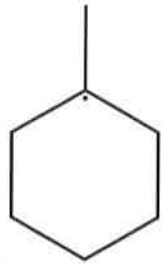
Alkanes #5: Radical Stability and Free Radical Halogenation

Hey, gang. It's time to practice our first legitimate reaction: The Free Radical Chain Reaction. This worksheet will reinforce the organic principles that are involved with the free radical chain reaction as well as give us *plenty* of practice drawing out the mechanism of this reaction and predicting the products certain reactions yield. Let's get after it ☺.

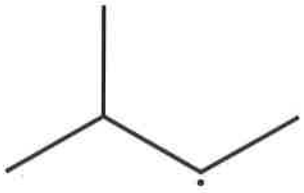
1.)

a.) Given the four radical alkane structures below, rank the stability of the 4 structures (4 being the ***most*** stable and 1 being the ***least*** stable).



4

1



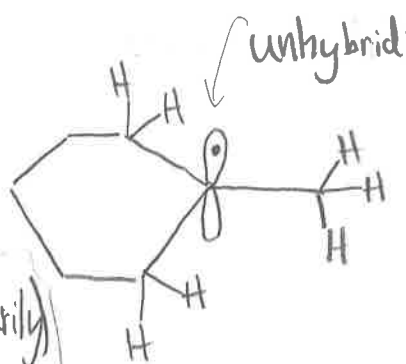
3

2

b.) Now having ranked the structures, explain, **through a diagram**, why the radical structure ranked 4 is the most stable radical.

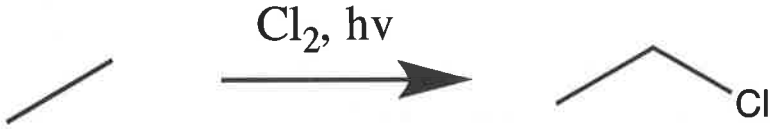
Side view of the ring:

- Radical e⁻ will hyperconjugate with all of the neighboring C-H bonds (become parallel momentarily)



2.) Well done, guys and gals. Okay, moving on: Let's get to the Free Radical Chain Reaction. Just as we discussed in the previous video, we can illustrate how organic reactions proceed by drawing the ***reaction mechanism***.

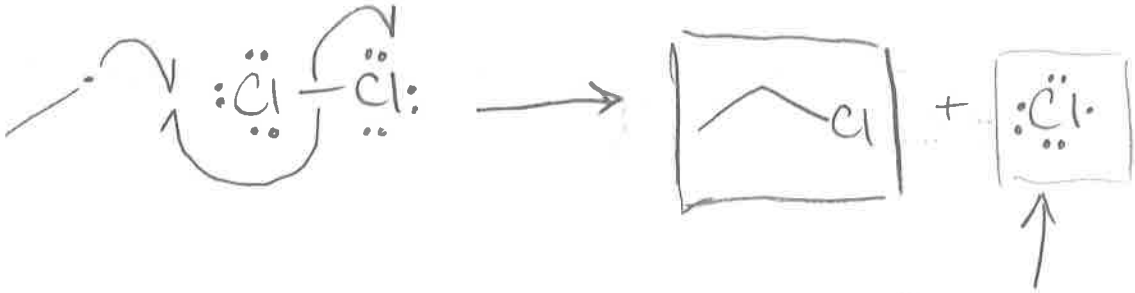
Below, draw the reaction mechanism for the following reaction:



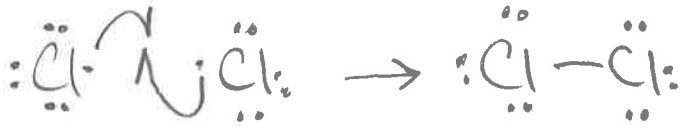
Initiation:

Propagation 1:

Propagation 2:

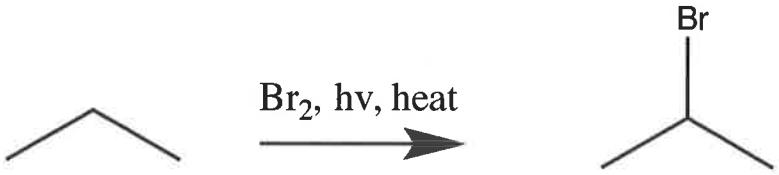


Termination:

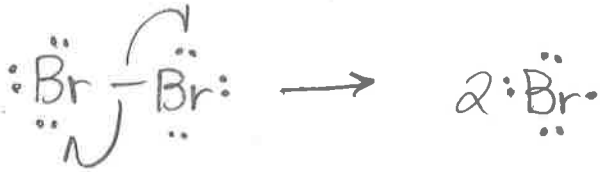


3.)

a.) Great job! Alright, because we just started drawing mechanisms, and I want to make sure you all have this one down pat—So let's give it another go, except this time with bromination instead of chlorination.

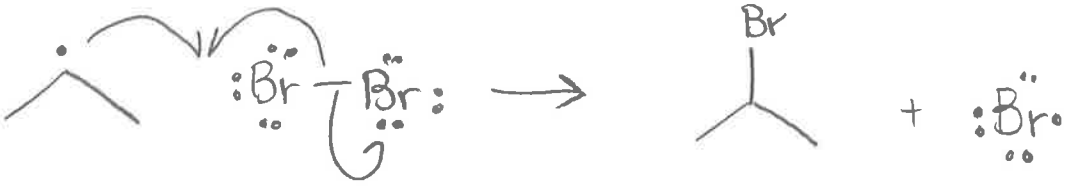


Initiation:



Propogation 1:

Propogation 2:



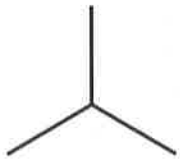
Termination:

b.) In a short, concise explanation, detail why radical bromination is "more selective" than radical chlorination?

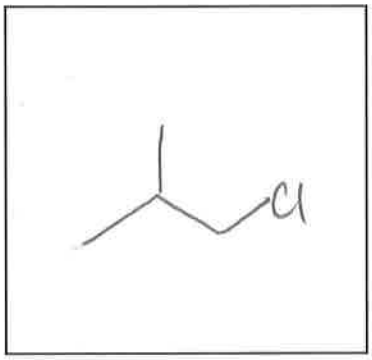
Radical Chlorination ⇒ very exothermic
Radical Bromination ⇒ just slightly exothermic

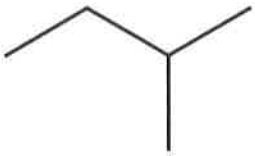
} As a result in Bromination, the most stable Carbon radicals are formed

4.) Way to go, gang. One last question; we're almost done with this worksheet.
So now that we've drawn the reaction mechanism twice, it's time to **predict the products** of various reactions.

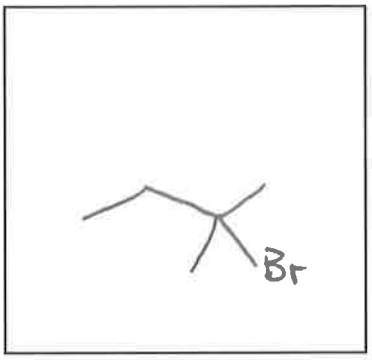


Cl_2, hv





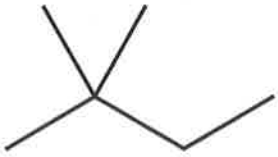
Br_2, hv, heat



I_2, hv, heat

NR

(doesn't work with I_2)



Br_2, hv, heat