**Distinguishing between organic substances – Level 3**

(see also Level 2 summary) at <https://www.chemical-minds.com/identifying-tests.html>

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **water** | **NH3** | **add Tollens reagent**  **and heat** | **warm with Fehling’s**  **or**  **Benedicts solution** | **Cu2+** | **conc HCl** | **heat with**  **acidified MnO4-** | **heat with**  **acidified Cr2O7 2-** | **Universal indicator** | **DAMP litmus paper** |
| **amine** | soluble |  |  |  | complex ions forms with a **deep blue** colour | white cloud forms |  |  | **blue** colour | damp **red** litmus paper turns **blue** |
| **alcohol** (primary) |  |  |  |  |  |  | oxidation reaction (**partial**)  **purple** 🡪 colourless  forming aldehyde  oxidation reaction (**total/full**)  **purple** 🡪 colourless  forming carboxylic acid | oxidation reaction (**partial**)  **orange** 🡪 **green**  forming aldehyde  oxidation reaction (**total/full**)  **purple** 🡪 colourless  forming carboxylic acid |  |  |
| **alcohol** (secondary) |  |  |  |  |  |  | oxidation reaction  **purple** 🡪 colourless  forming ketone | oxidation reaction  **orange** 🡪 **green**  ketone |  |  |
| **alcohol** (tertiary) |  |  |  |  |  |  | no reaction | no reaction |  |  |
| **aldehyde** |  |  | colourless solution forms silver mirror  or  **black** precipitate | **blue** solution changes to a **brick red** precipitate |  |  | oxidation reaction  **purple** 🡪 colourless  forming carboxylic acid | oxidation reaction  **purple** 🡪 colourless  forming carboxylic acid |  |  |
| **ketone** |  |  | no reaction | no reaction |  |  | no reaction | no reaction |  |  |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ester** | insoluble & less dense,  visible ester layer at top |  |  |  |  |  |  |  |  |  |
| **carboxylic acid** |  |  |  |  |  |  |  |  | **orange** or **yellow** as acidic | damp **blue** litmus paper turns **red** |
| **amide** |  |  |  |  |  |  |  |  | no change | no change |
| **acyl chloride** | vigorous exothermic reaction, fumes given off  forming carboxylic acid | white fumes given off |  |  |  |  | vigorous exothermic reaction | vigorous exothermic reaction | **red** colour | damp **blue** litmus paper turns **red** |

**amine with water**

eg propanamine in water

H3CCH2CH2NH2 + H2O 🡪 H3CCH2CH2NH3+ + OH–

**acyl chloride with water**

eg propanoyl chloride with water

CH3COCl + H2O → CH3COOH + HCl

**Oxidation of alcohols** *(you will not be required to write half or full redox equations in the* ***Organic*** *exam paper)*

**partial oxidation of a primary alcohol**

acidified KMnO4  or K2Cr2O7

primary alcohol 🡪 aldehyde

RCH2OH 🡪 RCHO + 2e + 2H+

eg propan-1-ol

acidified KMnO4  or K2Cr2O7

C3H7OH 🡪 C3H6O + 2H+ + 2e

**full/complete oxidation of a primary alcohol**

acidified KMnO4  or K2Cr2O7

primary alcohol 🡪 carboxylic acid

RCH2OH 🡪 RCOOH + 2e + 2H+

eg propan-1-ol

acidified KMnO4  or K2Cr2O7

C3H7OH 🡪 C2H5COOH + 2H+ + 2e

**oxidation of a secondary alcohol**

acidified KMnO4  or K2Cr2O7

secondary alcohol 🡪 ketone

RCH2OH 🡪 RCOR’ + 2e + 2H+

eg propan-2-ol

acidified KMnO4  or K2Cr2O7

C3H7OH 🡪 C3H6O + 2H+ + 2e

**carboxylic acid with water**

carboxylic acids + H2O ⇄ carboxylate ion + H3O+ *(weak acids so only partially dissociate)*

eg propanoic acid in water

C2H5COOH + H2O ⇄ C2H5COO- + H3O+

(propanoate ion)

**Reactions of aldehydes**

Silver mirror test

Tollens reagent is reduced by aldehydes to form a silver metal, known as the “silver mirror” test

Ag(NH3)2+ (aq) + e 🡪 Ag (s) + 2NH3 (aq)

the aldehyde is oxidised to form a carboxylic acid

RCHO(aq) + 2OH-(aq) 🡪 RCOOH(aq) + H2O(l) + 2e

eg propanal in Tollen’s

CH3CH2CHO + Ag+ → CH3COOH + Ag

(OR half equations)

Fehlings and Benedicts Solutions

the blue aqueous copper ions are reduced by aldehydes to form a red insoluble solid

2Cu2+ (aq) + 2OH-(aq) + 2e 🡪 Cu2O(s) + H2O(l)

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