

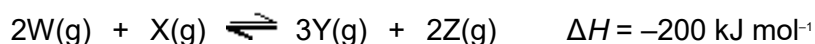
- Q1.** (a) Name and outline a mechanism for the reaction between propanoyl chloride, $\text{CH}_3\text{CH}_2\text{COCl}$, and methylamine, CH_3NH_2 . Draw the structure of the organic product. (6)
- (b) Benzene reacts with propanoyl chloride in the presence of aluminium chloride. Write equations to show the role of aluminium chloride as a catalyst in this reaction. Outline a mechanism for this reaction of benzene. (5)
- (c) Write an equation for the reaction of propanoyl chloride with water. An excess of water is added to 1.48 g of propanoyl chloride. Aqueous sodium hydroxide is then added from a burette to the resulting solution. Calculate the volume of 0.42 mol dm^{-3} aqueous sodium hydroxide needed to react exactly with the mixture formed. (5)
- (Total 16 marks)**

- Q2.** (a) Addition reactions to both alkenes and carbonyl compounds can result in the formation of isomeric compounds.
- (i) Choose an alkene with molecular formula C_4H_8 which reacts with HBr to form two structural isomers. Give the structures of these two isomers and name the type of structural isomerism shown.
- Outline a mechanism for the formation of the major product.
- (ii) Using HCN and a suitable carbonyl compound with molecular formula $\text{C}_3\text{H}_6\text{O}$, outline a mechanism for an addition reaction in which two isomers are produced. Give the structures of the two isomers formed and state the type of isomerism shown. (14)

- (b) Explain why ethanoyl chloride reacts readily with nucleophiles.
Write an equation for one nucleophilic addition–elimination reaction of ethanoyl chloride.
(A mechanism is not required.)

(4)
(Total 18 marks)

- Q3.** (a) The gaseous reactants **W** and **X** were sealed in a flask and the mixture left until the following equilibrium had been established.



Write an expression for the equilibrium constant, K_p , for this reaction.
State one change in the conditions which would both increase the rate of reaction and decrease the value of K_p . Explain your answers.

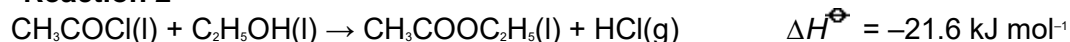
(7)

- (b) Ethyl ethanoate can be prepared by the reactions shown below.

Reaction 1



Reaction 2



- (i) Give one advantage and one disadvantage of preparing ethyl ethanoate by **Reaction 1** rather than by **Reaction 2**.
- (ii) Use the information given above and the data below to calculate values for the standard entropy change, ΔS^\ominus , and the standard free-energy change, ΔG^\ominus , for **Reaction 2** at 298 K.

	$\text{CH}_3\text{COCl}(l)$	$\text{C}_2\text{H}_5\text{OH}(l)$	$\text{CH}_3\text{COOC}_2\text{H}_5(l)$	$\text{HCl}(g)$
$S^\ominus / \text{JK}^{-1}\text{mol}^{-1}$	201	161	259	187

(8)
(Total 15 marks)

