

M1.1-chloropropane no visible change
Accept 'small amount of precipitate' or 'precipitate forms slowly'.

1

ethanoyl chloride white precipitate
Accept 'large amount of precipitate' or 'precipitate forms immediately'.

1

[2]

M2.(a) **For 2 marks at least one correct reference either to M_r or value to 5 decimal places required**

QoL (associated with the bold statement here)

M1 Compounds 1 and 3 (butanal and butanone) have the same M_r (to 5dp) because either

It may be possible to award 2 marks if there is a clear statement about oxygen having a different precise A_r in the context of the comparison

- they contain the same number of atoms of the same / each element
- are both C_4H_8O
- have the same molecular formula
NB The word "similar" does not mean "the same"
- contain the same number of C, H and O atoms

M2 Compound 2 (pentane) has a different M_r (to 5dp) because either

- it has different numbers of atoms of different elements
- is C_5H_{12} / only contains C and H
- different molecular formula
- does not contain oxygen (atom) / C=O

2

(b) **With Tollens' (reagent)**

M1 silver mirror

OR black solid/precipitate

(NOT silver (mirror) precipitate)

M2 (stays) colourless

OR no change / no reaction

OR no silver mirror

With Fehling's (solution)

M1 Red solid/precipitate

(Credit orange or brown solid)

M2 (stays) blue

OR no change / no reaction

OR no red solid

OR no (red) precipitate

N.B No mark is awarded for the reagent

If no reagent given allow 1 mark for a consistent statement of M1 and M2

For M2, ignore "nothing (happens)"

And ignore "no observation"

2

[4]

M3.Test

bromine (water) / iodine

Accept 'Br₂' or 'bromine in a named solvent'.

Do not accept 'Br'

Use of UV light, CE (lose next mark as well)

1

Observation orange / yellow / (red-)brown to colourless

Must have correct reagent to score this mark.

For I₂, allow red-brown / purple to colourless.

1

[2]

M4.(a) M1 concentrated sulfuric acid OR c(onc) H₂SO₄
If no reagent or incorrect reagent in M1, CE= 0 and no marks for M2 or M3

M2 (cream solid) turns orange
OR orange / red / brown fumes / gas / vapour
If dilute sulfuric acid OR "aq" (alone) CE=0

M3 (yellow solid) turns black
OR purple fumes / gas / vapour
OR correct reference to H₂S observation (eg bad egg smell)
If H₂SO₄ / sulfuric acid given but not stated whether dilute or concentrated, penalise M1 and mark on for M2 and M3
If incorrect formula for the acid, penalise M1 but mark M2 and M3

OR as an alternative

M1 concentrated ammonia OR c(onc) NH₃
If NH₃ / ammonia / aq ammonia given, but not stated as concentrated OR if dilute ammonia given, penalise M1 but mark on for M2 and M3
Ignore "partially" and ignore "clear" in M2

M2 (cream solid) dissolves / solution formed

M3 precipitate remains / does not dissolve / insoluble
OR no reaction / no change / (yellow solid) turns to white solid
If incorrect formula for ammonia, penalise M1 but mark M2 and M3
In M3 for ammonia.
ignore "nothing (happens)".
ignore "no observation".

3

(b) M1 AgNO₃ **OR** silver nitrate **OR** any soluble silver salt
If no reagent OR incorrect reagent in M1, CE= 0 and no marks for M2 OR M3

M2 white precipitate or white solid / white suspension
An insoluble silver salt OR Tollens' OR Ag OR ammoniacal silver nitrate or HCl / AgNO₃ CE= 0 for the clip.

M3 remains colourless **OR** no reaction **OR** no (observed) change **OR** no precipitate

For M1
Credit acidified (OR HNO₃) silver nitrate for M1 and mark on.
If silver ions or incorrect formula for silver nitrate, penalise

M1 but mark M2 and M3

Credit alternative test for nitrate ions

For M2

Ignore "cloudy solution" **OR** "suspension".

For M3

Ignore "nothing (happens)".

Ignore "no observation".

Ignore "clear".

Ignore "dissolves".

3

- (c) M1 Br₂ **OR** bromine (water) **OR** bromine (in CCl₄ / organic solvent)

If no reagent or incorrect reagent in M1, CE= 0 and no marks for M2 or M3

Either Order

M2 (stays) Orange / red / yellow / brown / the same

OR no reaction **OR** no (observed) change

OR reference to colour going to cyclohexane layer

No credit for combustion observations; CE=0

For M2 in every case.

Ignore "nothing (happens)".

Ignore "no observation".

Ignore "clear".

M3 decolourised / goes colourless / loses its colour

With bromine (water)

For M1, it must be a whole reagent and / or correct formula.

If oxidation state given in name, it must be correct.

For M1 penalise incorrect formula, but mark M2 and M3

OR as an alternative

Use KMnO₄/H₂SO₄

M1 acidified potassium manganate(VII) or KMnO₄/H₂SO₄

OR KMnO₄/ H⁺ **OR** acidified KMnO₄

M2 (stays) purple or no reaction or no (observed) change

With potassium manganate(VII)

For M1

M3 purple to colourless solution **OR** goes colourless

If "manganate" or "manganate(IV)" or incorrect formula or no acid, penalise M1 but mark M2 and M3

Credit alternative test using **iodine** (for M1)

M2 (brown) to purple or accept no change, M3 colourless

Credit alternative test using concentrated H₂ SO₄

M2 no change, M3 brown

Credit alkaline / neutral KMnO₄ for possible full marks but M3 gives brown precipitate or solution goes green.

3

- (d) M1 Tollens' (reagent) OR ammoniacal silver nitrate OR a description of making Tollens'
(Ignore either AgNO_3 or $[\text{Ag}(\text{NH}_3)_2]^+$ or "the silver mirror test" on their own, but mark M2 and M3)

M2 silver mirror

OR black solid / precipitate (Ignore silver precipitate)

M3 (stays) colourless or no reaction or no (observed) change

If no reagent or incorrect reagent in M1, CE= 0 and no marks for M2 or M3

For M3 in every case

Ignore "nothing (happens)".

Ignore "no observation".

Alternative using Fehling's (solution)

M1 Fehling's (solution) or Benedict's solution

(Ignore $\text{Cu}^{2+}(\text{aq})$ or CuSO_4 on their own, but mark M2 and M3)

M2 Red solid / precipitate (Credit Orange or brown solid)

M3 (stays) blue or no reaction or no (observed) change

With potassium dichromate(VI)

For M1

If "dichromate" or "(potassium) dichromate(IV)" or incorrect formula or no acid, penalise M1 but mark M2 and M3

Alternative using $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4$

M1 acidified potassium dichromate or $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4$

OR $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+$ **OR** acidified $\text{K}_2\text{Cr}_2\text{O}_7$

M2 (Orange to) green solution OR goes green

M3 (stays) Orange or no reaction or no (observed) change

For M3

Ignore dichromate described as "yellow" or "red".

With potassium manganate(VII)

For M1

If "manganate" or "(potassium manganate(IV)" or incorrect formula or no acid, penalise M1 but mark M2 and M3

Alternative using $\text{KMnO}_4/\text{H}_2\text{SO}_4$

M1 acidified potassium manganate(VII) or $\text{KMnO}_4/\text{H}_2\text{SO}_4$

OR KMnO_4/H^+ **OR** acidified KMnO_4

M2 purple to colourless solution OR goes colourless

M3 (stays) purple or no reaction or no (observed) change

Credit alkaline / neutral KMnO_4 for possible full marks but M2 gives brown precipitate or solution goes green.

3

[12]

M5.(a) If 2 stage test for one compound, award no marks for that compound, eg no

mark for ROH or RX to alkene then Br₂ test. If reagent is wrong or missing, no mark for that test; if wrong but close/incomplete, lose reagent mark but can award for correct observation. In each test, penalise each example of wrong chemistry, eg AgClr₂

propan-1-ol

acidifiedpotassiumdichromate

sodium

Named acid + conc H₂SO₄

named acyl chloride

PCl₅

M1

1

(orange) turns green

effervescence

Sweet smell

Sweet smell /misty fumes

Misty fumes

M2

1

propanal

add Tollens or Fehlings / Benedicts

acidifiedpotassiumdichromate

Bradys or 2,4-dnph

if dichromate used for alcohol cannot be used for aldehyde

M3

1

Tollens: silver mirror or Fehlings/ Benedicts: red ppt

(orange) turns green

Yellow or orange ppt

M4

1

propanoic acid

Named carbonate/ hydrogencarbonate

water and UI (paper)

Named alcohol + conc H_2SO_4

sodium or magnesium

PCl_5

if sodium used for alcohol cannot be used for acid

M5

1

effervescence

orange/red

Sweet smell

effervescence

Misty fumes

if PCl_5 used for alcohol cannot be used for acid

M6

1

1-chloro propane

NaOH then acidified AgNO_3

AgNO_3

If acidification missed after NaOH , no mark here but allow mark for observation

M7

1

white ppt

white ppt

M8
1

(b) oxidation (of alcohol by oxygen in air)

M1
1

absorption at 1680 -1750 (due to C=O)
Must refer to the spectrum

M2
1

comparison of polarity of molecules or correct imf statement:propanone is less polar
OR propan-2-ol is more polarOR propanone has dipole-dipole forcesOR propan-2-ol
has hydrogen bonding

M3
1

about attraction to stationary phase or solubility in moving phasePropan-2-ol has
greater affinity for stationary phase or vice versaOR propanone is more soluble in
solvent/moving phase or vice versa

M4
1

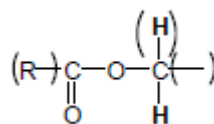
[12]

M6.(a) M1 Ester 1

If Ester 2, can score M3 only.

1

M2 peak at $\delta = 4.1$ due to



*When marking M2 and M3, check any annotation of
structures in the stem at the top of the page.*

1

- M3 ($\delta = 4.1$ peak is) quartet as adjacent / next to / attached to CH₃ 1
- M4 Other spectrum quartet at $\delta = 2.1-2.6$ (or value in this range) 1
- (b) M1 Quaternary (alkyl) ammonium salt / bromide 1
- M2 CH₃Br or bromomethane
Penalise contradictory formula and name. 1
- M3 Excess (CH₃Br or bromomethane)
Mention of acid eg H₂SO₄ OR alkali eg NaOH loses both M2 and M3. 1
- M4 Nucleophilic substitution
Can only score M3 if reagent correct.
Ignore alcohol or ethanol (conditions) or Temp. 1

(c)

	Bromine (penalise Br but mark on)	Acidified KMnO ₄ (Penalise missing acid but mark on)
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Wrong reagent = no marks.

If bromine colour stated it must be red, yellow, orange, brown or any combination, penalise wrong starting colour.

1

Benzene	no reaction / colour remains / no (visible) change	no reaction / colour remains / no (visible) change
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*Ignore 'clear', 'nothing'.
Allow colour fades slowly.
Allow 'nvc' for no visible change.*

1

cyclohexene	(Bromine) decolourised	(Acidified KMnO_4) decolourised
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1

[11]

M7. Identification of acid by suitable method eg named indicator, named carbonate, specified reactive metal

Ignore any reference to the smell of the ester.

1

with expected results

Do not allow the use of any instrumental method eg i.r. or n.m.r.; must be a chemical test.

1

Identification of alcohol by suitable method eg oxidation by acidified potassium dichromate(VI)

1

with expected results

1

[4]