Shapes of Molecules - Questions by Topic

Q1.

This question is about compounds containing chlorine.

(a) A precipitate of silver chloride is formed when silver nitrate solution reacts with sodium chloride solution.

A student wrote an ionic equation for the reaction.

$$Ag^{2+}(l) + 2Cl^{-}(l) \rightarrow AgCl_2(s)$$

Explain why this equation is incorrect, even though it is balanced.

(2)

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(b) A sample of a compound is analysed and found to contain **only** 3.09 g carbon, 0.26 g hydrogen and 9.15 g chlorine.

The molar mass of the compound is 97.0 g mol^{-1}.

Calculate the molecular formula of this compound.

You **must** show your working.

(3)

(c) Nitrogen trichloride has the formula NCl_3.

(i) A sample of nitrogen trichloride contained only nitrogen atoms with mass number 14, and chlorine atoms with mass numbers 35 and 37.

Give the formula and mass/charge ratio for each of the **four** ions responsible for the molecular ion peaks in the mass spectrum of nitrogen trichloride.

(2)

(ii) Complete the table to predict the shape and Cl—N—Cl bond angle in nitrogen trichloride.

(3)

Number of bonding pairs of electrons on nitrogen	
Number of lone pairs of electrons on nitrogen	
Shape of molecule	
Cl—N—Cl bond angle	

(d) Aluminium chloride exists as an ionic lattice in the solid state and as a covalent dimer, Al_2Cl_6, in the gas phase, just above its boiling temperature.

(i) Explain why aluminium chloride in the solid state has significant covalent character.

(2)

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(ii) Describe how two $AlCl_3$ molecules are joined together in the dimer.

Include a diagram in your answer.

(2)

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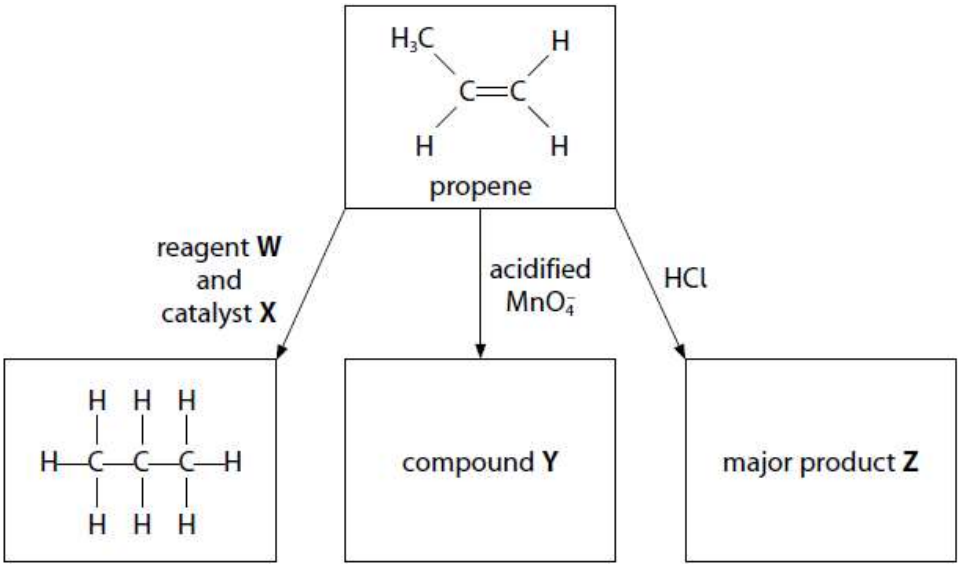
(Total for question = 14 marks)

Q2.

Alkenes contain a double bond between two carbon atoms.

(a) Some reactions of propene are shown.



(i) Give the names of reagent **W** and catalyst **X**.

(2)

Reagent **W**

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Catalyst **X**

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(ii) Draw the displayed formula of compound **Y**.

(1)

(iii) Draw the skeletal formula of the major product **Z**.

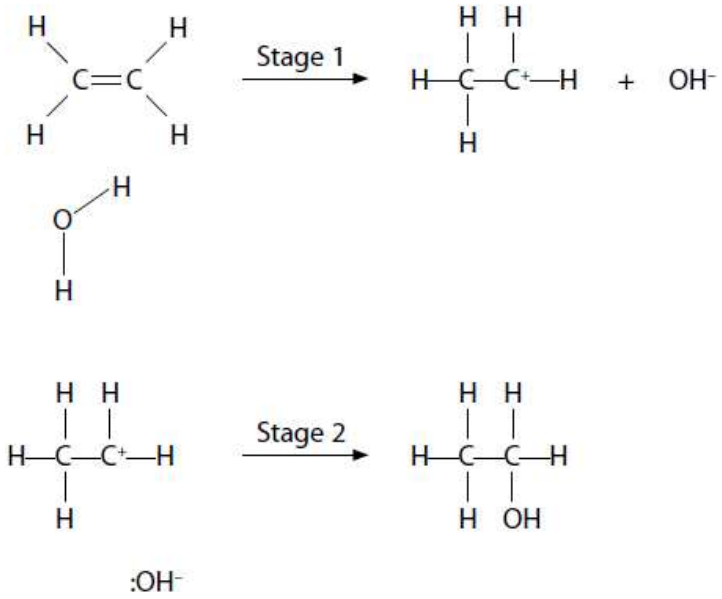
(1)

(b) Ethene reacts with steam in the presence of a catalyst to form ethanol.

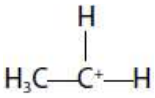
The mechanism takes place in two stages.

(i) Complete the simplified mechanism for the reaction by adding curly arrows and the relevant dipole.

(4)



(ii) Predict the shape of the intermediate ion with reference to the positively-charged carbon. Justify your answer.



(3)

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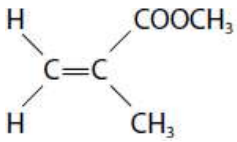
(c) Methyl 2-methylpropenoate has the structure:



Draw a section of the polymer formed from methyl 2-methylpropenoate, showing two repeat units.

(2)

(Total for question = 13 marks)

Q3.

Which species is **not** tetrahedral?

☐ **A** CCl_4

☐ **B** CH_4

☐ **C** ICl_4^-

☐ **D** NH_4^+

(Total for question = 1 mark)

Q4.

What are the shapes of the $AlCl_3$ and PH_3 molecules?

	Shape of $AlCl_3$ molecule	Shape of PH_3 molecule
☐ **A**	pyramidal	pyramidal
☐ **B**	pyramidal	trigonal planar
☐ **C**	trigonal planar	trigonal planar
☐ **D**	trigonal planar	pyramidal

(Total for question = 1 mark)