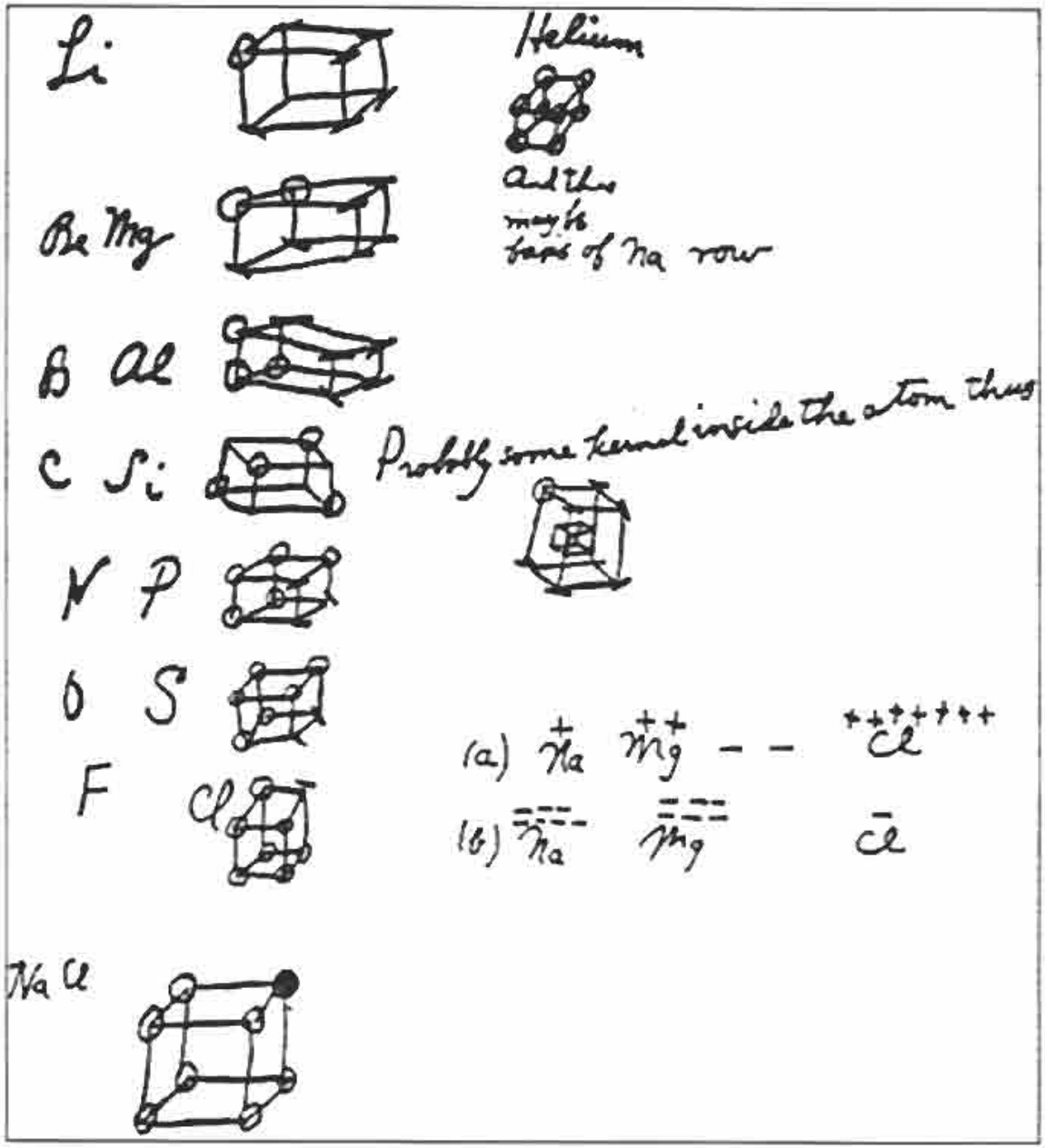
Welcome to 3.091

Lecture 9

September 27, 2004

G.N. Lewis in a memo dated 3/28/1902



Lewis Notation: electron-dot symbols (1916)

Period	1A(1)	2A(2)
	ns^1	ns^2
2	· Li	· Be ·
3	· Na	· Mg ·

3A(13)	4A(14)	5A(15)	6A(16)	7A(17)	8A(18)
ns^2np^1	ns^2np^2	ns^2np^3	ns^2np^4	ns^2np^5	ns^2np^6
· B ·	· C ·	· N ·	: O ·	: F :	: Ne :
· Al ·	· Si ·	· P ·	: S ·	: Cl :	: Ar :

- element symbol ≡ nucleus & inner e⁻s
- dots ≡ valence e⁻s

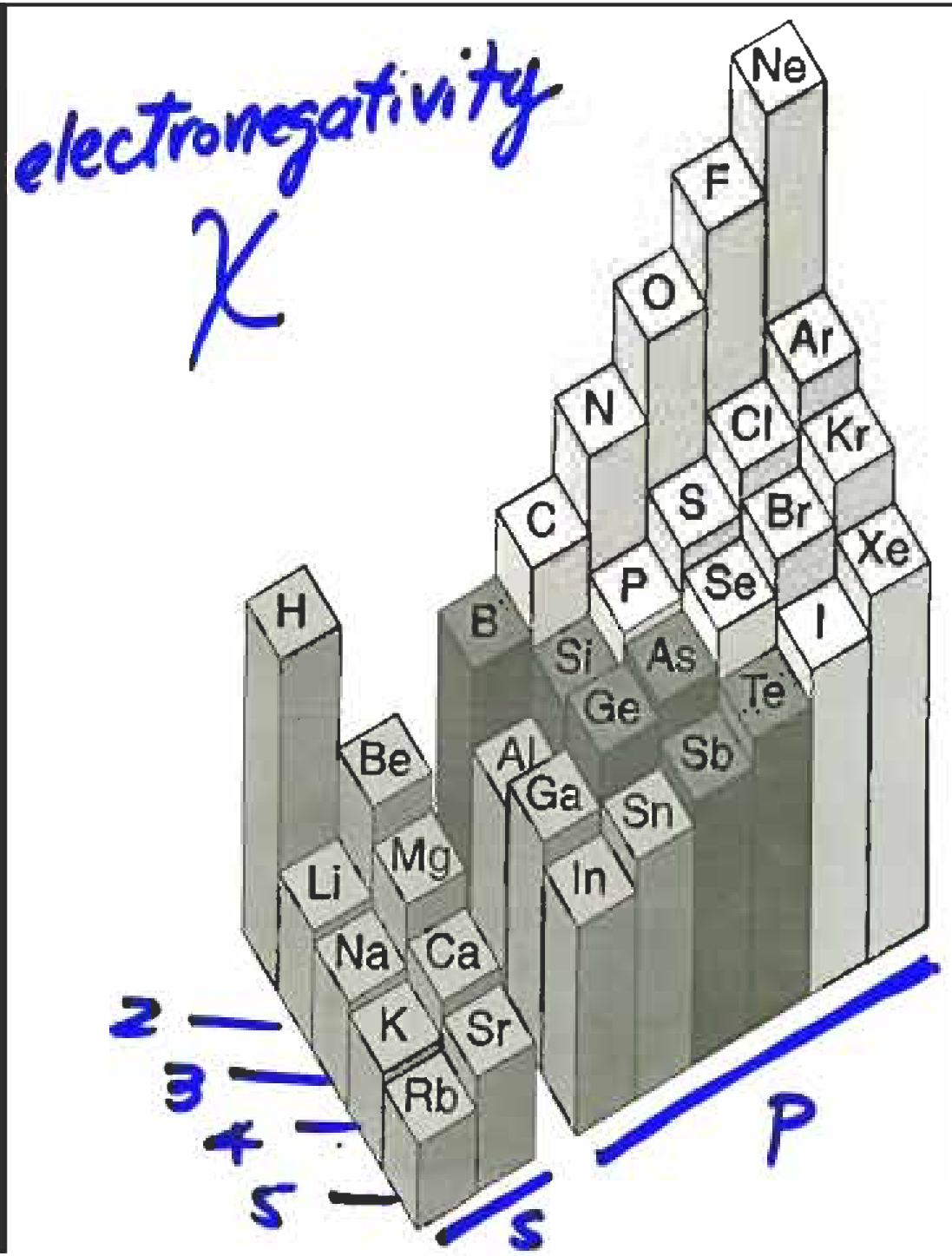
Drawing Lewis Structures

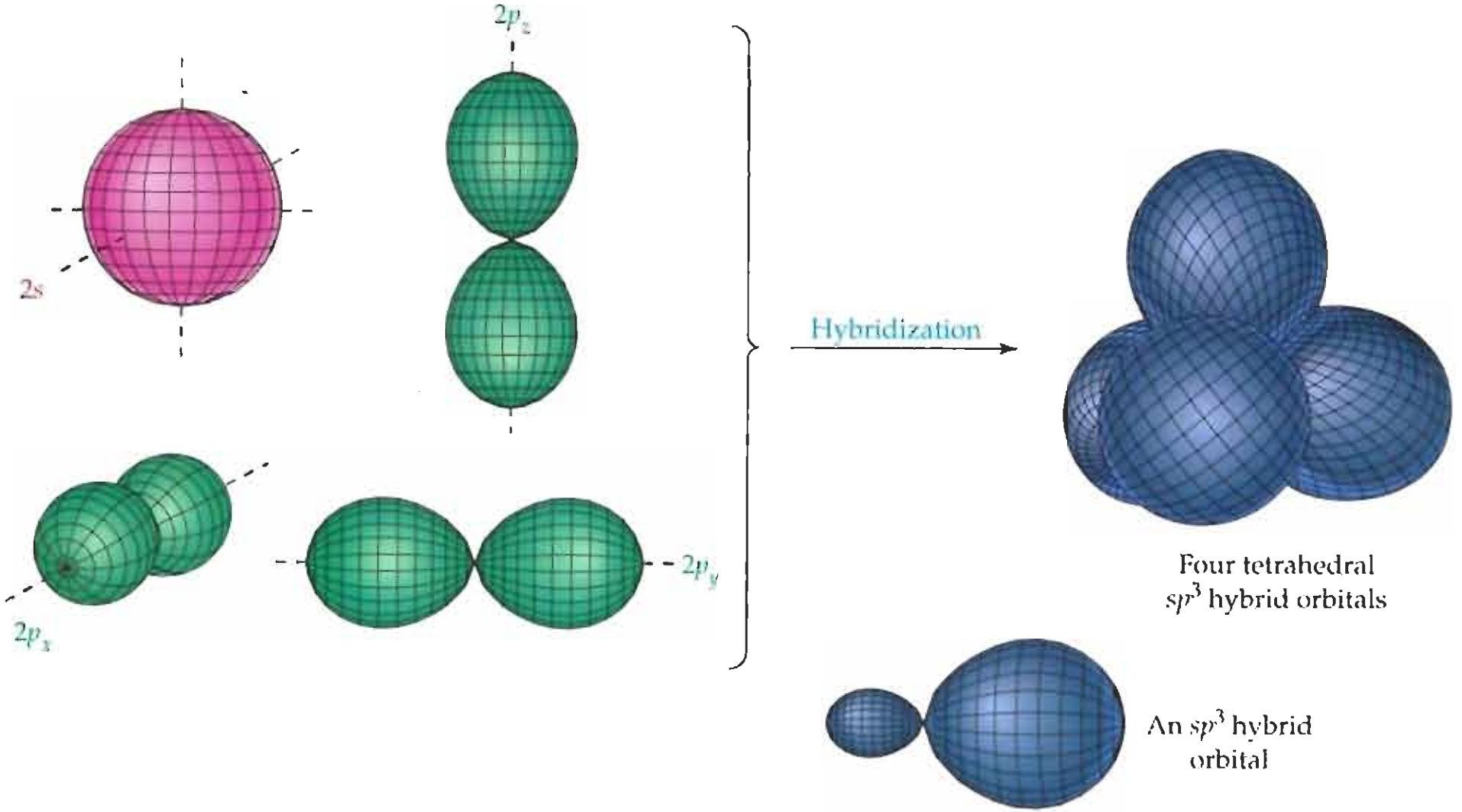
1. center the element with lowest AVEE
2. count all valence electrons
3. draw a single bond from each surrounding atom to the central atom; subtract 2 valence e^-s for each bond
4. distribute remaining e^-s in pairs so that each atom has 8; place NB pairs on peripheral atoms first (higher AVEE)

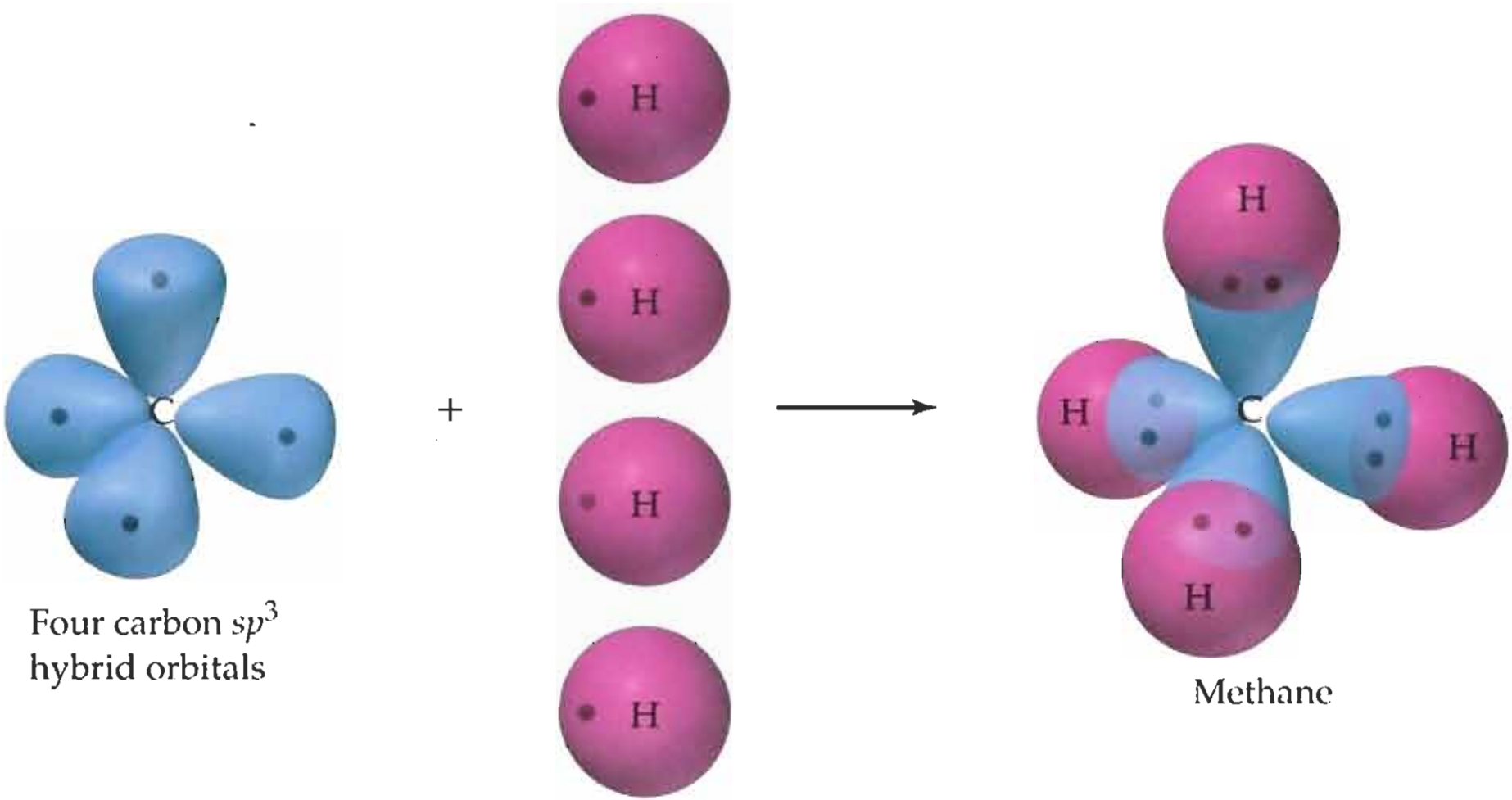
Electronegativity values

H 2.30																H 2.30	He 4.16
Li 0.91	Be 1.58											B 2.05	C 2.54	N 3.07	O 3.61	F 4.19	Ne 4.79
Na 0.87	Mg 1.29											Al 1.61	Si 1.92	P 2.25	S 2.59	Cl 2.87	Ar 3.24
K 0.73	Ca 1.03	Sc 1.2	Ti 1.3	V 1.4	Cr 1.5	Mn 1.6	Fe 1.7	Co 1.8	Ni 1.9	Cu 1.8	Zn 1.6	Ga 1.76	Ge 1.99	As 2.21	Se 2.42	Br 2.69	Kr 2.97
Rb 0.71	Sr 0.96	Y 1.0	Zr 1.1	Nb 1.3	Mo 1.4	Tc 1.5	Ru 1.7	Rh 1.8	Pd 1.9	Ag 2.0	Cd 1.5	In 1.66	Sn 1.82	Sb 1.98	Te 2.16	I 2.36	Xe 2.58
Cs 0.66	Ba 0.88										Hg 1.76						

Figure by MIT OCW.


electronegativity
χ
Ne
F
O
Ar
N
Cl
Kr
C
S
Br
Xe
P
Se
I
H
B
Si
As
Te
Ge
Be
Al
Sb
Ga
Sn
Li
Mg
In
Na
Ca
K
Sr
Rb
2
3
4
5
s
p


2p_z
2s
Hybridization
2p_y
2p_x
Four tetrahedral
sp^3 hybrid orbitals
An sp^3 hybrid
orbital



Four carbon sp^3 hybrid orbitals

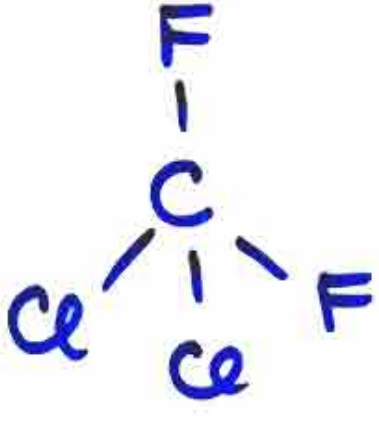
Four hydrogen 1s atomic orbitals

Methane

Thomas "sp^3" Midgley

Freon 12: designer molecule, tailored chemical

- early refrigerants were toxic or flammable, e.g., ammonia, methyl chloride, sulfur dioxide
- in late 1920s Midgley discovered CCl_2F_2 with properties of a refrigerant ***and*** propellant: **perfect!**



dichlorodifluoromethane

chlorofluorocarbon

CFC

- but in the upper atmosphere, u.v. light breaks the C – Cl bond, and atomic Cl attacks ozone

$$Cl + O_3 \rightharpoonup ClO + O_2$$

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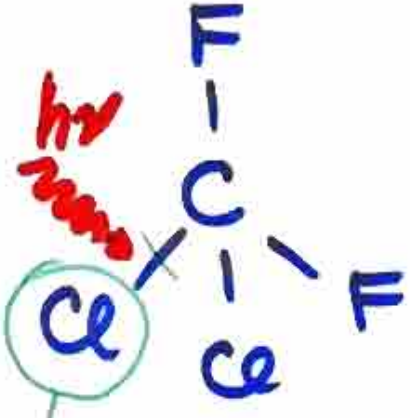

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$$Cl + O_3 \rightarrow ClO + O_2$$

CFCs ⇒ ozone depletion