The electronic configuration of the Group 1 metals is \( ns^1 \). They are big atoms (atomic size decreases across a period as shielding decreases) and hence the outermost electron is far from the nucleus. They therefore have low ionisation energies. They are powerful reducing agents as they lose a single electron very easily.

Paramagnetism arises as a result of the presence of 1 or more unpaired electrons.

A Lewis acid is an electron pair acceptor. BF\(_3\) possess an empty p-orbital on B. CH\(_3\)CH\(_2\)OCH\(_2\)CH\(_3\) possess a lone pair on O.

A catalyst is a substance that increases the rate of a reaction without being consumed in the reaction. A catalyst works by providing an alternative reaction pathway of lower activation energy, \( E_a \).

The critical temperature \( (T_c) \) is the temperature above which a substance cannot exist as a liquid. Thus methane cannot be liquefied at 25 °C.

Allotropes are different structural forms of the same element. white phosphorus and red phosphorus, \( O_2 \) and \( O_3 \), many other examples
2008-J-4

<table>
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<tr>
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<th>III</th>
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<tr>
<td>Cl</td>
<td>O and N</td>
<td>Cl and N</td>
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</tbody>
</table>

2008-J-5

- 8.24
- 0.26 mol

2008-J-6

- Rate = $k[H_2][NO]^2$
  - $k = 2.9 \times 10^2 \ M^{-2} \ s^{-1}$
  - $4.1 \times 10^{-5} \ M \ s^{-1}$
- \[ \text{NO} + \text{NO} \leftrightarrow \text{N}_2\text{O}_2 \] (fast equilibrium) \[ \text{Eq 1} \]
- \[ \text{H}_2 + \text{N}_2\text{O}_2 \rightarrow \text{N}_2\text{O} + \text{H}_2\text{O} \] (slow) \[ \text{Eq 2} \]
- \[ 2\text{NO} + \text{H}_2 \rightarrow \text{N}_2\text{O} + \text{H}_2\text{O} \] Overall stoichiometry is consistent

As Eq 1 is an equilibrium, $K_{eq} = \frac{[\text{N}_2\text{O}_2]}{[\text{NO}]^2} \Rightarrow [\text{N}_2\text{O}_2] = K_{eq}[\text{NO}]^2$

From Eq 2: \[ \text{Rate} = k[H_2][\text{N}_2\text{O}_2] \]

\[ = k[H_2]K_{eq}[\text{NO}]^2 = k_1[H_2][\text{NO}]^2 \] so rate equation is satisfied

2008-J-7

- constitutional isomers
- conformational isomers
- diastereoisomers
- same compound
- diastereoisomers
  - (E)-2-butene
  - (R)-2-bromopropanal or (R)-2-bromopropionaldehyde

No. It's a meso isomer and has a plane of symmetry.
2008-J-8

- \[ \text{CH}_3\text{CH}_2\text{C} - \text{OCH}_2\text{CH}_3 \]

- \[
\begin{array}{c}
\text{Br} \\
\text{Br} \\
\text{H}\text{C} - \text{C} - \text{CH}_3 \\
\text{Br} \\
\text{Br}
\end{array}
\]

\[
\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{O} - \text{C} \rightarrow \text{CH}_3 + \text{CH}_3\text{COOH}
\]

2008-J-9

- **A**: hot concentrated H\textsubscript{2}SO\textsubscript{4}
- **B**: dilute H\textsubscript{2}SO\textsubscript{4}
- **C**: Cr\textsubscript{2}O\textsubscript{7}\textsuperscript{2-} / H\textsuperscript{+}
- **D**: hot concentrated HCl or SOCl\textsubscript{2}
- **E**: hot concentrated KOH in ethanol solvent
C₈H₉O₂N

amine (primary) ester

\[
\begin{align*}
\text{Cl}^- & \quad \text{H}_3\text{N}^+ \quad \text{O}^-
\end{align*}
\]

\[
\begin{align*}
\text{H}_2\text{N} & \quad \text{CO}_2\text{Na}^+ \quad \text{H}_3\text{O}^+
\end{align*}
\]

\[
\begin{align*}
\text{Cl}^- & \quad \text{H}_3\text{N}^+ \quad \text{OH}^-
\end{align*}
\]

\[\text{H}_3\text{N}\text{O}_2\text{Na} + \text{CH}_3\text{OH} \rightarrow \text{H}_3\text{N}\text{O}_2\text{Cl} + \text{CH}_3\text{OH}\]

\[\text{H}_3\text{N}\text{O}_2\text{Na} + \text{CH}_3\text{OH} \rightarrow \text{H}_3\text{N}\text{O}_2\text{Cl} + \text{CH}_3\text{OH}\]
1. CH₃MgBr / dry ether
2. H⁺ / H₂O

CH₃CH₂Br→

Na
or NaNH₂
or other v. strong base

1. LiAlH₄
2. H⁺ / H₂O

Br₂→
HBr is the electrophile