Radical Reactions: Peroxides & Halogenation

INSTRUCTOR ANSWER KEY

Instructions: Select the best answer for questions 1–8 and briefly justify your choice using substrate, reagents, or reaction conditions. For 9–10, explain your reasoning in complete sentences.

1. **Propene + HBr with ROOR favors:**

   A. 1-Bromopropane B. 2-Bromopropane C. Propanol D. 1,2-Dibromopropane

   Answer: A. 1-Bromopropane

   Explanation: Peroxide-triggered radical HBr addition is anti-Markovnikov.

2. **Propene + HBr without peroxides favors:**

   A. 2-Bromopropane B. 1-Bromopropane C. Propanol D. Propane

   Answer: A. 2-Bromopropane

   Explanation: Ionic HBr addition follows the Markovnikov pattern.

3. **Which HX reliably exhibits the classic peroxide effect?**

   A. HBr B. HCl C. HI D. HF

   Answer: A. HBr

   Explanation: Suitable propagation energetics make this effect characteristic of HBr.

4. **The step that consumes one radical and makes another is typically:**

   A. Propagation B. Termination C. A closed-shell initiation D. Tautomerization

   Answer: A. Propagation

   Explanation: Propagation transfers a reactive radical center along the chain.

5. **A radical chain can be terminated by:**

   A. Coupling of two radicals B. Hydrogen abstraction yielding a new radical C. Adding ROOR to initiate D. UV-induced bond cleavage

   Answer: A. Coupling of two radicals

   Explanation: Radical coupling removes radical centers.

6. **Free-radical chlorination of butane can produce:**

   A. 1-Chlorobutane and 2-chlorobutane B. Only 1-chlorobutane C. Only 2-chlorobutane D. No chlorinated products

   Answer: A. 1-Chlorobutane and 2-chlorobutane

   Explanation: There are non-equivalent primary and secondary hydrogens.

7. **Bromine addition to an alkene in inert solvent (no light) usually involves:**

   A. Bromonium ion B. Free radical HBr chain C. E1 D. A Grignard reagent

   Answer: A. Bromonium ion

   Explanation: Br_2 adds electrophilically via a bromonium-ion intermediate.

8. **Which may help initiate a radical reaction?**

   A. Peroxides or light B. PCC exclusively C. Dilute NaOH exclusively D. A carbonyl oxygen alone

Answer: A. Peroxides or light

Explanation: Radical initiators form radicals by bond cleavage.

9. **Compare HBr addition to propene with and without peroxides.**

Suggested response: Without peroxides 2-bromopropane is expected; with ROOR, 1-bromopropane is favored by radical addition.

10. **Why might radical monochlorination of butane form more than one structural product?**

Suggested response: Butane has primary and secondary C–H positions, giving 1-chlorobutane and 2-chlorobutane (and stereoisomeric products where relevant).