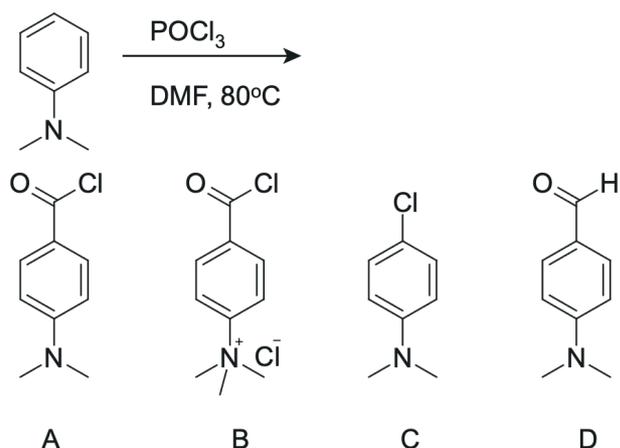


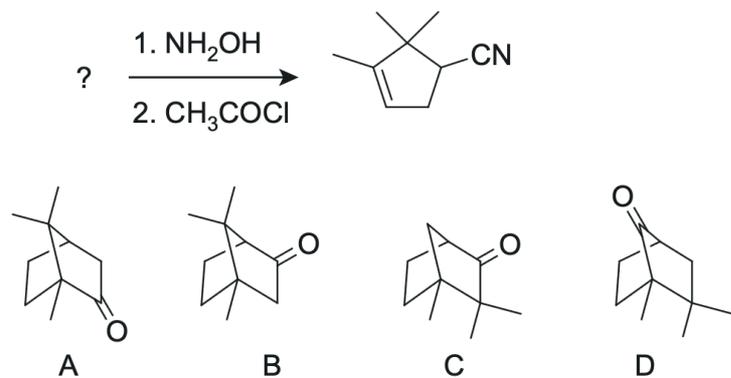
Q1. Predict the product of the following reaction:



Q2. Mixing FeSO_4 solution with NaNO_3 , followed by a slow addition of concentrated H_2SO_4 through the side of the test tube, produces a brown ring. The brown ring is due to the formation of

- A) $[\text{Fe}(\text{NO})_2(\text{H}_2\text{O})_4]^{3+}$ B) $[\text{Fe}(\text{NO})(\text{H}_2\text{O})_5]^{2+}$ C) $[\text{Fe}(\text{NO})_4(\text{SO}_4)_2]$ D) $[\text{Fe}(\text{NO})_2(\text{SO}_4)_2]^{2-}$

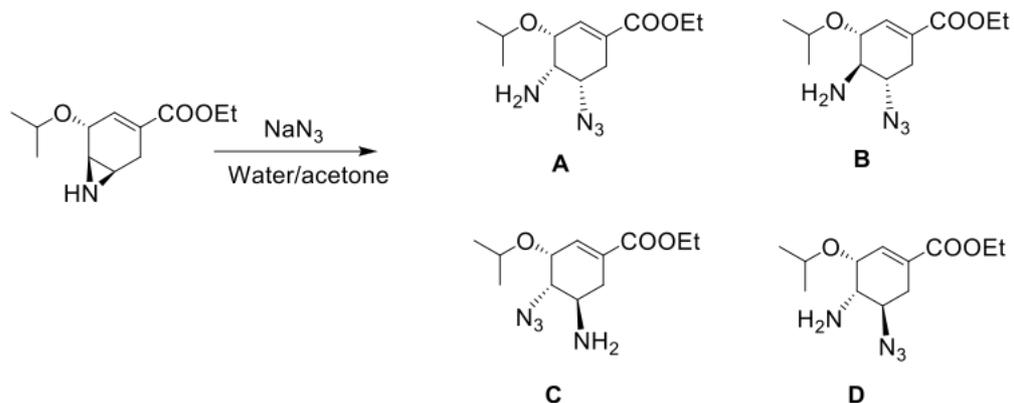
Q3. Predict the starting material.



Q4. For a given first-order reaction, if 63.5% of the material is reacted in 100 s, what is the half-life of the reaction?

- A) 69 s B) 91 s C) 154 s D) 32 s

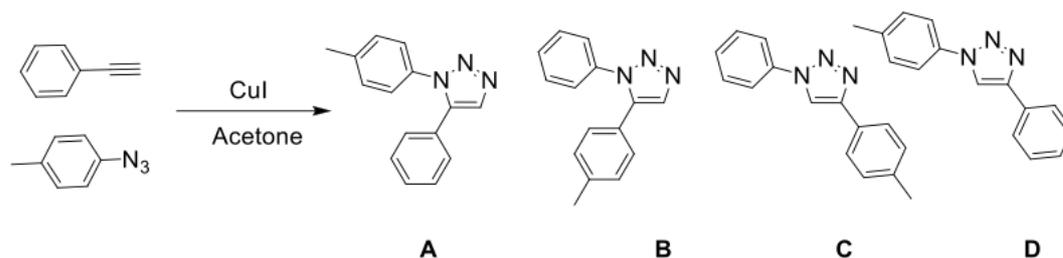
Q5. Predict the major product in the following transformation.



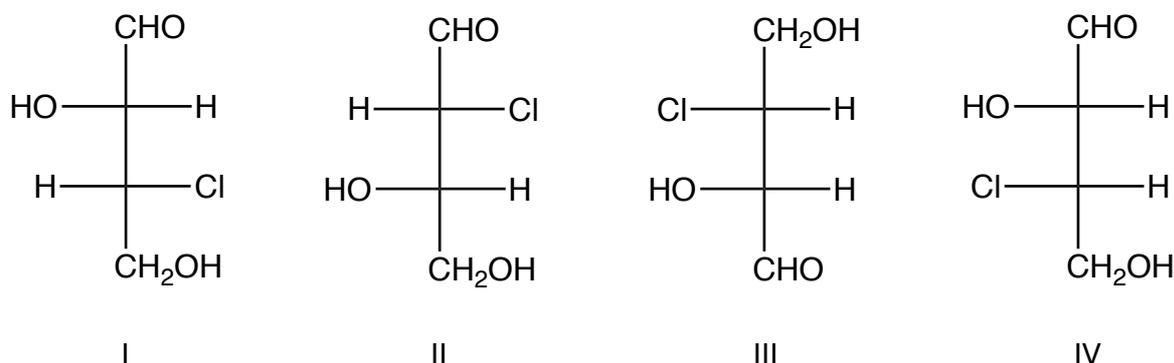
Q6. In gas chromatography, what is the basis of the separation of a mixture of molecules on a solid stationary phase?

- A) Molecular weight of the molecules
- B) Size of the molecules
- C) Polarity of the molecules
- D) Polarity and molecular weight of the molecules

Q7. Predict the correct product of the following reaction.

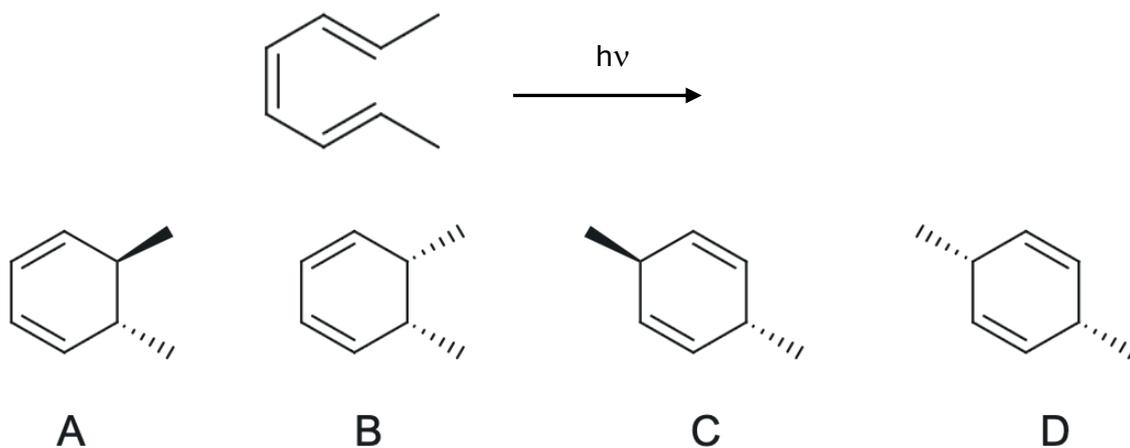


Q8. Identify the pair of enantiomers.

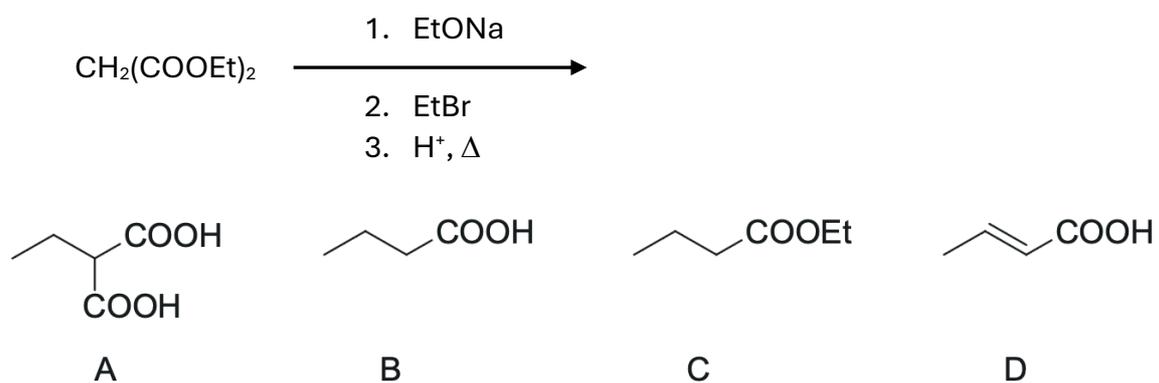


- A) I & II
- B) III & IV
- C) I & IV
- D) II & III

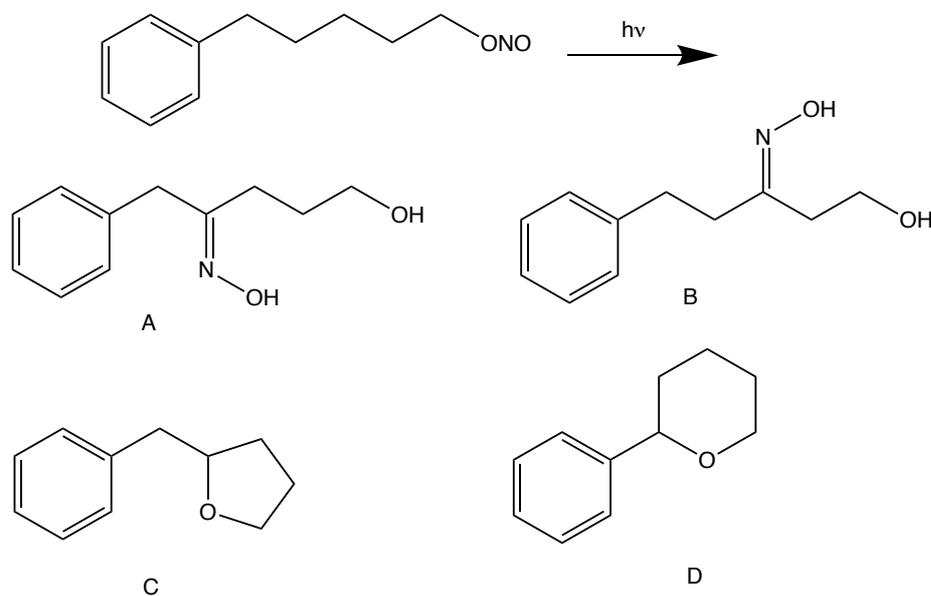
Q9. Predict the product.



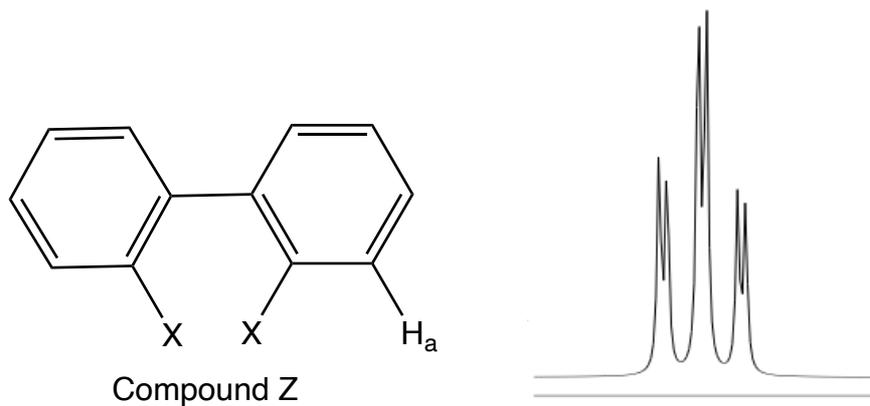
Q10. Predict the product.



Q11. Predict the product.

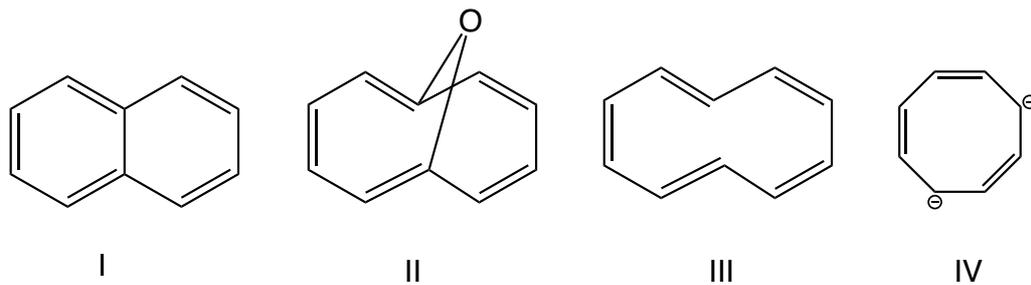


Q12. In the ^1H NMR of compound Z, if the peak for H_a is as shown, with three coupling constants as 8.0, 7.5, and 1.5, what is the substituent X?



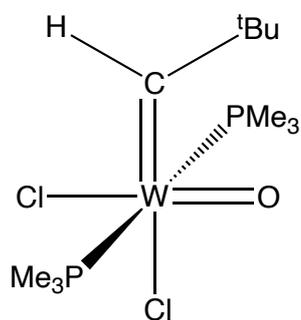
- A) F B) Cl C) CH_3 D) OCH_3

Q13. Which of the following compounds are aromatic?



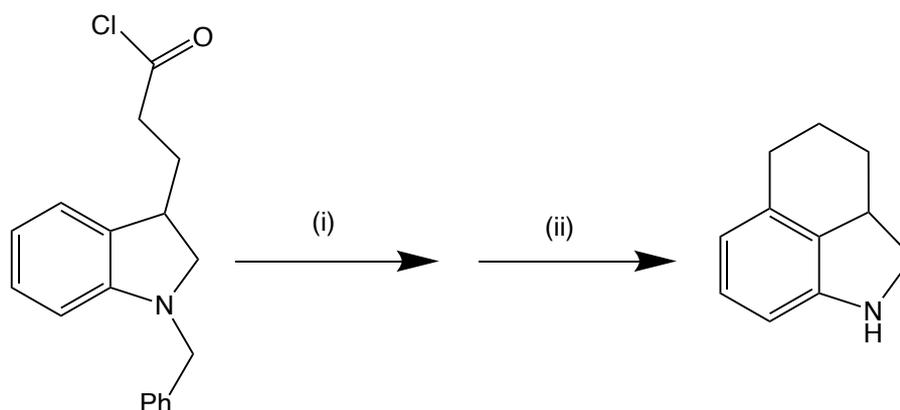
- A) I, III, and IV B) I and IV C) I, II, and IV D) I, II, III, and IV

Q14. The oxidation state of tungsten in the following complex is



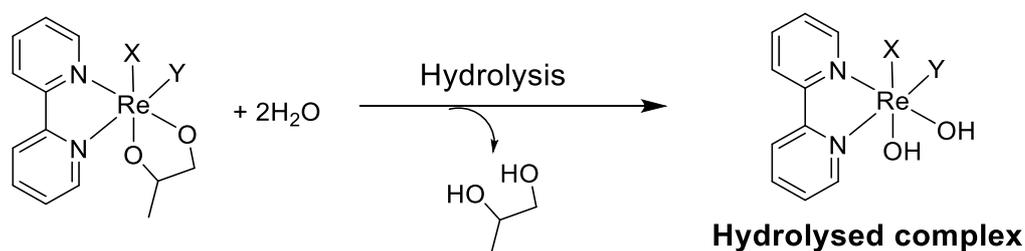
- A) +2 B) +4 C) +6 D) +3

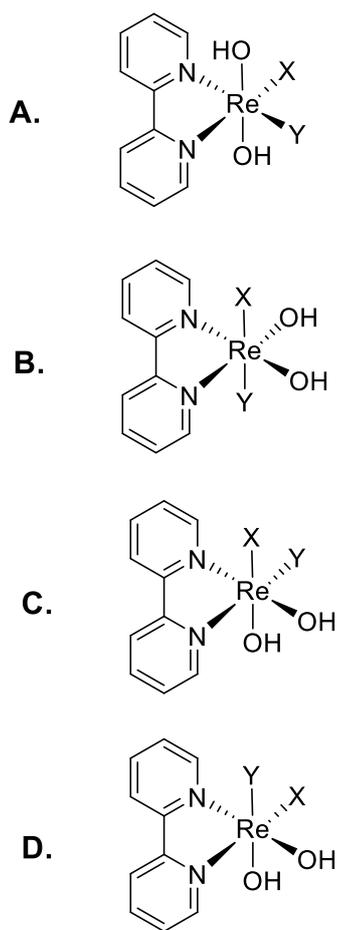
Q15. Predict the reagents (i) and (ii) for the following two-step reaction.



- A) (i) NaOH; (ii) Pd/C, H₂ (5 bar) B) (i) Pd/C, H₂ (5 bar); (ii) AlCl₃
 C) (i) AlCl₃; (ii) Pd/C, H₂ (5 bar) D) (i) Pd/C, H₂ (5 bar); (ii) NaOH

Q16. The hydrolysis of a rhenium complex and the structure of the resulting hydrolyzed complex are shown below. The ¹H NMR of the hydrolysed complex in D₂O showed a total of four signals (two doublets and two triplets) in the aromatic region corresponding to the bi-pyridine ligand. Predict the correct stereoisomer of the hydrolysed species present in D₂O.

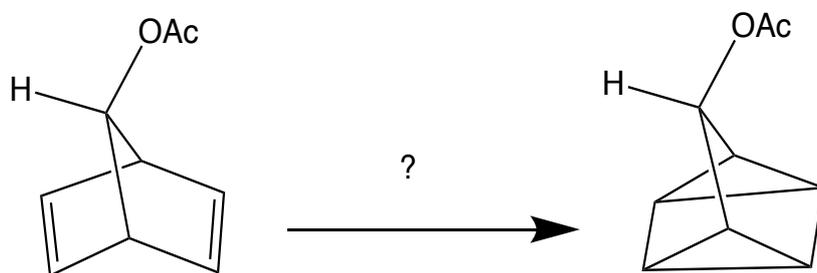




Q 17. Which of the following compounds is diamagnetic?

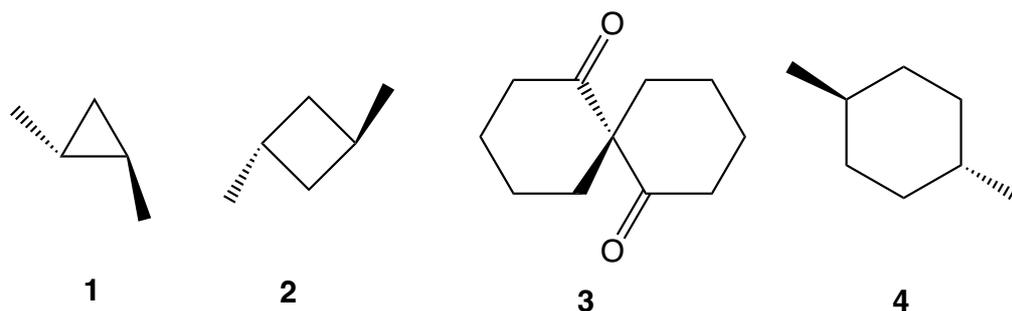
- A) $[\text{Mn}(\text{CN})_6]^{3-}$ B) $[\text{Co}(\text{NH}_3)_6]^{3+}$ C) $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ D) $[\text{FeF}_6]^{4-}$

Q18. Predict the reaction condition for the following transformation.



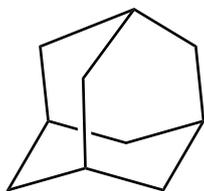
- A) Heat B) Light C) Acid D) Base

Q19. Indicate which among the following molecules are achiral.



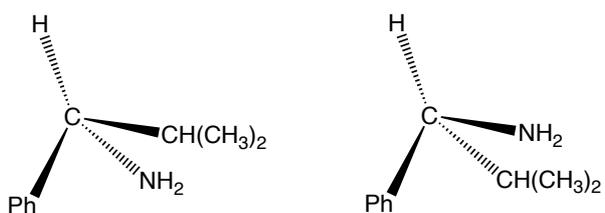
- A) 1 & 3 B) 2 & 4 C) 3 & 4 D) 2, 3, & 4

Q20. How many signals would you expect in the ^{13}C NMR of this compound?



- A) 10 B) 8 C) 2 D) 4

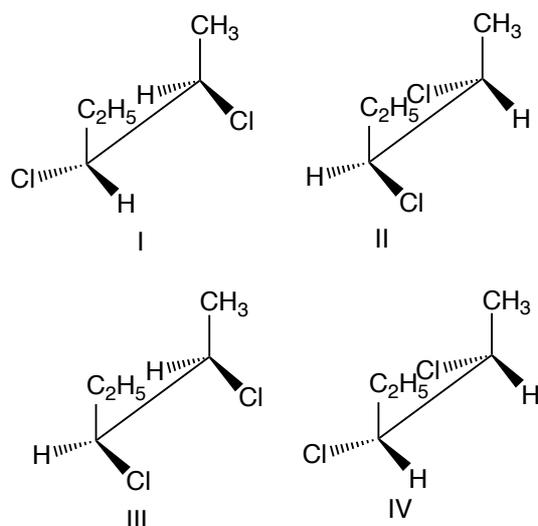
Q21. Amino-2-methyl-1-phenylpropane has a chiral center. It can be written in two distinct ways, and named as R- and S- forms:



The priority sequence for the groups attached to the chiral center is:

- A) NH_2 , C_3H_7 , C_6H_5 , H
 B) C_6H_5 , C_3H_7 , NH_2 , H
 C) C_6H_5 , NH_2 , C_3H_7 , H
 D) NH_2 , C_6H_5 , C_3H_7 , H

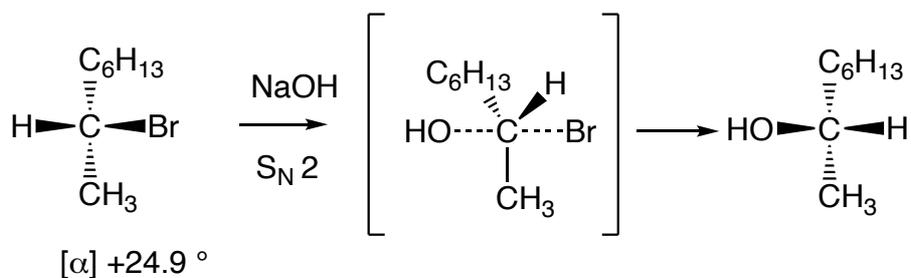
Q22. 2,3-Dichloropentane has two chiral centers. For this compound, two sets of structures can be drawn:



One of the following statements is true:

- A) I and II are superimposable and hence enantiomers.
- B) III and IV are superimposable and hence enantiomers.
- C) I and III are non-superimposable and hence are enantiomers.
- D) I and III are not mirror images of each other and hence are diastereomers.

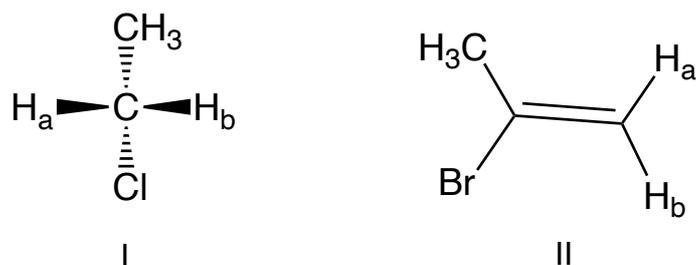
Q23. A sample of 2-bromooctane with a specific rotation of $[\alpha] +24.9^\circ$, when treated with NaOH, yielded 2-octanol with complete inversion of configuration.



Then, one of the following statements holds good:

- A) The product, 2-octanol, is optically inactive.
- B) The product, 2-octanol, is laevorotatory, and its configuration is R.
- C) The product, 2-octanol, is dextrorotatory, and its configuration is R.
- D) It is not possible to predict the optical rotation and configuration of the product based on the provided information.

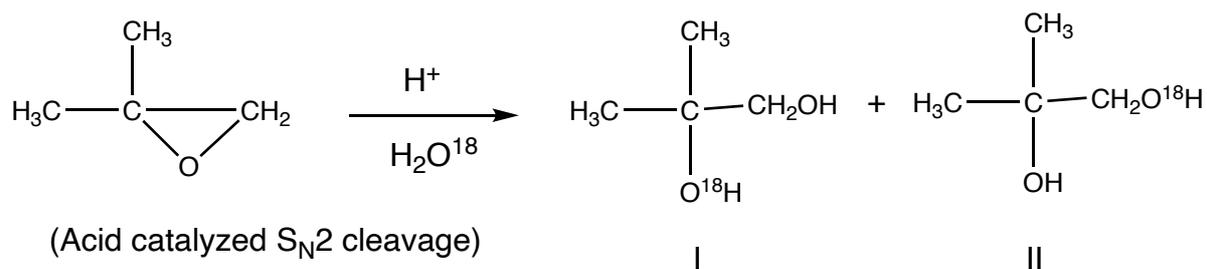
Q24. The compounds I (chloroethane) and II (2-bromopropene) have two protons each, marked as H_a and H_b . In I, replacement of either of the two protons would give a pair of enantiomers. In II, replacement of either of the vinylic protons would give a pair of diastereomers.



Based on the above, the ^1H NMR of I and II for H_a and H_b , two of the following statements are true:

- A) The enantiotopic protons of I will appear as a doublet.
- B) The enantiotopic protons of I will appear as a singlet.
- C) The diastereotopic protons of II will appear as a doublet.
- D) The diastereotopic protons of II are non-equivalent, and there will be separate NMR signals.

Q25. Protonation followed by $\text{S}_{\text{N}}2$ cleavage of the epoxide in H_2O^{18} may lead to mixed products, I & II:



Which one of the following statements is correct:

- A) Both I and II are formed with equal ease.
- B) Mostly I is formed.
- C) Mostly II is formed.
- D) The epoxide does not react under the above reaction conditions.