CFCs and Substitutes, alphabetical naming: B(Br), C(Cl), F(F)

LECTURES #19 (W, Oct 19) #18 (M, Oct 17)

chemicals	structures	PROPERTIES — positives & (negatives): non-corosv? non-toxic? non-flambl? degrades? O3-depl-potentl (if Cl, Br) bp-range COMPLEX [+ decisions] economics-etc	USES of these chemicals	
NH_3 SO_2	(Lewis structures of NH_3 and SO_2) NO CS	$NH_3 + HOH \rightarrow NH_4OH \rightarrow NH_4^+ + OH^-$ ← BASE (SOLUTION) $H_2O + SO_2 \rightarrow H_2SO_3 \rightarrow H^+ + HSO_3^-$ ← ACID want -10 to -30°C; CiC, pg 97.5 Lec 18, Montreal Protocol, slide 33; "recovery expected by 2050"	before 1930, household refrigerators now, some INDUSTRIAL refrigerants	L18, sl
O3↓ **CFC** standard for comparison	GH - no H, some Cl CCl_3F, lt = 60y CCl_2F_2, lt = 120y (as F↑, Cl↓, lt↑)	non-toxic, non-flam (inert) colorless, odorless, tasteless not removed by RAIN or by REACTNS only in stratosph: CFC →(UV-C) Cl· (EQN 2.9, CiC pg 90) CiC, pgs 90-1, 93-4 + long lifetimes Lec 18, slides 58-65 CCl_2F_2 is gas at room T, bp = -20F = -29C L18 (sl 18) mixing of trop/strat, 3-6y	from Lec 18, sl 19-58: 1- REFRIGERANT GAS (refrigrts, car AC) 2- PROPELLANT for spray cans (hair, deodorant, paint, insects) 3- PROPELLANT for drugs (for asthma, bronchitis, emphysema) 4- to FIGHT FIRES 5- FOAMING AGENT (for styrofoam...) and more. (but not in L-19)	
O3↓ **HCFC** LIFETIME↓	GH - some H, some Cl CH_3ClF_2, lt = 21y (142b) CH_3CCl_2F, lt = 9.2y (141b) * CH_2CF_3 (is 134a), lt = 12y	H → lifetime↓ compared w/ CFCs, Hs → more reactive, a little more toxic, (sl 33) more flambl. (Fs replace Cl but lt↓) ?* no H → LONGER LIFETIME * lt↑ as more Fs (replacing Cl) but H's are bigger factor have Cl, so deplete O3, but less than CFCs, bec. lt shorter (but conc. still↑ing)	(I think (but it's not on L-19 slides) HCFCs are replacement for some CFC uses: REF?)	
LTm↓ **HFC** and no Cl, no Br, no O3↓	GH - some H, no Cl OOPS, 134a is HFC This was in your lab, pg 7-10, w/ CH_2FCH_3	134a has lots of Hs → L19, sld 53 (nontoxic) H's → some flamab, but (non-flam under ordinary condtns) CiC pg 98.5 HFC has no Cl, no Br, so no O3↓ HFCs praised for 4 paragraphs on pg 98, but... "not long-term solution" GREEN HOUSE	refrigerators, auto refrign AC (L19, sl 46-52)	
FC first exam FEF	GH - strong C-F bonds ? READ Lec 19, Slides 39-42	doesn't deplete O3 non-toxic ("generates non-toxic ...") highly biodegradable, w/ "innocuous products" effective at low concentrations of halons (→ less waste) sl 42: Green Chem		CiC pg 176 BOND ENERGIES C-H (416), C-F (485), C-Cl (327), C-Br (285)
HBFC	H, Br, F, along with C	UV → Br·, O3↓		*
Halons BFC + CBFC?	always Br & F, sometimes Cl no H	Lec 19, sl 36-39, 43-45 sl 43 (why the difference?) Halon-1301, $CBrF_3$ 225y → long blue curve Halon-1211, $CBrClF_2$ 25y → short red curve * Br → O3↓ sl 105	Lec 18, sl 46-50 fire fighting where don't want water: LIBRARIES, MUSEUMS, AIRCRAFT, COMPUTERS (electronics)	
CH_3Br	not in L-18, L-19 } OOPS, is in L19, sl 25,... for MONTREAL PROTOCOL	non-CH3Br INFO } → ■ CFCs-etc are "non-polar" (LOW polarity) (but not ZERO) (polarity-canceling due to tetrahedral geometry) so don't dissolve much ("washout") in RAIN		
		bp range (-10 to -30 °C), **dynamic** equilibrium (→ and ←) (both are 3 x 10^8 tons of O_3/day) — in Chapman Cycle		

2.9 (pp 82-83), f-2.15 (p. 85), 2.11-2.12-C (pgs 88-94), W (Oct 20); Ozone Hole, 2.10 + M-11 and beyond.

Greenhouse Gases
- CO_2, H_2O, CH_4
- CFC, HCFC, HFC, etc
- not (N_2, O_2, H_2), Ar... (nobles)

default: absorbs IR

CO_2 only .04%

N_2, O_2, H_2, Cl_2... are diatomic/symmetric so no IR-abs, which is good because N_2 ~78%, O_2 ~21%, Ar ~.9% } if absorb, too much GH, T is too high

also see lower part of EM-Grid

Molecules

Bond #s (C-4, N-3, O-2, F-1, Ne-0), H-O-H or O=O. (2 bonds for O)

How many directions to see electrons? (bonding, non-b) els repel/avoid → logical shapes → logical names: 2 (linear), 3 (trigonal planar), 4 (tetrahedral) but with non-b els: 3 (OSO bent), 4 (HOH bent, NH_3 trig pyr).

radical: if unpaired el (≠ non-b els); always if odd #.

On a test, you must draw every bond and every atom, for a structural formula. And you must draw electrons (UNSHARED) for a Lewis formula.

- chemical formula, C3H8
- condensed structural f, $CH_3CH_2CH_3$
- structural f, draw ALL atoms and bonds
- Lewis f = structural f + unshared electrons

isomers defn: if same chemical formula (same # of each type of atom) but different structural formula (different connectivity)

drawing: be creative (get all, for each chain-length #), systematically + critical (eliminate all duplicates with same connectivity)

- alkanes (CH, only C-C, C_nH_{2n+2}); draw structure to see why (1 extra, each end).
- alkenes (CH, one C=C, lose 2 Hs); draw each (ane, ene, yne, ring) to see why.
- alkynes (CH, one C≡C, lose 4 Hs). draw: hexane (6 5 5 4 4), butene (4 4 3).
- any ring (CH, if only C-C, lose 2H). also C-C-OH (alcohols), C-O-C (ethers).

non-metals: F, O, N, Cl, C, H — metals — ELECTRONEGATIVITY

POLARITY depends on
- EN difnces
- geometry (shape) → cancels?

SHAPE, ask "how many directions are els?"
- if 2 dirns (O=C=O) is LINEAR
- if 3 dirns (:SO_2) is TRIGONAL PLANAR
- if 4 dirns (CH_4, :NH_3, H_2O) TETRAHEDRAL (is polar [≠0] unless all attached are same)

if only 2 atoms, trivial LINEAR

CF_4 polarity = 0, CF_2Cl_2, CF_3Cl ≠ 0