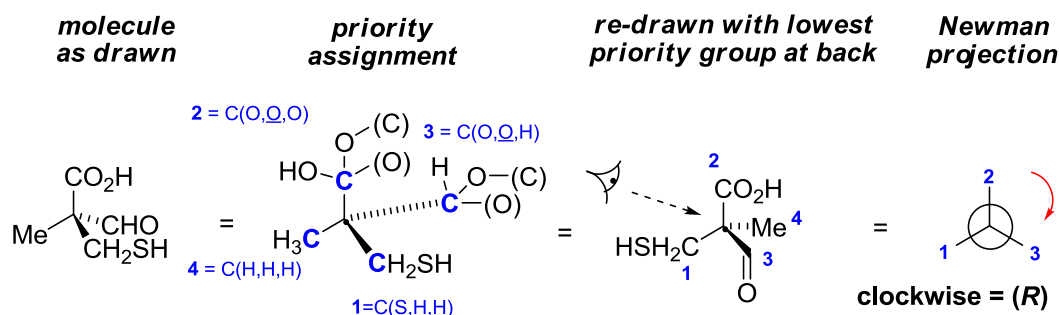
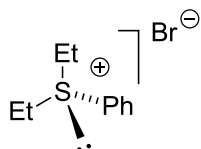
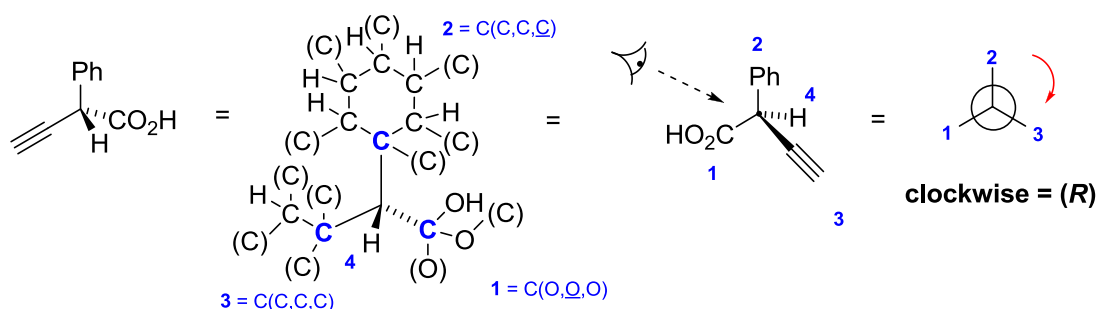


## Stereochemistry 2011-2012 EXAM-STYLE QUESTION - OUTLINE ANSWERS

(a) Applying the CIP rules we obtain:

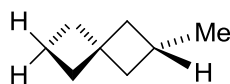
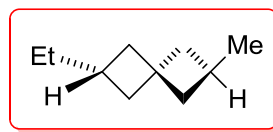
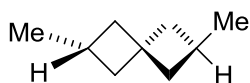


NB. 'ghost' atoms, as defined in the notes, are shown in brackets on the structure and underlined in the 'priority summation' (in blue)



internal plane of symmetry, achiral, no stereogenic centre

(b) Only one of the following molecules, molecule **C**, has an asymmetric enantiomeric form – see below. Molecule **B** is achiral due to an internal mirror plane (*i.e.* an  $S_1$  improper rotation axis) and molecule **A** has a  $C_2$  axis and therefore has a dissymmetric enantiomeric form.



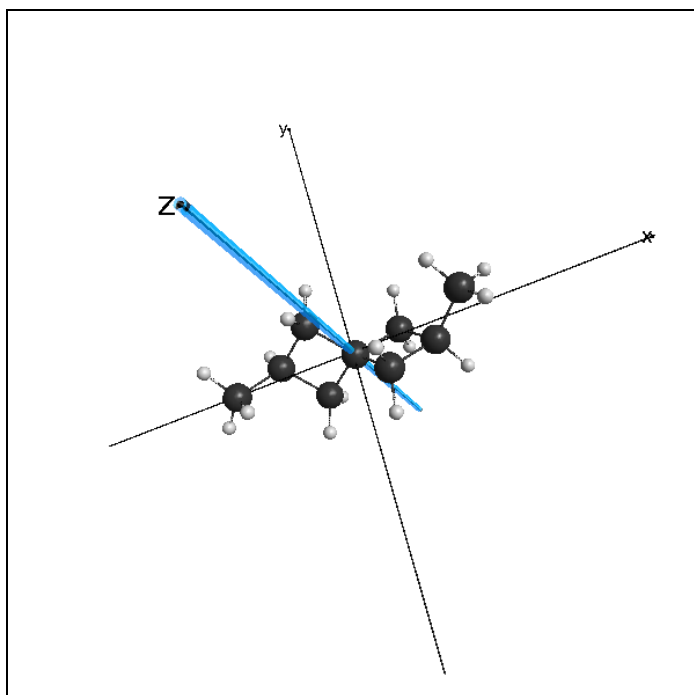
**A**  
dissymmetric  
enantiomers  
( $C_2$  symmetric)

**B**  
internal mirror plane ( $C_s$ )  
( $C_s=S_1$  'axis')  
(achiral)

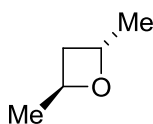
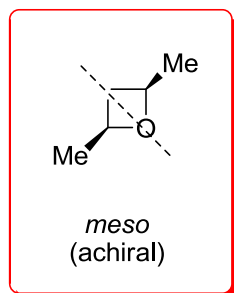
**C**  
asymmetric  
enantiomers

It is non-trivial to spot that molecule **A** has a  $C_2$  axis of symmetry. A 3D model of this compound has been uploaded here: <http://www.ch.ic.ac.uk/spivey/teaching/org1stereochemistry/stereochemistryjmsols/0910stereochemistry5.html> to allow you to rotate the molecule (A model of

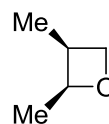
molecule **B** is also there, showing its internal mirror plane). The below image was generated using the program 'wxMacMolPlt' which can be downloaded free from: <http://www.scl.ameslab.gov/MacMolPlt/>. This program has the facility to allow you to identify symmetry operations within any 3D molecule coordinates. In this case, the  $C_2$  axis is coincident with the Z axis (as defined for the coordinates of molecule at the above URL).



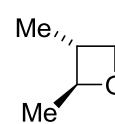
- (c) The *cis*-1,3-dimethyl compound is a *meso* compound as it is achiral by virtue of an internal mirror plane ( $S_1$  axis) but has a stereoisomer that is chiral: the *trans*-1,3-dimethyl compound, which has a dissymmetric enantiomeric form. The *cis*- and *trans*-1,2-dimethyl compounds both have asymmetric enantiomers.



dissymmetric enantiomer  
 $C_2$ -symmetric  
(chiral)



both have asymmetric enantiomers  
(chiral)



Meso is the term given to achiral members of a series of diastereoisomers in which at least one is chiral