Chemistry A-Level Cheat Sheet

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Transition metal complexes

Complex	Few drops NaOH/NH3	Excess NaOH	Excess NH3
pale green [Fe(H20)6]$^{3+}$	dirty green Fe(OH)2	-	-
green/violet [Cr(h206]$^{3+}$	pale green Cr(OH)3	deep green soln. [Cr(OH)6]$^{3+}$	violet soln. [Cr(NH3)6]$^{3+}$
yellow [Fe(H2O)6]$^{3+}$	brown Fe(OH)2	-	-
blue [Cu(H2O)6]$^{2+}$	pale blue Cu(OH)2	-	deep blue soln. [Cu(NH3)4(H2O)2]$^{2+}$
pale pink [Mn(H2O)6]$^{2+}$	light brown Mn(OH)2	-	-

Test for halide ions

Halide ion	Adding HNO3 and AgNO3	Adding NH3
Chloride	White ppt	Dissolves in dilute
Bromide	Cream ppt	Dissolves in conc.
Iodide	Yellow ppt	Doesn't dissolve

HNO3 added first to the halide, then AgNO3. This forms a ppt, from which the colour can be used to identify the halide. NH3 is then added if necessary; in dilute ammonia, e.g: only chloride ions dissolves, whereas iodide ions don't dissolve at all.

Organic tests (AS)

Alcohols	Add K2Cr2O7/H+	Orange to green for 1st and 2nd alcohols
Alkenes	Add bromine water	Orange to colourless
Haloalkanes	Dissolve in ethanol, add water, then do the halide test	

Organic tests (A-level)

Aldehyde/-ketone	Add 2,4-DNP (Brady's reagent)	Orange ppt forms
Aldehyde	Add Tollen's reagent	Siler mirror forms
	Add Fehling's reagent	Red ppt forms
Carboxylic acid	Add carbonate (same as AS)	CO2 forms
	Add PCl5	Steamy white fumes produced
Benzne	Add bromine water (room temp)	no reaction.
	Combustion	Burns with sooty flame

Radical Substitution

Conditions	UV light
Bond fission	homolytic (2 radicals formed from covalent bond)
Organic product	haloalkane
Limitations	further substitution is almost impossible to control, products have to be separated by fractional distillation or chromatography
INITIATION	Cl2 -> 2Cl*
PROPOG-ATION	CH4 + Cl* -> *CH3 + HCl
	CH3 + Cl2 -> CH3Cl + Cl
TERMIN-ATION	2Cl* -> Cl2
	*CH3 +*CH3 -> C2H6
	CH3 +Cl -> CH3Cl

Electrophilic Substitution (nitration of benzene)

Reagents/conditions	conc. HNO3, conc. H2SO4, 50*C
Electrophile	NO2^{+}
Organic product	nitrobenzene
Gen. of electrphile	HNO3 + H2SO4 -> **NO2**$^{+}$ + HSO4– + H2O
Regen. of catalyst	HSO4– + H^{+} -> **H2SO4**

Electrophilic Sub. (chlorination of benzene)

Reagents/conditions	Cl2, AlCl3
Electrophile	Cl^{+}
Organic product	chlorobenzene
Gen. of electrphile	AlCl3 + Cl2 -> AlCl4^{-} + **Cl**$^{+}$
Regen. of catalyst	AlCl4^{-} + H^{+} -> **AlCl3** + HCl

Electrophilic Sub. (acylation of benzene)

Reagents/conditions	CH3COCl, AlCl3
Electrophile	$CH3CO^+$
Organic product	phenyl ethanone
Gen. of electrphile	AlCl3 + CH3COCl -> $AlCl4^-$ + $CH3CO^+$
Regen. of catalyst	$AlCl4^-$ + H^+ -> AlCl3 + HCl

Electrophilic Sub. (alkylation of benzene)

Reagents/conditions	CH3Cl, AlCl3
Electrophile	$CH3^+$
Organic product	methyl benzene
Gen. of electrphile	CH3Cl + AlCl3 -> $CH3^+$ + $AlCl4^-$
Regen. of catalyst	$AlCl4^-$ + H^+ -> AlCl3 + HCl

Electrophilic Sub. (bromination of benzene)

Reagents/conditions	Br2, AlBr3
Electrophile	Br^+
Organic product	bromobenzene
Gen. of electrphile	AlBr3 + Br2 -> $AlBr4^-$ + Br^+
Regen. of catalyst	AlBr4– + H^+ -> AlBr3 + HBr

Ammonium, NH4+

Add NaOH to test for NH3	Red litmus paper turns blue if present

Carbonate, CO3^2-

Add HCl to carbonate solution	CO2 forms. Turns limewater cloudy

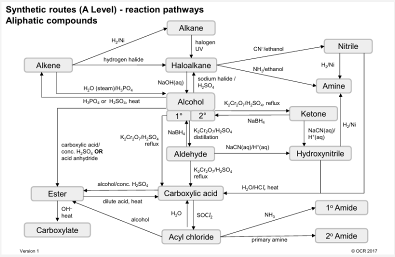
Sulphate, SO4^2-

Add BaCl2	White ppt forms if present (BaSO4)

Rate equations

Rate = $k[A]^m[B]^n$
k = $Ae^{-Ea/RT}$
ln k = -Ea/RT + ln A
k = rate constant
[A] = concentration of A
[B] = concentration of B
m = order wrt A
n = order wrt B
A = Arrhenius pre-exponential factor
e = exponential
Ea = activation energy ($kJmol^{-1}$)
T = temperature, K
R = gas constant (8.314 $JK^{-1}mol^{-1}$)
ln = natural log

Reaction pathways (aliphatic compounds)



Conditions and reactants/reagents shown

Electrophilic Addition (alkenes)

Electrophile	electron pair acceptor
Carbocation	positive ion with electron deficient carbon
Bond fission	heterolytic (cation and anion formed from covalent bond)
Organic product	haloalkane

! Curly arrows show movement of an electron

Nucleophilic Substitution (haloalkanes)

Reaction	Reagent/conditions	Nucleophile	Organic product
Hydrolysis (NaOH)	hot NaOH(aq)	OH	alcohol
NH3	ethanolic NH3	-	amine
KCN	ethanolic KCN	-	nitrile

Nucleophile: electron pair donor
Substitution: when an atom or group of atoms is replaced by another
Ethanolic: derived from or containing ethanol

Nucleophilic Addition (carbonyl compounds)

Reaction with NaBH4	
Reagents/conditions	NaBH4, warmed
Reaction type	reduction
Nuceophile	H^-
Organic product	alcohol
Reaction with HCN	
Reagents/conditions	HCN
Nucleophile	CN^-
Organic product	hydroxynitrile

Free radical sub. of ozone

Depletion 1*

CFCl3 --UV-> CFCl2* + Cl*
Cl* + O3 -> ClO* + O2
ClO* + O -> Cl* + O2

Depletion 2**

N2 + O2 -> 2NO*
NO* + O3 -> NO2* + O2
NO2* + O -> NO* + O2

*due to chlorine radicals from CFC's
**due to nitrogen oxide from aircraft engines and lightning