2018-2019 CORRECTION of Test 2 (December 14th, 2018)

Part I : Generalities

1. Globally, Ionization energy increases from the left to the right along a period (with some exceptions)

2. The values provided do not follow this general rule.

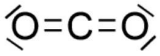
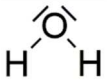
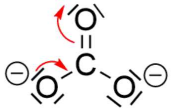
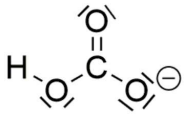
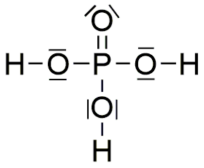
N : $1s^2 2s^2 2p^3$: 2p sublayer half filled, which leads to an overstabilization of the atom → E_i higher than excpected

3. C : $1s^2 2s^2 2p^2$ → Sn : $5s^2\ 5p^2$ because same column but fifth line (n_{max}=5)

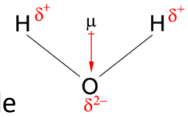
Sn : $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^2$

Part II : Carbonated water and acidifier

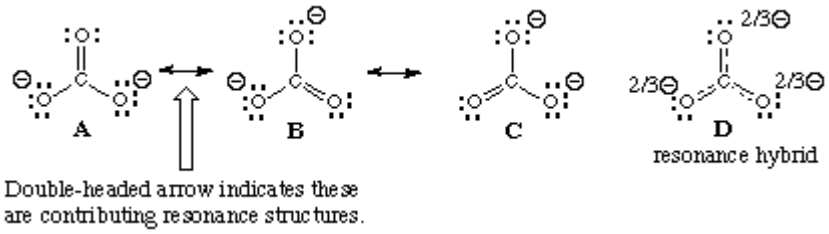
5. and .6

Lewis formula	*Geometry*
	Linear
	Bent
	Planar triangular
	Planar triangular
 (1)	Tetrahedral

7. CO_2 : The two bonds are polarized, but because of the shape the sum of the two dipolar moments is 0 → non polar molecule.

H_2O : The two bonds are polarized, because of the shape of the molecule the sum of the two dipolar moments is not 0 → polar molecule 

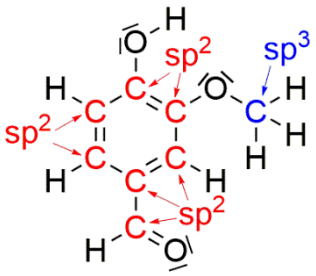
8. The CO_3^{2-} ion presents the following mesomeric formulas which highlight the partially double character of each CO bond (intermediate between a double and a single bond) :



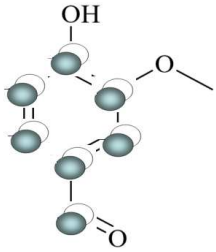
Cl : all the CO bonds present the same bond length (intermediate between a single and a double bond)

Part III : Vanilla flavour

9. and 10.



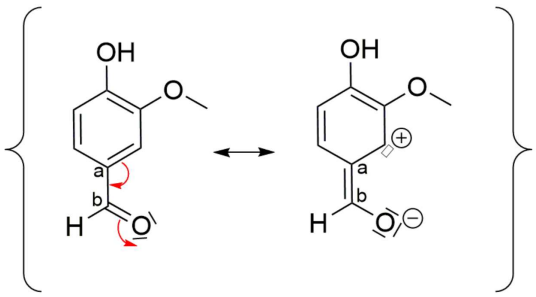
11. For the C atoms hybridized sp2, there is a lateral overlap of the non hybridized 2p AO :



The 6 given C are thus in the same plane.

12. Free rotation is not possible because the lateral overlap described above (that stabilizes very much the molecule) would not exist anymore.

One can also realize that free rotation is excluded with writing a mesomeric form that shows that the given Ca-Cb bond is partially double: :

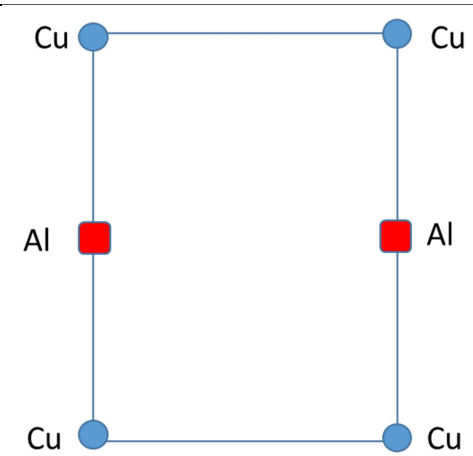


13. As we can have a partially double bond character for (Ca-Cb) bond, just as for the C-C bonds in the benzene ring: they all have the same bond length

14. 7 C atoms Cwith 4 valence AO ($2s^2\ 2p^2$)

6 H atoms with 1 valence AO ($1s^1$)

	1 O atom with 4 valence AO ($2s^2\ 2p^4$) ➔ Total of 38 valence AO interacting to form 38 MO.
15.	7 C atoms Cwith 4 valence electrons ($2s^2\ 2p^2$) 6 H atoms with 1 valence electron ($1s^1$) 1 O atom with 6 valence electrons ($2s^2\ 2p^2$) Total of 40 valence electrons.
16.	$\Delta E = \frac{hc}{\lambda}$ λ = 129.6 nm
17.	Dichloromethane is a polar solvant. Vanilline is a polar molecule → Van der Waals interactions (in particular Keesom type involving permanent dipole – permanent dipole) Can't be a Hydrogen bond: the latter involves a small and highly electronegative element as an acceptor (F, O, N): Cl is not electronegative enough, and too big for such purpose
18.	Max absorption wavelength (346 nm) in the UV domain : colorless molecule.
19.	$$A_i(\lambda, T) = \varepsilon_i(\lambda, T) \times l \times c_i$$ With l, the length of the cuvette that is crossed by the light (in cm), c_i, concentration of the absoprbing species I (in mol/L) ε_i, molar absorption coefficient of compound i at the given wavelength λ and temperature T (in $L.mol^{-1}.cm^{-1}$).
20.	If no dilution : A = 3,9 →out of the range which Beer Lambert's law apply.
21.	$C_{N°3} = 3.29 \times 10^{-5}$ mol.L^{-1}
22.	Dilution factor = 5 (integer value !!!!)
23.	For S_0, A_{346} = 0.398 thus $C = 10 \times \frac{0.398}{28173}$ = 1.43 10^{-4} mol.L^{-1}
24.	Vtot(S0) = 500 mL Thus $n_{vanilline}$ = 7.07. 10^{-5} mol in a can (whatever the capacity of the can is!!!!) And $m_{vanilline}$ = 10.75 mg per can A 70 kg person can thus have at maximum 700mg of vanillin /day → have then at maximum 66,5 can.
Partie IV : Consitution of cola cans	
25.	Fcc with one atom at eahc vertex plus one at the very center of each face
26.	Population = 4 atoms per cell
27.	From the density, one can write : $a = \left(\frac{4 \times M(Al)}{Na \times \rho}\right)^{1/3}$ a = 4.05 Å
28.	Tangency condition along the diagonale of a face : $R = \frac{a \times \sqrt{2}}{4}$ R = 1.43 Å

29.	C= $\frac{4\times(4/3)\pi R^3}{a^3}$ C = 0.74 → compact structure
30.	O holes : very center of the cube + center of each edge : total of (1 + 12/4) = 4 T holes : at each corner : total of 8
31.	$R_O = \frac{a}{2} - R$ → R_O = 59.5 pm $R_T = \frac{a\sqrt{3}}{4} - R$ → R_T = 32.4 pm
32.	Substitution alloy as the radius of copper is bigger than R_O and R_T (see above), and is comparable to the radius of Al Or : according to the description of the cell : some aluminum are substituted by some copper atoms
33.	
34.	There is per cell : 1 atom of Cu (each vertex : 8 * 1/8) and 3 atoms of Al (center of each face ! 6 * ½) → alloy is Al_3Cu_1