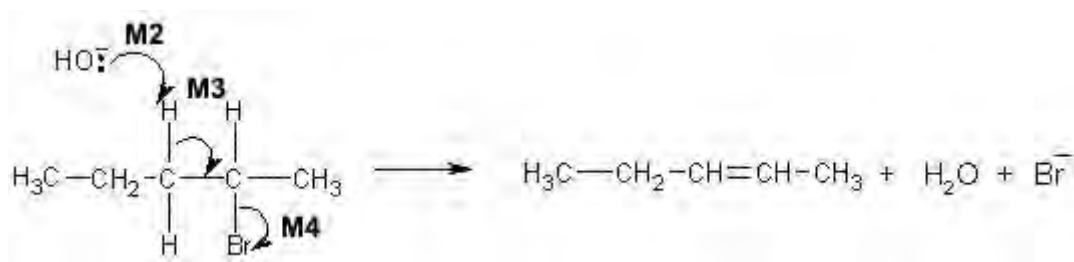


**M1.** (a) (i) **M1** Elimination



**M2** must show an arrow from the lone pair on the oxygen of a negatively charged hydroxide ion to a correct H atom

**M3** must show an arrow from a C-H bond adjacent to the C-Br bond towards the appropriate C-C bond. Only award if a reasonable attempt has been made at the attack on the H atom of the appropriate adjacent C-H

**M4** is independent provided it is from their original molecule

Award full marks for an E1 mechanism in which **M3** is on the correct carbocation.

**N.B. These are double-headed arrows**

*For M1, accept "Base elimination" but no other prefix.*

*Penalise **M2** if covalent KOH*

*Penalise **M4** for formal charge on C of C-Br or incorrect partial charges on C-Br*

*Ignore other partial charges*

*Penalise once only in any part of the mechanism for a line and two dots to show a bond.*

*Max any 2 of 3 marks for the mechanism for wrong reactant (or wrong product if shown).*

*Accept the correct use of "sticks" for the molecule except for the C-H being attacked*

4

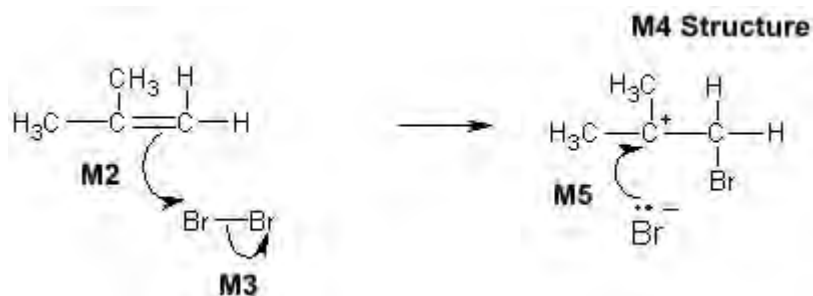
(ii) **Structure for pent-1-ene**



Penalise C<sub>3</sub>H<sub>7</sub>,  
Accept correct "sticks"

1

(b) **M1** Electrophilic addition



**M2** must show an arrow from the double bond towards the Br atom of the Br-Br molecule

**M3** must show the breaking of the Br-Br bond.

**M4** is for the structure of the tertiary carbocation with Br on the correct carbon atom.

**M5** must show an arrow from the lone pair of electrons on the negatively charged bromide ion towards the positively charged carbon atom.

**N.B. These are double-headed arrows**

*For M1, both words required.*

**For the mechanism**

**M2** Ignore partial negative charge on the double bond.

**M3** Penalise partial charges on Br-Br bond if wrong way and penalise formal charges

*Penalise once only in any part of the mechanism for a line and two dots to show a bond*

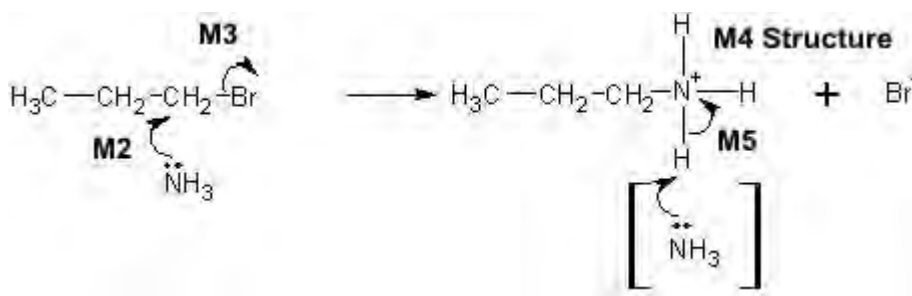
**Max any 3 of 4 marks for the mechanism** for wrong organic reactant or wrong organic product (if shown) or primary carbocation.

*If HBr is used, max 2 marks for their mechanism*

*Accept the correct use of "sticks"*

5

(c) **M1** Nucleophilic substitution



**M2** must show an arrow from the lone pair of electrons on the nitrogen atom of an ammonia molecule to the C atom.

**M3** must show the movement of a pair of electrons from the  $\text{C}-\text{Br}$  bond to the Br atom. **M3** is independent provided it is from their original molecule

**M4** is for the structure of the alkylammonium ion, which could be a condensed formula. A positive charge must be shown on/or close to, the N atom.

**M5** is for an arrow from the  $\text{N}-\text{H}$  bond to the N atom.

Award full marks for an  $\text{S}_{\text{N}}1$  mechanism in which **M2** is the attack of the ammonia on the intermediate carbocation.

**N.B. These are double-headed arrows**

*For **M1**, both words required.*

*Penalise **M2** if  $\text{NH}_3$  is negatively charged.*

*Penalise **M3** for formal charge on C or incorrect partial charges*

*The second mole of ammonia is not essential for **M5**; therefore ignore any species here.*

*Penalise once only for a line and two dots to show a bond.*

*Max any 3 of 4 marks **for the mechanism** for wrong organic reactant (or wrong organic product if shown)*

*Accept the correct use of "sticks"*

5

[15]

- M2.(a)** (i) Green  
*Ignore shades of green.* 1
- (ii) Excess acidified potassium dichromate(VI) 1
- Reflux (for some time) 1
- In the diagram credit should be given for
- a vertical condenser  
*Lose M3 and M4 for a distillation apparatus.* 1
  - an apparatus which would clearly work  
*Do not allow this mark for a flask drawn on its own.  
Penalise diagrams where the apparatus is sealed.* 1
- (iii) Distillation 1
- Immediately (the reagents are mixed) 1
- (b) Keep away from naked flames  
*Allow heat with water-bath or heating mantle.  
If a list is given ignore eye protection, otherwise lose this mark.* 1
- (c) (i) Tollens' or Fehling's reagents

*Incorrect reagent(s) loses **both** marks.  
Accept mis-spellings if meaning is clear.*

1

Silver mirror / red ppt. formed  
*Accept 'blue to red' but not 'red' alone.*

1

- (ii) Sodium carbonate (solution) / Group II metal  
*Allow indicator solutions with appropriate colours.  
Accept any named carbonate or hydrogen carbonate.*

1

Effervescence / evolves a gas  
*Accept 'fizzes'.*

1

- (d) Propanoic acid  
*If this mark is lost allow one mark if there is reference to  
stronger intermolecular forces in the named compound.  
Lose M1 and M3.*

1

Contains hydrogen bonding

1

Some comparison with other compounds explaining that the intermolecular forces are stronger in propanoic acid

1

[15]

- M3.** (a) **M1** Cl<sub>2</sub> (provides the pale green colour)  
*M1 requires the formula*

**M2** NaOH reacts with the acid(s)/the HCl/the HClO/H<sup>+</sup>  
*Ignore "reacts with the products"*

*Ignore "reacts with chloride ion"*

*Ignore "reacts with chlorine"*

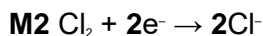
**M3 requires a correct answer in M2**

Equilibrium shifts (from left ) to right **OR** write

3

- (b) **M1** A reducing agent is an electron donor OR (readily) loses/ gives away electrons

*Penalise M1 if "electron pair donor"*



For M3 and M4, iodide ions are stronger reducing agents than chloride ions, because

*Ignore state symbols in M2 Accept no charge on the electron  
Credit the electrons being lost on the RHS*

**M3 Relative size of ions/atomic radius/ionic radius**

Iodide ions are larger/have more (electron) shells/levels than chloride ions (or converse for chloride ion) OR electron(s) to be lost/outer shell/level is further from the nucleus (or converse for chloride ion) OR greater/more shielding

*For M3 insist on "iodide ions"*

**M4 Strength of attraction for electron(s) being lost**

Electron(s) lost from an iodide ion is less strongly held by the nucleus compared with that lost from a chloride ion

*M3 and M4 must be comparative and should refer to electrons.*

(assume argument refers to iodide ions but accept converse argument for chloride ions)

4

- (c) **M1**  $2\text{Cl}_2 + 2\text{H}_2\text{O} \rightarrow 4\text{HCl} + \text{O}_2$   
*Or multiples*

**M2** silver chloride ONLY

*M2 requires a name*

**M3** The solid/precipitate would dissolve  
**OR** is soluble  
**OR** (It) forms a (colourless) solution

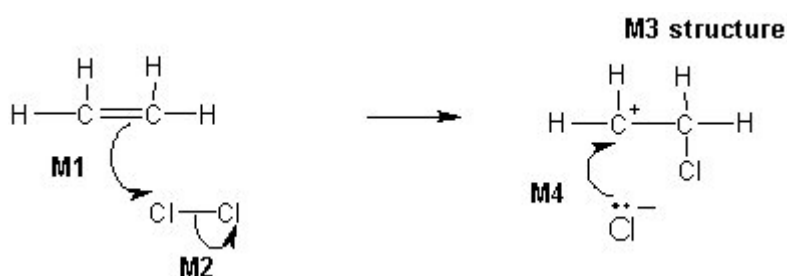
Mark M3 independently  
Ignore "disappears"

3

(d) Electrophilic addition

1

Mechanism:



**M2** Penalise partial charges if wrong way around, otherwise ignore

Max 3 marks **for the mechanism** for wrong reactant and/or "sticks" (wrong reactant could be HBr or Br<sub>2</sub> or incorrect alkene)

**M1** must show an arrow from the double bond towards one of the Cl atoms on a Cl-Cl molecule.

**M2** must show the breaking of the Cl-Cl bond.

**M3** is for the structure of the carbocation with Cl substituent.

**M4** must show an arrow from the lone pair of electrons on a negatively charged chloride ion towards the positively charged carbon atom.

4

[15]

**M4.(a)** Hydrochloric acid = **C**

1

Barium chloride = **A**

1

- (b) Barium sulfate is insoluble 1
- $$\text{CuSO}_4 + \text{BaCl}_2 \rightarrow \text{BaSO}_4 + \text{CuCl}_2$$
  
*Accept multiples.*  
*Accept ionic equation.*  
*Do not penalise lack of state symbols, but if used they must be correct.* 1
- (c) CO<sub>2</sub> / Carbon dioxide 1
- (d) Reagent 1 silver nitrate (solution)  
*Ignore lack of reference to acidifying prior to addition of silver nitrate solution.* 1
- Observation 1 White precipitate 1
- Reagent 2 (dilute) ammonia solution / aqueous ammonia  
*Do not accept addition of **ammonia** only.* 1
- Observation 2 (Colourless) solution  
*Allow ppt dissolves.*  
*Do not allow 'goes colourless' or 'goes clear'.*  
*Chlorine and no visible change or solution does not become orange scores M3 and M4.* 1
- (e) Gloves / wash hands after use  
*Ignore 'eye protection'.*  
*Do not accept 'do not ingest the chemicals', 'wipe up spillages', 'use a fume cupboard', 'wear a lab coat' (list principle).* 1



**M5.(a)** To ensure that other (an)ions do not interfere

*Accept 'to prevent other salts precipitating'.*

*Accept 'to remove carbonate / hydroxide (ions)'.*

1

(b) Concentrated (ammonia)

*'Precipitate partially soluble in dilute ammonia' scores both marks.*

1

Precipitate soluble / dissolves

1

[3]