Organic Problem Solving

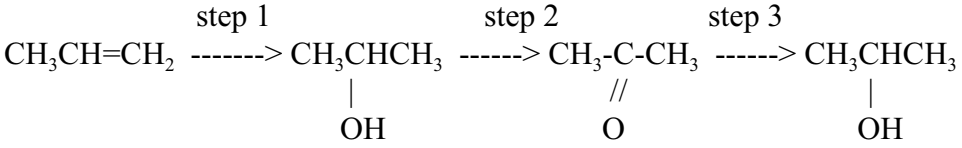
1. Suggest a way (either physical or chemical) to distinguish between ethanol and methoxymethane.

2. Compound A, of formula C_2H_6O, is oxidized to compound B of formula C_2H_4O. B is further oxidized to compound C of formula $C_2H_4O_2$. C reacts with A to produce a compound D of formula $C_4H_8O_2$. Give the names of structures A, B, C, and D, explain your reasoning, and write out one of the mechanisms.

3. A compound of formula C_3H_8O exists as two isomers, A and B. With a strong oxidizing agent, A forms a compound C of formula C_3H_6O, while B forms compound D of formula $C_3H_6O_2$. D turns blue litmus red. Give names and structures of the four compounds, linking compounds that are related.

4. The compounds butanone, 1-butanol, ethoxyethane, and butane have boiling points of 272 K, 307 K, 352 K and 390 K, though not in that order. Match the compound with the boiling points, explaining your reasoning.

5. Discuss the chemical reagents and reaction conditions necessary to complete each of the three steps in the reaction sequence shown below.



6. An aliphatic compound, X, is known to have a molecular formula $C_4H_{10}O$.
   a) Compound X reacts with sodium metal to produce hydrogen gas. To what class of compounds may compound X be assigned? Write 3 possible structural formulae for compound X.
   b) Dehydration of compound X by hot, concentrated sulphuric acid yields a gaseous compound, Z, of formula C_4H_8. Write a balanced equation which describes this process. (IB exam 1993)

7. Compound A, C_3H_6O, is a liquid which reacts with an oxidizing agent such as $Cr_2O_7^{-2}$ and is thereby oxidized to B, $C_3H_6O_2$, a strongly smelling liquid.

   Compound A also reacts with $LiAlH_4$ (a strong reducing agent) to form compound C, C_3H_8O. This is easily dehydrated to give a gas, C_3H_6, which reacts with hydrogen bromide to form D.

   The compounds B and C react together in the presence of concentrated $H_2SO_{4\,(aq)}$ to form E, $C_6H_{12}O_2$, a liquid with a pleasant, fruity smell.

   Write structural formulae and names for the compounds A, B, C, D and E.
   (IB exam 1991).

8. When pentan-2-ol and pentan-3-ol are each heated with a n acidified solution of potassium permanganate (VII), the colour of the solution changes from purple to nearly colourless.

   a) What is the oxidation stated of the manganese product?
   b) Name another reagent which would have the same effect upon the alcohols as potassium permanganate (VII)
   c) Draw the structural formulae of the two alcohols and the products of their reactions with potassium permanganate (VII). (IB exam 1990).

9. The chemical formula C_2H_6O has two isomers. Draw each isomer and identify the functional group in each case. Predict how the boiling points and solubility in water will differ. Explain the basis for your predictions.

10. Predict the reagents (3) necessary to produce the following:
    a) methylmethanoate
    b) ethylbutanoate
    c) propylethanoate

11. Liquid **A** on standing with silver nitrate solution gives a cream precipitate and a solution of **B**. When **B** is boiled with concentrated sulphuric acid, it gives a colourless gas **C**. **C** reacts with bromine to give a liquid **D** which o boiling with hot, concentrated, alcoholic sodium hydroxide gives a gas **E**. **E** reacts with an oxidising agent such as acidified $KMnO_4/OH^{-1}$, to form ethan-1,2-dioic acid, (aka: oxalic acid). If a contains two carbon atoms, identify **A to E**, explain your reasoning and write equations for all the reactions occurring.

12. A solid **P** burns with a very smoky flame and a solution of **P** is very slightly basic. When a solution of **P** in water is treated with bromine water, a white precipitate, **Q**, forms. When **P** is treated with concentrated nitric acid a yellow solid, **R** forms. Identify **P, Q, and R** and give equations for the reactions.

13. Show by means of equations and essential reaction conditions only, how you would carry out the following transformations, (using reactions you have already met):

    (a) $H_2C = CH_2$ into $CH_3CH_2CH_2OH$
    (b) CH_3CH_2OH into $(OH)CH_2CH_2(OH)$
    (c) C_6H_6 into C_6H_5Cl
    (d) C_6H_6 into C_6H_5COOH