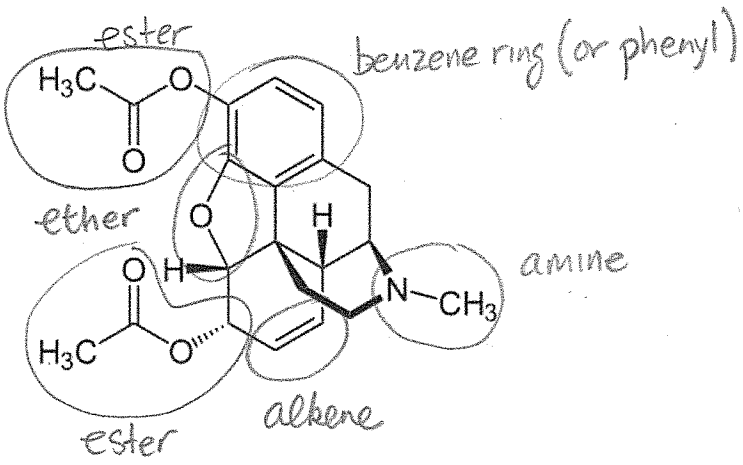
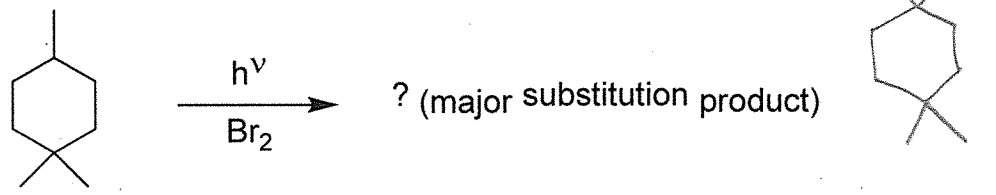
Answer Guide

1. The structure of heroin, a simple derivative of morphine, is shown below. Identify (**draw a circle around it**) and **name** the five (5) **distinct** functional groups present. [5 MARKS]

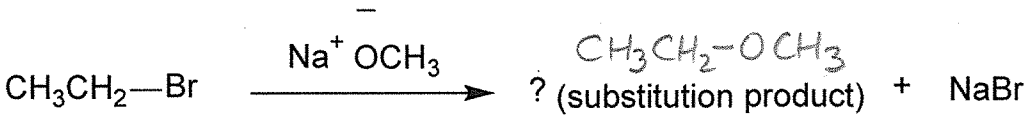


2. For the reactions shown below, draw the structure of the expected product. [8 MARKS]

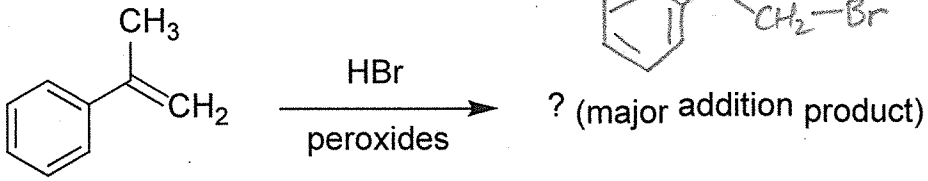
(a)



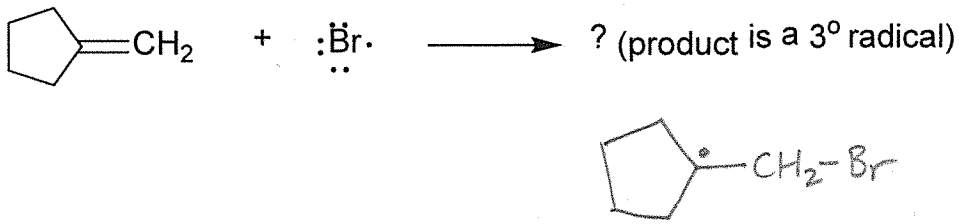
(b)



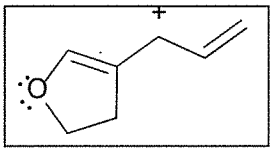
(c)



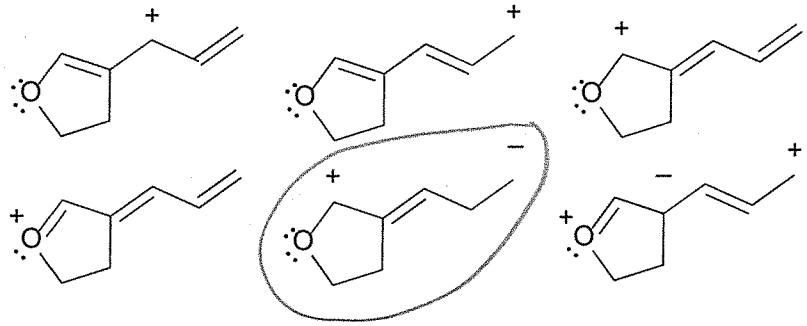
(d)



3.



Circle **one** (1) of the structures below that is **not** a resonance structure of the above structure shown in the box. If you circle more than one, you will not receive any marks. [3 MARKS]

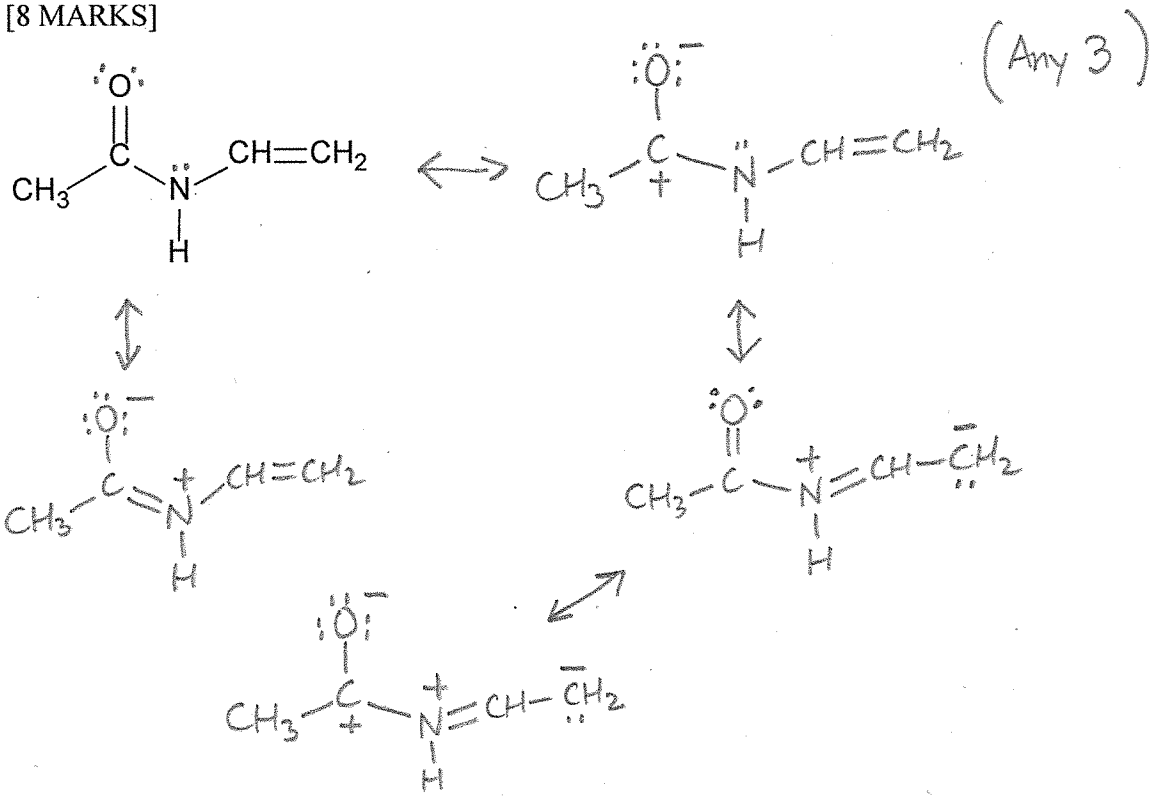


4. Circle and identify the **STRONGEST** acid and the **WEAKEST** acid from the list below. [2 MARKS]

$HC{\equiv}CH$ H_3O^+ $H_2C{=}CH_2$ NH_3 CH_3CH_3 CH_3OCH_3

STRONGEST WEAKEST

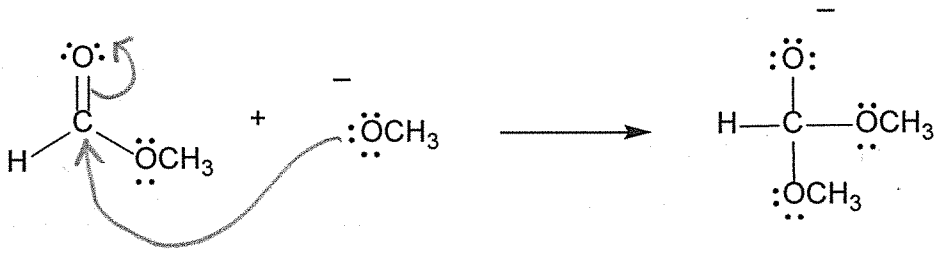
5. Draw **THREE (3)** valid and distinct resonance structures for the amide shown below (not counting the structure already shown). Show all **non-bonding** electrons and all non-zero **formal charges**. You **do not** have to show "movement" of electrons to generate the resonance structures. [8 MARKS]



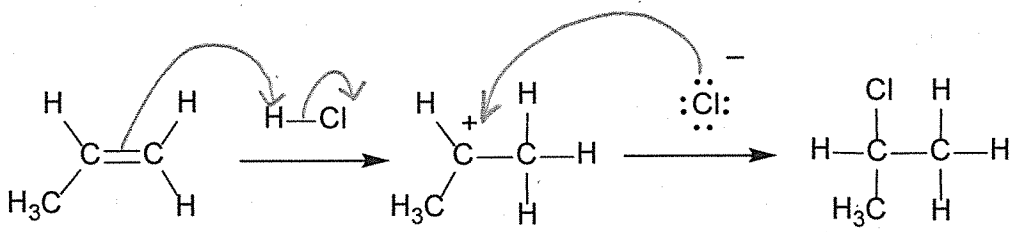
(Any 3)

6. Using **curved arrow** notation, show the required electron flow(s) for **each step** of the reactions below. [6 MARKS]

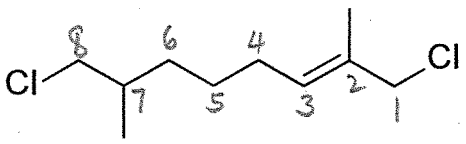
(a)



(b)

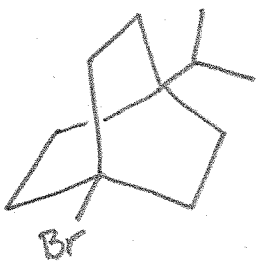


7. Provide an acceptable IUPAC name for the compound shown below.
[3 MARKS]

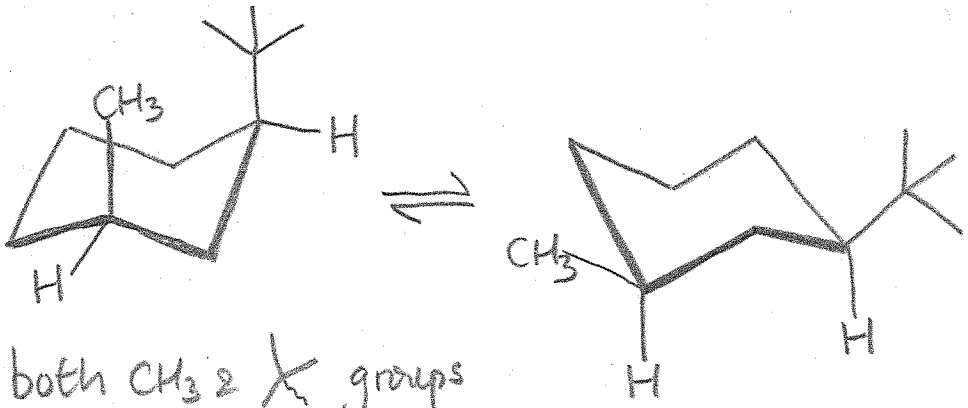


trans-1,8-dichloro-2,7-dimethyl-2-octene

8. Draw the correct structure for 1-bromo-4-isopropylbicyclo[2.2.2]octane.
[3 MARKS]



9. Draw the **two distinct** chair conformations of *cis*-1-*tert*-butyl-3-methylcyclohexane and **identify and explain** which chair conformation is **more stable**. [6 MARKS]



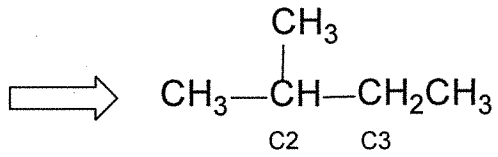
both CH_3 & t-Bu groups in axial positions have 1,3-diaxial interactions

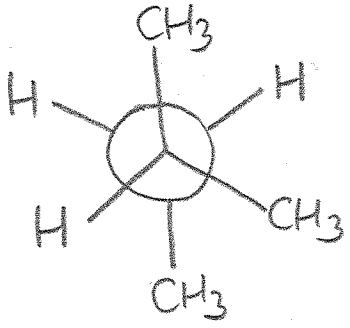
more stable no 1,3-diaxial interactions

10. Draw 2-methylbutane [$(CH_3)_2CHCH_2CH_3$)] in its (a) **most** stable, and (b) **least** stable **staggered** conformations using Newman projections, viewing down the **C2-C3 bond axis**. [6 MARKS]

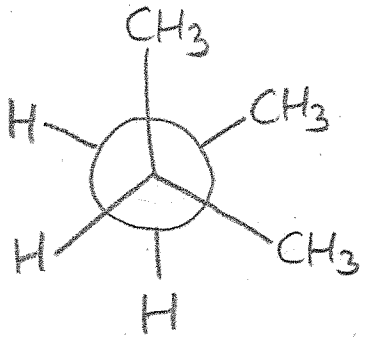
(**NOTE:** You need to draw **TWO** (2) Newman projections to get full marks, one being the most stable, and the other being the least stable **staggered** conformation. You **do not** need to show how one is converted to the other)

view from this end of molecule; front carbon of Newman projection is labelled C2





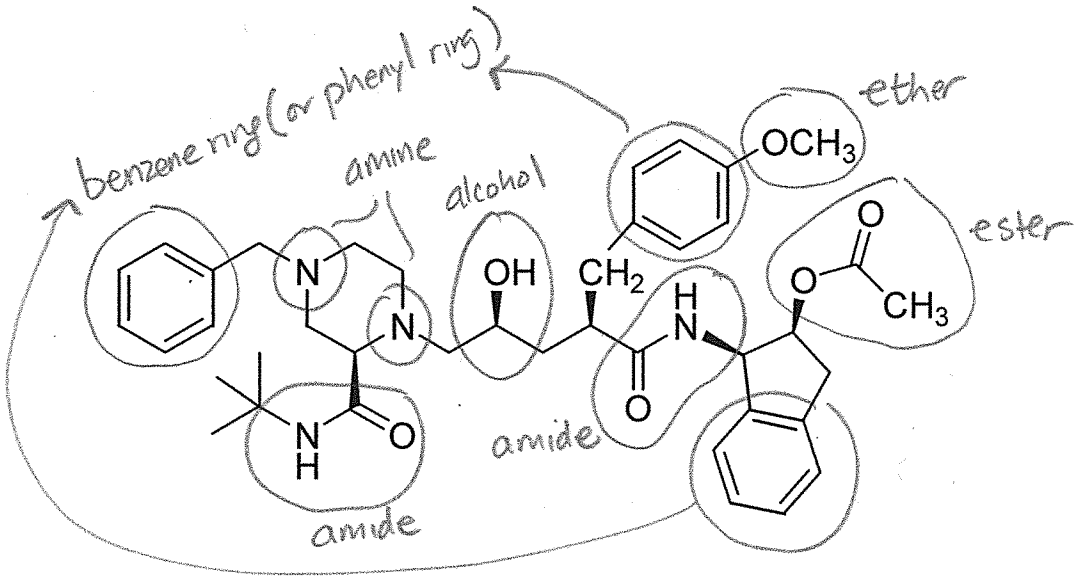
most stable



least stable staggered

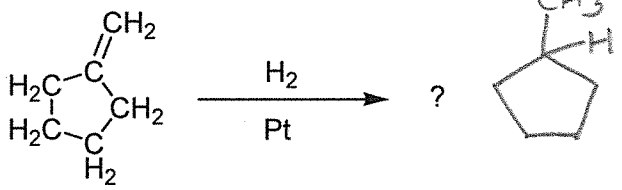
END

1. The compound shown below is related to an early anti-AIDS drug. Identify (draw a circle around it) and name five (5) functional groups present (avoiding repeats; that is, uniquely different functional groups only). [5 MARKS]

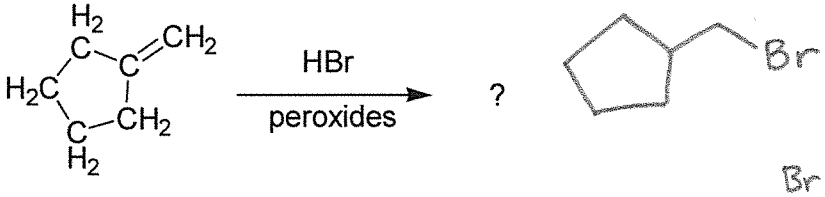


2. For the reactions shown below, draw the structure(s) of the expected product(s). Where atoms have net formal charge, show them.
[8 MARKS]

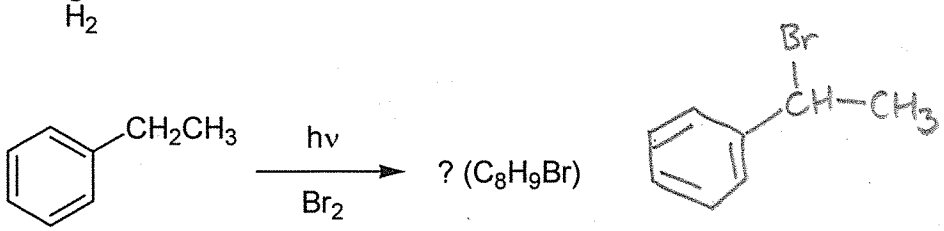
(a)



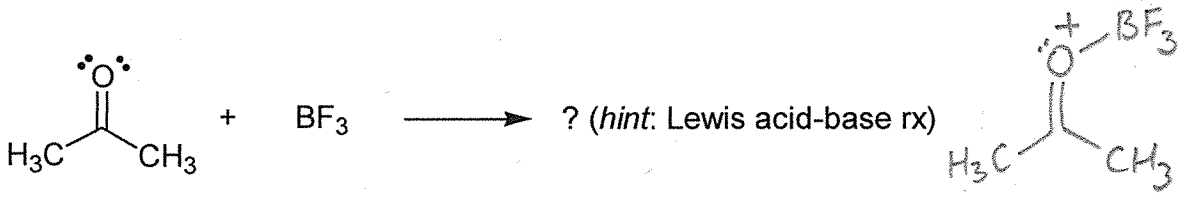
(b)



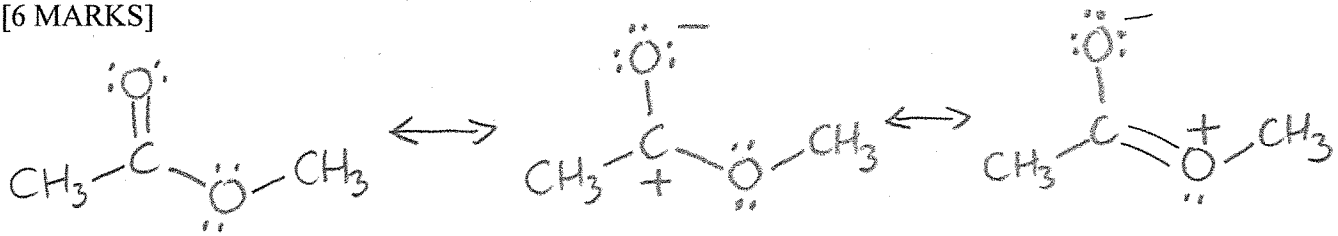
(c)



(d)

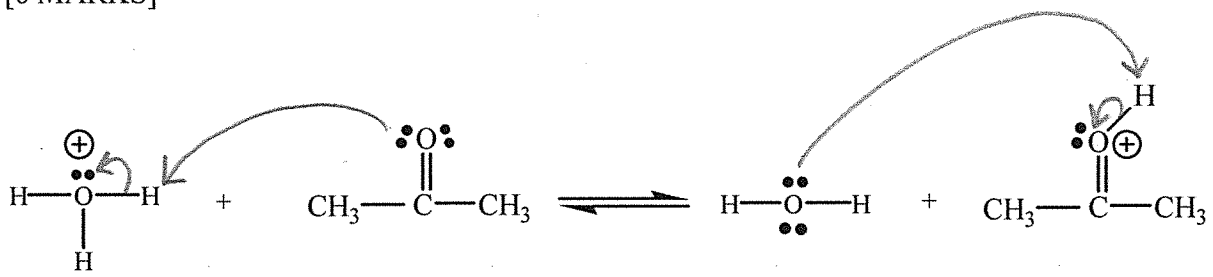


3. Draw **TWO** valid resonance (Lewis) structures for $CH_3CO_2CH_3$ (an ester) that obey the octet rule where possible. Show all the required bonds, valence electrons, including non-bonding electrons. Show the formal charge on all atoms where it is not zero.
[6 MARKS]



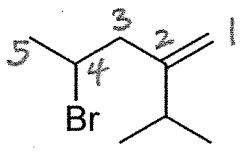
(any two structures)

4. Using **curved arrow notation**, show the electron flow for the forward and reverse steps in the acid-base reaction below. **Label** the acid and base in the starting materials (left hand side).
[6 MARKS]



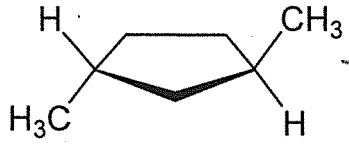
5. Provide acceptable names (IUPAC rules) for each compound shown below.
[6 MARKS]

(a)



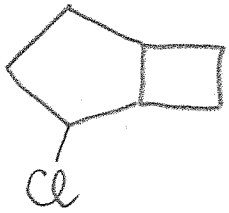
4-bromo-2-isopropyl-1-pentene

(b)

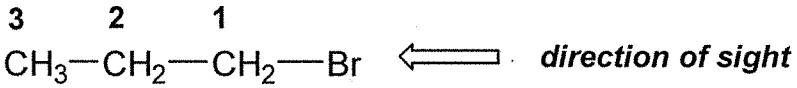


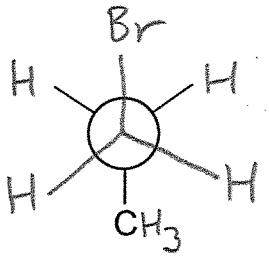
trans-1,3-dimethylcyclopentane

6. Draw the correct structure for 2-chlorobicyclo[3.2.0]heptane.
[3 MARKS]

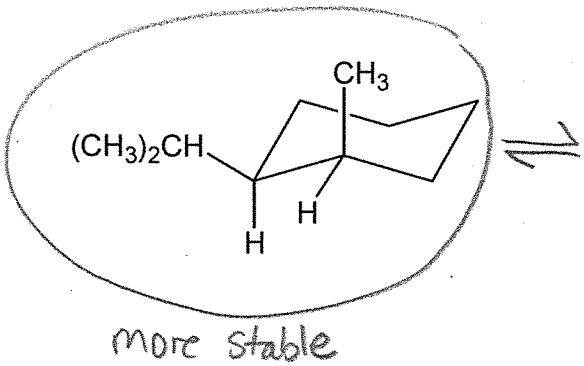


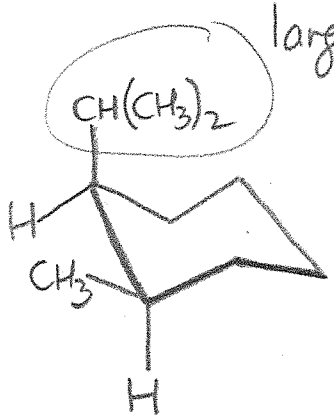
7. Consider 1-bromopropane (structure shown below). Sighting along the **C1-C2 bond**, draw the Newman projection of the **MOST STABLE** conformation. You **must** use the template provided. You cannot delete any item already on the template. However, you may need to **add** missing bonds and atoms.
[4 MARKS]





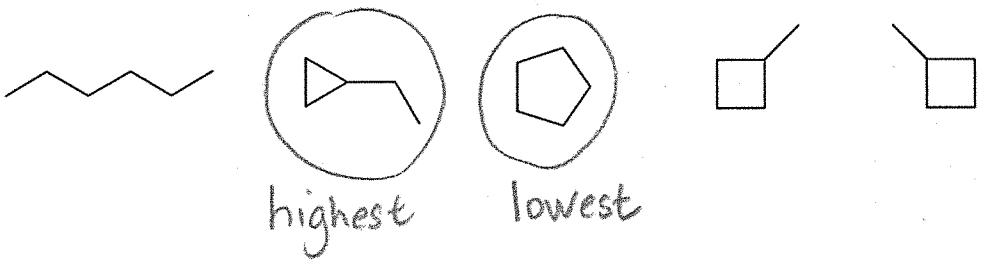
8. For the substituted cyclohexane molecule shown below, draw its ring-flipped conformer (*i.e.,* the other chair conformation), making sure you draw in all the ring substituents shown in the first structure. Of the two conformations, ***circle*** the **more stable** conformation. Explain briefly why the one you have circled is the more stable conformation.
[6 MARKS]



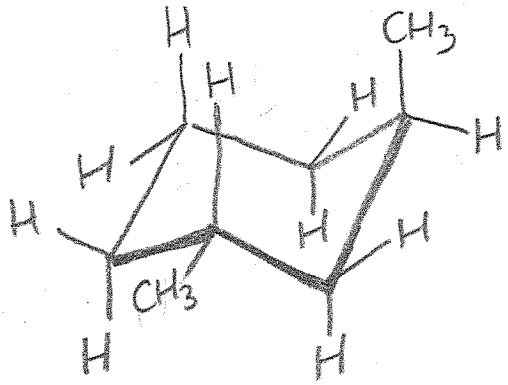


larger group that is axial gives rise to greater 1,3-diaxial interactions

9. For the compounds below, **identify** the **cyclic** compound with the **highest** ring (angle) strain and the **cyclic** compound with the **lowest** ring (angle) strain.
[3 MARKS]



10. Draw *trans*-1,3-dimethylcyclohexane in any chair conformation. Show **all** the hydrogen atoms that are attached to the cyclohexane ring using well-drawn carbon-hydrogen (C-H) bonds.
[3 MARKS]



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