2010-N-2

- Fe: $\frac{1}{8} \times 8 = 1$,   O: $\frac{1}{2} \times 6 = 3$,   Sr: 1.   Therefore consistent with $FeSrO_3$.

  Coordination numbers: Sr: 6 (O^{2-} ions), O: 2 (Sr^{2+} ions), Fe: 12 (O^{2-} ions)
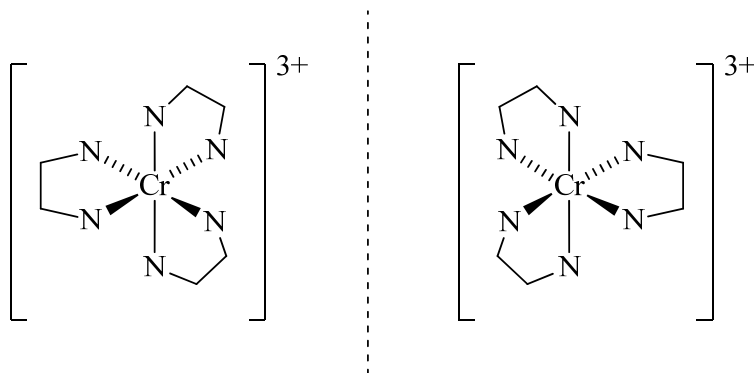
  Fe^{4+} is d^4 | ↑ | ↑ | ↑ | ↑ | | Therefore 4 unpaired electrons.

  La^{3+} ion is of similar size to the Sr^{2+} ion so can fit into the same interstices of the O^{2-} lattice. Charge balance is maintained by a neighbouring Fe^{4+} ion being reduced to Fe^{3+}.

2010-N-3

- *tris*(ethane-1,2-diamine)chromium(III) tetrachloridoferrate(III)

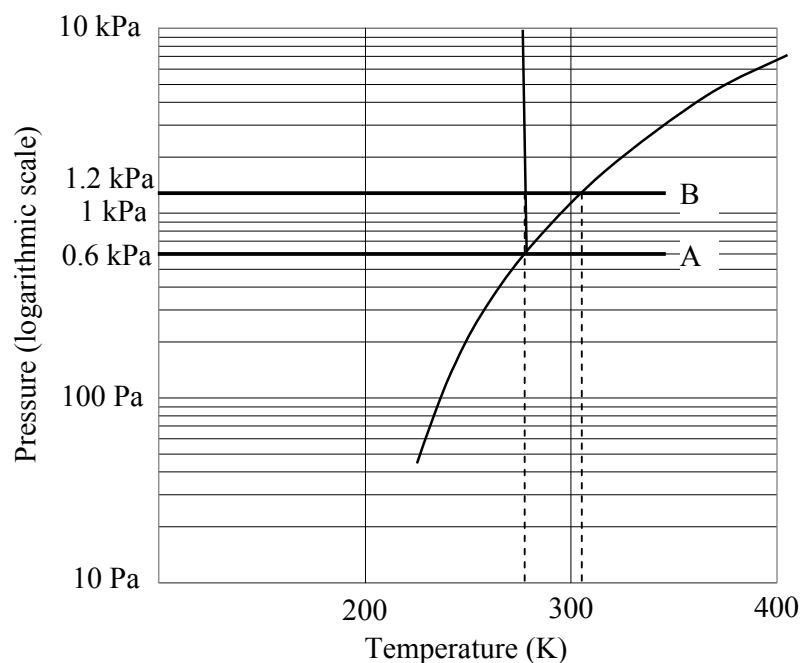 Yes, it's chiral as it's not superimposable on its mirror image.

  $[Cr(en)_3][FeCl_4]_2Cl$, $[Cr(en)_3][FeCl_4]Cl_2$, $[Cr(en)_3]Cl_3$, $K[FeCl_4]$ all possible

2010-N-4

- The high ionic charge on Co^{3+} polarises the O–H bond in the aqua ligand. This weakens the O–H bond causing the complex to be acidic in aqueous solution.

  3.35

  9.35

  47 mL of solution A and 953 mL of solution B

-

Pressure (logarithmic scale)

10 kPa

1.2 kPa
1 kPa

0.6 kPa

100 Pa

10 Pa

200   300   400

Temperature (K)

It sublimes. Line A at 0.6 kPa (*i.e.* 600 Pa) crosses the solid/gas equilibrium line just below the triple point.

Line B on the phase diagram. Water is liquid in the range approx. 272 - 305 K.
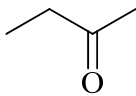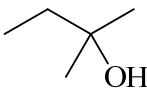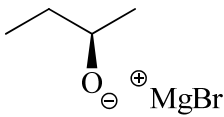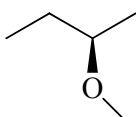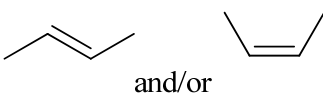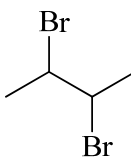

2010-N-6

- At the critical point, the gas and liquid phases are indistinguishable. As a liquid is heated and undergoes a phase change in a closed container, the density of the liquid decreases and the density of the vapour increases. When these values are the same, there is no longer a phase boundary and a supercritical fluid has been produced. Water has strong H-bonds, whereas H_2S, H_2Se, H_2Te have much weaker dispersion and dipole-dipole interactions. The stronger H-bonds require a higher temperature to overcome the intermolecular forces, so water has a higher critical temperature than the other Group 16 hydrides.

- 5.9×10^{-3} mol   (0.21 g)

2010-N-7

• (R)-2-butanol

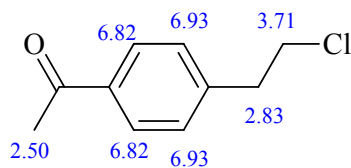| A	B	C
(structure: butanone)	(structure: 2-methyl-2-butanol with OH)	(structure: sec-butyl–O⁻ ⁺MgBr)
D	E	F
(structure: 2-methoxybutane with O)	(structures: trans and cis 2-butene) and/or	(structure: 2,3-dibromobutane, Br Br)

acid/base

S$_N$2 (nucleophilic substitution)

elimination
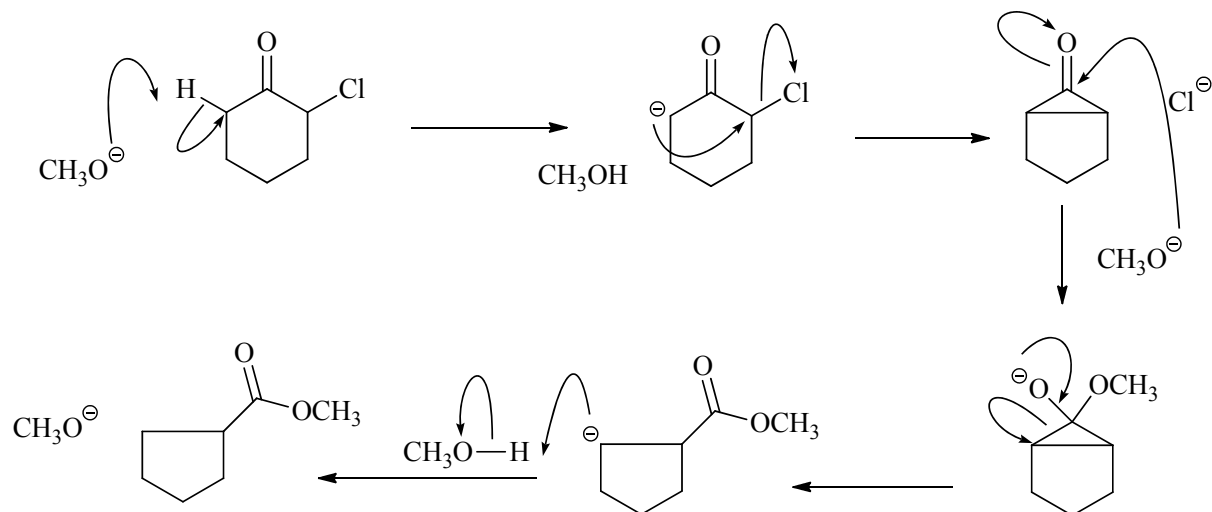
electrophilic addition

2010-N-8

Peak at $m/z = 43$ in MS typical of COCH$_3$, confirmed by peak at 1700 cm^{-1} in IR and singlet at 2.5 in ^{1}H nmr. Doublets in ^{1}H nmr just below 7 are characteristic of a 1,4-disubstituted benzene ring. Triplets at 2.8 and 3.7 in ^{1}H nmr suggest 2 adjacent CH$_2$ groups. Hence structure below, supported by chemical data shift from page 2010-N-13.
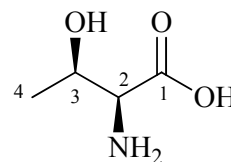
(structure: 4-acetylphenethyl chloride with shifts 6.82, 6.93, 3.71, 2.83, 2.50, 6.82, 6.93; —Cl)

2010-N-9

•

(reaction mechanism scheme with CH$_3$O⁻, CH$_3$OH, CH$_3$O⁻, Cl⁻, OCH$_3$, CH$_3$O—H)

About C2: NH_2 > COOH > $CH(OH)CH_3$ > H   - anticlockwise
About C3: OH > $CH(NH_2)COOH$ > CH_3 > H   - clockwise

Therefore (2*S*, 3*R*)-2-amino-3-hydroxybutanoic acid
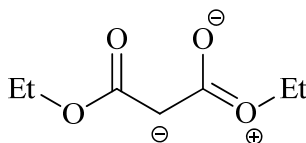

2010-N-10

•
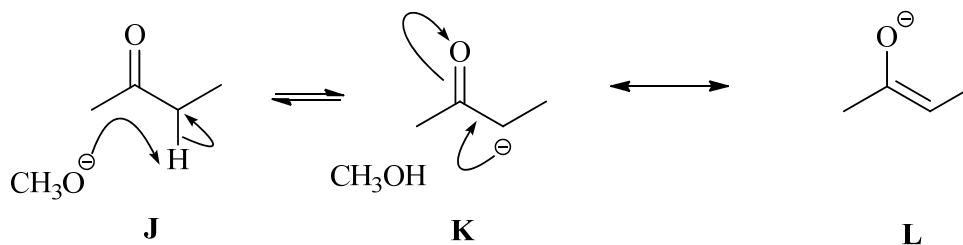
J = 19, **M** = 9, **N** = 13

M and **N** are stronger acids than **J** as the charge on the carbanion can be delocalised onto 2 carbonyl groups rather than 1(*i.e.* there are more resonance structures). Enolate anions are stabilised by electron withdrawing groups which help reduce the negative charge on the carbon atom. **N** is a weaker acid than **M** because the OEt group of the ester donates electron density towards the enolate anion, thus destabilising it. Also the following resonance form of the ester would mean that the carbonyl group is less available to share the negative charge of the enolate anion.

2010-N-11

•   Substitution at position 2 gives 3 canonical forms for the Wheland intermediate, *versus* only 2 for the substitution at position 3.
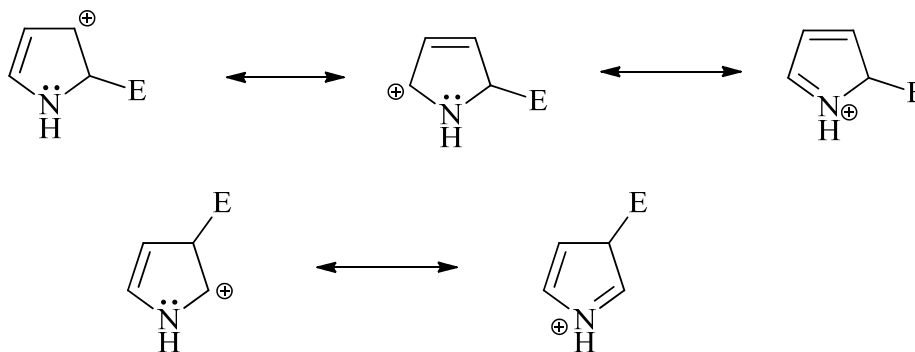
The intermediate with the greater number of resonance structures is the more stable and leads to the major product.