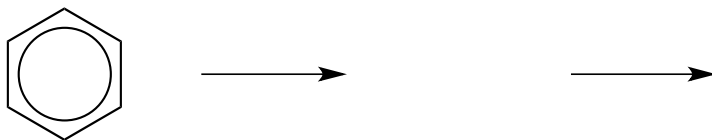


## EXAM-STYLE QUESTIONS – A2 Organic Reaction Mechanisms

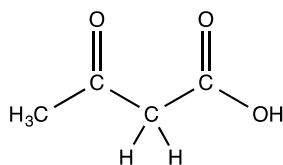
1 Bromobenzene can be prepared from benzene, through reaction with  $\text{Br}_2$  and an  $\text{FeBr}_3$  catalyst.

- Draw and name the mechanism for this reaction.
- Use  $\text{Br}^+$  as the electrophile. Include any intermediate(s) and the product(s).



Name of mechanism:..... (5 marks)

2 Acetoacetic acid, shown below, is an organic compound used in the synthesis of some dyes.



acetoacetic acid

(a) Explain briefly why acetoacetic acid is soluble in water.

.....  
..... (1 mark)

(b) Name the **functional groups** present in acetoacetic acid.

..... (2 marks)

(c) Acetoacetic acid can be reduced using sodium borohydride,  $\text{NaBH}_4$ , to form  $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{COOH}$ .

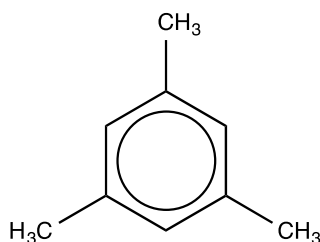
Draw a mechanism for this reaction, using curly arrows and showing relevant dipoles. Use  $:\text{H}^-$  as the nucleophile.

(4 marks)

- 3 Nitrobenzene is formed from the reaction of benzene with concentrated nitric acid and concentrated sulfuric acid.
- (a) Outline the mechanism for this reaction. Your answer should also include a balanced equation showing how the electrophile is formed.

(5 marks)

- (b) 1,3,5-trimethylbenzene is used as the starting material instead of benzene in the synthesis of some azo dyes.



1,3,5-trimethylbenzene

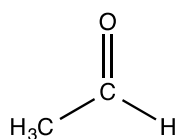
How many different  
formed from the  
trimethylbenzene?

**structural isomers** could be  
mononitration of 1,3,5-

.....

(1 mark)

- 4 Ethanal reacts with  $:\text{CN}^-$  ions, formed from HCN in the presence of KCN.
- (a) Draw and name the mechanism for this reaction. The structure of ethanal is given below.



Name of mechanism:.....

(5 marks)

- (b) The product of this reaction contains a **chiral** centre. Identify this centre by marking the chiral carbon in your answer to (a) with an asterisk (\*).

(1 mark)

- (c) Would you expect the reaction to produce a racemic mixture of products? Explain your answer. (Note: A 'racemic mixture' is a solution in which both optical isomers are present in equal amounts.)

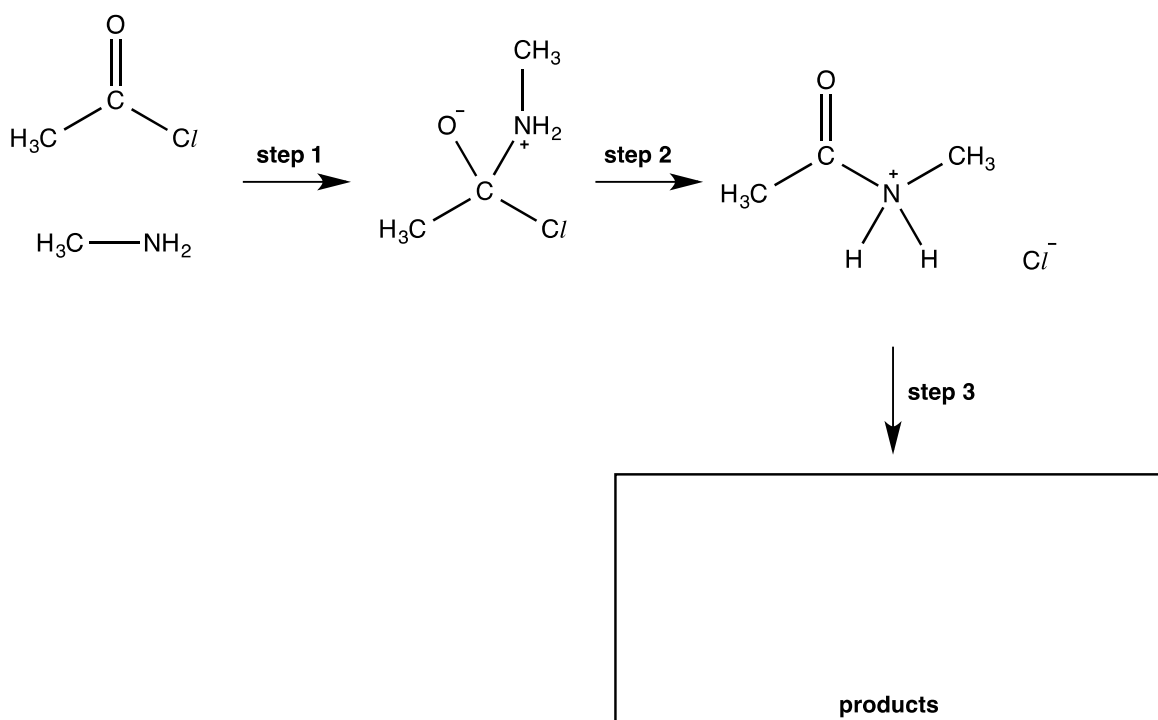
.....  
 .....  
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(2 marks)

- 5 Amides can be produced by reacting amines with acyl chlorides.

This reaction proceeds via a nucleophilic addition-elimination mechanism.

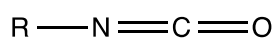
Using your knowledge of reaction mechanisms, draw appropriate curly arrows to complete the mechanism for the reaction of  $\text{CH}_3\text{COCl}$  with  $\text{CH}_3\text{NH}_2$ , showing all relevant dipoles. Draw the products of the reaction.



(5 marks)

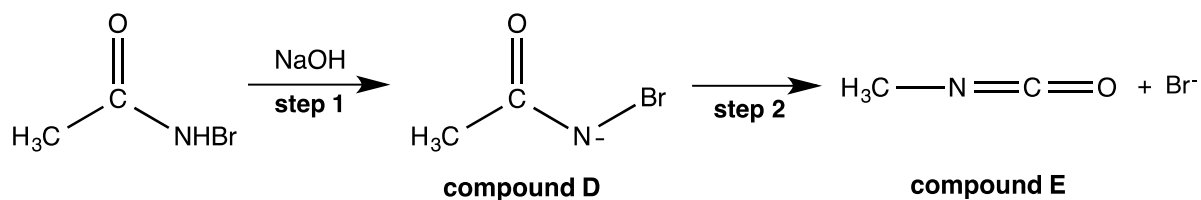
## EXTENSION QUESTION

- 6 Isocyanates are organic compounds used in the production of polymers and pesticides. The general structure of an isocyanate is shown below, with the 'R' representing any generic alkyl group.



isocyanate

Some of the steps in the formation of an isocyanate compound are shown below.



- (i) What type of reaction occurs in **step 1**?

.....

(1 mark)

- (ii) Draw curly arrows on **compound D** to suggest a mechanism for **step 2**.

(3 marks)

**TOTAL MARKS: 35**