MARKING SCHEME- CHEMISTRY (043)
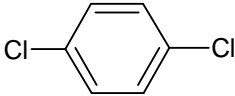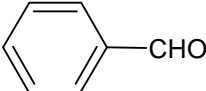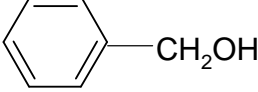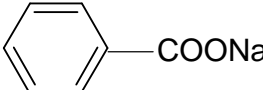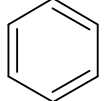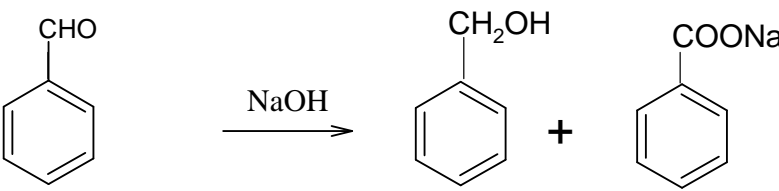
SAMPLE PAPER (CLASS - XII)

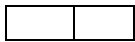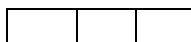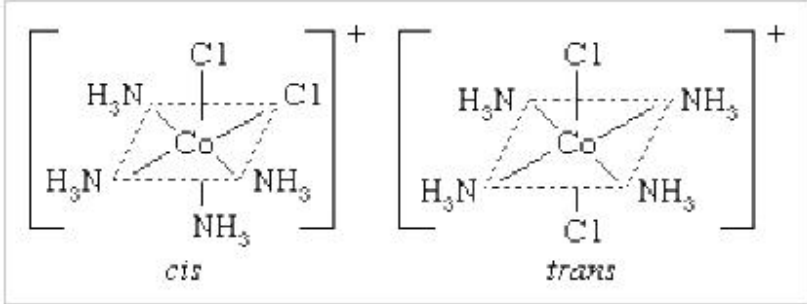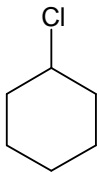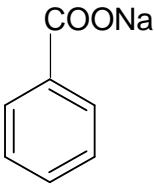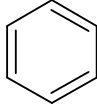| Q.No.	Value Points	Marks
1.	T1 < T2 < T3	1
2.	XeF_2	1
3.	It strengthens the bond between CO and the metal.	1
4.	The oxidation state of P in PCl_5 is +5 it cannot increase its oxidation state beyond +5 but it can decrease from +5 to +3.	1
5.	Iodobenzene	1
6.	Schottky defect	1
	It is shown by ionic substances in which the cation and anion are of almost similar sizes. / ionic substances having high coordination number.	1
7.	The plot is nearly a straight line and can be extrapolated to zero concentration(i.e. from the intercept) to find the value of $\lambda_m^0 = 150.0$ S cm^2 mol^{-1}	1
	$[\Lambda_m^c = \Lambda_m^0 - A \sqrt{c}\,]$	½
	$A = -\text{slope} = \dfrac{\Delta y}{\Delta x}$	
	$= \dfrac{150.0 - 147.0}{0.034}$	½
	$= 88.23$ S cm^2 mol^{-1}	
8.	r = 125 pm, a = ?	
	for fcc structure $r = \dfrac{a}{2\sqrt{2}}$	½
		½
	$a = 125 \times 2 \times 1.414$	
	$= 353.5$ pm	½ +

		½
9. (i)		1
(ii)		1
	OR	
(i)	$3\,Cl_2 + 6\,NaOH \rightarrow 5\,NaCl + NaClO_3 + 3\,H_2O$	1
(ii)	$2\,Fe_{3+} + SO_2 + 2\,H_2O \rightarrow 2\,Fe^{2+} + SO_4^{2-} + 4\,H^+$ (½ mark to be deducted for an unbalanced chemical equation)	1
10.	KCl is an electrolyte, it undergoes dissociation $\Delta T_f = i\,K_f\,m$ $i = \dfrac{\Delta T_f}{K_f\,m}$ $\Delta T_f = 0 - (-0.24) = 0.24^{\,0}$ Molar mass of KCl = 39 + 35.5 = 74.5 u substituting the values $i = \dfrac{\mathbf{0.24\ x\ 74.5\ x100}}{\mathbf{1.86\ x\ 0.5\ x1000}}$ i = 1.92 α is the degree of dissociation i = 1 + α α = 1.92 – 1 = 0.92 Percentage dissociation = 92 % (or any other suitable method)	½ ½ ½ ½
11. (i)	**Hydraulic washing:** **Principle involved**: differences in gravities of the ore and the gangue particles e.g.oxide ores (haematite), native ores Au, Ag (any one example)	1 ½
(ii)	**Zone refining:** **Principle involved**: the impurities are more soluble in the melt than in the solid state of the metal. e.g. germanium, silicon, boron, gallium and indium (any one example)	1 ½
12.		

(i)	A warm solution is obtained on mixing the two liquids A and B indicate that the process of mixing is exothermic. (ΔH_{mixing} = - ve). So the solution shows a **negative deviation** from the Raoult's law.		½
	P-X graph for non-ideal solution showing –ve deviation		1
	The forces of interaction between A and B molecules are more than in the A-A and B-B molecules. So **the partial vapour pressure of each component will be less and the partial vapour pressure of the solution will also be less** than that from the Raoult's law.		½

(ii)	For CH_3OH (non electrolyte) i = 0
	    $KCl \rightarrow K^+ + Cl^-$ i = 2
	    $Na_3PO_4 \rightarrow 3 Na^+ + PO_4^{3-}$ i = 4
	$CH_3OH < KCl < Na_3PO_4$
			1

13.	Nernst equation:		
	$$E_{cell} = E^0_{cell} - \frac{0.0591}{2} \log \frac{[Mg^{2+}]}{[Cu^{2+}]}$$		½
	$$E_{cell} = 2.71 - \frac{0.0591}{2} \log \frac{[10^{-3}]}{[10^{-4}]}$$		½
	E_{cell} = 2.68 V		½ + ½
	E_{cell} increases with the increase in the concentration of Cu^{2+} ions and decrease in the concentration of Mg^{2+} ions.		1
14. (i)	Decomposition of ozone into oxygen is an exothermic process (ΔH = -ve) and results in an increase in entropy(ΔS = +ve), resulting in **large negative Gibbs energy change(ΔG = -ve)**. Decomposition of ozone to oxygen is a spontaneous process.		1
(ii)	As we move down the group, the size of the central atom increases and the electronegativity decreases. therefore the bond pair of electrons lie away from the central atom, **the force of repulsion between the adjacent bond pairs decreases**. So the bond angle decreases.		1
(iii)	The bleaching action of Cl_2 is due to **the oxidation of coloured substance to colourless by nascent oxygen.**		½
	$Cl_2 + H_2O \rightarrow 2 HCl + [O]$ Nascent oxygen		½

15. (i)	Mn has the configuration $3d^5 4s^2$. Hence the configuration of Mn^{2+} in $[MnBr_4]^{2-}$ is $3d^5$. Mn^{2+}		½
	 3d 4s 4p Since it is tetrahedral in shape, the hybridization is sp^3. There are **five unpaired electrons.**		½
(ii)			(½ +½)
(iii)	$[Pt(NH_3)BrCl(NO_2)]^-$		1
16. (i)	When silver nitrate solution is added to potassium iodide solution, **a precipitate of silver iodide is formed which adsorbs iodide ions from the dispersion medium and a negatively charged colloidal solution is formed.**		1
(ii)	As the size of the gold sol particles increases, the colour of the solution changes from red to purple, then blue and finally golden because **the colour of colloidal solution depends on the wavelength of the light scattered by the dispersed particles and wavelength further depends on the size of the particles.**		1
(iii)	When oppositely charged sols are mixed in almost equal proportions, **neutralization of their charges occur and precipitation occurs.**		1
17. (i)	Undergoes S_N1 faster. **It is a secondary halide, which forms a secondary carbocation which is more stable than the primary carbocation so greater will be its ease of formation from the corresponding alkyl halide and faster will be the rate of reaction.**		½ ½
(ii)	The para-isomer		

(iii)	has the highest melting point as compared to their ortho- and meta-isomers. The para-isomer **is more symmetrical and fits into the crystal lattice better**, as a result **intermolecular forces are stronger, higher temperature required to melt the para-isomer.** $CH_2Cl_2 < CHCl_3 < CCl_4$ (increasing order of density) The density increases with the increase in the number of the halogen atoms.	½ ½ ½ ½
18.	A (C_7H_6O) $\xrightarrow{NaOH}$ B (C_7H_8O) + C (sodium salt of an acid) $\quad\quad\quad\quad\quad\quad\quad\quad\quad$ ↓ [O] $\quad\quad\quad\quad\quad\quad$ ↓ NaOH + CaO $\quad\quad\quad\quad\quad\quad\quad\quad\quad$ A $\quad\quad\quad\quad\quad\quad\quad$ D (A) undergoes disproportionation in presence of an alkali (Cannizzaro reaction) so there is no α hydrogen. (C) undergoes decarboxylation. A B C D 	½ ½ ½ ½ ½

	A B C		
	COONa $\underrightarrow{\text{NaOH + CaO}}$ C D		½

19. (a) (i)	**Chemical test**	**Methylamine** (1^0 aliphatic amine)	**Dimethylamine** (2^0 aliphatic amine)	
	Carbylamine test: To 1 ml of the organic compound add an alcoholic solution of KOH and $CHCl_3$	Gives offensive smell.	No odour obtained (no reaction)	1

(ii)	**Chemical test**	**Aniline** (1^0 aromatic amine)	**Benzylamine** (1^0 aliphatic amine)	
	Azo dye test: To 1mL of the organic compound add HNO_2 ($NaNO_2$ + dil. HCl) at 273-278 K. then add an alkaline solution of β naphathol to the solution.	A brilliant red dye is obtained	No dye obtained	1

(b)

(any other suitable test)

Four structural isomers are possible for C_3H_9N

Only primary amines react with HNO_2 to liberate nitrogen gas.

1^0 amines: $CH_3CH_2CH_2NH_2$

$$CH_3\text{-}CH\text{-}CH_3$$
$$|$$
$$NH_2$$

½

½

No reaction for 2^0 and 3^0 amines

2^0 amine: $CH_3\text{-}NH\text{-}C_2H_5$

3^0 amine:

$$CH_3\text{-}N\text{-}CH_3$$
$$|$$
$$CH_3$$

20. (a) (i)	When acid chloride is hydrogenated over catalyst, palladium on barium sulphate they are reduced to the corresponding aldehydes. This reaction is called Rosenmund reduction.	½

	  Benzoyl chloride Benzaldehyde	½
(ii)	Alkali metal salts of carboxylic acids undergo decarboxylation on electrolysis of their aqueous solutions and form hydrocarbons having twice the number of carbon atoms present in the alkyl group of the acid. This reaction is called Kolbe electrolysis reaction. $2CH_3COOK + 2H_2O \rightarrow CH_3\text{-}CH_3 + 2CO_2 + 2KOH + H_2$	½ ½
(b)	Acetaldehyde : CH_3CHO Acetone : CH_3COCH_3 Di-tert-butyl ketone : $(CH_3)_3C\text{-}CO\text{-}C(CH_3)_3$ Di-tert-butyl ketone < Acetone < Acetaldehyde	1
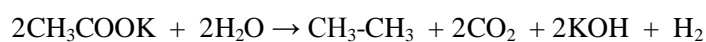
OR
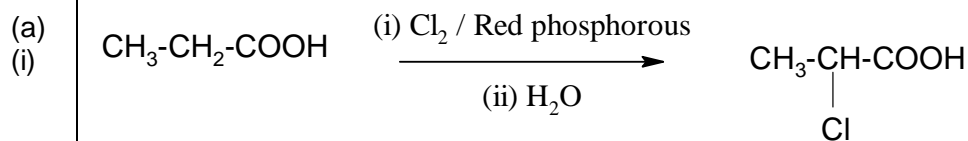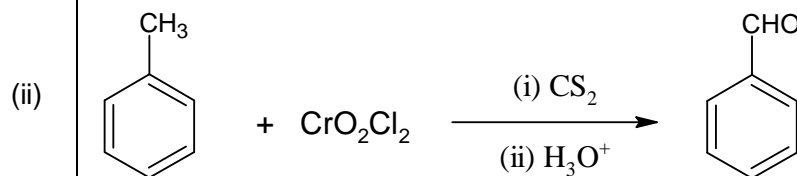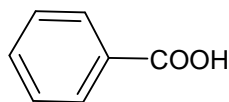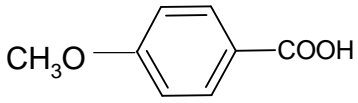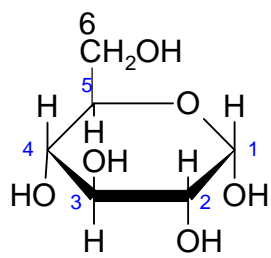
(a) (i)	$CH_3\text{-}CH_2\text{-}COOH \xrightarrow[\text{(ii) } H_2O]{\text{(i) } Cl_2 \text{ / Red phosphorous}}$ $CH_3\text{-}\underset{\underset{Cl}{\mid}}{CH}\text{-}COOH$	1
(ii)		1
(b)	Benzoic acid 4-Nitrobenzoic acid 4-Methoxybenzoic acid	

	CH_3O———⟨benzene ring⟩———$COOH$	1
	4-Methoxybenzoic acid < Benzoic acid < 4-Nitrobenzoic acid	
21. (i)	Buta-1,3diene : $CH_2=CH-CH=CH_2$ and Acrylonitrile : $CH_2=CH(CN)$ (either name or structure)	½ ½
(ii)	Neoprene is classified as an **Elastomer.** (the polymeric chain are held together by weakest intermolecular forces)	1
(iii)	**Yes** a co-polymer can be formed in addition and condensation polymerization.	1
22. (i)	**Keratin** is insoluble in water. It is a fibrous protein in which the polypeptide chains are held together by **strong intermolecular forces,** hence insoluble in water.	½ ½
(ii)	α-D-Glucopyranose 	1
(iii)	The sequence in the complimentary strand is ATGCTTGA	1
23. (a) (i)	No the chemist did not give the appropriate medicine. Cimetidine is an antihistamine, but it is an antacid and not an antiallergic drug.Antacid and antiallergic drugs work on different receptors. Therefore cimetidine cannot be used to treat nasal congestion.	½ 1 ½
(ii)	Critical thinking Social responsibility (or any other two reasons)	1 1
24. (a)	Mechanism of hydration of ethene to ethanol by acid catalysed hydration:	

The mechanism of the reaction involves the following three steps:

Step 1: Protonation of alkene to form carbocation by electrophilic attack of H_3O^+.

$$H_2O + H^+ \rightarrow H_3O^+$$

$$>C=C< \;+\; H-\overset{H}{\underset{..}{O}}{}^+-H \rightleftharpoons \;-\overset{|}{\underset{|}{C}}-\overset{+}{\underset{|}{C}}< \;+\; H_2\ddot{O}$$
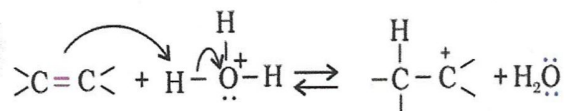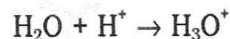
Step 2: Nucleophilic attack of water on carbocation.

$$-\overset{H}{\underset{|}{C}}-\overset{+}{\underset{|}{C}}< \;+\; H_2\ddot{O} \rightleftharpoons \;-\overset{H}{\underset{|}{C}}-\overset{H}{\underset{|}{C}}-\overset{+}{O}-H$$

Step 3: Deprotonation to form an alcohol.

$$-\overset{H}{\underset{|}{C}}-\overset{H}{\underset{|}{\overset{+}{C}}}-\overset{}{O}-H \;+\; H_2\ddot{O} \rightarrow \;-\overset{H}{\underset{|}{C}}-\overset{:OH}{\underset{|}{C}}- \;+\; H_3\overset{+}{O}$$
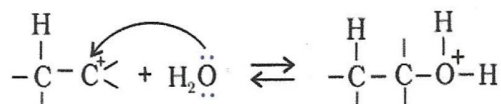
(b)
(i)

$$CH_3CH_2CH_2\text{-}OH \xrightarrow[\text{Heat}]{H_2SO_4} CH_3CH=CH_2 \xrightarrow{HBr} CH_3\text{-}CH(Br)\text{-}CH_3$$

Propanol

$\downarrow$ aq. KOH

$$CH_3\text{-}CH(OH)\text{-}CH_3$$
Propan-2-ol

(ii)

$$CH_3CH_2CH_2\text{-}OH \xrightarrow{SOCl_2} CH_3CH_2CH_2\text{-}Cl$$
$\downarrow$ NaOH
$$CH_3CH_2CH_2\text{-}ONa$$

$$CH_3CH_2CH_2\text{-}Cl + CH_3CH_2CH_2\text{-}ONa \rightarrow CH_3CH_2CH_2\text{-}O\text{-}CH_2CH_2CH_3$$

(c)

OH $\xrightarrow{\text{conc. } HNO_3}$ 2,4,6-Trinitrophenol (O_2N, NO_2, NO_2)

OR
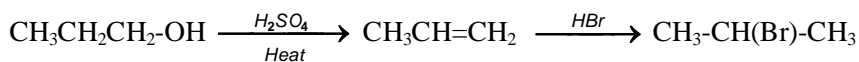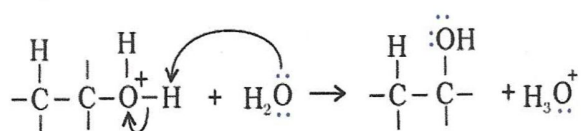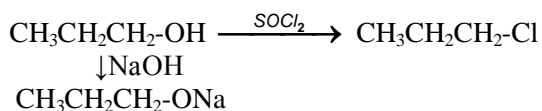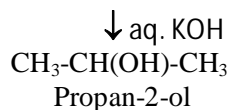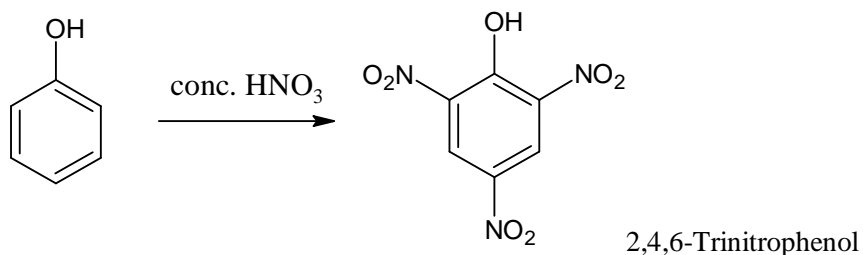
(a) The mechanism of the reaction of HI with methoxymethane involves the following steps:

Step I : protonation of ether molecule

$$CH_3 - \ddot{O} - CH_3 \;+\; H-I \rightleftharpoons CH_3 - \overset{H}{\overset{|}{\underset{..}{O}}}{}^+ - CH_3 \;+\; I^-$$

	1
	½
	½
	1
	½
	½
	½
	½

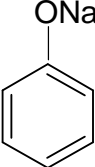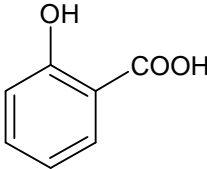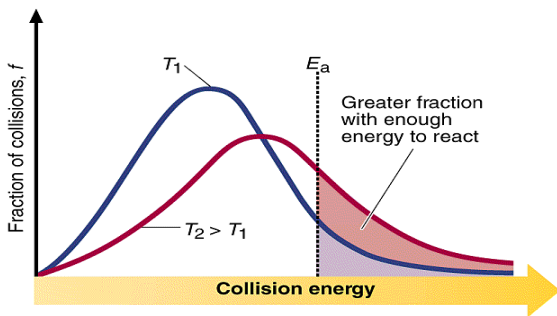|		
	Step II : nucleophilic attack by I⁻ by S_N2 mechanism	½
	$I^- + CH_3 - \overset{H}{\overset{|}{\underset{\cdot\cdot}{O}}}{}^{+}\!\!-CH_3 \longrightarrow \left[I \cdots CH_3 \cdots \overset{H}{\overset{|}{O}}{}^{+} \cdots CH_3 \right]$	½
	$CH_3 - I + CH_3 - OH$ Iodomethane methanol	
	Step III : when HI is in excess and the reaction is carried out at high temperature, methanol formed in the second step reacts with another molecule of HI and is converted to methyl iodide.	
	$CH_3 - \overset{\cdot\cdot}{\underset{\cdot\cdot}{O}} - H + H - I \rightleftharpoons CH_3 - \overset{H}{\overset{|}{\underset{\cdot\cdot}{O}}}{}^{+}H + I^-$	1
	$I^- + CH_3 - \overset{+}{O}H_2 \longrightarrow CH_3 - I + H_2O$ Methyl iodide	
(b) (i)	**A** ONa attached to benzene ring **B** OH and COOH attached to benzene ring	½ + ½
(ii)	A : CH_3CHO B : $CH_3\text{-}CH(OH)\text{-}CH_3$	½ ½
(c)	$\underset{\text{}}{C_6H_5OC_2H_5} \xrightarrow[\text{conc. } H_2SO_4]{\text{conc. } HNO_3} O_2N\text{-}C_6H_4\text{-}OC_2H_5$ 1- Ethoxy-4-nitrobenzene	½ ½
25. (a)	A : MnO_2 B : K_2MnO_4 C : $KMnO_4$	½ ½ ½

	$2\ KMnO_4 \xrightarrow{\Delta} K_2MnO_4\ +\ MnO_2\ +O_2$	½
(b) (i)	Mn^{3+} and Co^{3+} are the strongest oxidizing agents from the data given.	½ +½
(ii)	Copper (I) compounds are unstable in aqueous solution and undergo disproportionation $2\ Cu^+ \rightarrow Cu^{2+}\ +\ Cu$ Cu^{2+} (aq) is more stable than Cu^+ because it has high negative $\Delta_{hydr}H^0$ as compared to $Cu^{+.}$	½ ½
(iii)	The highest oxidation state of a metal is exhibited in its oxide **as oxygen has the ability to form multiple bonds to metal atoms.**	1

<center>**OR**</center>

(a) (i)	$2\ Cu^{2+}\ +\ 4I^-\ \rightarrow\ Cu_2I_2\ (s)\ +\ I_2$	1
(ii)	$Cr_2O_7^{2-}\ +\ 14\ H^+\ +\ 6\ Fe^{2+}\ \rightarrow\ 2\ Cr^{3+}\ +\ 6\ Fe^{3+}\ 7\ H_2O$	1
(b) (i)	The third series (5d elements) of the transition elements have the highest first ionization enthalpy (Hf to Au). This is because of the poor shielding of the nucleus by the 4f electrons in the 5d elements which results in greater effective nuclear charge on the valence electrons.	½ ½
(ii)	Due to the **lanthanoid contraction** the change in the ionic radii in the lanthanoids is very small, their chemical properties are similar, so the separation is difficult.	1
(iii)	**+3 is the most stable oxidation** state of lanthanides. Ions in +2 tend to change to +3 by losing electrons so act as reducing agents, whereas ios in +4 tend to change to +3 by gaining electrons so act as oxidizing agents.	1
26. (i)	For a chemical reaction with rise in temperature by 10^0, the rate constant is nearly doubled.	½
	 $(T_2 = T_1 + 10^0)$	1
	Increasing the temperature of the substance increases the fraction of molecules which collide with energies greater than E_a (activation energy) As the temperature increases (T_2) , the fraction of molecules having energy equal to or greater than activation energy gets doubled leading to doubling the rate of reaction.	1

	$k = A\,e^{-E_a/RT}$ (Arrhenius equation)	½
(ii)	$k = A\,e^{-E_a/RT}$	
	$-\dfrac{E_a}{RT} = -\dfrac{28000\ K}{T}$	1
	$E_a = 28000\ K \times 8.314\ J/K/mol$	½
	$E_a = 232.79\ kJ/mol$	½
	OR	
(i)	$t_{99\%} = 2\,t_{90\%}$ Given for reactant Q. for first order reaction	
	$t_{99\%} = \dfrac{2.303}{k}\log\dfrac{a}{a-0.99a} = \dfrac{2.303}{k}\log 10^2 = 2\times\dfrac{2.303}{k}$	½
	$t_{90\%} = \dfrac{2.303}{k}\log\dfrac{a}{a-0.90a} = \dfrac{2.303}{k}\log 10 = \dfrac{2.303}{k}$	½
	Therefore $t_{99\%} = 2\,t_{90\%}$, therefore it is a **first order reaction with respect to Q**	½
	From the graph it is evident that the concentration of R decreases linearly with time, therefore the **order with respect to R is zero.**	½
	The overall order of the reaction is 1. **Units for rate constant = s^{-1}** Rate = k [Q]^1 [R]^0	½ ½
(ii)	For a first order reaction $t = \dfrac{2.303}{k}\log\dfrac{[R]_0}{[R]}$	½
	Time required for the 3 /4 th of the reaction $[R]_0 = a,\ \ [R] = a - \dfrac{3}{4}a = \dfrac{1}{4}a$	½
	$t_{\frac{3}{4}} = \dfrac{2.303}{k}\log\dfrac{a}{\frac{1}{4}a}$	
	$t_{\frac{3}{4}} = \dfrac{2.303}{2.54\times10^{-3}}\log 4$	½
	$= 545\ s$	½