**CH3.5 91391 “Cheat sheet” for learning reactions**

Print pages back to back, cut out the cards and shuffle them. You can use the cards in a number of ways.

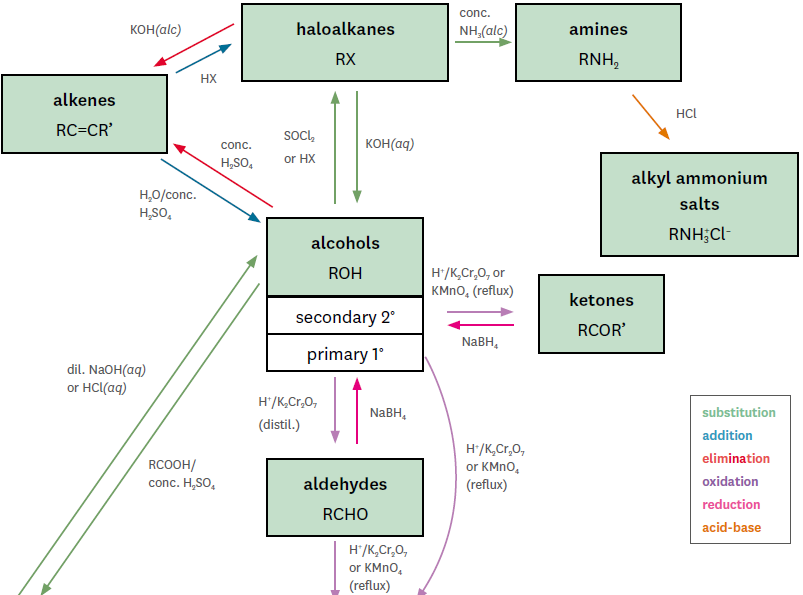
**Flash card / recall**

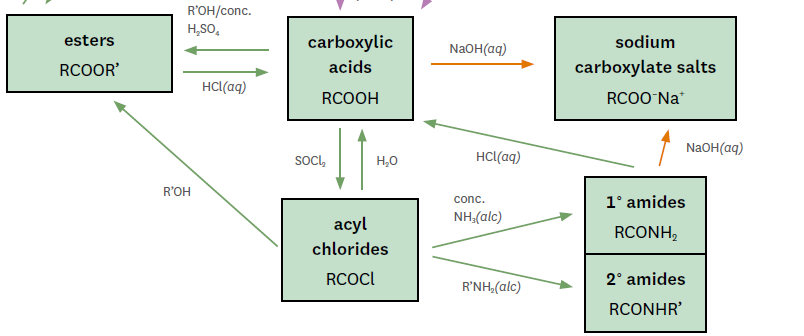
Pick up a card, with black print facing towards you. Name as many reactions that involve that card as a reactant, reagent or product. Then turn over the card to see if you are correct.

**Game challenge**

Share out the cards amongst players. See how many reactions you can make or how many cards you can use up. The one who can make the most reactions / uses the most cards wins. (If playing by yourself, then draw 15 cards)

**Reaction scheme :**





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| **RC=CR’** | **RC=CH2** | **1o**  **R–X** |
| **2o**  **R–X** | **1o**  **R–OH** | **2o**  **R–OH** |
| **R–NH2** | **R’**  ӏ  **R – NH** | **R–C–H** |

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| **OH-*(alc)***  **1o R–X → RC=CH2**  **Conc NH3**  **1o R–X → RNH2**  **R’–NH2**  **1o R–X → RNH–R’**  **OH­-*(aq)***  **1o R–X → 1o R–OH**  **SOCl2**  **1o R–OH → 1o R–X**  **HX**  **RC=CH2 → 1o R–X** | **H2/Pt**  **RC=CH2 → RCH2–CH3**  **HX**  **RC=CH2 → 1o R–X** (minor)  **Conc H2SO4/H2O**  **RC=CH2 → 1o R–OH** (minor)  **Conc H2SO4/H2O**  **RC=CH2 → 2o R–OH** (major)  **Conc H2SO4**  **1o R–OH → RC=CH2**  **OH-*(alc)***  **1o R–X → RC=CH2** | **H2/Pt**  **RC=CR’ → RCH–CHR’**  **HX**  **RC=CR’ → 2o R–X**  **Conc H2SO4/H2O**  **RC=CR’ → 2o R–OH**  **Conc H2SO4**  **2o R–OH → RC=CR’**  **OH-*(alc)***  **2o R–X → RC=CR’** |
| **Conc H2SO4**  **2o R–OH → RC=CR’**  **SOCl2**  **2o R–OH → 2o R–X**  **R’COOH / conc H2SO4**  **2o R–OH → R’COOR**  **H+/Cr2O72- *reflux* OR H+/MnO4-**  **2o R–OH → RCOR’**  **Conc H2SO4/H2O**  **RC=CH2 → 2o R–OH** (major)  **Conc H2SO4/H2O**  **RC=CR → 2o R–OH** (major)  **OH­-*(aq)***  **2o R–X → 2o R–OH**  **NaBH4**  **RCOR’ → 2o R–OH** | **Conc H2SO4**  **1o R–OH → RC=CH2**  **SOCl2**  **1o R–OH → 1o R–X**  **H+/Cr2O72- *distil***  **1o R–OH → RCHO**  **R’COOH / conc H2SO4**  **1o R–OH → R’COOR**  **H+/Cr2O72- *reflux* OR H+/MnO4-**  **1o R–OH → RCOOH**  **Conc H2SO4/H2O**  **RC=CH2 → 1o R–OH (minor)**  **OH­-*(aq)***  **1o R–X → 1o R–OH**  **NaBH4**  **RCHO → 1o R–OH** | **OH-*(alc)***  **2o R–X → RC=CR’**  **Conc NH3**  **2o R–X → R-NH2**  **OH­-*(aq)***  **2o R–X → 2o R–OH**  **SOCl2**  **2o R–OH → 2o R–X**  **HX**  **RC=CR’ → 2o R–X**  **HX**  **RC=CH2 → 2o R–X** (major) |
| **H+/Cr2O72- *reflux* OR H+/MnO4-**  **RCHO → RCOOH**  **NaBH4**  **RCHO → 1o R–OH**  **H+/Cr2O72- *distil***  **1o R–OH → RCHO**    **Turns damp red litmus blue** | **R’–NH2**  **R-X → R-NH-R’**  **R’X**  **R–NH2 → R-NH-R’**  **H­+*(aq)***  **R-NH-R’→ R-NH2+R’**  **Turns damp red litmus blue** | **Conc NH3**  **2o R–X → R-NH2**  **Conc NH3**  **1o R–X → R-NH2**  **H­+*(aq)***  **R-NH2 → R-NH3+**  **Tollen’s; Fehling’s; Benedict’s solution** |

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| **O**  **ǁ**  **R–C–R’** | **R–C–OH** | **R–C–O–** |
| **R–C–OR’** | **R–C–Cl** | **R–C–NH2** |
| **R–C–NHR’** | Major product | Minor product |

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| **OH—*(aq)***  **RCOOR → RCOO—**  **(base hydrolysis of esters)**  **OH—*(aq)***  **RCONHR’ → RCOO—**  **(base hydrolysis of peptide links)**  **OH—*(aq)***  **RCOOH → RCOO—** | **SOCl2**  **RCOOH → RCOCl**  **H+/Cr2O72- *reflux* OR H+/MnO4-**  **RCHO → RCOOH**  **R’OH / conc H2SO4**  **RCOOH → RCOOR’**  **H+/Cr2O72- *reflux* OR H+/MnO4-**  **1o R–OH → RCOOH**  **H2O**  **RCOCl → RCOOH**  **OH—*(aq)***  **RCOOH → RCOO—**  **H+*(aq)***  **R’COOR → RCOOH** | **NaBH4**  **RCOR’ → 2o R–OH**    **H+/Cr2O72- *reflux* OR H+/MnO4-**  **2o R–OH → RCOR’** |
| **OH—*(aq)***  **RCONH2 → RCOO—**  **(base hydrolysis of amides)**  **Conc NH3*(alc)***  **ROCl → R’CONH2** | **SOCl2**  **RCOOH → RCOCl**  **R’OH**  **RCOCl → RCOOR’**  **Conc NH3*(alc)***  **ROCl → R’CONH2**  **R’NH2*(alc)***  **ROCl → R’CONHR’**  **H2O**  **RCOCl → RCOOH** | **OH—*(aq)***  **RCOOR → RCOO—**  **(base hydrolysis of esters)**  **R’OH / conc H2SO4**  **RCOOH → RCOOR’**  **R’COOH / conc H2SO4**  **ROH → R’COOR**  **R’OH**  **RCOCl → RCOOR’** |
| **Elimination**  **Sayseff’s rule**: The hydrogen is removed from the C atom with the least number of H atoms (so minor product is the other way).  **Addition**  Markovnikov’s rule: The hydrogen is removed from the C atom with the least number of H atoms. (so minor product is the other way) | **Elimination**  **Sayseff’s rule**: The hydrogen is removed from the C atom with the least number of H atoms.  **Addition**  Markovnikov’s rule: The hydrogen is removed from the C atom with the least number of H atoms. | **OH—*(aq)***  **RCONHR’ → RCOO—**  **(base hydrolysis of peptide links)**  **R’NH2*(alc)***  **RCOCl → R’CONHR’** |

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| **HX**  **HCl or HBr** | **SOCl2** | **conc H2SO4** |
| **OH–*(alc)***  **NaOH or KOH** | **OH–*(aq)***  **NaOH or KOH** | **conc NH3 *(alc)*** |
| **H2O** | **H3O+** | **H+ / MnO4–** |

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| **R’COOH / conc H2SO4**  **R–OH → R’COOR**  **R’OH / conc H2SO4**  **RCOOH → RCOOR’**  **Conc H2SO4/H2O**  **RC=CH2 → 1o R–OH (minor)**  **Conc H2SO4/H2O**  **RC=CH2 → 2o R–OH (major)**  **Conc H2SO4/H2O**  **RC=CR’ → 2o R–OH** | **SOCl2**  **RCOOH → RCOCl**  **SOCl2**  **1o ROH → 1o R–X**  **(chloride added)**  **SOCl2**  **2o ROH → 2o R–X**  **(chloride added)** | **H­+*(aq)***  **R-NH2 → R-NH3+**  **HX**  **RC=CH2 → 1o R–X**  **H+*(aq)***  **R’COOR → RCOOH**  **H+*(aq)***  **RCOOR → RCOO—**  **(acid hydrolysis of esters)** |
| **Conc NH3*(alc)***  **R–X → R–NH2**  **Conc NH3*(alc)***  **ROCl → R’CONH2** | **OH­-*(aq)***  **1o R–X → 1o R–OH**  **OH­-*(aq)***  **2o R–X → 2o R–OH**  **OH—*(aq)***  **RCONHR’ → RCOO—**  **(base hydrolysis of peptide links)**  **OH—*(aq)***  **RCOOR → RCOO—**  **(base hydrolysis of esters)**  **OH—*(aq)***  **RCOOH → RCOO—** | **OH-*(alc)***  **1o R–X → RC=CH2**  **OH-*(alc)***  **2o R–X → RC=CR’** |
| **H+ / MnO4– *(reflux.)***  **1o R–OH → RCOOH**  **H+ / MnO4– *(reflux.)***  **2o R–OH → RCOR’**  **H+ / MnO4– *(reflux.)***  **RC=CR’ → RC(OH) –C(OH)R’**  **Colour change from purple MnO4- to colourless Mn2+** (turns to brown MnO2 if no H+ is present) | **H3O+**  **RCOOR’ → RCOOH**  **H­+*(aq)***  **R-NH2 → R-NH3+**  **Acid hydrolysis of condensation polymers** | **H2O**  **RCOCl → RCOOH**  **Conc H2SO4 / H2O**  **RC=CH2 → 2o R–OH** (major)  **Good starting point when trying to identify unknown liquids** (does it dissolve in water?) |

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| **H+ / Cr2O72–**  ***distil.*** | **H+ / Cr2O72–**  ***reflux*** | **NaBH4** |
| ***Tollen’s***  ***Reagent*** | ***Benedict’s***  ***Reagent*** | ***Fehling’s***  ***Reagent*** |
| **Br2*(aq)*** | **1o ROH**  ***(as reagent)*** | **1o RNH2**  ***(as reagent)*** |

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| **NaBH4**  **RCHO → 1o R–OH**  **NaBH4**  **RCOR’ → 2o R–OH** | **H+ / Cr2O72– *(reflux.)***  **1o R–OH → RCOOH**  **H+ / Cr2O72– *(reflux.)***  **2o R–OH → RCOR’**  **Colour change from orange Cr2O72- to green Cr3+ test for 1o and 2o ROH and RCHO** | **H+ / Cr2O72– *(distil.)***  **1o R–OH → RCHO**  **Colour change from green Cr2O72- to green Cr3+ test for 1o and 2o ROH** |
| **Colour change test for RCHO**  **Fehling’s reagent**  Blue CuSO4 solution (with citrate and carbonate) is reduced to brick red Cu+ solid  Aldehyde oxidised to carboxylic acid | **Colour change test for RCHO**  **Benedict’s reagent**  Blue Cu2+ solution (with tartrate and NaOH) is reduced to brick red Cu+ solid  Aldehyde oxidised to carboxylic acid | **Colour change test for RCHO**  **Silver mirror test**  Ag+ in warmed ammonia solution is reduced to Ag (silver mirror or grey deposit).  Aldehyde oxidised to carboxylic acid |
| **R’–NH2**  **1o R–X → RNH–R’**  **R’NH2*(alc)***  **ROCl → R’CONHR’** | **R’OH / conc H2SO4**  **RCOOH → RCOOR’**  **R’OH**  **RCOCl → RCOOR’** | **Colour change test for C=C**  **Bromine water**  Yellow / orange-brown bromine water rapidly goes colourless in presence of alkene as colourless dibromoalkane is formed  (Note: other organic compounds react much more slowly) |