

M1.B

[1]

M2.D

[1]

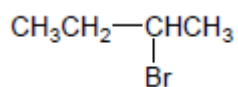
M3.Step 1

HBr

In any step, if wrong reagent or extra wrong reagent, can only score mechanism mark, but if AlCl₃ added in Step 3, lose M7 but can score M8 & M9

M1

1



M2

1

electrophilic addition

If 1-bromobutane structure given for M2 then 1-aminobutane structure for M5, penalise M2 and M5 but mark M8 consequentially

M3

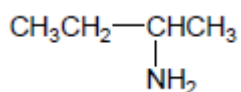
1

Step 2

NH₃

M4

1



If 1-bromobutane structure given for M2 then 2-aminobutane structure for M5, penalise M2, M5 and M8

M5
1

nucleophilic substitution

If 2-bromobutane structure given for M2 then 1-aminobutane structure, penalise M5 and M8

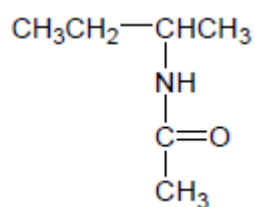
M6
1

Step 3

CH₃COCl or (CH₃CO)₂O

Allow C₂H₅ for CH₃CH₂

M7
1



M8
1

(nucleophilic) addition-elimination

Not allow (electrophilic) addition-elimination

M9
1

[9]

M4.(a) Hydrogen bond(ing)

Allow H bonding.

Penalise mention of any other type of bond.

1

(b) (i) Ammonia is a nucleophile

Allow ammonia has a lone pair.

1

Benzene repels nucleophiles

Allow (benzene) attracts / reacts with electrophiles.

OR benzene repels electron rich species or lone pairs.

OR C–Cl bond is short / strong / weakly polar.

1

(ii) H_2 / Ni **OR** H_2 / Pt **OR** Sn / HCl **OR** Fe / HCl

Ignore dil / conc of HCl.

Ignore the term 'catalyst'.

Allow H_2SO_4 with Sn and Fe but not conc.

Ignore NaOH following correct answer.

Not $NaBH_4$ nor $LiAlH_4$.

1

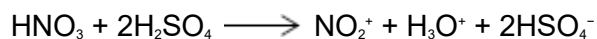
(iii) conc HNO_3

conc H_2SO_4

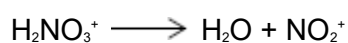
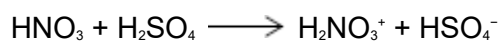
If either or both conc missed can score 1 for both acids.

1

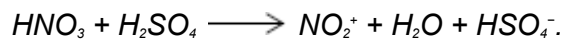
1



OR using two equations



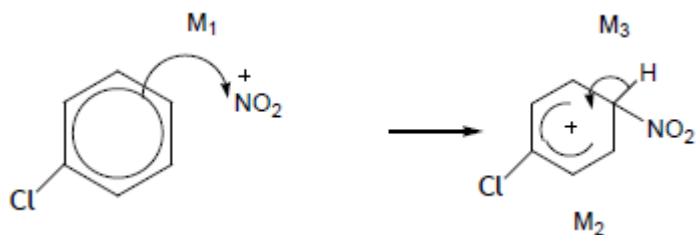
Allow 1:1 equation.



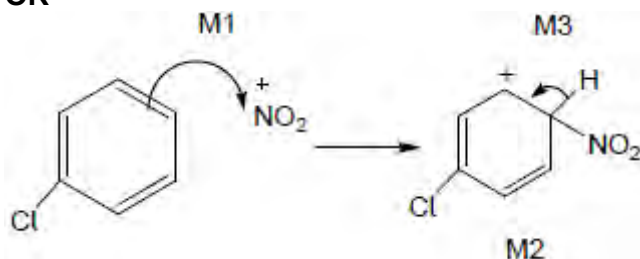
1

(iv) Electrophilic substitution

1



OR



- Ignore position or absence of Cl in M1 but must be in correct position for M2.
- M1 arrow from within hexagon to N or + on N.
- Allow NO_2^+ in mechanism.
- Bond to NO_2 must be to N for structure mark M2.
- Gap in horseshoe must be centered around correct carbon (C1).
- + in intermediate not too close to C1 (allow on or "below" a line from C2 to C6).
- M3 arrow into hexagon unless Kekule.
- Allow M3 arrow independent of M2 structure.
- Ignore base removing H in M3.
- + on H in intermediate loses M2 not M3.

3

[11]

M5. (a) (i) Single reagent

If wrong single reagent, CE = zero

Incomplete single reagent (e.g. carbonate) or wrong formula (e.g. NaCO_3) loses reagent mark, but mark on

For "no reaction" allow "nothing"

Different reagents

If different tests on E and F; both reagents and any follow on chemistry must be correct for first (reagent) mark.

Reagent must react: i.e. not allow Tollens on G (ketone) – no reaction.

Second and third marks are for correct observations.

i.e. for different tests on E and F, if one reagent is correct and one wrong, can score max 1 for correct observation with correct reagent.

PCl₅ PCl₃

SOCl₂

1

E ester

Na₂CO₃/NaHCO₃ named carbonate

metal e.g. Mg

no reaction

no reaction

named indicator

no effect

No reaction

1

F acid

Na₂CO₃/NaHCO₃ named carbonate

Effervescence or CO₂

metal e.g. Mg

Effervescence or H₂

named indicator

acid colour

fumes

1

(ii) Single reagent

If wrong single reagent, CE = zero

Incomplete single reagent (e.g. carbonate) or wrong formula (e.g. NaCO₃) loses reagent mark, but mark on

For “no reaction” allow “nothing”

Different reagents

If different tests on E and F; **both** reagents and any follow on chemistry must be correct for first (reagent) mark.

Reagent must react: i.e. not allow Tollens on

G (ketone) – no reaction.
Second and third marks are for correct observations.

1

i.e. for different tests on E and F, if one reagent is correct and one wrong, can score max 1 for correct observation with correct reagent.

G ketone

AgNO₃

no reaction

Na₂CO₃/NaHCO₃ named carbonate

water

no reaction

named indicator

no effect

Named alcohol

no reaction

Named amine or ammonia

no reaction

1

H Acyl chloride

AgNO₃

(white) ppt

Na₂CO₃/NaHCO₃ named carbonate

Effervescence or CO₂ or fumes or exothermic

water

fumes

named indicator

acid colour

Named alcohol

Smell or fumes

Named amine or ammonia

fumes

1

Allow iodoform test or Brady's reagent (2,4,dnph) test (both positive for G)

(iii) Single reagent

If wrong single reagent, CE = zero

Incomplete single reagent (e.g. carbonate) or wrong formula (e.g. NaCO_3) loses reagent mark, but mark on

For "no reaction" allow "nothing"

Different reagents

If different tests on E and F; **both** reagents and any follow on chemistry must be correct for first (reagent) mark.

Reagent must react: i.e. not allow Tollens on G (ketone) – no reaction.

Second and third marks are for correct observations.

i.e. for different tests on E and F, if one reagent is correct and one wrong, can score max 1 for correct observation with correct reagent.

1

J Primary alcohol

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

goes green

$\text{KMnO}_4 / \text{H}^+$

decolourised / goes brown

Lucas test (ZnCl_2/HCl)

Penalise missing H^+ but mark on

1

K Tertiary alcohol

$K_2Cr_2O_7 / H^+$

No reaction

$KMnO_4 / H^+$

no reaction

Lucas test ($ZnCl_2/HCl$)

Rapid cloudiness

1

If uses subsequent tests e.g. Tollens/Fehlings, test must be on product of oxidation

(b) (i) 3,3-dimethylbutan-1-ol

Allow 3,3-dimethyl-1-butanol

1

4

1

Triplet on three

1

(ii) 2-methylpentan-2-ol

Allow 2-methyl-2-pentanol

1

5

1

Singlet or one or no splitting

1

[15]

M6. Acidified potassium dichromate(VI)

1

Turns green with propan-2-ol and propanal

1

No reaction with hexene and 1-bromopropane

1

Tollens with propan-2-ol and propanal

only propanal gives silver mirror	1
Bromine water	1
Decolourised by hexane	1
No reaction with 1-bromopropane	1
Warm NaOH followed by acidified AgNO ₃	1
White ppt with 1-bromopropane	1

[10]

M7.In each section

- If wrong or no reagent given, no marks for any observations;
- Penalise incomplete reagent or incorrect formula – but mark observations
- Mark each observation independently
- Allow *no reaction* for no change / no observable reaction in all three parts, but not *none* or *nothing*
- Q says **one test**. If two tests are given, score zero

(a)

	K ₂ Cr ₂ O ₇ / H ⁺	KMnO ₄ / H ⁺	Lucas test (ZnCl ₂ / HCl)
--	--	------------------------------------	---

1

R Primary alcohol	(Orange) goes green Penalise wrong starting colour	(purple) goes colourless / decolourises allow goes brown	No cloudiness
-----------------------------	--	--	---------------

1

S Tertiary alcohol	no change / no observable reaction	no change / no observable reaction	Rapid cloudiness
------------------------------	------------------------------------	------------------------------------	------------------

1

Allow acidified potassium manganate and acidified potassium dichromate without oxidation numbers

(b)

	Na ₂ CO ₃ / NaHCO ₃ named carbonate	metal eg Mg	named indicator
--	---	-------------	-----------------

*PCl₅ PCl₃
SOCl₂
Named alcohol + HCl / H₂SO₄*

1

T ester	no change / no observable reaction	no change / no observable reaction	no effect
-------------------	------------------------------------	------------------------------------	-----------

no change / no observable reaction

1

U Acid	Effervescence or (CO ₂) gas formed	Effervescence or (H ₂) gas formed	acid colour
------------------	--	---	-------------

*Fumes / (HCl) gas formed
Sweet smell*

1

(c)

	Fehling's / Benedict's	Tollens' / $[\text{Ag}(\text{NH}_3)_2]^+$	$\text{K}_2\text{Cr}_2\text{O}_7/$ H^+
--	---------------------------	---	--

I₂ / NaOH

1

V Ketone	no change / no observable reaction	no change / no observable reaction	no change / no observable reaction
--------------------	--	---	--

Yellow ppt

1

W aldehyde	Red ppt	Silver mirror	(Orange) goes green Penalise wrong starting colour
----------------------	---------	---------------	--

no change / no observable reaction

1
[9]