

ORGANIC CHEMISTRY II

- Organic chemistry of hydrocarbon derivatives. Analysis of functional groups structure and their reactivity, influence of the neighbouring skeleton upon their reactivity and opposite influence of the certain functional group upon the hydrocarbon skeleton. Steroides and heterocyclic compounds in an overview.

At the end of the course the student should understand reactivity of various functional groups and their influence upon the hydrocarbon skeleton with the final aim to deduce chemical behaviour of a complex molecule, which might be a centre of the interest.

References:

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Solomons, Graham T. W. *Organic chemistry*. 6th ed. New York : John Wiley & Sons, 1996. xxvii, 121. ISBN 0-471-01342-0.

J. Clayden, N. Greeves, S. Warren, P. Wothers. *Organic Chemistry*. Oxford University Press 2001

John McMurry. *Organická chemie, český překlad*. Vyd. 1. Praha : Vysoká škola chemicko-technologická v Praze *Organická chemie.*, 2007. 1 sv. (ISBN 978-80-7080-637).

Červinka, Otakar. *Chemie organických sloučenin. Díl 1*. 1. vyd. Praha : Státní nakladatelství technické literatury, 1985. 1131 s.

Otakar Červinka, *Chemie organických sloučenin. Díl 2.* 1. vyd. Praha : Státní nakladatelství technické literatury, 1987. 1052 s.

Potáček, Milan - Mazal, Ctibor - Janků, Slávka. *Řešené příklady z organické chemie*. Masarykova univerzita v Brně, 2008. 243 s. ISBN 80-210-2274-4.

PERIODICKÁ SOUSTAVA PRVKŮ

IA	d										IIA	IIIA	IVA	VA	p	VIA	VIIA	VIII A					
1,008 1 H 0,01 VODÍK Hydrogenium											4,00 2 He HELIUM Helium												
6,94 3 Li 0,97 LITHIUM Lithium	9,01 4 Be 1,5 BERYLIIUM Beryllium											10,81 5 B 2,0 BOR Bor	12,01 6 C 2,0 UHLÍK Carbonium	14,01 7 N 3,0 DUSÍK Nitrogenium	16,00 8 O 3,0 KYSLÍK Oxygenium	18,99 9 F 4,0 FLUOR Fluor	20,18 10 Ne NEON Neon						
22,99 11 Na 1,0 NÁTRÍK Natrium	24,31 12 Mg 1,2 HOŘK Magnesium											26,98 13 Al 1,0 ALUMÍN Aluminium	28,09 14 Si 1,7 KŘÍDELNÍK Silicium	30,07 15 P 3,1 FOSFÓR Phosphorum	32,06 16 S 2,0 SIŘIČ Sulfur	35,45 17 Cl 2,0 CHLÓR Chlorium	39,95 18 Ar ARGON Argon						
39,10 19 K 0,9 DRAŽEK Kalium	40,08 20 Ca 1,0 VÁPNEK Calcium	44,96 21 Sc 1,2 SKANDIUM Scandium	47,88 22 Ti 1,2 TITAN Titanium	50,94 23 V 1,0 VANAD Vanadium	52,00 24 Cr 1,0 CHROM Chromium	54,94 25 Mn 1,0 MANGAN Manganium	55,85 26 Fe 1,0 ŽELEZO Ferrum	58,93 27 Co 1,0 KOBALT Cobaltum	58,93 28 Ni 1,7 NIKEL Nickelium	63,55 29 Cu 1,7 MĚD Cuprum	65,38 30 Zn 1,7 CINK Zincum	69,72 31 Ga 1,3 GALIUM Gallium	72,64 32 Ge 2,2 GERMÁNÍUM Germanium	74,90 33 As 2,2 ARSEN Arsenicum	78,96 34 Se 2,2 SELENIUM Selenium	79,90 35 Br 2,7 BROM Bromium	83,80 36 Kr KRYPTON Krypton						
85,47 37 Rb 0,9 RUBIDIUM Rubidium	87,62 38 Sr 0,9 STRONCIUM Strontium	88,91 39 Y 1,1 YTRIIUM Yttrium	91,22 40 Zr 1,2 CERK Zirconium	92,91 41 Nb 1,2 NIKEL Niobium	95,94 42 Mo 1,2 MOLYBDÉN Molybdenum	97,91 43 Tc 1,0 TECHNETIUM Technetium	101,07 44 Ru 1,0 RUTHENIUM Ruthenium	102,91 45 Rh 1,0 RHODIUM Rhodium	106,42 46 Pd 1,0 PALADIUM Palladium	107,87 47 Ag 1,0 STŘEBRO Argentum	112,41 48 Cd 1,0 KADÉMBÍ Cadmium	118,71 49 In 1,0 INDIUM Indium	118,71 50 Sn 1,7 CIN Stannum	121,76 51 Sb 1,3 ANTIMON Antimonium	127,60 52 Te 2,1 TELUR Tellurium	127,60 53 I 2,2 JOD Iodum	131,30 54 Xe XENON Xenon						
132,91 55 Cs 2,6 CÉZIUM Caesium	137,33 56 Ba 0,9 BARIUM Barium	138,91 57 La 1,0 LANTHAN Lanthanum	178,48 58 Hf 1,0 HAFNÍUM Hafnium	180,95 59 Ta 1,2 TANTAL Tantalum	183,85 60 W 1,0 WOLFRAM Wolframium	186,21 61 Re 1,0 REHÉNÍUM Rhenium	186,21 62 Os 1,0 OSMIUM Osmium	192,22 63 Ir 1,0 IRIDIUM Iridium	195,08 64 Pt 1,0 PLATINA Platinum	196,97 65 Au 1,0 ZLATO Aurum	200,59 66 Hg 1,4 RTUŤ Hydrargyrum	204,39 67 Tl 1,0 THALIUM Thallium	208,98 68 Pb 1,0 OLOVŮ Plumbum	208,98 69 Bi 1,0 BISMUT Bismutum	208,98 70 Po 1,0 POLONIUM Polonium	210 71 At 1,0 ASTAT Astatium	222 72 Rn RADON Radon						
223 83 Fr 260 FRANCIUM Francium	226,03 84 Ra 2,6 RADIUM Radium	227,03 85 Ac 1,0 AKTINIUM Actinium	261 104 Ku KURČATOVŮV Kurchatovium	265 105 Ha HABERMAN Hassium	269 106 107																		

hmotnost/částic
značka (symbol)
protonové číslo

elektronová konfigurace
elektronogalvita
český název
švédský název

relativní atomová hmotnost

Skupení prvků při 30°C:

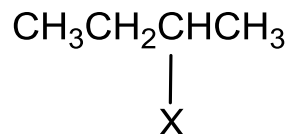
- Prvky zřísadotvorné slabé
- amfoterní
- kyselinotvorné slabé
- inertní
- umělé
- He – plyné
- Hg – kapalné
- Fe – pevné

* LANTHANOIDY	140,12 58 Ce 1,0 CER Cerium	140,91 59 Pr 1,1 PRASEODYM Praseodymium	144,24 60 Nd 1,1 NEODYM Neodymium	174,97 61 Pm 1,1 PROMETIUM Promethium	150,36 62 Sm 1,0 SAMARIUM Samarium	151,96 63 Eu 1,0 EUROPIUM Europium	157,25 64 Gd 1,0 GADOLINIUM Gadolinium	158,93 65 Tb 1,1 TERBIUM Terbium	162,50 66 Dy 1,1 DYSPROSIUM Dysprosium	164,93 67 Ho 1,1 HOLMIUM Holmium	167,26 68 Er 1,1 ERBIUM Erbium	168,93 69 Tm 1,1 THULIUM Thulium	173,04 70 Yb 1,1 YTERBIUM Ytterbium	174,97 71 Lu 1,1 LUTECIUM Lutetium
* AKTINOIDY	230,04 90 Th 1,1 THORIUM Thorium	231,04 91 Pa 1,1 PROTAKTIUM Protactinium	238,03 92 U 1,0 URAN Uranium	237,05 93 Np 1,0 NEPTUNIUM Neptunium	244 94 Pu 1,0 PLUTONIUM Plutonium	243 95 Am 1,0 AMEZICIUM Americium	243 96 Cm 1,0 CURIUM Curium	247 97 Bk 1,0 BERKELIUM Berkelium	251 98 Cf 1,0 KALIFORNIUM Californium	252 99 Es 1,0 EINSTEINIUM Einsteinium	257 100 Fm 1,0 FERMIUM Fermium	258 101 Md 1,0 Mendelevium Mendelevium	259 102 No 1,0 Nobelium Nobelium	259 103 Lr 1,0 Lawrencium Lawrencium

Halogen derivatives

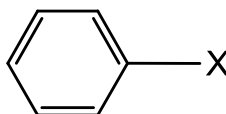
according their reactivity we can summarize the types of halogen derivatives by the way the halogen at the molecule is bound to the hydrocarbon skeleton

Halogenides with halogen at carbon sp^3

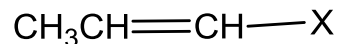


„normal“ reactive

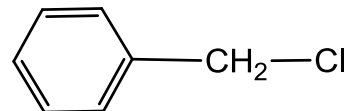
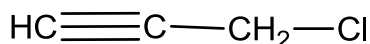
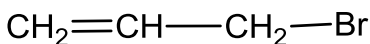
Halogenides with halogen at carbon sp^2



nonreactive

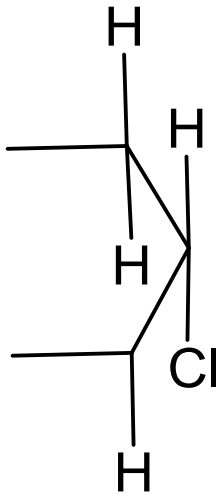
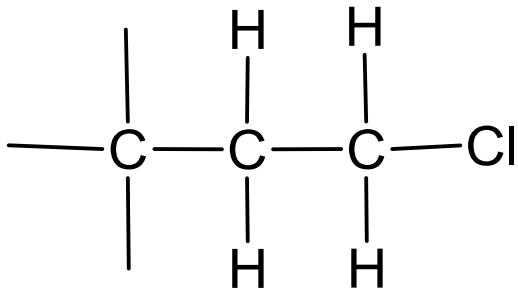


Halogenides with halogen at carbon sp^3 in neighbourhood of carbon sp^2 or sp

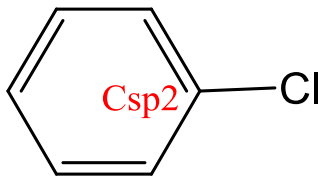
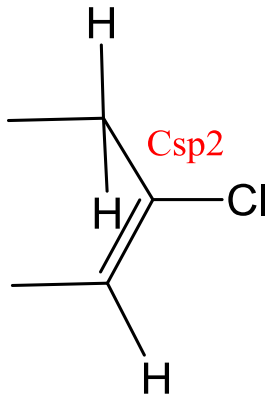
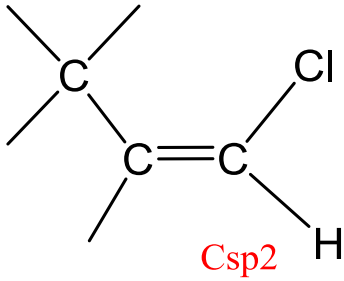


very reactive

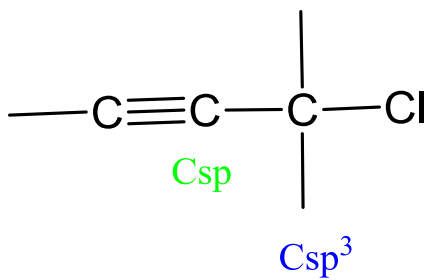
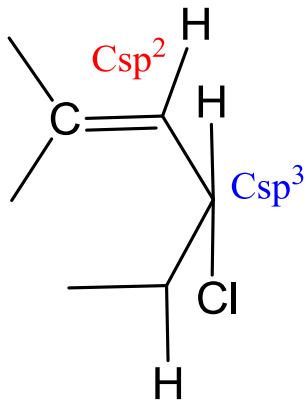
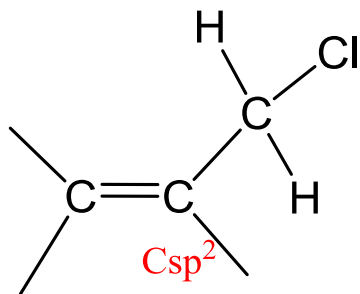
HALOGEN DERIVATIVES



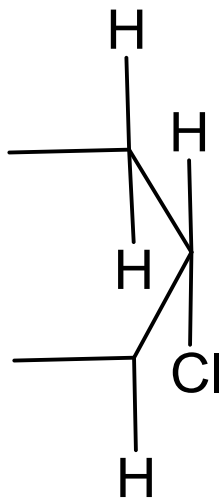
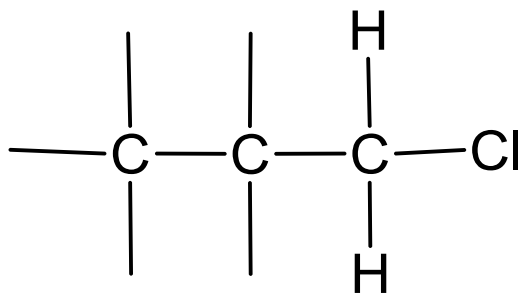
HALOGEN DERIVATIVES



Csp^3 HALOGEN DERIVATIVES



HALOGEN DERIVATIVES



HALOGEN DERIVATIVES

	C - F	C - Cl	C - Br	C - I
Dipole moment [C. m.10 ⁻³⁰]	4,69	4,86	4,56	3,96
Bond energy [kJ/mol]	447	339	280	221
Polarisability [10 ²⁴ .cm ⁻³ .mol ⁻¹]	0,81	5,84	8,74	13,95

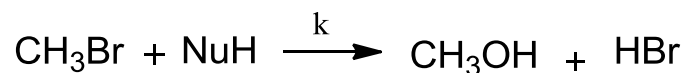
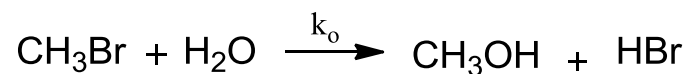
Overview of some hard and soft acids and bases

	Bases	Acids
HARD	H_2O , HO^- , F^- , Cl^- CH_3COO^- , SO_4^{2-} , NO_3^- ClO_4^- , CO_3^{2-} , ROH , R_2O , NH_3 , RNH_2	H^+ , Li^+ , Na^+ , K^+ , Al^{3+} , Fe^{3+} AlCl_3 , BF_3 , $(\text{RO})_3\text{B}$ R_3C^+ , RCO^+ , NC^+
SOFT	RSH , RS^- , R_2S I^- , SCN^- , $\text{S}_2\text{O}_3^{2-}$ R_3P , $(\text{RO})_3\text{P}$, CN^- , RNC , alkeny benzen, H^- , R^-	Cu^+ , Ag^+ , Hg^+ CH_3Hg^+ , BH_3 RS^+ , I^+ , Br^+ I_2 , Br_2 chinony, karbeny, kovy

Basicity and nucleophilicity comparison

Swain – Scott equation

$$\log \frac{k}{k_0} = s \cdot n$$



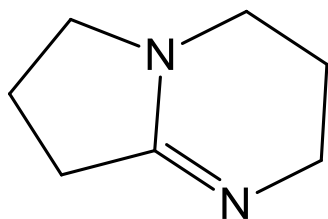
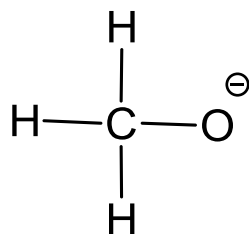
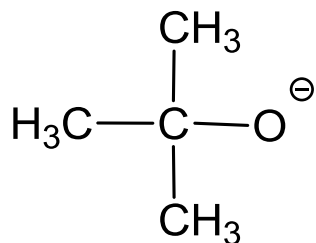
k = rate constant for reaction of bromomethane with a nucleophile with nucleophilicity n

k_0 = rate constant for reaction of bromomethane with water [$n_{(\text{H}_2\text{O})} = 0$]

s = sensitivity of substrate to nucleophilic attack (dependent upon the structure, for bromomethane $s=1$)

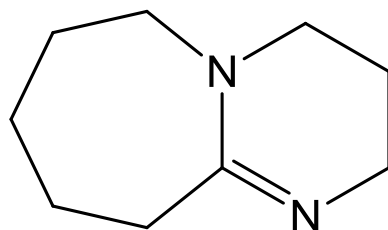
Reagent	Nucleophilicity	Basicity
H ₂ O	0,0	0,0
F ⁻	2,0	4,9
Cl ⁻	3,0	- 3,0
Br ⁻	3,8	-6,0
I ⁻	5,0	-9,0
HO ⁻	4,2	17,5
CH ₃ COO ⁻	2,7	6,5
CN ⁻	5,1	-9,0
HS ⁻	5,1	14,7

Basicity



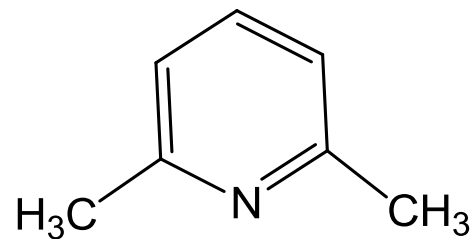
DBN

1,5-diazabicyclo[4.3.0]non-5-ene

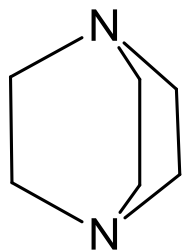


DBU

1,5-diazabicyclo[5.4.0]undecene



2,6-dimethylpyridin



DABCO

1,4-diazabicyclo[2.2.2]octane