

[TP] The different of speeds, u_1, u_2, etc., in a gas is due to ...

13% 1. collisions of gas particles with the walls of the container.
13% 2. collisions of gas particles with one another
13% 3. attractions between the particles of the gas and the particles of the walls of the container.
13% 4. attractions between the particles of the gas.
13% 5. 1 and 2
13% 6. 1 and 3
13% 7. 1, 2 and 3
13% 8. 1, 2, 3 and 4

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Lecture 6 CH102 A1 (MWF 9:05 am)

Wednesday, January 31, 2018

- Review: Localized and delocalized π orbitals
- Review: Localized and delocalized electrons
- Kinetic molecular theory, PDF: http://goo.gl/njf3em

Next: Complete kinetic molecular theory; Practice with particle picture of gases; Molecular speeds and their distribution; real gases (attraction and size)

Localized and delocalized π orbitals

Localized π orbitals are those MOs built from only two AOs, each AO on adjacent atoms. As a result, localized π orbitals extend over only two adjacent atoms.

Delocalized π orbitals are those MOs built from more than two AOs, from more than two adjacent atoms. As a result, delocalized π orbitals extend over more than two adjacent atoms.

5

Localized and delocalized electrons

A localized electron is in an orbital that has 0 density between adjacent atoms.

A delocalized electron is in an orbital that has non-zero density between adjacent atoms.

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Localized and delocalized electrons

An electron is localized on an atom if it is ...

in a σ framework non-bonding orbital, or

in a π framework orbital that has a nodal plane (or 0 amplitude) between adjacent atoms

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Localized and delocalized electrons

Example of electrons in a σ framework non-bonding orbital:

In formate, $HC(O)O^-$, the two sp^2 non-bonding AOs on each O atom each contain two electrons and so there are 4 σ framework electrons localized on the O atom.

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Localized and delocalized electrons

Example of electrons π framework orbital that has a nodal plane (or 0 amplitude) between adjacent atoms:

In formate, $HC(O)O^-$, the π^n orbital has a nodal plane between the two O atoms (and 0 amplitude on the C atom) and so 1 electron of the two electrons it contains is localized on each O atom.

The π (bonding) orbital does not have a nodal plane, and so the two electrons it contains are spread among O-C-O atoms, rather than being localized on each atom.

This was the error I made in A1 lecture 5 on Monday, January 29.

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Localized and delocalized electrons

Therefore in formate, $HC(O)O^-$, there are a total of 5 electrons (4 in the σ framework + 1 in the π framework)) localized on each O atom.

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[TP] In carbonic acid, H_2CO_3, how many electrons are localized on the terminal O atom?

0% 1. 0
0% 2. 1
0% 3. 2
0% 4. 3
0% 5. 4
0% 6. 5
0% 7. 6
0% 8. 7
0% 9. 8

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[TP] In carbonic acid, H_2CO_3, how many electrons are localized on the C atom?

1. 0
2. 1
3. 2
4. 3
5. 4
6. 5
7. 6
8. 7
9. 8

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Kinetic-molecular theory of gases

Goal: Get microscopic expression for pressure P

Key idea 1: Pressure is due to force exerted by particles during collisions with the container walls

Key idea 2: Force is due to momentum change in collision with the container walls.

Note: Here upper-case P is used for pressure and lower-case p is used for momentum.

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Kinetic-molecular theory of gases

Force due to j^{th} particle of mass m and speed u_j

$\Delta p = 2mu_j$ (elastic collision)

$\Delta t = 2L/u_j$ (travel to opposite wall and back)

$F = \Delta p/\Delta t = mu_j^2/L$

Pressure due to j^{th} particle of mass m and speed u_j

$$P_j = \frac{F}{\text{area}} = \frac{F}{L^2} = \frac{mu_j^2}{L^3} = \frac{mu_j^2}{V}$$

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