1. A compound that decolourises bromine water contains:

   ☐ a halogen atom

   ☐ a C=C double bond

   ☐ an –OH group

   ☐ a –COOH group

2. The best way to plan a multi-step synthesis is to:

   ☐ skip the reagents

   ☐ only work forwards from the start

   ☐ guess random reactions

   ☐ work backwards from the target, one reaction at a time

3. An orange precipitate with 2,4-DNPH indicates:

   ☐ an alkene

   ☐ an aldehyde or ketone

   ☐ an alcohol

   ☐ a carboxylic acid

4. If your route needs to add a carbon atom, the key step is:

   ☐ esterification

   ☐ oxidation with dichromate

   ☐ reduction with $NaBH_4$

   ☐ reaction with KCN

5. According to the reaction map, an alkene + steam (H_3PO_4) gives:

   ☐ a carboxylic acid

   ☐ a nitrile

   ☐ an alcohol

   ☐ an ester

6. A good synthetic route uses as many steps as possible to give a high overall yield.

   ☐ True ☐ False

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☐ True ☐ False

8. A route has four steps, each with a 90% yield. What is the overall percentage yield?

   _____

9. Which step lengthens the carbon chain by one?

   ☐ oxidation of an alcohol

   ☐ esterification

   ☐ reduction of a carbonyl

   ☐ reaction of a halogenoalkane with KCN

10. When analysing each step of a given route, you should state:

    ☐ only the product name

    ☐ nothing

    ☐ only the colour change

    ☐ the type of reaction and the reagent used

1. **a C=C double bond**

   Decolourising bromine water is the test for a C=C double bond.

2. **work backwards from the target, one reaction at a time**

   Working backwards from the target finds which reaction makes it, and from what, step by step.

3. **an aldehyde or ketone**

   2,4-DNPH detects the carbonyl group (aldehyde or ketone).

4. **reaction with KCN**

   KCN is the only AS reaction that lengthens the carbon chain.

5. **an alcohol**

   Electrophilic addition of water across the C=C gives an alcohol.

6. **False**

   False. Each step loses some product, so a good route uses few steps; the overall yield is the product of the yields of every step.

7. **True**

   Used to plan and identify reactions.

8. **65.61**

   $0.90^4 = 0.6561$, so about 66%: even good steps add up to a large loss.

9. **reaction of a halogenoalkane with KCN**

   KCN adds a CN group (a carbon) – the only AS reaction that lengthens the chain.

10. **the type of reaction and the reagent used**

    Identify the reaction type (oxidation, substitution, etc.) and the reagent/conditions for each step.

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