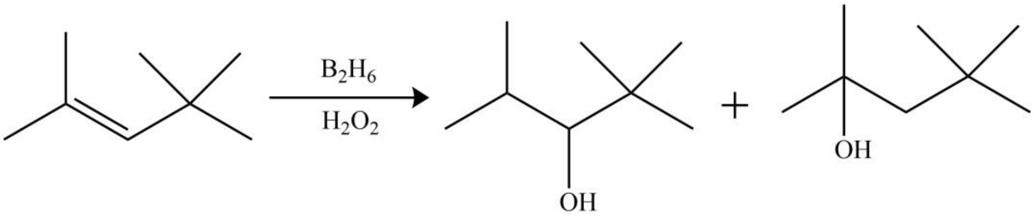
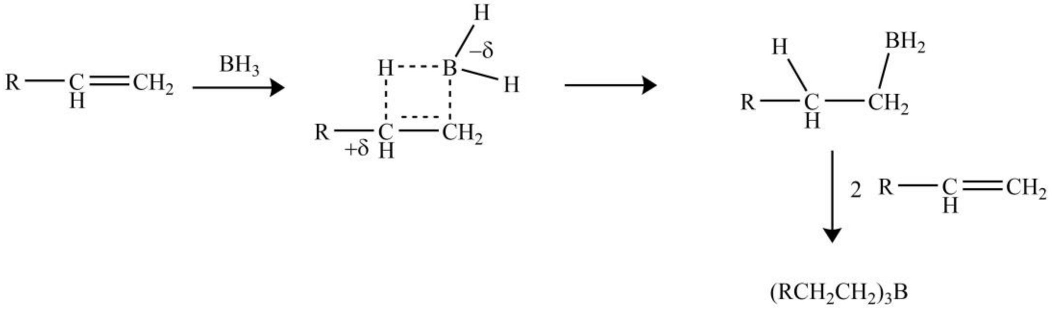
❖ Hydroboration

The hydroboration may simply be defined as the addition of a hydrogen-boron bond to C-N double bonds, and C-O double bonds, and C-C double or triple bonds. Hydroboration is extremely valuable in synthetic organic chemistry. Herbert C. Brown, who developed the conceptual and technological framework of hydroboration, received Nobel Prize in Chemistry for his work.

Illustrative reaction: A typical organic reaction hydroboration-type addition to carbon-carbon multiple reactions is given below.



Mechanism Involved: The hydroboration reactions are primarily dictated by anti-Markovnikov's rule, which means that the H gets attached to the most substituted carbon of the multiple bond. This reversal of regiochemistry indicates a polar $B^{\delta+}-H^{\delta-}$ bond. The hydroboration reaction occurs via a four-membered transition state where the H and the B atoms are attached to the same double bond's face. Since the mechanism is of concerted-type, the C-H bond is slightly slower than the formation of the C-B bond. Therefore, the B atom develops a somewhat negative charge in the transition state; whereas the partially positive charge resides on the more substituted carbon, which can be compensated via the +I effect from substituting groups. In other words, we may say that it is a case of group transfer reaction. Nevertheless, orbitals' investigation showed that the transformation is 'pseudopericyclic'; and therefore, the Woodward-Hoffmann rule cannot be implemented strictly for reactivity rationalization.



The hydroboration generally gives rise to compounds beyond monoalkyl borane if the reagent used is BH_3 (particularly in the case of alkenes with very small sterically hindrance). The hydroboration of trisubstituted alkenes can give rise to dialkyl boranes; though any subsequent alkylation of the organoboranes is discouraged due to increased steric hindrance. The difference of rate in the generation of di- and tri-alkyl boranes can be employed in the synthesis of bulky boranes to fine-tune the regioselectivity.

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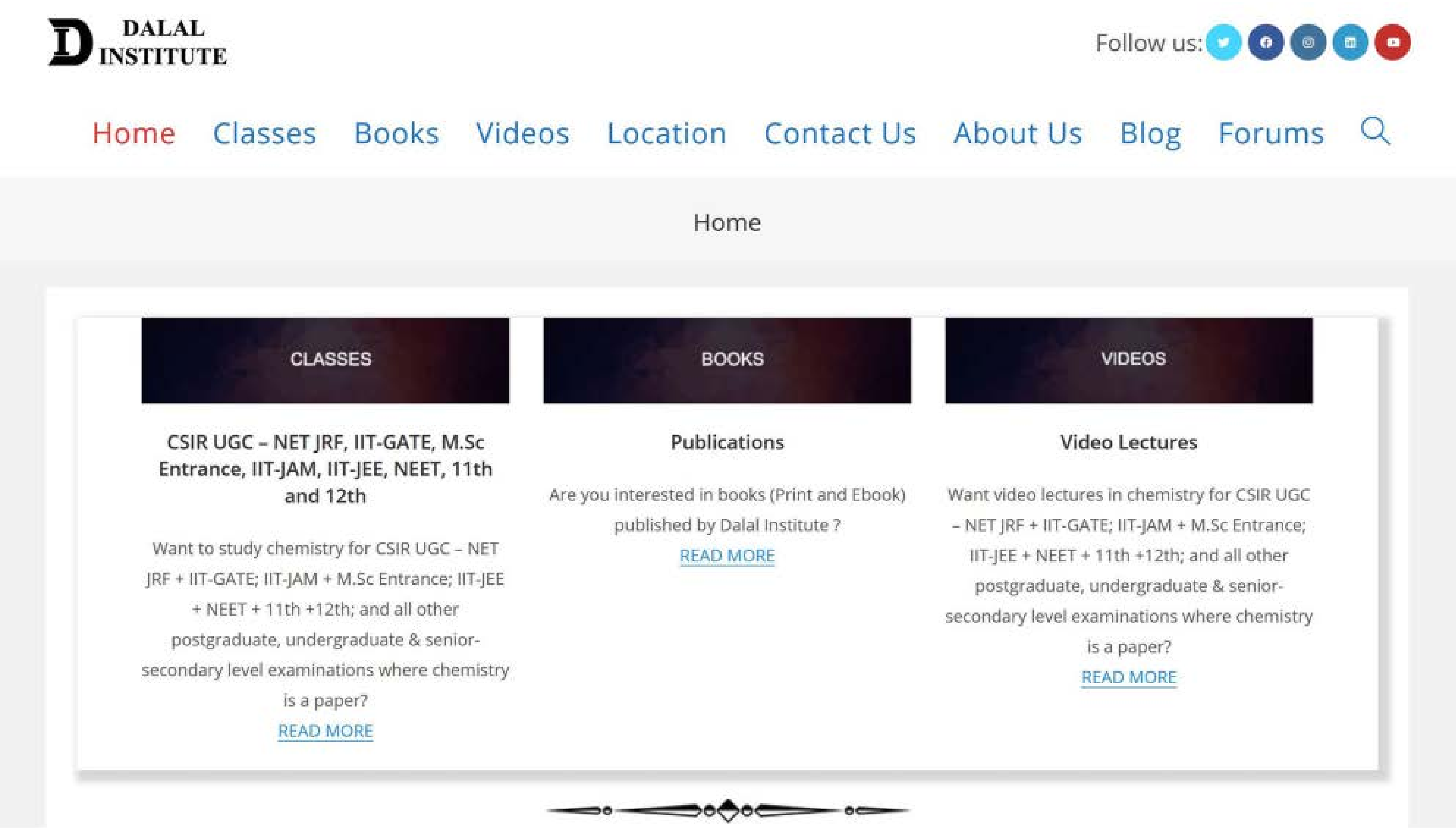
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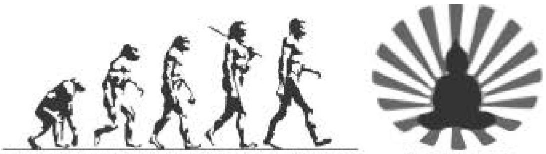

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MANDEEP DALAL

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