

شكراً لتحميلك هذا الملف من موقع المناهج الإماراتية



مراجعة نهائية وفق الهيكل الوزاري

[موقع المناهج](#) ⇨ [المناهج الإماراتية](#) ⇨ [الصف الحادي عشر العام](#) ⇨ [كيمياء](#) ⇨ [الفصل الأول](#) ⇨ [الملف](#)

تاريخ نشر الملف على موقع المناهج: 08:15:03 2023-11-29 | اسم المدرس: Saifudeen Jincy

التواصل الاجتماعي بحسب الصف الحادي عشر العام



روابط مواد الصف الحادي عشر العام على تلغرام

[الرياضيات](#)

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المزيد من الملفات بحسب الصف الحادي عشر العام والمادة كيمياء في الفصل الأول

حل تجميعية أسئلة وفق الهيكل الوزاري	1
تلخيص الوحدة الأولى الجدول الدوري والقانون الدوري	2
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Chemistry EOT based Study material-Term1



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CHAPTER 1

The Periodic Table and Periodic Law

BIG IDEA

Periodic trends in the properties of atoms allow us to predict physical and chemical properties.

SECTIONS

- 1 Development of the Modern Periodic Table
- 2 Classification of the Elements
- 3 Periodic Trends

Nitrogen 7 N 14.007	Oxygen 8 O 15.999	Fluorine 9 F 18.998
Phosphorus 15 P 30.97	Sulfur 16 S 32.066	Chlorine 17 Cl 35.453
Arsenic 33 As	Selenium 34 Se 78.96	Bromine 35 Br 79.90

Sulfur

يوضح تطورات الجدول الدوري من مندليف حتى الجدول الدوري الحديث

Table 2 Contributions to the Classification of Elements

J. Newlands (1837–1898)

- arranged elements by increasing atomic mass
- noticed the repetition of properties every eighth element
- created the law of octaves

Lothar Meyer (1830–1895)

- demonstrated a connection between atomic mass and elements' properties
- arranged the elements in order of increasing atomic mass

Dmitri Mendeleev (1834–1907)

- demonstrated a connection between atomic mass and elements' properties
- arranged the elements in order of increasing atomic mass
- predicted the existence and properties of undiscovered elements

Henry Moseley (1887–1915)

- discovered that atoms contain a unique number of protons called the atomic number
- arranged elements in order of increasing atomic number, which resulted in a periodic pattern of properties

Modern Periodic
table



In the first version of Mendeleev's table.

What did the empty spaces represent?

في الإصدار الأول من جدول مندلييف.

ماذا تمثل المساحات الفارغة ؟

Typische Elemente			K = 39	Rb = 85	Cs = 133	—	—
H = 1	Li = 7	Na = 23	Ca = 40	Sr = 87	Ba = 137	—	—
Be = 9,4	Mg = 24	—	—	Yt = 88?	Di = 138?	Er = 178?	—
B = 11	Al = 27,3	—	Ti = 48?	Zr = 90	Co = 140?	La = 180?	Th = 231
C = 12	Si = 28	—	V = 51	Nb = 94	—	Ta = 182	—
N = 14	P = 31	As = 75	Cr = 52	Mo = 96	—	W = 184	U = 240
O = 16	S = 32	Se = 78	Mn = 55	—	—	—	—
—	—	—	Fe = 56	Ru = 104	—	Os = 195?	—
—	—	—	Co = 59	Rh = 104	—	Ir = 197	—
—	—	—	Ni = 59	Pd = 106	—	Pt = 198?	—
—	—	—	Cu = 63	Ag = 108	—	Au = 199?	—
—	—	—	Zn = 65	Cd = 112	—	Hg = 200	—
—	—	—	—	In = 113	—	Tl = 204	—
—	—	—	—	Sb = 116	—	Pb = 207	—
—	—	—	—	Bi = 122	—	Po = 208	—
—	—	—	—	—	—	—	—

Learning Outcomes Covered

- CHM.5.1.01.004

a.

Isotopes

b.

Radioactive elements

ع ر مشعة

c.

Natural elements

ع ر طبيعية

d.

Undiscovered elements

ع ر لم تُكتشف بعد

Identify the location of elements and the main features of the modern periodic table

تحديد مواقع العناصر والمظاهر الرئيسية للجدول الدوري الحديث

PERIODIC TABLE

Representative Elements ←s-block→			Representative Elements ←p-block→															Noble gases 18	
1	1	2											13	14	15	16	17	18	
1	H																	He	
2	Li	Be	Transition Elements d-block										B	C	N	O	F	Ne	
3	Na	Mg	3	4	5	6	7	8	9	10	11	12	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		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
7	Fr	Ra		Rf	Db	Sg	Bh	Hs	Mt										
			Inner Transition Elements f-block																
			La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu		
			Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr		

Periodic table of the elements

																		18	
period	group 1*											13	14	15	16	17	2		
	1	1											5	6	7	8	9	10	
		H											B	C	N	O	F	He	
	2	3	4											6	7	8	9	10	
		Li	Be											C	N	O	F	Ne	
	3	11	12	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		Na	Mg											Al	Si	P	S	Cl	Ar
4		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
		K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5		37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
		Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
6		55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
		Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7		87	88	89	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
		Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og

Alkali metals

Alkaline-earth metals

Transition metals

Other metals

Other nonmetals

Halogens

Noble gases

Rare-earth elements (21, 39, 57–71)
and lanthanoid elements (57–71 only)

Actinoid elements

lanthanoid series 6

58	59	60	61	62	63	64	65	66	67	68	69	70	71
Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu

actinoid series 7

90	91	92	93	94	95	96	97	98	99	100	101	102	103
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

Question 1

ترتيب العناصر Order of the elements

The order of elements in the modern periodic table is based on an element's.....

ترتيب العناصر في الجدول الدوري الحديث يعتمد على للعنصر.

name

الاسم ☐

atomic number

العدد الذري ☐

chemical symbol

الرمز الكيميائي ☐

atomic mass

العدد الكتلي ☐

Answer: atomic number

2	CHM.5.1.01.007 يتعرف موقع اللانثانيدات والأكتينيدات في الجدول الدوري موضحا بعض استخداماتها	نص الكتاب	9,10
	CHM.5.1.01.007 Identify the location of Lanthanides and Actinide in the periodic table while illustrating some of their uses	Textbook	

Group 1: Alkali metals

- All have same physical and chemical properties
- They have same valence electron that is **1.**
- They all are metals.

Group 2: alkaline earth metals

- All have same physical and chemical properties
- They have same valence electron that is **2.**
- They all are metals.

- **Group 13 ,14,15,16,17 and Group 18**
- There are metals, metalloids and nonmetals.
- General configuration **$ns^2 np^{1-6}$**

S block elements

P block elements

Representative
elements



- **Group 3 – Group 12**
- There are metals.



F block elements

- There are metals.
- There divided into **Lanthanides** and **Actinides**



PERIODIC TABLE OF ELEMENTS

Metal										Metalloid		Nonmetal					
H															He		
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La-Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac-Lr															
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu			
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr			

- **Metalloids** or **semimetals** have physical and chemical **properties of both metals and non-metals**. Represented in green box
- Such as **silicon (Si)** and **germanium (Ge)** which used in **computer chips** and **solar cells**.

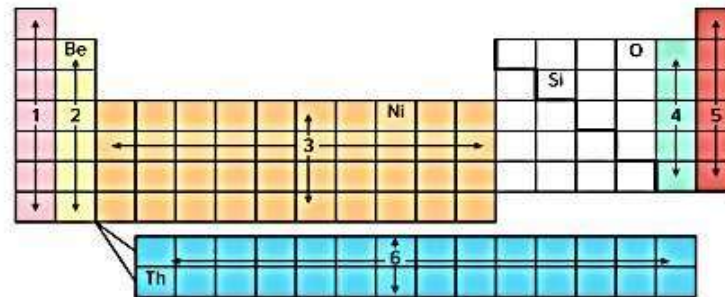
Connection to Biology **Nonmetals** Nonmetals occupy the upper-right side of the periodic table. They are represented by the yellow boxes in **Figure 5**. **Nonmetals** are elements that are generally gases or brittle, dull-looking solids. They are poor conductors of heat and electricity. The only nonmetal that is a liquid at room temperature is bromine (Br). The most abundant element in the human body is the nonmetal oxygen, which constitutes 65% of the body mass.

Group 17 is comprised of highly reactive elements that are known as **halogens**. Like the group 1 and group 2 elements, the halogens are often part of compounds. Compounds made with the halogen fluorine (F) are commonly added to toothpaste and drinking water to prevent tooth decay. The extremely unreactive group 18 elements are commonly called the **noble gases** and are used in lasers, a variety of light bulbs, and neon signs.

Question 2

Which number represents inner transition metals in the diagram of periodic table of elements shown below?

ما الرقم الذي يمثل الفلزات الانتقالية الداخلية في الرسم التخطيطي أدناه للجدول الدوري للعناصر؟



5

☐

6

☐

3

☐

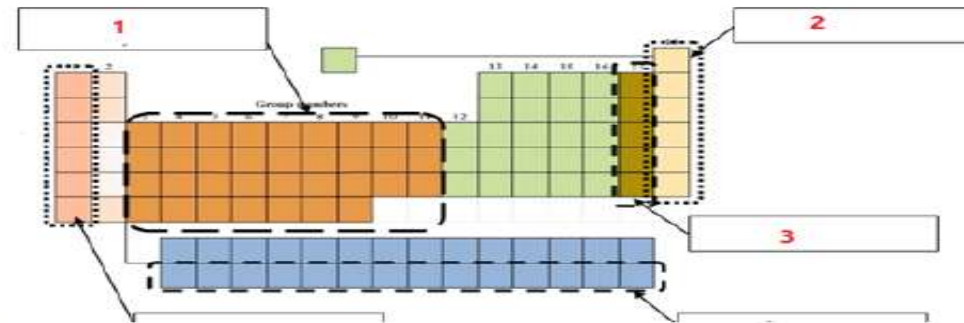
1

☒

Answer: 6

What elements are represented by the region labeled by the number 1 in the figure below?

ما هي العناصر التي تُمثّلها المنطقة المشار إليها بالرقم 1 في الشكل أدناه ؟



Learning Outcomes Covered

- CHM.5.1.01.004

a.

Transition elements

عناصر الانتقالية

b.

Representative elements

عناصر الرئيسية

c.

Actinides

أكتينيدات

d.

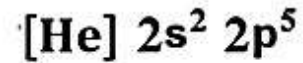
Alkali metals

إت القلوية

Question 3

Which element similar in chemical properties to the element have the electron configuration?

أي عنصر يُشابه في الخواص الكيميائية عنصر له الترتيب الإلكتروني؟



An element located in block S

عنصر الذي يقع في المجمع S



An element located in period 2

عنصر الذي يقع في الدورة 2



An element located in block p

عنصر الذي يقع في المجمع p



An element located in group 17

عنصر الذي يقع في المجموعة 17



Answer: an element located in group 17

Question 4

Which block that element have the electron configuration is located in it?

أي مجمع الذي يقع فيه العنصر ذو الترتيب الإلكتروني التالي؟



Block f	المجمع f	<input type="radio"/>
Block S	المجمع S	<input type="radio"/>
Block d	المجمع d	<input type="radio"/>
Block p	المجمع p	<input type="radio"/>

Answer: Block d

What does the green boxes bordering the staircase line in below figure represent?

ماذا تُمثّل المربعات الخضراء على جانب الخط المتعرج في الشكل أدناه؟



Learning Outcomes Covered

- CHM.5.1.01.004

a.

Metals

إت

b.

Nonmetals

أزات

c.

Metalloids

ه الفلزات

d.

Lanthanides

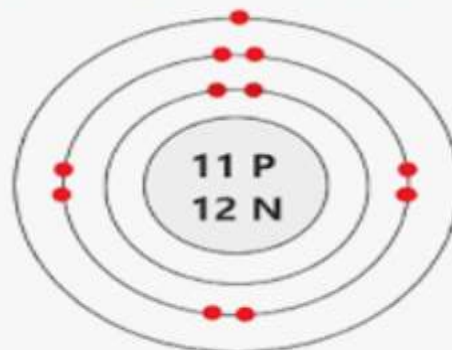
ثينيدات

Valence electrons are the electrons present in the outermost energy level (shell/ring)

Elements belongs to same group have same number of valence electron. For example, Group 1 (Li, Na, K have same valence electron that is 1.

Elements in Group 2 have 2 valence electron, group 13 have 3 , Group 14 have 4 , group 18 have 8 valence electrons.

Bohr model of Sodium atom

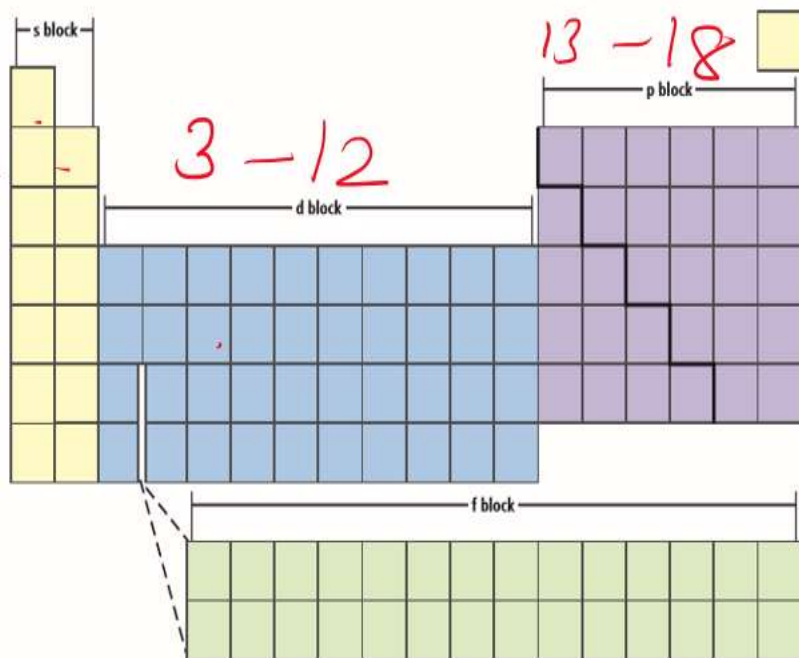


Lewis Dot Structure for Sodium



	1	2		13	14	15	16	17	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.		Ga.	Ge.	As.	Se.	Br.	Kr:
5	Rb.	Sr.		In.	Sn.	Sb.	Te.	I.	Xe:
6	Cs.	Ba.		Tl.	Pb.	Bi.	Po.		Rn:

Elements are organized into different blocks in the periodic table according to their electron configurations.



■ **Figure 6.8** The periodic table is divided into four blocks—s, p, d, and f.

Analyze What is the relationship between the maximum number of electrons an energy sublevel can hold and the size of that block on the diagram?

S block consists of group 1,2

P block consist of group 13 to 18

d block consist of group 3 to 12

F block consist of inner transition elements (period 6,7)

- Because **s** orbitals hold **2 electrons** at most, the **s-block** spans **2 groups**.
- The **p-block** spans **6 groups** **because** the **3 p orbitals** can hold **a maximum of 6 electrons**.
- The **5 d orbitals** can hold **10 electrons**, so the d-block spans **10 groups** on the periodic table.

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

مجموعة نفسها

Learning Outcomes Covered

- CHM.5.1.01.004
- CHM.5.1.01.008
- CHM.5.1.01.009
- CHM.5.1.01.011
- CHM.5.1.01.013
- CHM.5.1.01.014
- CHM.5.1.02.002
- CHM.5.1.02.003
- CHM.5.1.02.007
- CHM.5.1.02.022

a.

Because they have the same number of valence electrons

b.

Because they have the same atomic number

c.

Because they have the same mass number

d.

Because they have the same number of isotopes

Question 5

What is the number of valence electrons
in the elements of the group shown down?

ما عدد إلكترونات التكافؤ التي تتواجد في عناصر المجموعة المبيّنة أدناه؟

group 17



7

☐

1

☐

8

☐

17

☐

Answer: 7

Use the electron configuration notation, orbital notation, and noble gas notation of an element to identify the location of an element in the periodic table (period, group and block)

يوظف ترميز الترتيب الإلكتروني، وترميز الغاز النبيل للعناصر، ومخططات الأقاليم الذرية، وترميز الغاز النبيل للعناصر لتحديد موقع عنصر ما في الجدول الدوري (الدورة، المجموعة)

EXAMPLE 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**.

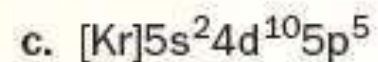
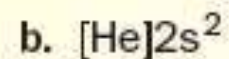
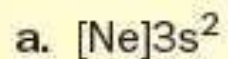
The 5 in $5s^2$ indicates that strontium is in **period 5**.

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

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

APPLICATIONS

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



Electron Configuration	Group	Period	Block
a. $[\text{Ne}]3s^2$	2	3	s
b. $[\text{He}]2s^2$	2	2	s
c. $[\text{Kr}]5s^24d^{10}5p^5$	17	5	p

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

a. s^2d^1

b. s^2p^3

c. s^2p^6

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

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

a. s^2d^1

Sc, Y, La, Ac

b. s^2p^3

N, P, As, Sb, Bi

c. s^2p^6

Ne, Ar, Kr, Xe, Rn

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

a. the group 2 element in the fourth period

$1s^22s^22p^63s^23p^64s^2$

b. the group 12 element in the fourth period

$1s^22s^22p^63s^23p^64s^23d^{10}$

c. the noble gas in the fifth period

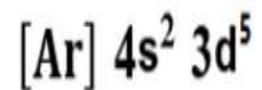
$1s^22s^22p^63s^23p^64s^23d^{10}4p^65s^24d^{10}5p^6$

d. the group 16 element in the second period

$1s^22s^22p^4$

Using the following electron configuration,

مُستخدماً الترتيب الإلكتروني التالي ،



In which block in the periodic table the elements is most likely found?

ما المجمع في الجدول الدوري الذي يقع فيه العنصر ؟

a.

Block s

b.

Block p

c.

Block d

d.

Block f

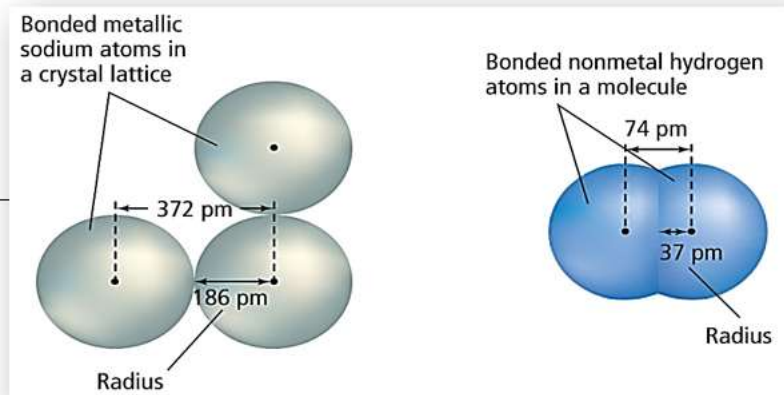
1. Atomic radius

Atomic radius: Size of an atom distance from nucleus to outermost e^- .

Atomic radius: defined as $\frac{1}{2}$ distance between two neighbouring nuclei in a molecule or crystal.

Affected by

- 1) number of energy levels.
- 2) proton pulling power (*ppp*).



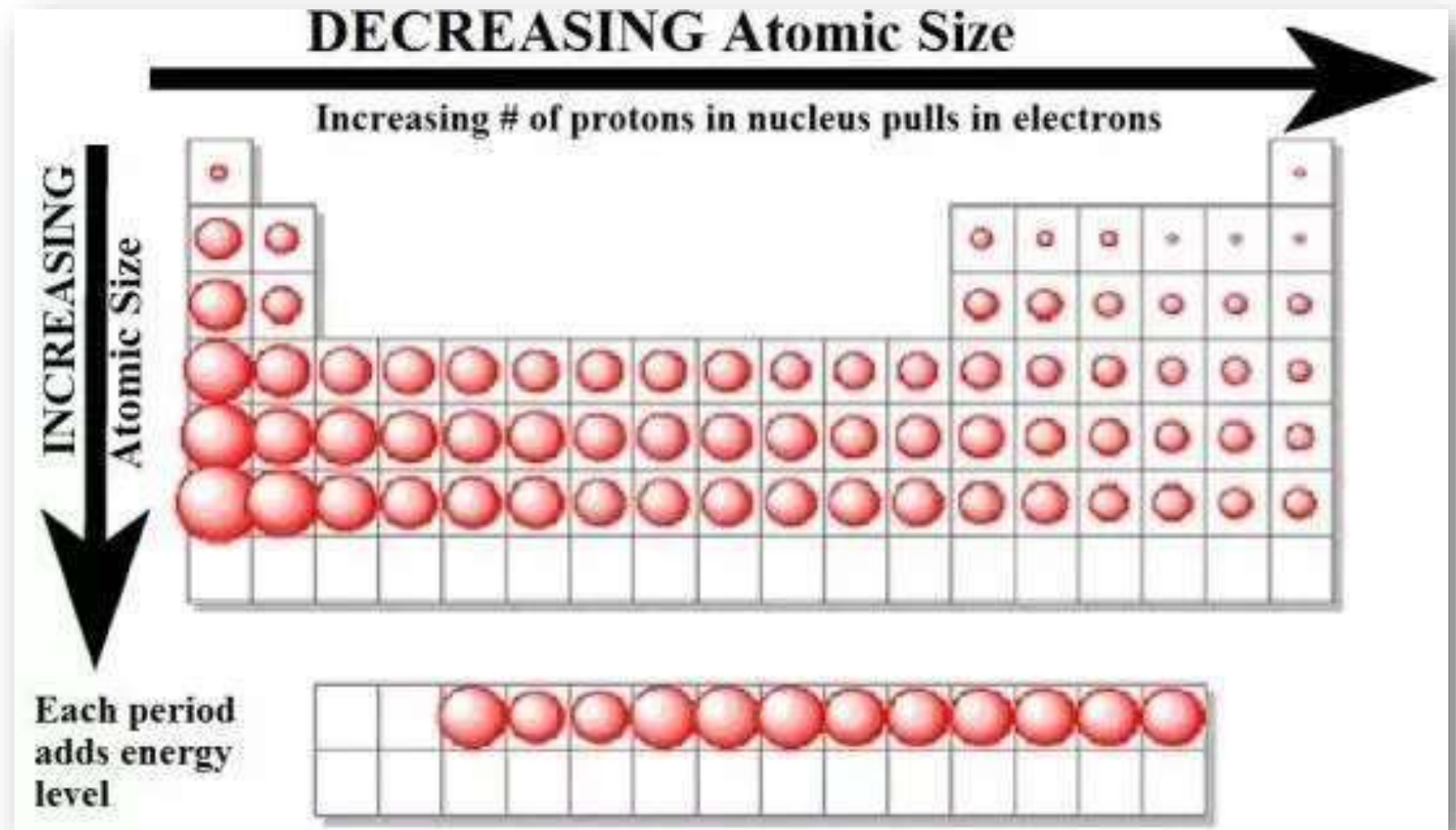
Explain the periodic trend of atomic radii across a period and down a group

يشرح الاتجاه الدوري لأحجام الأقطار الذرية عبر فورة و للأسفل عبر المجموعة

Down a group atomic size increases because as you go down shell/ring/Energy level is added.

As you go across a period (L to R) ,

atomic radius decreases.



Which has the largest atomic radius: carbon (C), fluorine (F), beryllium (Be), or lithium (Li)? Explain your answer in terms of trends in atomic radii.

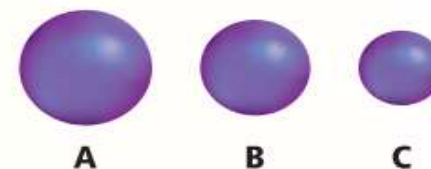
ANSWER

- From the periodic table, all the elements are found to be in **period 2**.
- Ordering the elements from left-to-right across the period yields: Li, Be, C, and F.
- The first element in period 2, **lithium (Li)**, has the **largest radius**.

APPLICATIONS

Answer the following questions using your knowledge of group and period trends in atomic radii. Do not use the atomic radii values in Figure 11 to answer the questions.

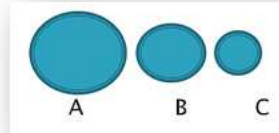
16. Which has the largest atomic radius: magnesium (Mg), silicon (Si), sulfur (S), or sodium (Na)? The smallest?
17. The figure on the right shows helium, krypton, and radon. Which one is krypton? How can you tell?
18. Can you determine which of two unknown elements has the larger radius if the only known information is that the atomic number of one of the elements is 20 greater than the other? Explain.
19. **Challenge** Determine which element in each pair has the largest atomic radius:
 - a. the element in period 2, group 1; or the element in period 3, group 18
 - b. the element in period 5, group 2; or the element in period 3, group 16
 - c. the element in period 3, group 14; or the element in period 6, group 15
 - d. the element in period 4, group 18; or the element in period 2, group 16



ANSWER

16) Na has the **largest** atomic radius, while S has the **smallest** atomic radius.

17) B is krypton (Kr), as He, Kr and Rn are in the **same group**, group 18 and the **atomic radius increases** as we go down the **group**, so Kr has **medium size** as it is between, He and Rn.



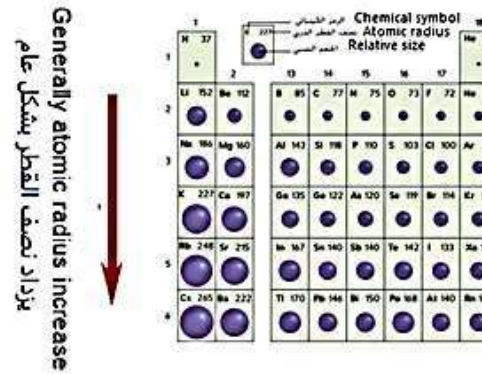
ANSWER for 19

- a. The element in **period 2 group 1**.
- b. The element in **period 5 group 2**.
- c. The element in **period 3 group 14**.
- d. The element in **period 2 group 16**.

Question 7

Why atomic radius generally increases as move down a group?

لماذا تزداد أنصاف الأقطار الذرية عند الانتقال لأسفل خلال أي مجموعة؟



Because the principal energy level remains the same

بسبب بقاء مستوى الطاقة الرئيس ثابت



Because the valence electrons are farther from the nucleus

بسبب ازدياد بعد إلكترونات التكافؤ عن النواة



Because the decreasing positive charge in the nucleus

بسبب نقصان شحنة النواة



Because the valence electrons are closer to the nucleus

بسبب ازدياد قرب إلكترونات التكافؤ من النواة

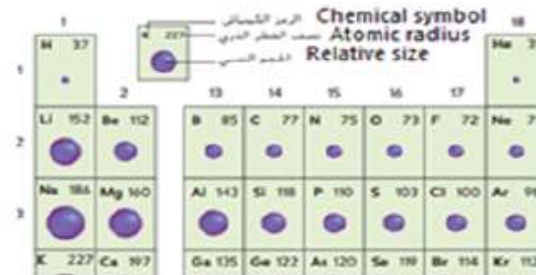


Answer: Because the valence electrons are farther away from the nucleus

Why atomic radii generally decrease as moving from left to right across a period?

لماذا تقل أنصاف الأقطار الذرية عند الانتقال من اليسار إلى اليمين عبر الدورة بوجه عام؟

تقل أنصاف الأقطار الذرية
Atomic radii decrease



a. Because the number of principle energy levels decrease

أ نقصان عدد مستويات الطاقة الرئيسية

b. Because the positive charge in the nucleus decrease

ب نقصان الشحنة الموجبة في النواة

c. Because the positive charge in the nucleus increase

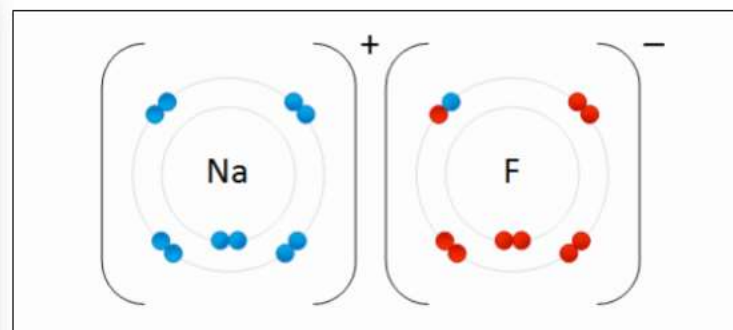
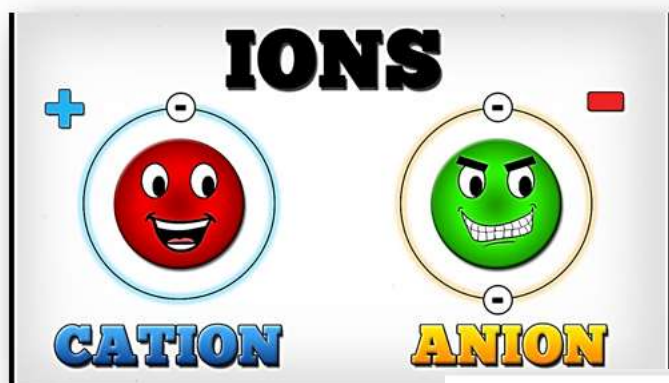
ب زيادة الشحنة الموجبة في النواة

d. Because the number of principle energy levels increase

ب زيادة عدد مستويات الطاقة الرئيسية

2. Ionic radius trend

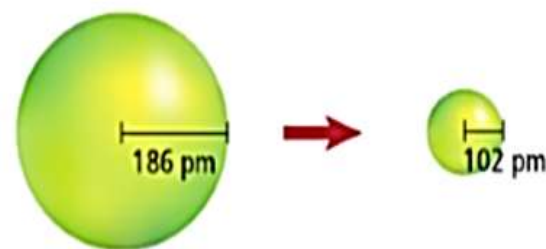
- **Ion**: an atom or bonded group of atoms that has a positive or negative charge.



When atoms lose electrons and form positively ions, they always become smaller.

When atoms gain electrons and form negative ions, they always become larger.

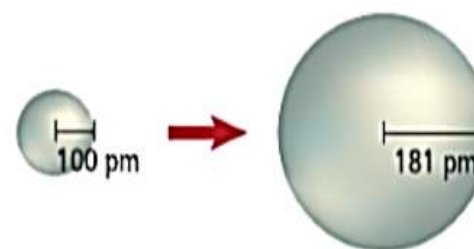
a



Sodium atom (Na)
[Ne]3s¹

Sodium ion (Na⁺)
[Ne]

b



Chlorine atom (Cl)
[Ne]3s²3p⁵

Chlorine ion (Cl⁻)
[Ne]3s²3p⁶ or [Ar]

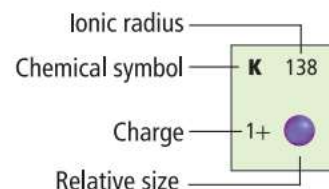
■ **Figure 13** The size of atoms varies greatly when they form ions.

a. Positive ions are smaller than the neutral atoms from which they form.

b. Negative ions are larger than the neutral atoms from which they form.

■ **Figure 14** The ionic radii of most of the representative elements are shown in picometers (10^{-12} m).

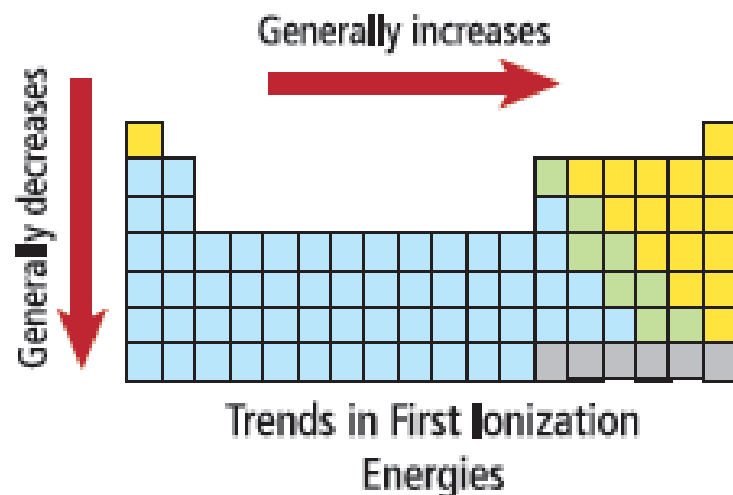
Explain why the ionic radii increase for both positive and negative ions as you move down a group.



	1	2	13	14	15	16	17
2	Li 76 1+	Be 31 2+	B 20 3+	C 15 4+	N 146 3-	O 140 2-	F 133 1-
3	Na 102 1+	Mg 72 2+	Al 54 3+	Si 41 4+	P 212 3-	S 184 2-	Cl 181 1-
4	K 138 1+	Ca 100 2+	Ga 62 3+	Ge 53 4+	As 222 3-	Se 198 2-	Br 196 1-
5	Rb 152 1+	Sr 118 2+	In 81 3+	Sn 71 4+	Sb 62 5+	Te 221 2-	I 220 1-
6	Cs 167 1+	Ba 135 2+	Tl 95 3+	Pb 84 4+	Bi 74 5+		

➤ **Group Trend** – As you go down a column, ionic radius *increases*.

Periodic Trend – As you go across a period (Left to Right), ionic radius *decreases*



■ **Figure 17** Ionization energies generally increase from left to right in a period and generally decrease as you move down a group.

Ionization energy: Amount of energy required to remove an electron from the gaseous atom.

- ❑ As we go along a **period ionization energy increases** because atomic size is approaching smaller and smaller.
- ❑ As we go down a **group ionization energy decreases** because atomic size is getting bigger.

Small size, electrons are near to nucleus and attracted more. So difficult to remove electron and hence more ionization energy.

large size electrons are far away from nucleus and attracted less . So easily you can remove electron. Hence less ionization energy.

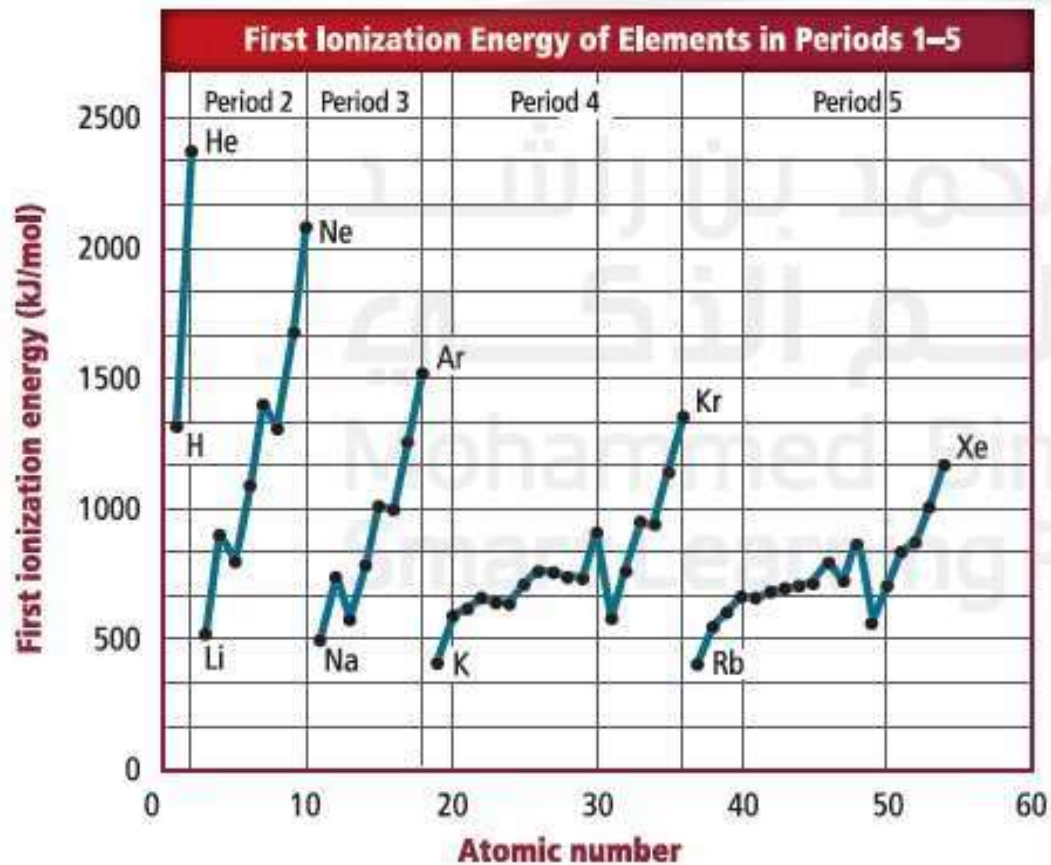


Figure 16 The first ionization energies for elements in periods 1 through 5 are shown as a function of the atomic number.

Table 5 Successive Ionization Energies for the Period 2 Elements

Element	Valence Electrons	Ionization Energy (kJ/mol)*								
		1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th
Li	1	520	7300	11,810						
Be	2	900	1760	14,850	21,010					
B	3	800	2430	3660	25,020	32,820				
C	4	1090	2350	4620	6220	37,830	47,280			
N	5	1400	2860	4580	7480	9440	53,270	64,360		
O	6	1310	3390	5300	7470	10,980	13,330	71,870	84,080	
F	7	1680	3370	6050	8410	11,020	15,160	17,870	92,040	106,430
Ne	8	2080	3950	6120	9370	12,180	15,240	20,000	23,070	115,380

Question 6

Which electron configuration represents the **highest** first ionization energy?

ما الترتيب الإلكتروني الذي يُمثل **أعلى** طاقة تأين أولى؟

$[\text{He}]2s^2 2p^3$



$[\text{He}]2s^1$



$[\text{He}]2s^2 2p^1$



$[\text{He}]2s^2 2p^2$



Answer: $[\text{He}] 2s^2 2p^3$

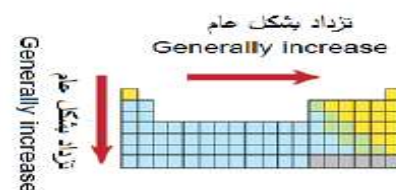
Which diagram **correctly** shows the trends for the first ionization energy?

أي مخطط مما يلي يصف تدرج طاقة التأين الأولى بشكل صحيح؟

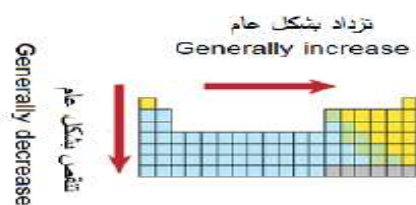
Learning Outcomes Covered

- CHM.5.1.01.009

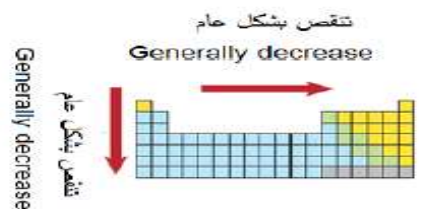
a.



b.



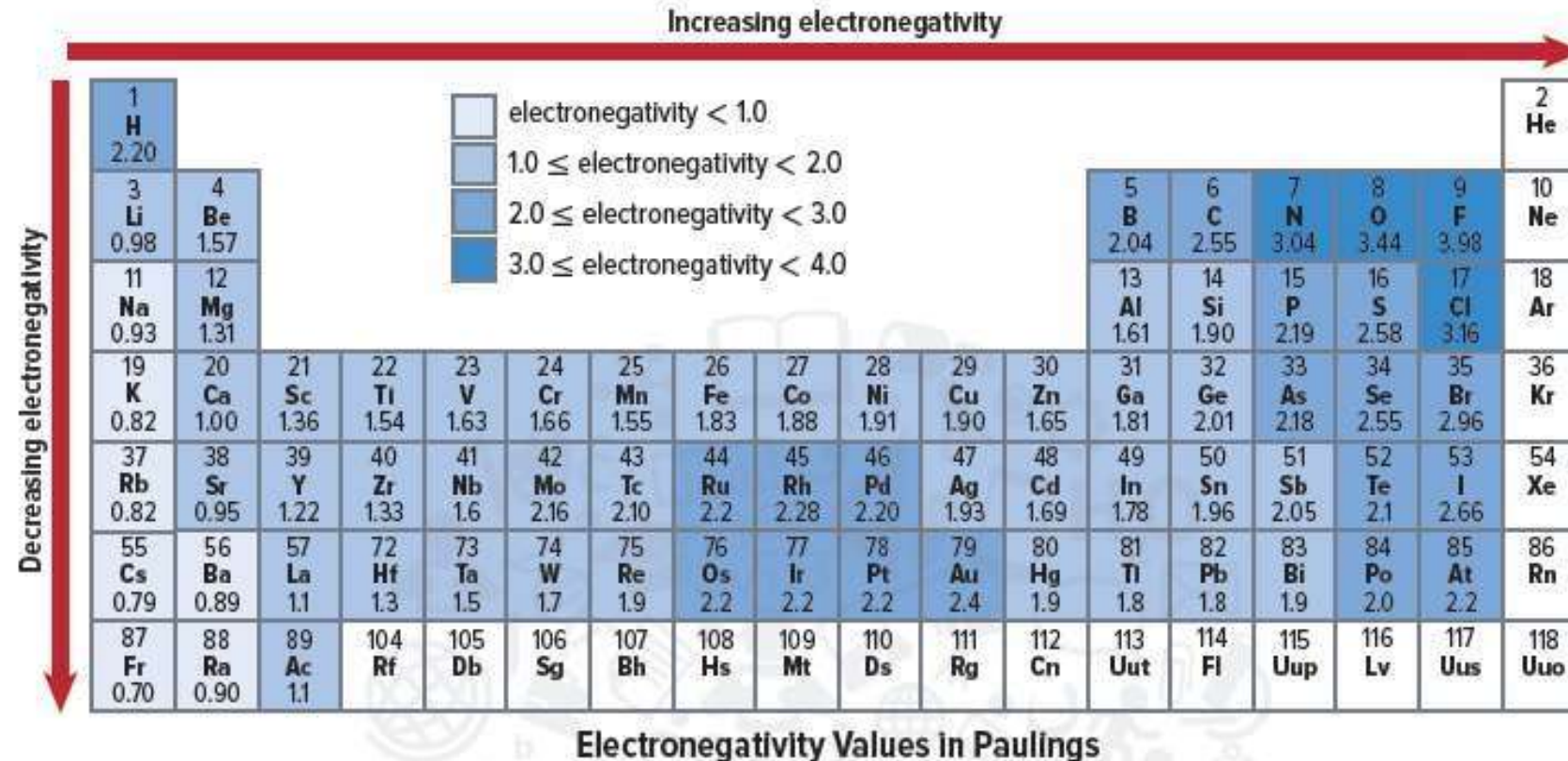
c.



Explain the periodic trend of electronegativity across a period and down a group of the periodic table

يشرح الاتجاه الدوري للسالبية الكهربية عبر فترة ما ومجموعة ما من الجدول الدوري (بالتحرك من اليسار حتى اليمين عبر الدورة ومن الأعلى للأسفل عبر المجموعة)

Electronegativity is the ability of an atom to attract electrons in a chemical bond.

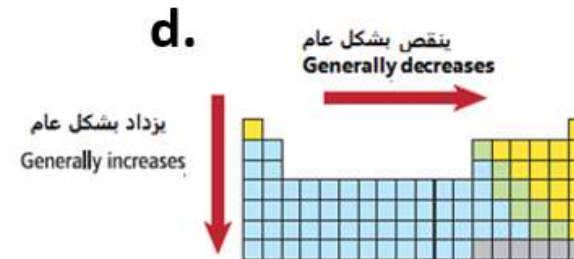
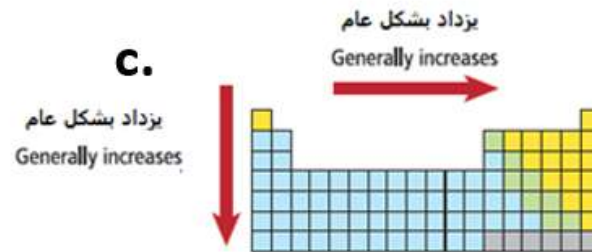
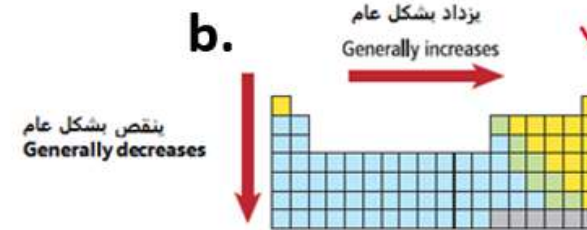
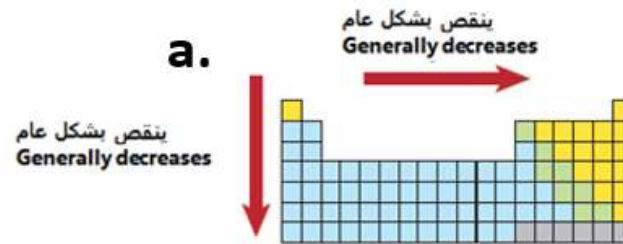


- Electronegativity increases along period
- Electronegativity decreases down a group

Question 8

Which of the following diagrams **correctly** shows the trend of electronegativity?
Which of the

المخططات التالية يُبين تدرج السالبية الكهربية بشكل **صحيح**؟



Answer: B

Which group **does not** have electronegativity values on the periodic table of elements?

PERIODIC TABLE OF THE ELEMENTS

الجدول الدوري للعناصر

1	
H 1.008	2
3 Li 6.941	4 Be 9.012

13	14	15	16
5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00

Learning Outcomes Covered

a.

Group 1

b.

Group 17

c.

Group 2

d.

Group 18

CHAPTER 2

Ionic Compounds and Metals

BIG IDEA Ionic compounds are held together by chemical bonds formed by the attraction of oppositely charged ions.

SECTIONS

- 1 Ion Formation
- 2 Ionic Bonds and Ionic Compounds
- 3 Names and Formulas for Ionic Compounds



How are cations formed?

Explain

Cation-A positively charged ion is called as cation.

- ☐ Ne atom – $1s^2 2s^2 2p^6$
- ☐ Na atom - $1s^2 2s^2 2p^6 3s^1$.
- ☐ Metals ions are reactive because
- ☐ they lose the electrons more easily.
- ☐ K^+ , Na^+ , Mg^{2+}

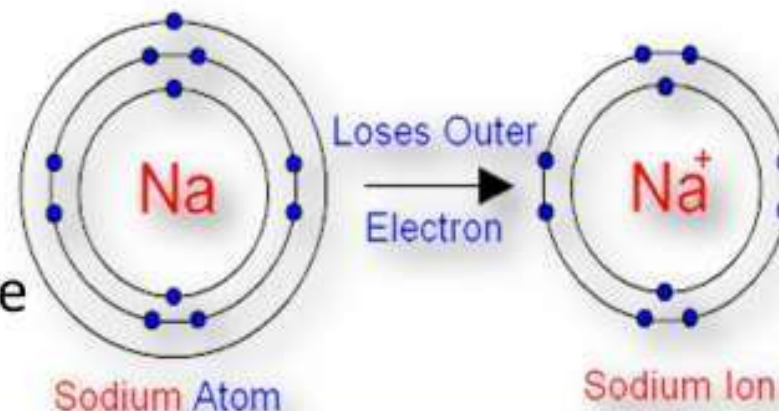


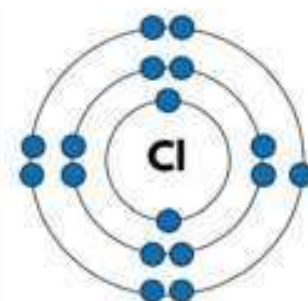
Table 2 Group 1, 2, and 13 Ions

Group	Configuration	Charge of Ion Formed
1	[noble gas] ns^1	1+ when the s^1 electron is lost
2	[noble gas] ns^2	2+ when the s^2 electrons are lost
13	[noble gas] ns^2np^1	3+ when the s^2p^1 electrons are lost

How are Anions formed?

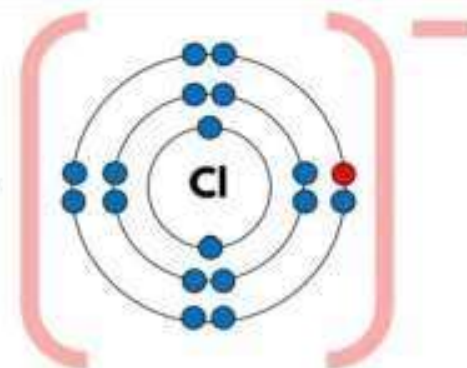
Explain

anion-A negatively charged ion is called as anion.



chlorine atom

gains 1 valence electron

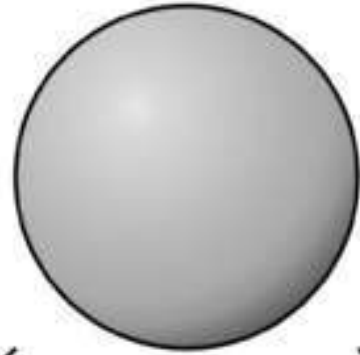


chloride anion

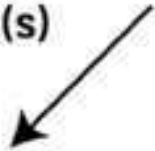
Table 3 Group 15–17 Ions

Group	Configuration	Charge of Ion Formed
15	[noble gas] ns^2np^3	3– when three electrons are gained
16	[noble gas] ns^2np^4	2– when two electrons are gained
17	[noble gas] ns^2np^5	1– when one electron is gained

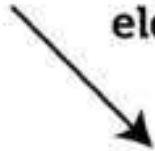
Neutral atom



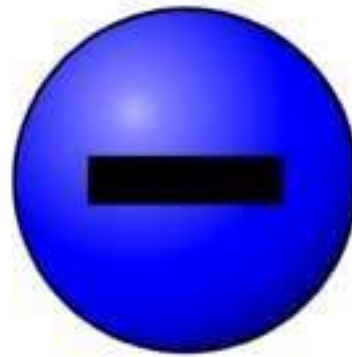
loss of
electron(s)



gain of
electron(s)



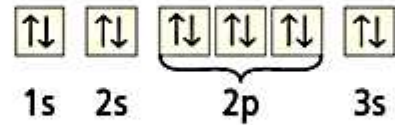
Cation



Anion

Question 9

The orbital notation of Magnesium is shown in the figure below. How does Magnesium form its ion?



الترميز الفلكي للمغنيسيوم مُبين في الشكل أدناه،

كيف يكون المغنيسيوم الأيون الخاص به؟

Lose four electrons

يفقد 4 إلكترونات

☐

Gain one electron

يكتسب إلكترون واحد

☐

Gain two electrons

يكتسب إلكترونين

☐

Lose two electrons

يفقد إلكترونين

☐

Answer: lose two electrons

Question 10

electron configuration of phosphorus atom is: $1s^2 2s^2 2p^6 3s^2 3p^3$

when phosphorus atom gains 3 electrons,

phosphide ion P^{3-} is formed

what is the electron configuration of P^{3-} ?

الترتيب الإلكتروني لذرة الفوسفور هو: $1s^2 2s^2 2p^6 3s^2 3p^3$

عندما تكسب ذرة الفوسفور 3 إلكترونات يتكون أيون الفوسفيد P^{3-} ،

ما الترتيب الإلكتروني لأيون P^{3-} ؟

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



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



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



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



Answer: B

The electron configuration of sodium atom **Na** is: **$1s^2 2s^2 2p^6 3s^1$**

الترتيب الإلكتروني لذرة الصوديوم **Na** هو: **$1s^2 2s^2 2p^6 3s^1$**

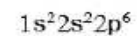
What is the correct electron configuration of sodium ion **Na⁺**?

ما الترتيب الإلكتروني الصحيح لأيون **Na⁺** ؟

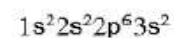
Learning Outcomes Covered

- CHM.5.1.01.004
- CHM.5.1.01.008
- CHM.5.1.01.009
- CHM.5.1.01.011
- CHM.5.1.01.013
- CHM.5.1.01.014
- CHM.5.1.02.002
- CHM.5.1.02.003
- CHM.5.1.02.007
- CHM.5.1.02.022

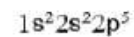
a.



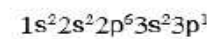
b.



c.

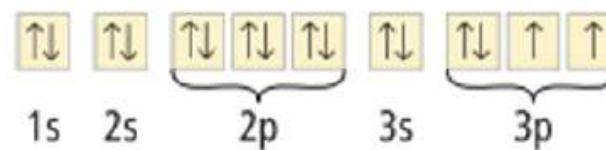


d.



Using the orbital notation of sulfur atom shown below,
how does sulfur atom forms an ion?

ناه



a. **Gains two electrons**

b. **Loses two electrons**

c. **Gains one electron**

d. **Loses four electrons**

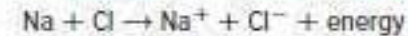
The electrostatic force that holds oppositely charged particles together in an ionic compound is called an **ionic bond**.

• Compounds that contain ionic bonds are called **ionic compounds**.

• Binary ionic compounds contain only two different elements—a metallic cation and a nonmetallic anion.

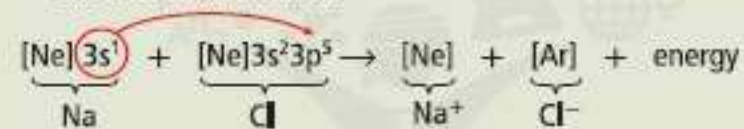
Table 4 Formation of Sodium Chloride

Chemical Equation



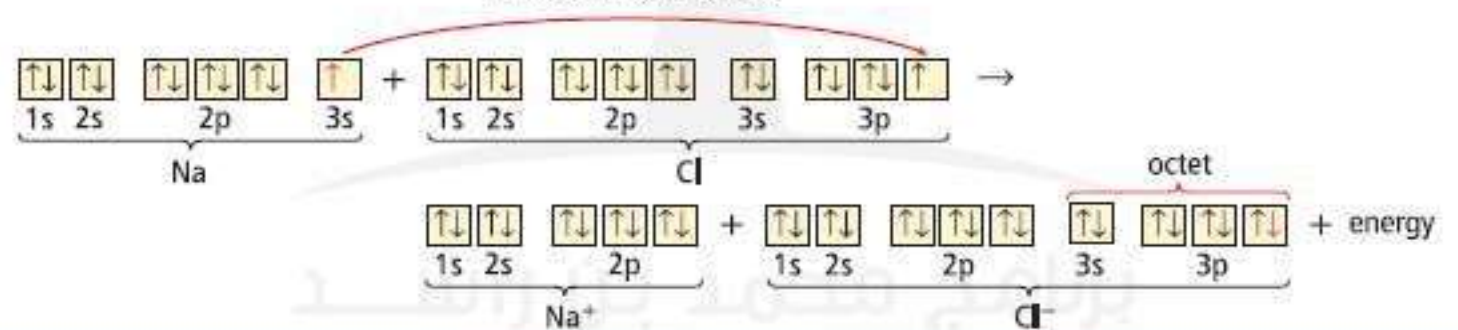
Electron Configurations

One electron is transferred.



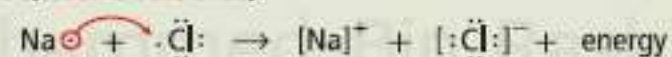
Orbital Notation

One electron is transferred.

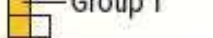


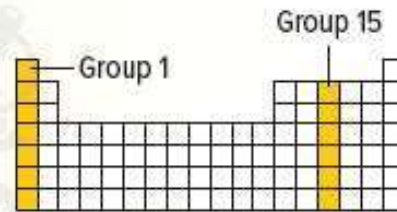
Electron-Dot Structures

One electron is transferred.



Explain how an ionic compound forms from these elements.

7. sodium and nitrogen 9. strontium and fluorine
8. lithium and oxygen 10. aluminum and sulfur
- 11. Challenge** Explain how elements in the two groups shown on the periodic table at the right combine to form an ionic compound.
- 
- Group 1



11. Challenge Explain how elements in the two groups shown on the periodic table at the right combine to form an ionic compound.

Three group 1 atoms loses 1 e^- , forming $1+$ ions.
One group 15 atom gains 3 e^- , forming a $3-$ ion.
The ions attract, forming X_3Y , where X represents a group 1 atom and Y represents a group 15 atom.

Explain the structure and properties of ionic compounds based on their bonds types, strength and organization

يفسر تركيب وخصائص المركبات الأيونية بالاعتماد على أنواع الروابط وقوتها وتنظيمها



UNITED ARAB EMIRATES
MINISTRY OF EDUCATION

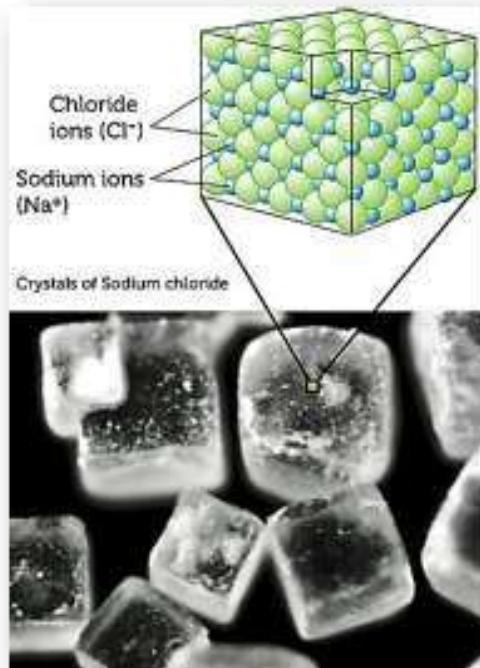
Modelling strategy

Explain



Properties of ionic compounds

Physical Structure



Physical Properties

- The **strong attractions** among the **positive** and **negative ions** result in the formation of the **crystal lattice**.
- A **crystal lattice** is the **three-dimensional geometric arrangement of particles**.

1. Melting point.
2. Boiling point.
3. Hardness.
4. Electrical conductivity.

Properties of ionic compounds

Physical Properties

1. **Melting point** : Ionic compounds have high melting point.
2. **Boiling point** : Ionic compounds have high boiling point
3. **Hardness** : Generally Hard
4. **Electrical conductivity**: Good conductors of electricity
(Note: Solids do not conduct electricity)
5. Many ionic crystals have brilliant colors. These colors are due to the presence of Transition elements on their Crystal lattice.

- In a solid, ions are locked into position and electrons cannot flow freely. Solids are poor conductors.

- Liquid ions or ions in aqueous solution have electrons that are free to move, so they conduct electricity easily.

An ionic solution whose aqueous solution conducts electricity is called **Electrolyte**

Why ionic crystals vary in shape
as shown by the minerals in the figure below?



Learning Outcomes Covered

- CHM.5.1.02.022

- a. Because of the sizes and relative numbers of the ions bonded بمسند الأحجام والأعداد النسبية للأيونات المترابطة
- b. Because there is no charged particles available بعدم توفر جزيئات مشحونة
- c. Because attractive forces are available بعدم توفر قوى الجذب
- d. Because the colors and texture of the ions bonded بعدم الألوان واللمس للأيونات المترابطة

Question 12

Why Ionic compounds in solution and in the liquid state are excellent conductors of electricity?

لماذا تُعتبر المركبات الأيونية في المحلول والحالة السائلة موصلات ممتازة للكهرباء؟

Because attractive forces available

بسبب توفر قوى الجذب الفعالة



Because motion of charged particles are locked

بسبب قيد حركة الجزيئات المشحونة



Because no charged particles available

بسبب عدم توفر جزيئات مشحونة



Because freely moving charged particles

بسبب حرية الحركة للجزيئات المشحونة



Answer: D

Energy and the Ionic Bond

- Reactions that **absorb** energy are **endothermic**. Reactions that release energy are exothermic

The energy required to separate 1 mol of an ionic compound into ions is called the **lattice energy**

- **Lattice energy** is **directly** related to **the size of the ions that are bonded** and also charge of the ion.
- Small ions-greater lattice energy
- High charge-Greater lattice energy

Lattice energy of MgO greater than NaF because charge of Mg^{2+} is greater than Na^+

Table 6 Lattice Energies of Some Ionic Compounds			
Compound	Lattice Energy (kJ/mol)	Compound	Lattice Energy (kJ/mol)
KI	632	KF	808
KBr	671	AgCl	910
RbF	774	NaF	910
NaI	682	LiF	1030
NaBr	732	SrCl ₂	2142
NaCl	769	MgO	3795

ما السبب الرئيس في اختلاف قيم طاقة الشبكة بين المركبات الأيونية الموضحة بالجدول أدناه ؟

Lattice Energyطاقة الشبكة (kJ/mol)	المركب Compound
2142	SrCl ₂
910	AgCl

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

The charge of the ions

The ionic radius

The ions' electronegativity

The distance between the ions

Write the chemical formula of an ionic compound containing monoatomic and polyatomic ions

يكتب الصيغة الكيميائية لمركب أيوني يحتوي على أيونات أحادية الذرة وأيونات متعددة الذرات

- **Monoatomic ions** are one-atom ions.
- **Oxidation number**, or oxidation state, is the charge of a monatomic ion.
- **Polyatomic ions** are ions made up of more than one atom.

EXAMPLE 1

FORMULA FOR AN IONIC COMPOUND Determine the formula for the ionic compound formed from potassium and oxygen.

EXAMPLE 2

FORMULA FOR AN IONIC COMPOUND Determine the formula for the compound formed from aluminum ions and sulfide ions.

APPLICATIONS

Write formulas for the ionic compounds formed by the following ions.

19. potassium and iodide

21. aluminum and bromide

20. magnesium and chloride

22. cesium and nitride

23. **Challenge** Write the general formula for the ionic compound formed by elements from the two groups shown on the periodic table at the right.

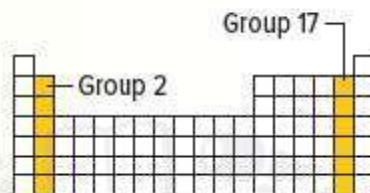


Table 9 Common Polyatomic Ions

Ion	Name	Ion	Name
NH_4^+	ammonium	IO_4^-	periodate
NO_2^-	nitrite	$\text{C}_2\text{H}_3\text{O}_2^-$	acetate
NO_3^-	nitrate	H_2PO_4^-	dihydrogen phosphate
OH^-	hydroxide	CO_3^{2-}	carbonate
CN^-	cyanide	SO_3^{2-}	sulfite
MnO_4^-	permanganate	SO_4^{2-}	sulfate
HCO_3^-	hydrogen carbonate	$\text{S}_2\text{O}_3^{2-}$	thiosulfate
ClO^-	hypochlorite	O_2^{2-}	peroxide
ClO_2^-	chlorite	CrO_4^{2-}	chromate
ClO_3^-	chlorate	$\text{Cr}_2\text{O}_7^{2-}$	dichromate
ClO_4^-	perchlorate	HPO_4^{2-}	hydrogen phosphate
BrO_3^-	bromate	PO_4^{3-}	phosphate
IO_3^-	iodate	AsO_4^{3-}	arsenate

Table 10 Oxyanion Naming Conventions for Sulfur and Nitrogen

- Identify the ion with the greatest number of oxygen atoms. This ion is named using the root of the nonmetal and the suffix *-ate*.
- Identify the ion with fewer oxygen atoms. This ion is named using the root of the nonmetal and the suffix *-ite*.

Examples: NO_3^- NO_2^- SO_4^{2-} SO_3^{2-}
 nitrate nitrite sulfate sulfite

APPLICATIONS

Write formulas for ionic compounds composed of the following ions.

24. sodium and nitrate

25. calcium and chlorate

26. aluminum and carbonate

27. **Challenge** Write the formula for an ionic compound formed by ions from a group 2 element and polyatomic ions composed of only carbon and oxygen.

27. Challenge Write the formula for an ionic compound formed by ions from a group 2 element and polyatomic ions composed of only of carbon and oxygen.

The polyatomic ion is carbonate (CO_3^{2-}).

The general formula is XCO_3 , where X is the symbol of a group 2 element.

APPLICATIONS

Name the following compounds.

28. NaBr

29. CaCl₂

30. KOH

31. Cu(NO₃)₂

32. Ag₂CrO₄

33. **Challenge** The ionic compound NH₄ClO₄ is a key reactant used in solid rocket boosters, such as those that power the Space Shuttle into orbit. Name this compound.

28. NaBr

sodium bromide

29. CaCl₂

calcium chloride

30. KOH

potassium hydroxide

31. Cu(NO₃)₂

copper(II) nitrate

32. Ag₂CrO₄

silver chromate

33. Challenge The ionic compound NH₄ClO₄ is key reactant used in solid rocket boosters, such as those that power the space shuttle into orbit. Name this compound.

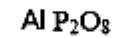
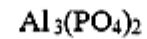
ammonium perchlorate



Question 11

What is the formula for a compound formed by
aluminum ions, Al^{3+} , and the phosphate ion, PO_4^{3-} ?

ما صيغة مركب مكون من
أيون الألمنيوم Al^{3+} وأيون الفوسفات PO_4^{3-} ؟

☐☐☐☐

Answer: B



Question 13

Which of the following names does **NOT** match the chemical formula written in front of it?

أي اسم مما يلي **لا** يتطابق مع الصيغة الكيميائية المكتوبة أمامه؟

Sodium hydroxide NaOH

NaOH هيدروكسيد الصوديوم



Ammonium sulfide $(\text{NH}_4)_2\text{S}$

$(\text{NH}_4)_2\text{S}$ كبريتيد الأمونيوم



Calcium chloride CaCl_2

CaCl_2 كلوريد الكالسيوم



Sodium bromide NaBrO_3

NaBrO_3 بروميد الصوديوم



Answer: D

What is the general formula for the ionic compound formed by elements from the two groups shown on the periodic table below?

ما الصيغة العامة للمركب الأيوني الذي يتكون من عناصر المجموعتين الموضحتين في الجدول الدوري أدناه؟

X: represent element in Group 2

Y: represent element in Group 17

The diagram shows a simplified periodic table with two columns highlighted in yellow. The first column is labeled 'المجموعة 2' (Group 2) and 'Group 2'. The second column is labeled 'المجموعة 17' (Group 17) and 'Group 17'.

X: يُمثّل عنصر بالمجموعة 2

Y: يُمثّل عنصر بالمجموعة 17

XY

XY₂

XY₃

X₂Y

What is the **correct** formula for the compound **chromium(III) oxide**?

ما الصيغة **الصحيحة** لمركب أكسيد الكروم (III) ؟

Learning Outcomes Covered

- CHM.5.1.01.004
- CHM.5.1.01.008
- CHM.5.1.01.009
- CHM.5.1.01.011
- CHM.5.1.01.013
- CHM.5.1.01.014
- CHM.5.1.02.002
- CHM.5.1.02.003
- CHM.5.1.02.007
- CHM.5.1.02.022

a.



b.



c.



d.



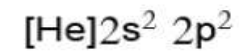
Which of the following is the **correct** electron configuration of an element in group 2, and the fourth period?

أي مما يلي هو الترتيب الإلكتروني **الصحيح** لعنصر في المجموعة 2 ، وفي الدورة الرابعة؟

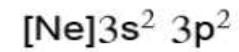
Learning Outcomes Covered

◦ CHM.5.1.01.008

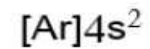
a.



b.



c.



d.



Which of the following is the **correct** match

between the compound's name and the chemical formula written in front of it?

أي مما يلي هو تطابق **صحيح** لاسم المركب

مع الصيغة الكيميائية المكتوبة أمامه؟

Learning Outcomes Covered

- CHM.5.1.01.004
- CHM.5.1.01.008
- CHM.5.1.01.009
- CHM.5.1.01.011
- CHM.5.1.01.013
- CHM.5.1.01.014
- CHM.5.1.02.002
- CHM.5.1.02.003
- CHM.5.1.02.007
- CHM.5.1.02.022

a.

Sodium nitrite **NaNO₃**

نترات الصوديوم **NaNO₃**

b.

Calcium sulfate **CaSO₄**

كبريتات الكالسيوم **CaSO₄**

c.

Aluminum sulfide **(NH₄)₂S**

كبريتات الألمنيوم **(NH₄)₂S**

GOOD

LUCK!!