Exemplar exam question – Option G

1 This question is about tertiary alcohols.

a Draw the full structural formula of 2-methylpropan-2-ol. [1]

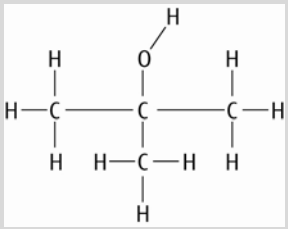
b Deduce the structural formulas of a Grignard reagent and another organic molecule from which 2-methylpropan-2-ol could be made. [2]

c Write an equation for the reaction that occurs when 2-methylpropan-2-ol is heated with concentrated phosphoric acid. [2]

d Describe the mechanism for the reaction in part **c**. [3]

Commentary

a [1]



The question requires a full structural formula and so all bonds and atoms should be shown, including the bond between the O and the H.

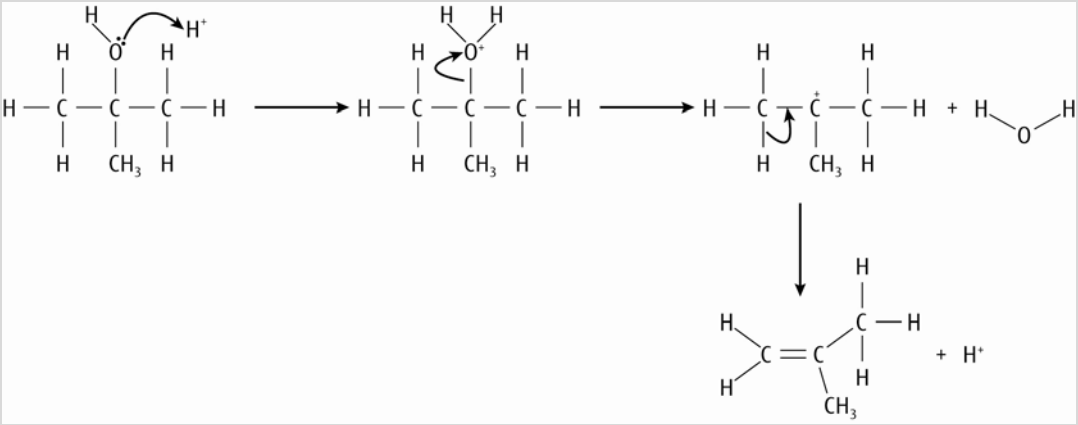
b CH_3MgBr and $(CH_3)_2CO$ [2]

Structural formulas are required here so the condensed structural formulas shown are acceptable. If, however, you find condensed structural formulas more difficult to write then full structural formulas would also be acceptable.

c $(CH_3)_3COH \xrightarrow{H_3PO_4(aq)} (CH_3)_2CCH_2 + H_2O$ [2]

'Write an equation' requires a balanced chemical equation. The reaction that occurs is a dehydration reaction. Again, full structural formulas would be acceptable but molecular formulas, e.g. C_4H_8 for the product, would not be as they will not show the nature of the reaction occurring.

d [3]



There are many ways in which students can be asked to draw out the mechanism for a reaction. Whichever action verb is used, the question always requires the mechanism to be drawn out using curly arrows.

The syllabus states specifically that H^+ should be used to represent the acid catalyst so the mechanism as shown should be sufficient to gain all marks. However, before the first stage the dissociation of phosphoric acid to form H^+ could also be shown. One recent mark scheme required the students to show the H^+ being removed at the third stage by the H_2O molecule. It is important that students are precise with curly arrows and it is usually better to draw in lone pairs on oxygen atoms, as in the first stage, to emphasise that movement of an electron pair is being shown.