

Name of the Student: \_\_\_\_\_

Max. Marks : 21 Marks

Time : 21 Minutes

Mark Schemes

Q1.

- (a) Electron pair donor

**OR**

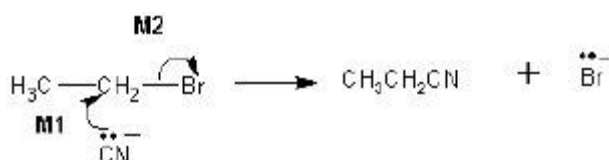
Species which uses a pair of electrons  
to form a co-ordinate / covalent bond.

**QoL**

Credit "lone pair" as alternative wording

1

- (b)



**M1** Must show an arrow from the lone pair of electrons  
on the carbon atom of the negatively charged  
cyanide ion to the central C atom.

**M2** Must show the movement of a pair of electrons from  
the C-Br bond to the Br atom. Mark M2 independently.

Award full marks for an S<sub>N</sub>1 mechanism in which M1 is the  
attack of the cyanide ion on the intermediate carbocation.

*Penalise M1 if covalent KCN is used*

*Penalise M2 for formal charge on C or incorrect partial charges*

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

*Max 1 mark for the wrong reactant or "sticks"*

2

- (c) Ethylamine / CH<sub>3</sub>CH<sub>2</sub>NH<sub>2</sub> is a nucleophile

**OR**

Ethylamine could react further

**OR**

Ethylamine could make secondary / tertiary amines

**OR**

To make reaction with ammonia more likely

**OR**

To minimise further substitution

**OR**

The idea of releasing free amine from the salt

**OR**

The idea of removing a proton from the intermediate alkylammonium ion

**OR**

The idea that ammonia acts both initially as a nucleophile and then as a base

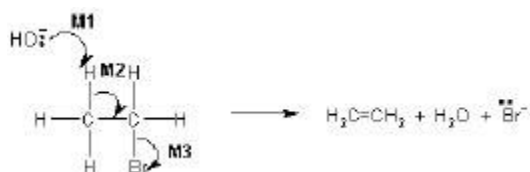
*Do not credit a simple reference to the equation or the mechanism requiring two moles of ammonia.*

1

(d) **Elimination**

*Credit "base elimination" but NOT "nucleophilic elimination"*

*No other prefix.*



1

**M1** Must show an arrow from the lone pair on oxygen of a negatively charged hydroxide ion to the correct H atom

**M2** Must show an arrow from the correct C-H bond to the C-C bond and should only be awarded if an attempt has been made at M1

**M3** Is independent.

Award full marks for an E1 mechanism in which M2 is on the correct carbocation.

Mechanism

*Penalise M1 if covalent KOH*

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

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

*Max 2 marks **for the mechanism** for wrong reactant or "sticks"*

3

[8]

Q2.

- (a) **M1** (Free-) **radical substitution**  
*Both words needed* 1
- M2**  $\text{Cl}_2 \rightarrow 2\text{Cl}\cdot$  1
- M3**  $\text{Cl}\cdot + \text{CH}_4 \rightarrow \cdot\text{CH}_3 + \text{HCl}$  1
- M4**  $\text{Cl}_2 + \cdot\text{CH}_3 \rightarrow \text{CH}_3\text{Cl} + \text{Cl}\cdot$  1
- M5**  $\text{CH}_4 + 3\text{Cl}_2 \rightarrow \text{CHCl}_3 + 3\text{HCl}$   
*Penalise the absence of a radical dot once only*  
**Ignore termination steps except, if and only if both M3 and M4 do not score, then accept for one mark**  
 $\text{Cl}\cdot + \cdot\text{CH}_3 \rightarrow \text{CH}_3\text{Cl}$  1
- (b) **M1** UV (light)/ sunlight / light / UV radiation
- M2** C–Cl or carbon-chlorine bond breakage  
**OR**  
homolysis of C–Cl  
**OR**  
equation to show a chlorine-containing organic compound forming two radicals  
*For M1 and M2, ignore use of  $\text{Cl}_2$ , but credit UV and C–Cl bond breakage if seen* 1
- M3**  $\text{Cl}\cdot + \text{O}_3 \rightarrow \text{ClO}\cdot + \text{O}_2$  1
- M4**  $\text{ClO}\cdot + \text{O}_3 \rightarrow \text{Cl}\cdot + 2\text{O}_2$   
*Ignore other equations*  
*Penalise the absence of a radical dot once only*  
*Accept radical dot anywhere on either radical.* 1
- M5** Any one from
- Combination  $2\text{O}_3 \rightarrow 3\text{O}_2$
  - Stated that  $\text{Cl}\cdot$  / chlorine atom is regenerated / not used up
  - Stated that the  $\text{Cl}\cdot$  / chlorine atom is unaffected by the process.
- For M5 accept  $\text{Cl}\cdot$  on both sides of the equation* 1
- M6** Stated that the role of the  $\text{Cl}\cdot$  / chlorine atom is to find an alternative route **OR** lower  $E_a$  / activation energy 1
- (c) **M1** Halothane contains C–Cl / Cl  
**OR**  
Desflurane does not contain C–Cl bonds / Cl

**OR**

Desflurane contains C–F / F as the only halogen

*Mark independently.*

*For M1, credit the idea that desflurane contains C–F bonds that are difficult to break OR that halothane contains C–Cl bonds which are easy to break.*

1

- M2** Desflurane / molecules that have fluorine as the only halogen, cause no damage / do not deplete / do not react with the ozone (layer)

**OR**

Halothane / chlorine-containing molecules, damage / deplete / react with the ozone (layer)

1

[13]