1. A halogenoalkane is:

   ☐ a carboxylic acid in which –COOH replaces a hydrogen

   ☐ an alcohol in which –OH replaces a hydrogen

   ☐ an alkene in which a C=C bond replaces a C–H bond

   ☐ an alkane with one or more halogen atoms in place of hydrogen (a C–X bond)

2. Heating a halogenoalkane with NaOH dissolved in ethanol gives:

   ☐ a nitrile

   ☐ an alkane

   ☐ an alkene (by elimination)

   ☐ an alcohol (by substitution)

3. A tertiary halogenoalkane has the halogen on a carbon joined to:

   ☐ three other carbons

   ☐ one other carbon

   ☐ two other carbons

   ☐ no other carbons

4. The SN1 mechanism:

   ☐ has two steps, but the rate depends only on the concentration of the nucleophile

   ☐ has two steps, going through a carbocation; the rate depends only on the halogenoalkane

   ☐ is a single step through a transition state; the rate depends on both reactants

   ☐ never forms a carbocation, so the rate depends on the nucleophile only

5. Warming a halogenoalkane with aqueous NaOH produces:

   ☐ a nitrile

   ☐ an alcohol

   ☐ an alkane

   ☐ an alkene

6. An SN2 mechanism goes via a carbocation intermediate.

   ☐ True ☐ False

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☐ True ☐ False

8. For the SN1 hydrolysis of 2-bromo-2-methylpropane, by what factor does the rate change if $[OH^-]$ is doubled?

   _____

9. Reaction with KCN in ethanol gives a nitrile, which is useful because it:

   ☐ forms an alkene

   ☐ forms an amine

   ☐ removes a carbon

   ☐ adds one carbon to the chain

10. The SN2 mechanism:

    ☐ has two steps via a carbocation

    ☐ is one step through a transition state; the rate depends on both reactants

    ☐ is favoured by tertiary halogenoalkanes

    ☐ depends only on the halogenoalkane

1. **an alkane with one or more halogen atoms in place of hydrogen (a C–X bond)**

   A halogenoalkane has a polar C–X bond, which is the reactive site.

2. **an alkene (by elimination)**

   NaOH in ethanol with heat favours elimination of HX to form an alkene; NaOH in water favours substitution.

3. **three other carbons**

   Primary = 1 carbon attached, secondary = 2, tertiary = 3, on the carbon bearing the halogen.

4. **has two steps, going through a carbocation; the rate depends only on the halogenoalkane**

   SN1: C–X breaks first to a carbocation, then the nucleophile attacks; tertiary halogenoalkanes favour it.

5. **an alcohol**

   NaOH(aq) substitutes the halogen for –OH, giving an alcohol.

6. **False**

   False. SN2 is a one-step concerted mechanism. It is SN1 that goes via a carbocation intermediate.

7. **True**

   The C–X bond is polar, so the carbon is $\delta+$ – exactly where an electron-pair donor attacks.

8. **1**

   In SN1 the slow step involves only the halogenoalkane, so rate = k[RBr] and doubling [OH^-] leaves it unchanged (factor 1).

9. **adds one carbon to the chain**

   The CN group adds a carbon, lengthening the chain; NH_3 instead gives an amine.

10. **is one step through a transition state; the rate depends on both reactants**

    SN2 is a single concerted step; primary halogenoalkanes favour it and its rate depends on both species.

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