A. General. Structure, Nomenclature and Physical properties

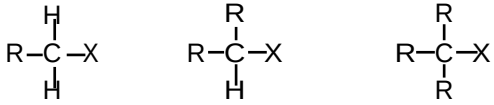
Haloalkanes

Structure: R–X

alkyl — halogen: (F), Cl, Br, I

	Bond length (Å)	Dipole Moment (D)
Cl	1.76	1.85
Br	1.93	1.8
I	2.13	1.6

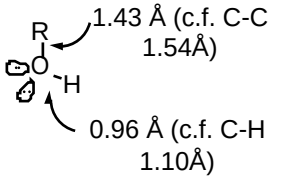
Nomenclature: Depending on the substitutionof the carbon bearing the halogen atom we classify alkyl halides as primary (1˚), secondary (2˚) or tertiary (3˚).



1˚ 2˚ 3˚

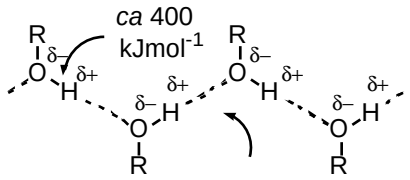
Alcohols

Structure: Oxygen sp^3 hydbridised with two lone pairs



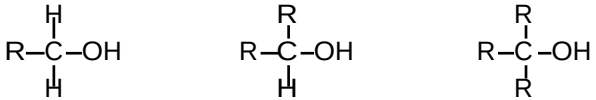
shortening of C-O and O-H due to increasing electro-negativity of O (3.44) vs C (2.55)

Alcohols participate in *Hydrogen-bonding*



Hydrogen bond 2.07 Å,ca 20 kJmol^{-1}

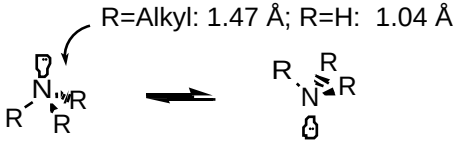
Nomenclature: As for the alkyl halides we classify alkyl alcohols as 1˚, 2˚ or 3˚.



1˚ 2˚ 3˚

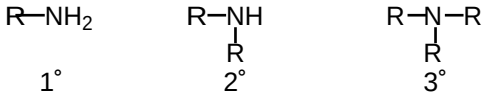
Amines

Structure: N is sp^3 hybridised with lone pair



pyramidal: but undergoes rapid inversion: *ca* 2 x 10^{11} s^{-1}

Nomenclature:



1˚ 2˚ 3˚

Beware confusion here: *e.g.*, "*tert*-butylamine", Me_3CNH_2 is a 1˚ amine.

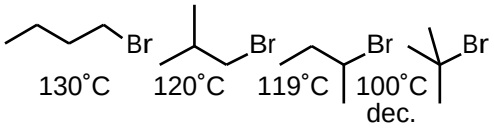
Haloalkanes have higher boiling points (bp's) than the corresponding alkanes:

e.g., CH_4 CH_3Cl CH_3Br CH_3I
-162˚C -24˚C 5˚C 43˚C

Boiling points increase *ca* 20-30˚C in the homolgous series

e.g., MeI EtI PrI BuI
43˚C 72˚C 102˚C 130˚C

Branching lowers bp's:



Haloalkanes are insoluble in water;

Haloalkanes are soluble in common organic solvents;

I, Br and poly-Cl alkanes are more dense than water.

Physical Properties:

Hydrogen bonding is weak, but their cumulative effect is considerable and responsible for: the anomalously high bp's of alcohols

e.g.	MeL	EtL	PrL	BuL
L = H	-162˚C	-88˚C	-42˚C	0˚C
L = OH	64˚C	78˚C	97˚C	118˚C

Hydrogen bonding is also responsible for the solubility of low molecular weight alcohols in water:

Compound:	Solubility (g/100g H_2O)
MeOH	∞
EtOH	∞
PrOH	∞
BuOH	7.9
$C_5H_{11}OH$	2.3

Physical properties:

Amines have a characteristic "fishy" odour.

Amines have higher bp's than non-polar compounds of similar molecular weight

H_3CNH_2 (MW 31) $CH_3CH_2NH_2$ (MW 45)
bp: -7.5˚C bp: 49˚C
CH_3CH_3 (MW 30) $CH_3CH_2CH_3$ (MW 44)
bp: -88˚C bp: -42˚C

Neat, 1˚ and 2˚ (but not 3˚) amines can intermolecularly hydrogen-bond:
$C_6H_{13}NH_2$: bp 131˚C
$(C_3H_7)_2NH$: bp 110˚C
$(C_2H_5)_3N$: bp 89˚C

1˚, 2˚ and 3˚ amines can all Hydrogen-bond to water. Therefore the low MW amines (<C6) are soluble in water.

B. Reactivity

Haloalkanes	Alcohols	Amines
Good electrophiles for nucleophilic Substitution by breaking of C-X bond.	Alcohols are only relative weak nucleophiles, but when deprotonated are good nucleophiles and good bases.	Lone pair renders amines nucleophilic.