

People's Democratic Republic of Algeria

Ministry of Higher Education and Scientific Research Faculty of Exact Sciences and Natural and Life Sciences

Natural and Life Sciences department

Level: L1

Sunday 14th January 2024

Time: 13hours to 14hours 30sec

Chemistry exam (S1)

Exercise N°1: (4 marks)

1. Complete the table, given below.
2. Calculate the charge of the particle given in this table (in coulomb).
3. Calculate the mass of its nucleus.

${}^A_ZX^q$	Number of protons	Number of neutrons	Number of electrons	Charge
${}^{27}_{..}X^{..}$			10	+3

We give: Mass(proton) = Mass(neutron)= $1,67.10^{-24}$ g, Proton charge= $+1,6.10^{-19}$ C ; Electron charge= $-1,6.10^{-19}$ C.

4. Complete the following nuclear reaction and indicate its nature : ${}^2_1H + \dots \rightarrow {}^4_2He + {}^1_0n$

Exercise N°2: (9 marks)

Consider the following elements: Ca (Z=20), Cu (Z=29), Br (Z=35), Sr (Z=38).

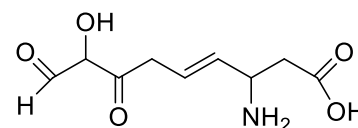
1. Give the electronic configuration (Block, Period and Group) of these elements.
2. Locate these elements in the periodic table.
3. Which family do these elements belong to?
4. Give the most stable ion for each element.
5. Give the four quantum numbers of the single electrons in the valence shell of Br (Z=35).
6. Arrange these elements in order of increasing electro-negativity.
7. An element X belongs to the same family of C (Z=6) and to the same period of Br(Z=35). Give its electronic configuration and its atomic number (Z).

Exercise N°3: (4 marks)

1. Represent H_3PO_3 using the Lewis diagram and indicate the nature of the bonds formed.
2. Using the VSEPR method: write in the form AX_mE_n , give the geometry and hybridization of H_3PO_3 . We give: P(Z=15), O(Z=8), H(Z=1), (AX_2 : Linear; AX_3 : Triangular; AX_3E : Pyramidal)

Exercise N°4: (3 marks)

1. Give the developed and Semi-developed formula of the molecule: C_2H_6O
2. Give all existing organic functions in the following structure:



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Correction of the chemistry exam (S1)

Exercise N°1:

1. Complete the table:

${}^A_ZX^q$	Number of protons	Number of neutrons	Number of electrons	Charge
${}^{27}_{13}X^{+3}$	13	14	10	+3

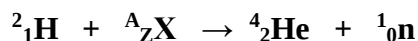
2. Charge in coulomb of the particle:

$$Q({}^{27}_{13}X^{+3}) = +3.1,6 \cdot 10^{-19} = 4,8 \cdot 10^{-19} \text{ C}$$

3. Mass of the nucleus:

$$\begin{aligned} M_{\text{Nucleus}} &= 13 m_{\text{proton}} + 14 m_{\text{neutron}} + 27 m_{\text{neutron}} \quad (m_{\text{proton}} = m_{\text{neutron}}) \\ &= 27 \cdot 1,67 \cdot 10^{-24} \text{ g} = 27 \cdot 1,67 \cdot 10^{-24} \cdot N_A \text{ a.m.u} \quad (N_A: \text{Avogadro number}) \\ &= 27 \cdot 1,67 \cdot 10^{-24} \cdot 6,023 \cdot 10^{23} = 27,1177 \text{ a.m.u.} \end{aligned}$$

4. Complete the nuclear reaction and indicate its nature



The conservation of mass and charge permit us to write:

$$\begin{cases} 2+A = 4+1 \\ 1+Z = 2+0 \end{cases} \Rightarrow \begin{cases} A = 3 \\ Z = 1 \end{cases}$$

The nature is: Fusion

Exercise N°2:

1. Electronic configuration (Block, Period and Group) of these elements

Elements	Electronic Configuration	Block	Periods	Groups
${}_{20}\text{Ca}$	$1s^2/2s^22p^6/3s^23p^6/4s^2$	S	4	IIA
${}_{29}\text{Cu}$	$1s^2/2s^22p^6/3s^23p^6/4s^23d^9 \Rightarrow 4s^13d^{10}$	d	4	IB
${}_{35}\text{Br}$	$1s^2/2s^22p^6/3s^23p^6/4s^23d^{10}4p^5$	P	4	VIIA
${}_{38}\text{Sr}$	$1s^2/2s^22p^6/3s^23p^6/4s^23d^{10}4p^6/5s^2$	S	5	IIA

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2. Locate these elements in the periodic table

IA												VIII A				
	IIA	III B		IVB	VB	VI B	VII B	VIII B		I B	II B	III A	IVA	VA	VI A	VII A
	²⁰ Ca									²⁹ Cu						³⁵ Br
	³⁸ Sr															

3. Family of these elements

²⁰Ca and ³⁸Sr: Alkaline earth;

²⁹Cu: Transition metal;

³⁵Br: Halogen

4. The most stable ion for each element

²⁰Ca²⁺: 1s²/2s²2p⁶/3s²3p⁶/4s⁰ because the rare gas closest to it is ¹⁸Ar.

²⁹Cu⁺: 1s²/2s²2p⁶/3s²3p⁶/4s⁰3d¹⁰ because the element belongs to the transition metal.

³⁵Br⁻: 1s²/2s²2p⁶/3s²3p⁶/4s²3d¹⁰4p⁶ because the rare gas closest to it is ³⁶Kr.

³⁸Sr²⁺: 1s²/2s²2p⁶/3s²3p⁶/4s²3d¹⁰4p⁶/5s⁰ because the rare gas closest to it is ³⁶Kr.

5. The four quantum numbers of the single electrons in the valence shell of Br (Z=35)

³⁵Br: 1s²/2s²2p⁶/3s²3p⁶/4s²3d¹⁰4p⁵

⇒ 3d¹⁰4s²4p⁵ ⇒

Quantum numbers of single electron in the valence shell: n=4, l=1, m=+1, s=+½.

6. Arrange these elements in order of increasing electro-negativity

In the same period, n=4 : ²⁰Ca, ²⁹Cu, and ³⁵Br ⇒ $\chi \nearrow \Rightarrow \chi_{Ca} > \chi_{Cu} > \chi_{Br} \dots\dots\dots(1)$

In the same Family, IIA : ²⁰Ca and ³⁸Sr et ⇒ $\chi \searrow \Rightarrow \chi_{Sr} > \chi_{Ca} \dots\dots\dots(2)$

(1)+(2) ⇒ $\chi_{Sr} > \chi_{Ca} > \chi_{Cu} > \chi_{Br}$

7. X: the same family of C (Z=6) and to the same period of Br(Z=35). Electronic configuration and atomic number (Z).

⁶C: 1s²/2s²2p² ⇒ Same family = IVA = Same family ⁶C

³⁵Br: 1s²/2s²2p⁶/3s²3p⁶/4s²3d¹⁰4p⁵ ⇒ n(³⁵Br)= 4 = n (⁶C).

^ZX: 1s²/2s²2p⁶/3s²3p⁶/4s²3d¹⁰4p² ⇒ Z= 32

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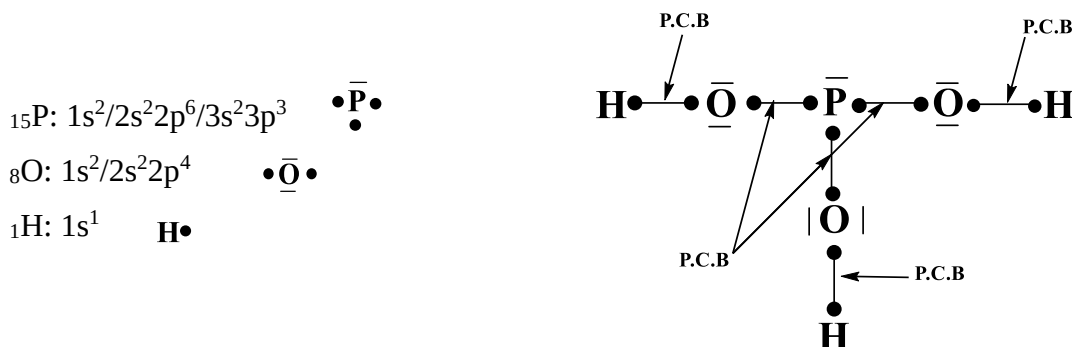
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Exercise N°3:

1. Represent H_3PO_3 using the Lewis diagram and indicate the nature of the bonds formed.



2. The geometry and hybridization of H_3PO_3 using the VSEPR method:

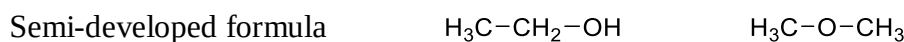
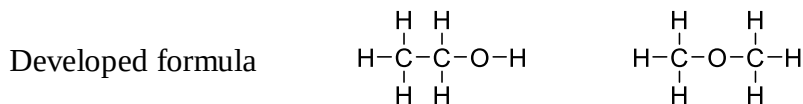
AX_mE_n ; $A = P$; $m = 3$; $n = 1 \Rightarrow AX_3E_1$;

Geometry: AX_3E_1 (Pyramidal);

Hybridization: $m+n=3+1=4 \Rightarrow Sp^3$.

Exercise N°4:

1. Give the developed and semi-developed formula of the molecule: C_2H_6O



2. All existing organic functions in the following structure:

