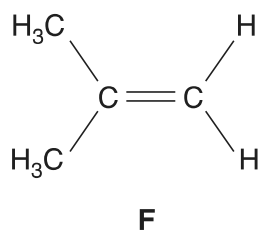
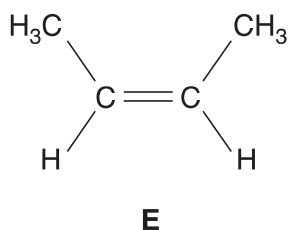
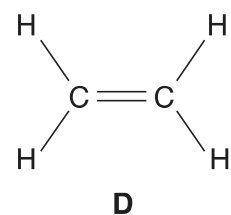
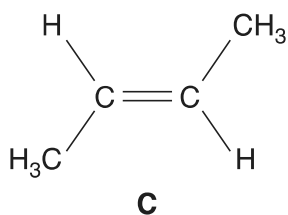
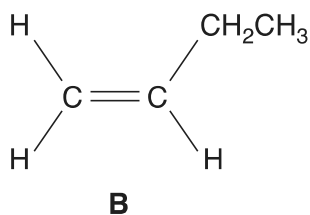


5 Alkenes **B**, **C**, **D**, **E** and **F** are shown below.



You will have to refer to these alkenes throughout the question.

(a) Describe, using the orbital overlap model, how the π -bond in alkene **D** is formed.

[2]

(b) Many alkenes show *E/Z* isomerism.

(i) Explain why *E/Z* isomerism is shown in some alkenes.

.....

 [2]

(ii) Which **two** alkenes are a pair of *E/Z* isomers?

Choose from **B**, **C**, **D**, **E** and **F**.

..... and

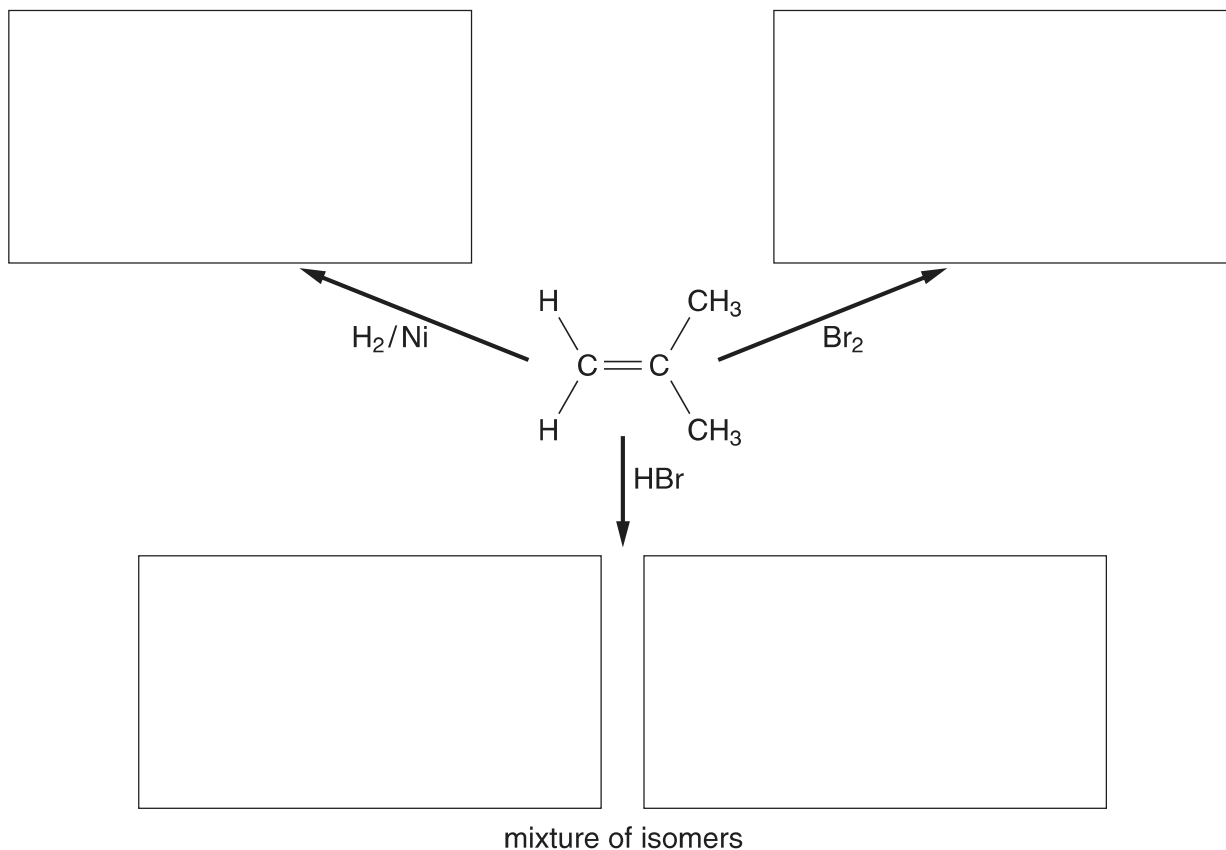
[1]

(c) What is the main organic product of the reaction between alkene **D** and steam in the presence of a phosphoric acid catalyst?

..... [1]

3 Alkenes are unsaturated hydrocarbons used in the industrial production of many organic compounds.

(a) Complete the flowchart below to show the organic product formed in each addition reaction of methylpropene.

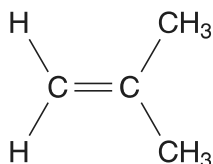


[4]

(b) Curly arrows are used in reaction mechanisms to show the movement of electron pairs during chemical reactions.

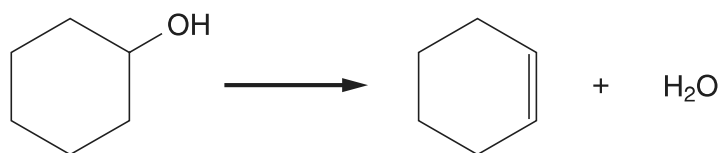
Use curly arrows to outline the mechanism for the addition reaction of methylpropene with bromine. The structure of methylpropene has been drawn for you.

Include relevant dipoles in your answer.



[4]

- (c) Alkenes can be prepared by the dehydration of alcohols with an acid catalyst. Cyclohexene can be prepared by the dehydration of cyclohexanol, shown below.



A student reacted 7.65 g of cyclohexanol, $C_6H_{12}O$, and obtained 0.0268 mol of cyclohexene.

- (i) What is the molecular formula of cyclohexene?

..... [1]

- (ii) Calculate the percentage yield of cyclohexene.

answer = % [3]

- (d) Percentage yield has been used for many years to measure the 'success' of a reaction. Recently, chemists have turned their thoughts also to the atom economy of a reaction.

- (i) Explain the term *atom economy*.

.....
 [1]

- (ii) Cyclohexene can also be prepared by the reaction below.



Explain why the atom economy of this cyclohexene preparation is higher than that from cyclohexanol in (c).

.....

 [2]

[Total: 15]

Turn over