

Alkene Addition to Form Bromoalkane

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User prompt: without rearrangement

Response: To determine which alkene(s) yield **3-bromo-3-methylhexane** as the major product upon addition of **HBr** (without carbocation rearrangement), we apply **Markovnikov's rule**: the proton (H^+) adds to the carbon with more hydrogen atoms, forming the more stable carbocation intermediate (tertiary > secondary > primary), followed by bromide (Br^-) attack.

Analysis of Starting Alkenes

- **(a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}(\text{CH}_3)=\text{CHCH}_3$ (3-methylhex-2-ene)**
 - **Addition:** H^+ adds to C2 (secondary carbon, attached to 1 H), forming a stable 3° carbocation at C3.
 - **Product:** Br^- attacks C3 $\rightarrow$ **3-bromo-3-methylhexane** (Major).
- **(b) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}=\text{CH}_2$ (3-methylhex-1-ene)**
 - **Addition:** H^+ adds to C1 (CH_2), forming a 2° carbocation at C2.
 - **Product (without rearrangement):** Br^- attacks C2 $\rightarrow$ **2-bromo-3-methylhexane** (Not 3-bromo-3-methylhexane).
- **(c) $\text{CH}_3\text{CH}=\text{CHCH}(\text{CH}_3)\text{CH}_2\text{CH}_3$ (4-methylhex-2-ene)**
 - **Addition:** Both C2 and C3 are 2° carbons with 1 H each. Addition yields a mixture of 2-bromo-4-methylhexane and 3-bromo-4-methylhexane (or 3-bromo-3-methylhexane only via rearrangement).
 - **Product (without rearrangement):** Does not yield 3-bromo-3-methylhexane as the direct major product.
- **(d) $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}(\text{CH}_2\text{CH}_3)=\text{CH}_2$ (2-ethylpent-1-ene)**
 - **IUPAC / Structure check:** $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{C}(\text{CH}_2\text{CH}_3)=\text{CH}_2$ has a 6-carbon main chain (3-methylhex-3-ene equivalent / 2-ethylpent-1-ene).
 - **Addition:** H^+ adds to the terminal double-bond carbon (CH_2), forming a 3° carbocation at the substituted carbon (C3 of the hexan-3-yl system).
 - **Product:** Br^- attacks the 3° carbon $\rightarrow$ **3-bromo-3-methylhexane** (Major).

Conclusion

The compounds that give 3-bromo-3-methylhexane as the major product without rearrangement are **(a)** and **(d)**.
