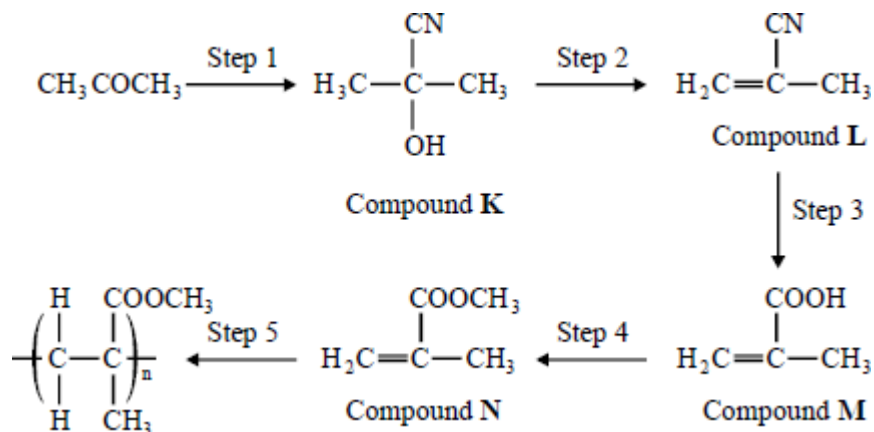**Q1.** This question concerns the preparation of the plastic poly(methyl 2-methylpropenoate) (*Perspex*), starting from propanone.

Which one of the following sets of reagents is **not** suitable for the step indicated?

A   Step 1 HCN (NaCN then dilute HCl)

B   Step 2 hot ethanolic KOH

C   Step 3 warm aqueous H_2SO_4

D   Step 4 CH_3OH with an acid catalyst

(Total 1 mark)

Q2.   Use the data given on the back of the Periodic Table (PT) to help you answer this question.
Compounds **A** to **G** are all isomers with the molecular formula $C_6H_{12}O_2$

(a)   Isomer **A**, $C_6H_{12}O_2$, is a neutral compound and is formed by the reaction between compounds **X** and **Y** in the presence of a small amount of concentrated sulphuric acid.
X and **Y** can both be formed from propanal by different redox reactions.
X has an absorption in its infra-red spectrum at 1750 cm^{-1}.
Deduce the structural formulae of **A**, **X** and **Y**. Give suitable reagents, in each case, for the formation of **X** and **Y** from propanal and state the role of concentrated sulphuric acid in the formation of **A**.
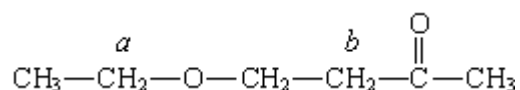
(7)

(b)   Isomers **B**, **C**, **D** and **E** all react with aqueous sodium carbonate to produce carbon dioxide.
Deduce the structural formulae of the three isomers that contain an asymmetric carbon atom.
The fourth isomer has only three singlet peaks in its proton n.m.r. spectrum. Deduce

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the structural formula of this isomer and label it **E**.

(4)

(c)   Isomer **F**, $C_6H_{12}O_2$, has the structural formula shown below, on which some of the protons have been labelled.

$$CH_3-CH_2-O-CH_2-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-CH_3$$

with *a* labelling the CH_2 and *b* labelling the CH_2 positions

A proton n.m.r. spectrum is obtained for **F**. Using Table 1 at the back of the Periodic Table (PT), predict a value of δ for the protons labelled *a* and also for those labelled *b*. State and account for the splitting patterns of the peaks assigned to the protons *a* and *b*.
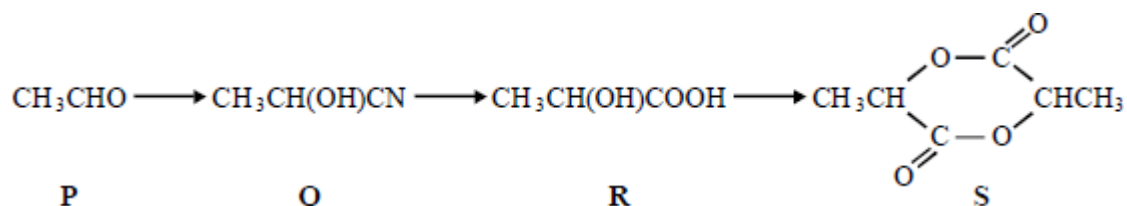
(6)

(d)   Isomer **G**, $C_6H_{12}O_2$, contains six carbon atoms in a ring. It has an absorption in its infra-red spectrum at 3270 cm⁻¹ and shows only three different proton environments in its proton n.m.r. spectrum. Deduce a structural formula for **G**.

(2)
(Total 19 marks)

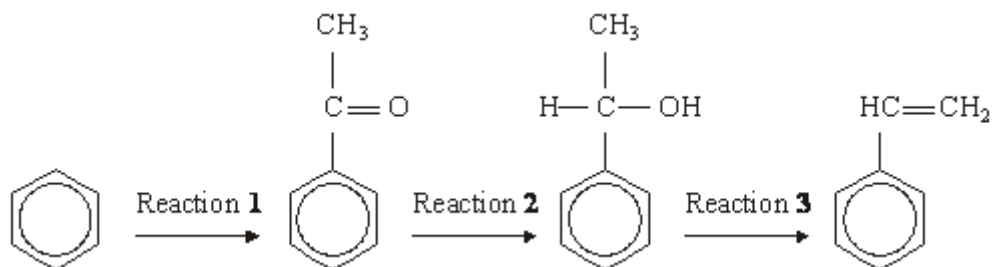**Q3.** This question refers to the reaction sequence below.

$$CH_3CHO \longrightarrow CH_3CH(OH)CN \longrightarrow CH_3CH(OH)COOH \longrightarrow S$$

P   Q   R

Which one of the following is **not** involved in the reaction sequence?

A   esterification

B   hydrolysis

C   nucleophilic addition

D   reduction

(Total 1 mark)

Q4. A possible synthesis of phenylethene *(styrene)* is outlined below.

(a) In Reaction **1**, ethanoyl chloride and aluminium chloride are used to form a reactive species which then reacts with benzene.
Write an equation to show the formation of the reactive species.
Name and outline the mechanism by which this reactive species reacts with benzene.

(6)

(b) $NaBH_4$ is a possible reagent for Reaction **2**.
Name and outline the mechanism for the reaction with $NaBH_4$ in Reaction **2**.
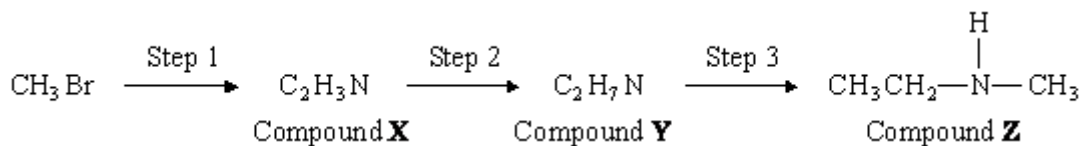Name the product of Reaction **2**.

(6)

(c) Name the type of reaction involved in Reaction **3** and give a reagent for the reaction.

(2)
(Total 14 marks)

Q5. Compound **Z** can be formed via compounds **X** and **Y** in the three step synthesis shown below.

Identify compounds **X** and **Y** and give reagents and conditions for Steps 1 and 2.

State the **type** of compound of which **Z** is an example.

Compound **Z** reacts with a large excess of bromomethane to form a solid product. Draw

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the structure of this product and name the type of mechanism for this reaction.

(Total 9 marks)

Q6.   (a)   Describe how propanal, CH_3CH_2CHO, and propanone, CH_3COCH_3, can be distinguished using

(i)   a chemical test and

(ii)   the number of peaks in their proton n.m.r. spectra.

(5)

(b)   Compound **Z** can be produced by the reaction of compound **X** with compound **Y** as shown in the synthesis outlined below.
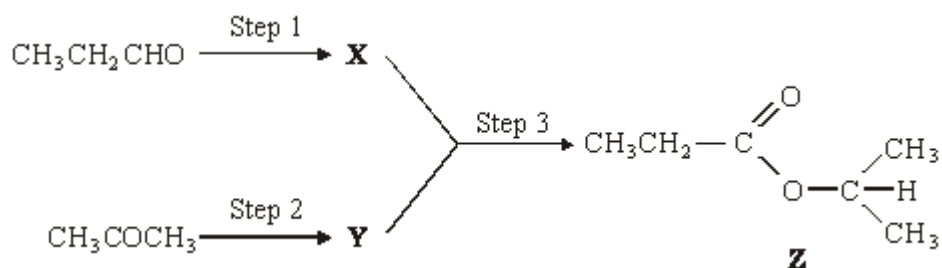
Identify compounds **X** and **Y**.
For each of the three steps in the synthesis, name the type of reaction involved and give reagents and conditions. Equations are **not** required.

(10)
(Total 15 marks)