**Name of the Student**:_____
**Max. Marks : 23 Marks** **Time : 23 Minutes**

Mark Schemes

Q1.

(a) **M1** The (relative) tendency of an atom to attract a pair of electrons/ the electrons/ electron density in a covalent bond

**1**

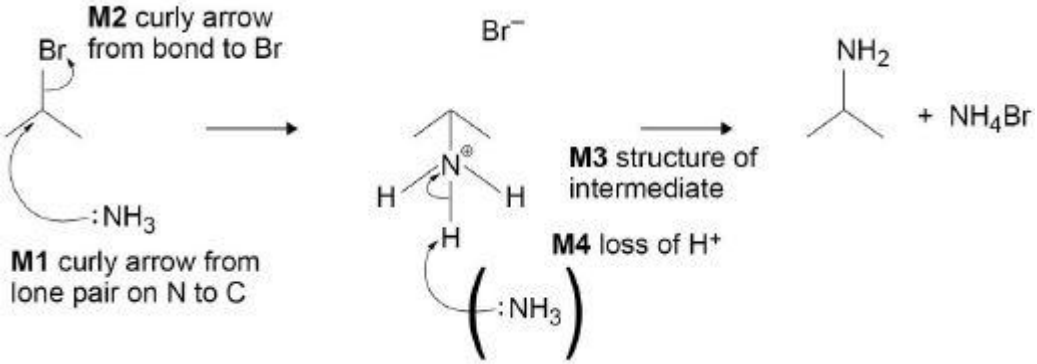
**M2** Br is more electronegative than C (or vice versa)

**1**

**M3** So Br is δ- and C is δ+

**1**

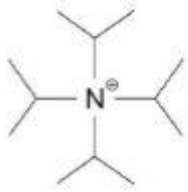
(b)




***M4*** *Penalise loss of $H^+$ using $Br^-$*
*Allow $S_n1$*

**4**

(c) **M1**




*Allow + outside square brackets*

**1**

**M2** Use: (Hair) conditioner / (Cationic) surfactant / disinfectant
*Allow fabric softener*

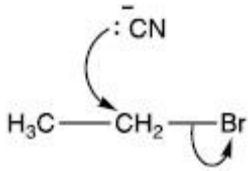
**1**

**[9]**

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Q2.

(a)




**M1** arrow from lone pair on C of $CN^-$ to the C of the $CH_2$ group

**M2** arrow from the C–Br bond to the Br

*All arrows are double-headed. Penalise one mark from the total for **2.1** if half headed arrows are used.*

*Do not penalise the "correct" use of "sticks"*

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

*Allow the minus sign to be anywhere on the $CN^-$ ion*

***M2** penalise formal charges or incorrect partial charges on C–Br bond*

*SN1: allow SN1 mechanism with **M1** for breakage of C–Br bond and **M2** for attack by $CN^-$ on correct carbocation*

***Max 1 of 2 marks** for wrong organic reactant*

*Ignore wrong organic product (if shown)*

***Extra arrows or incorrect covalent bonds:***

*Penalise the mark for breaking of C–Br bond for any extra arrows involving Br or covalent bond in KBr*

*Penalise the mark for attack by $CN^-$ for any extra arrows involving CN or covalent bond in KCN*

**2**

(b) propanenitrile

*Ignore any gaps, hyphens, commas*

*Allow propane-1-nitrile*

**1**

(c)

**M1** $\frac{55(.0)}{108.9+65.1}$ (x 100) or $\frac{55(.0)}{174(.0)}$ (x 100) or $\frac{55(.0)}{55(.0)+119(.0)}$ (x 100)

**1**

**M2** 31.6(%) (must be 3sf)

**1**

*31.6 scores 2 marks; 32 scores 1 mark*

*no ECF*

**[5]**

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Q3.

(a) $CF_2ClCF_2Cl \rightarrow \bullet CF_2CF_2Cl + \bullet Cl$

or

$C_2F_4Cl_2 \rightarrow \bullet C_2F_4Cl + \bullet Cl$

*Any correct structure or molecular formula for reactant and/or product*

*The dots can be shown anywhere around each radical*

**1**

(b) **M1** $Cl\bullet + O_3 \rightarrow ClO\bullet + O_2$

**1**

**M2** $ClO\bullet + O_3 \rightarrow Cl\bullet + 2O_2$

**1**

***M1** and **M2** could be in either order*

*Credit the dot anywhere on the radical*

*Penalise absence of dot once only*

*Individual multiples acceptable but both need to be equivalent multiples for both marks to be awarded*

*Ignore state symbols*

*(Accept alternative pair of equations for **M2** (both needed for **M2**)*

*$O_3 \rightarrow O + O_2$*

*$ClO\bullet + O \rightarrow Cl\bullet + O_2$)*

(c) Volume as a gas:

*Answers to **M4**, **M5** and **M6** should be 2sf or more*

***M1-M4** 15000 ($cm^3$) (14971) scores **M1-M4***

**M1** moles butane = $\frac{38.8}{58.0}$ (= 0.669)

***M1** may score from a value or expression within **M3***

**1**

**M2** $V = \frac{nRT}{P}$

***M2** could score from an attempt at **M3** that shows attempts at values for n, R, T and P in suitable places*

**1**

**M3** $V = \frac{0.669 \; x \; 8.31 \; x \; 272}{101000}$

**1**

**M4** ( = 0.0150 $m^3$) = 15000 ($cm^3$) (14971)

***M4** ignore additional answers following this in other units (if incorrect it will be penalised in **M6**)*

*Allow ECF in **M3** and **M4** based on incorrect moles of butane from **M1**; allow ECF in **M4** based on incorrect units in **M3***

*Allow ECF in **M3** and **M4** based on inverted expression for volume = $V = \frac{P}{nRT}$; for other incorrect expressions, allow a maximum of one mark for **M3** or **M4** for correct unit conversion for P to Pa in **M3** or volume to $cm^3$ in **M4***

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1

Volume as a liquid:

**M5** $V = \frac{38.8}{0.60}$ = 65 or 64.7 or 64.666... ($cm^3$)

***M5*** *ignore additional answers following this in other units (if incorrect it will be penalised in* ***M6****)*

*64.6 ($cm^3$) is outside range and does not score* ***M5***

*64.6 ($cm^3$) (i.e. 66.6 dot scores* ***M5****)*

1

Expansion factor

**M6** $(\frac{M4}{M5}) = (\frac{15000}{64.7}) = 232$ (allow 230 – 232)

1

***M6*** *allow ECF based on values for* ***M4*** *and* ***M5***

**[9]**

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