BOND ENERGY

→ the enthalpy change (ΔH) needed to break the bond in a mole of gaseous molecules

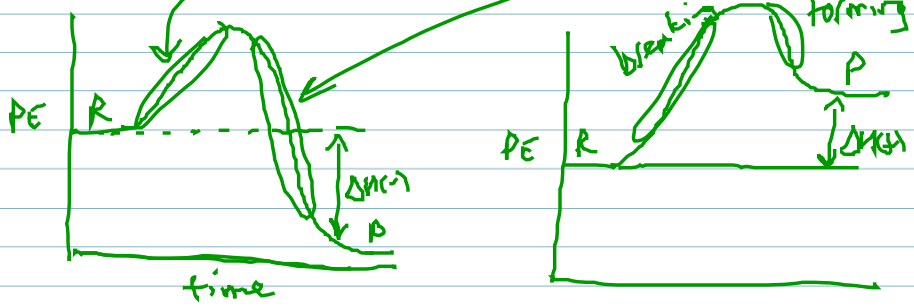
→ average values are determined for nonidentical atoms bonded together

R–O–H

BOND BREAKING IS ALWAYS ENDOTHERMIC
WHEN A BOND IS FORMED, E IS RELEASED

$$\Delta H_{rxn} = \sum BE_{reactants} + \sum BE_{products}$$

(+) bond breaking (−) bonds forming



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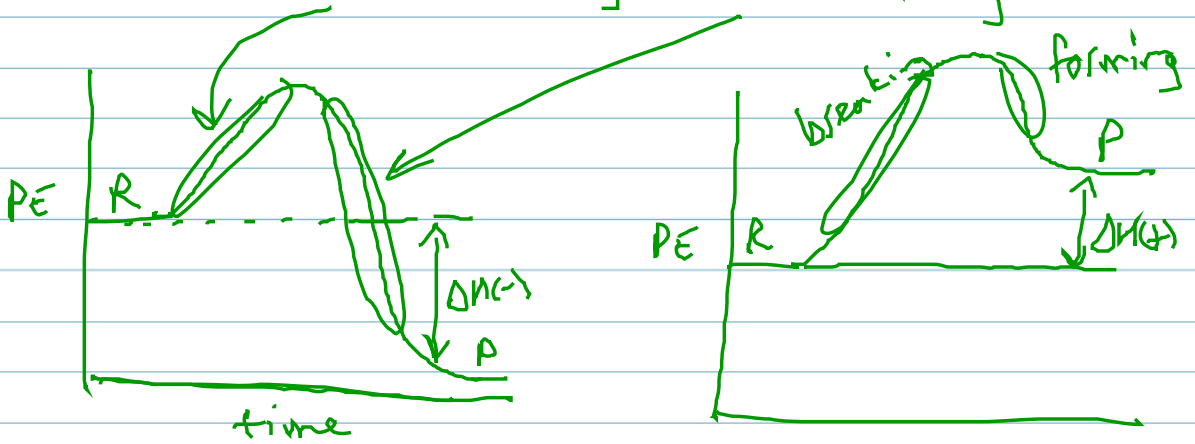
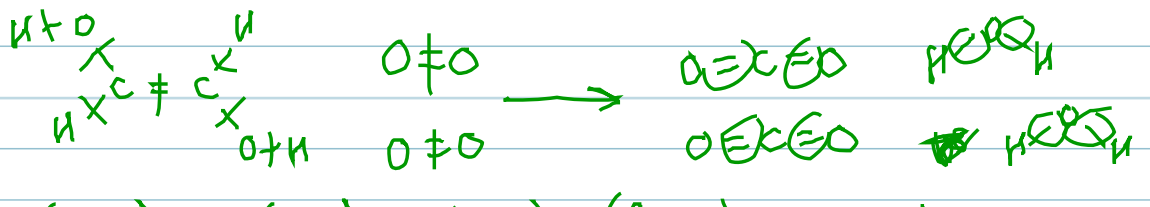


Combustion of oxalic acid

Oxalic acid + Oxygen gas → Carbon dioxide + water

$C_2H_4O_2 + 2\ O_2 \longrightarrow 2\ CO_2 + 2\ H_2O$



$2(C-H) + 2(O-H) + 2(C-O) + (C=C) + 2(O=O)$ ⊕
$2(411) + 2(459) + 2(358) + (602) + 2(494) =$ 4046 kJ/mol
ENDOTHERMIC

$4(C=O) + 4(O-H) = 4(799) + 4(459) =$ ⊖5032 kJ/mol

$\Delta H_{rxn} =$ ⊖986 kJ/mol

VSEPR = Valence Shell Electron Pair Repulsion

* place all the e⁻ pairs on the central atom as far away from each other as possible

→ lone pairs on the central atom repel more than bonding pairs
→ assymetric molecule (usually)
→ POLAR

e⁻ pair repulsion: lone pair vs. lone pair > lone pair vs. bonding pair > bonding pair vs bonding pair

NO LONE PAIRS IN CENTRAL ATOM — "regular" geometries — SYMMETRICAL

total # e⁻ pairs on central atom	"regular" geometry	examples
2	linear	BeF_2, $HgCl_2$
3	trigonal planar	BF_3
4	tetrahedral	CH_4
5	trigonal bipyramidal	PCl_5
6	octahedral	SF_6

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linear $X-M-X$ (180°)

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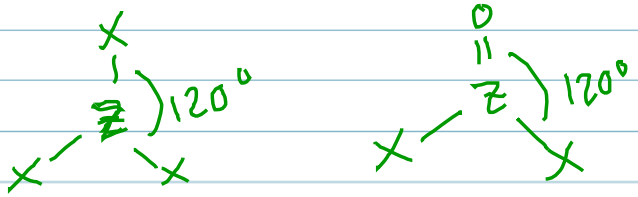
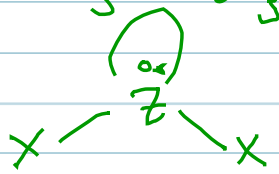
trigonal planar



NO_3^- CO_3^{2-} CH_2O

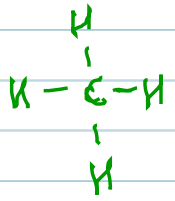


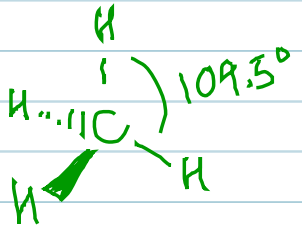
- ANGULAR
- BENT

BA < 120°

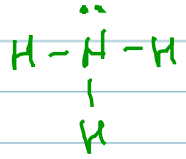
tetrahedral

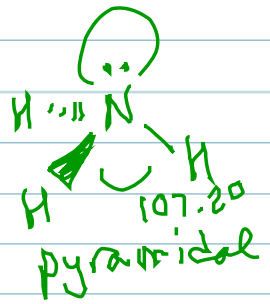
CH_4



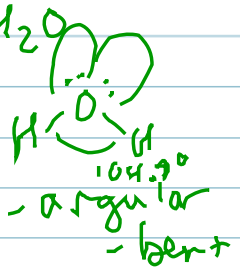


NH_3





H_2O



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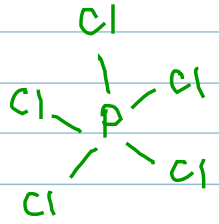
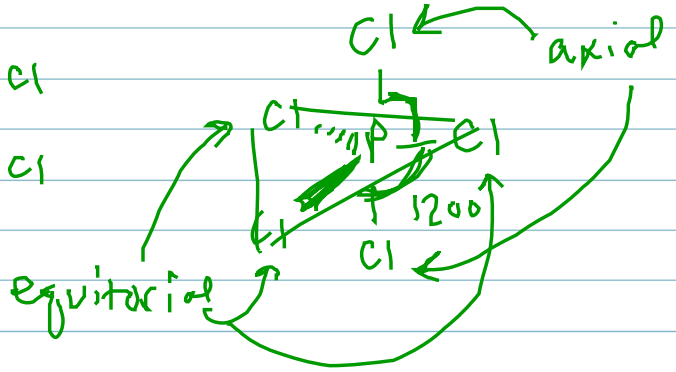
trigonal bipyramidal

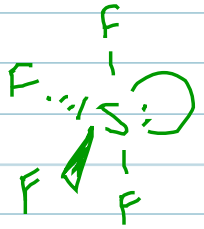
PCl_5





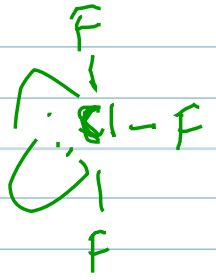
lone pairs go equitorial

SF_4

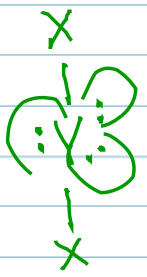


See saw

ClF_3



T-shaped



linear