- A) 1s
- B) 2s
- C) 2p
- D) 3s

Q3. After the 3p orbital is completely filled, which orbital gets filled next?

- A) 3d
- B) 4s
- C) 4p
- D) 5s

Q4. The word 'Aufbau' is German for:

- A) Building up
- B) Energy
- C) Orbitals
- D) Electrons

Q5. If an electron enters the 2p level, which energy level must already be full?

- A) 3s
- B) 2s
- C) 3p
- D) 1p

Objective-12

Q1. What does Hund's rule aim to maximize within a subshell?

- A) Paired electrons
- B) Unpaired electrons
- C) Protons
- D) Neutrons

Q2. In a p-sublevel with 3 available orbitals, how are 3 electrons arranged?

- A) All 3 in one orbital
- B) Two in one, one in the second
- C) One in each of the three orbitals
- D) They go to the s-orbital instead

Q3. According to Hund's rule, single electrons in separate orbitals must have:

- A) Opposite spins
- B) Parallel spins
- C) No spin
- D) Variable spin

Q4. Why do electrons stay unpaired in equal-energy orbitals if possible?

- A) To increase gravity
- B) To minimize electron-electron repulsion
- C) To change the atomic number
- D) To move faster

Q5. Which action would violate Hund's rule?

- A) Filling 1s before 2s
- B) Pairing electrons in a p-orbital before all three have one electron
- C) Having 8 valence electrons
- D) Spinning in opposite directions in the same orbital

Answer Key

Objective Number	Q1	Q2	Q3	Q4	Q5
Objective 1	B	C	B	C	C
Objective 2	B	A	B	C	C
Objective 3	B	C	B	C	C
Objective 4	A	B	B	D	C
Objective 5	C	A	A	D	C
Objective 6	C	C	B	A	A
Objective 7	C	C	A	C	B
Objective 8	C	D	B	B	C
Objective 9	B	B	C	A	D
Objective 10	B	B	D	B	C
Objective 11	B	A	B	A	B
Objective 12	B	C	B	B	B

Figure 4 Periodic Table of the Elements

1																	18		
1 H Hydrogen 1.008																	2 He Helium 4.003		
3 Li Lithium 6.941	4 Be Beryllium 9.012																	10 Ne Neon 20.180	
11 Na Sodium 22.990	12 Mg Magnesium 24.305																	18 Ar Argon 39.948	
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.847	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.723	32 Ge Germanium 72.61	33 As Arsenic 74.922	34 Se Selenium 78.971	35 Br Bromine 79.904	36 Kr Krypton 83.80		
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.95	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.82	50 Sn Tin 118.710	51 Sb Antimony 121.757	52 Te Tellurium 127.60	53 I Iodine 126.904	54 Xe Xenon 131.290		
55 Cs Cesium 132.905	56 Ba Barium 137.327	57 La Lanthanum 138.905	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium 209	85 At Astatine 210	86 Rn Radon 222.018		
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (266)	107 Bh Bohrium (264)	108 Hs Hassium (277)	109 Mt Meitnerium (268)	110 Ds Darmstadtium (281)	111 Rg Roentgenium (282)	112 Cn Copernicium (285)	113 Nh Nihonium (286)	114 Fl Flerovium (289)	115 Mc Moscovium (288)	116 Lv Livermorium (293)	117 Ts Tennessine (294)	118 Og Oganesson (294)		
The number in parentheses is the mass number of the longest-lived isotope for that element.																		* Properties are largely predicted	
Lanthanide series																			
58 Ce Cerium 140.12	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.242	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.965	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.50	67 Ho Holmium 164.930	68 Er Erbium 167.259	69 Tm Thulium 168.934	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967						
Actinide series																			
90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)						