

Arenes

Question Paper 3

Level	International A Level
Subject	Chemistry
Exam Board	CIE
Topic	Hydrocarbons
Sub-Topic	Arenes
Paper Type	Theory
Booklet	Question Paper 3

Time Allowed: 81 minutes

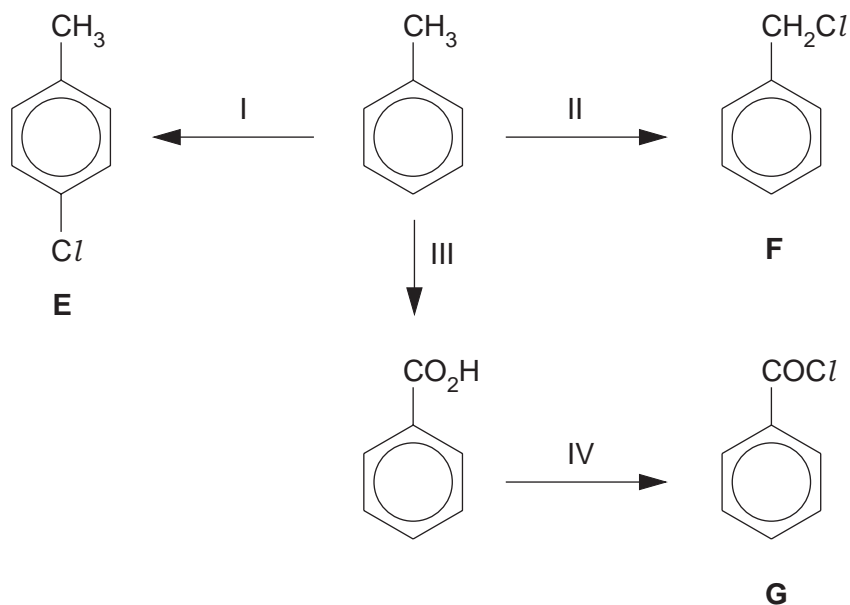
Score: /67

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

1 The following scheme shows some reactions of methylbenzene.



(a) Suggest reagents and conditions for reactions I to IV.

I

II

III

IV

[4]

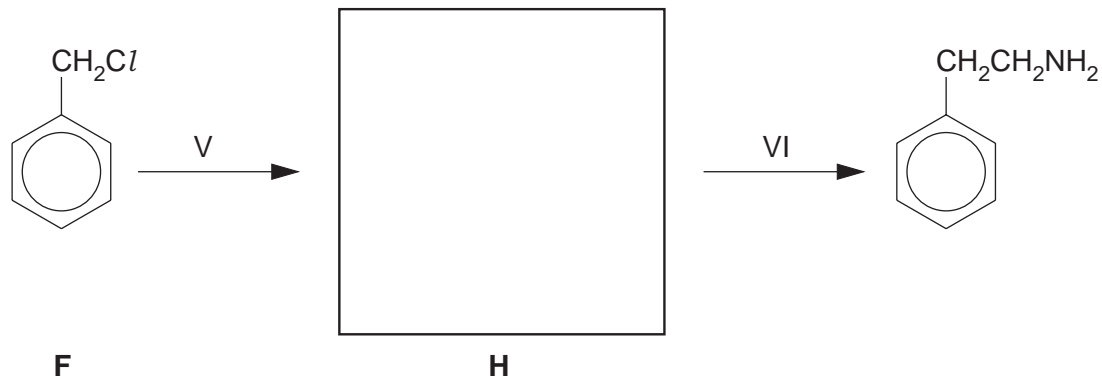
(b) What *type of reaction* is each of the following?

reaction I

reaction III

[2]

- (c) Compound **F** can be converted into 2-phenylethylamine in a two-stage process. Suggest a structure for the intermediate, **H**, in the box below, and suggest reagents and conditions for the steps V and VI.



reagents and conditions for step V

reagents and conditions for step VI

[4]

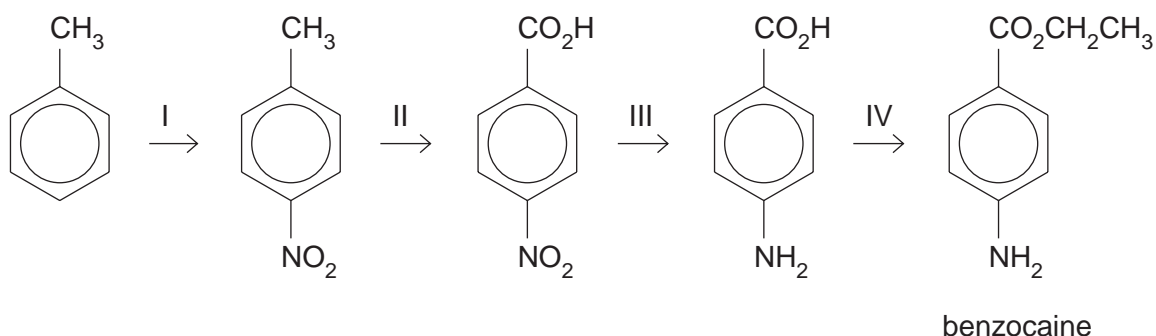
- (d) The compounds **E**, **F** and **G** react at different rates with nucleophilic reagents. Draw structures for the products of each compound with the following reagents. If no reaction occurs, write "**no reaction**" in the box.

compound	reagent	
	cold water	hot NaOH(aq)
E		
F		
G		

[6]

[Total: 16]

- 2 Benzocaine is an important local anaesthetic used in skin creams for sprains and other muscular pains. It can be made by the following route.



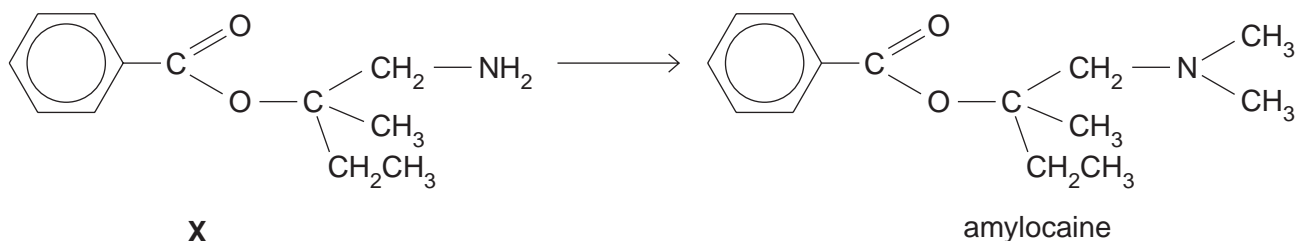
- (a) Suggest reagents and conditions for each of the above four reactions.

I
 II
 III
 IV [6]

- (b) Draw steps to show the mechanism of reaction I.

[2]

- (c) Another local anaesthetic is amylocaine, which can be made from compound X.



- (i) Apart from the benzene ring, name **two** functional groups in the molecule of compound X.

.....

- (ii) Explain whether compound **X** would be more or less basic than benzocaine.

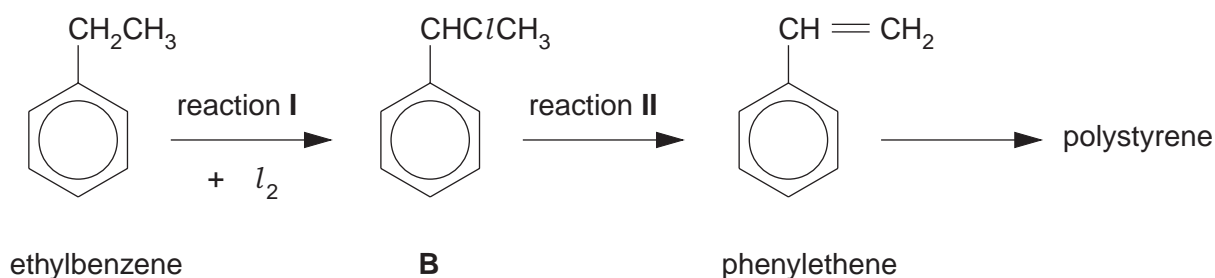
.....

.....

[3]

[Total: 11]

- 3 Ethylbenzene is an important starting material for making polystyrene (poly(phenylethene)).



- (a) (i) State the conditions needed to carry out reaction I in the laboratory.

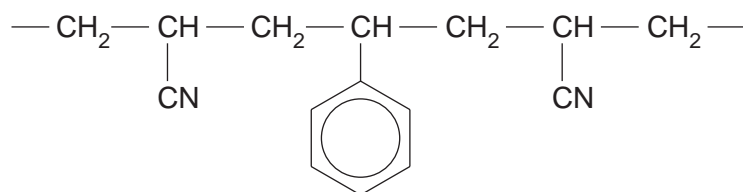
.....

- (ii) State the reagent and conditions needed for reaction II.

.....

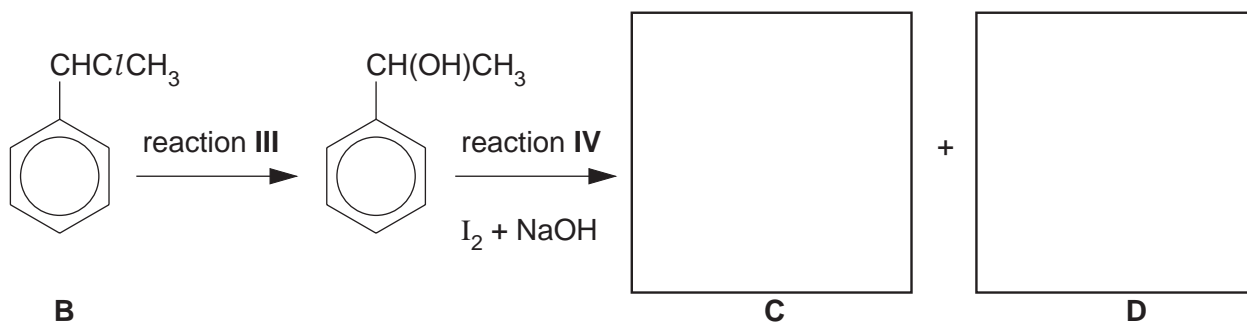
- (iii) Draw the structure of the repeat unit of polystyrene.

- (iv) There are several polymers that consist of phenylethene co-polymerised with other monomers. The following formula shows part of the chain of one such co-polymer.



Deduce the structural formula of the other monomer.

(b) Compound **B** undergoes the following series of reactions.



(i) Suggest reagents and conditions for reaction III.

.....

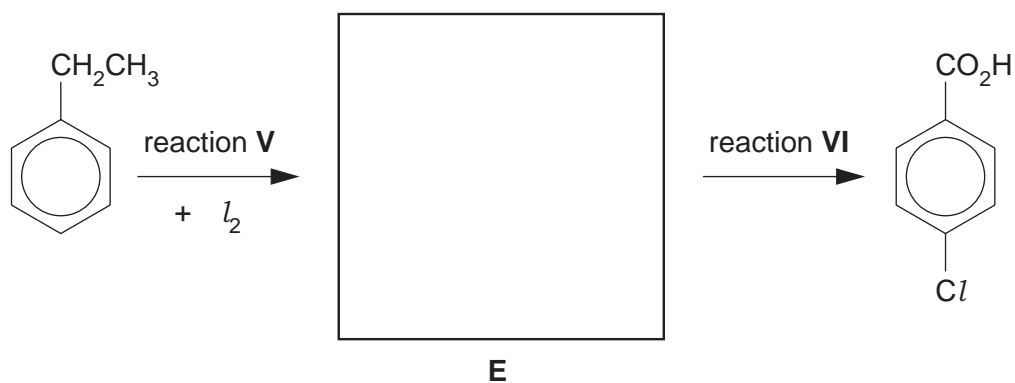
(ii) What would you see when reaction IV was carried out?

.....

(iii) Draw structures for **C** and **D** in the boxes above.

[4]

(c) Ethylbenzene can react with chlorine under a different set of conditions to give compound **E**, an isomer of compound **B**. Compound **E** undergoes the following reaction.



(i) Draw a structure for **E** in the box above.

(ii) Describe the conditions used for reaction V.

.....

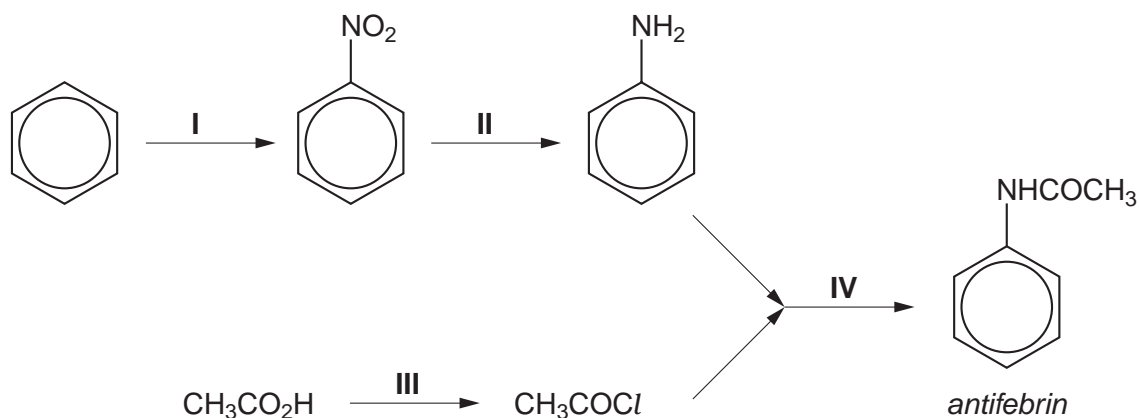
(iii) State the reagents used for reaction VI.

.....

[3]

[Total: 12]

- 4 The antipyretic (fever-reducing) drug *antifebrin* can be made from benzene and ethanoic acid by the following route.



- (a) (i) What type of reaction is reaction I?

.....

- (ii) Suggest the reagents and conditions for reaction I.

.....

- (iii) Complete the following scheme showing the mechanism of reaction I, by drawing appropriate formulae in the three boxes.



[6]

- (b) (i) What type of reaction is reaction II?

.....

- (ii) Suggest the reagents and conditions for reaction II.

.....

[2]

(c) Suggest the reagents and conditions for reaction III.

..... [1]

(d) (i) Apart from the benzene ring, name the functional group in *antifebrin*.

.....

(ii) What reagents and conditions are needed to hydrolyse *antifebrin*?

.....

[2]

[Total: 11]

5 (a) State the reagents and conditions needed to convert benzene into

(i) chlorobenzene,

.....

(ii) bromobenzene,

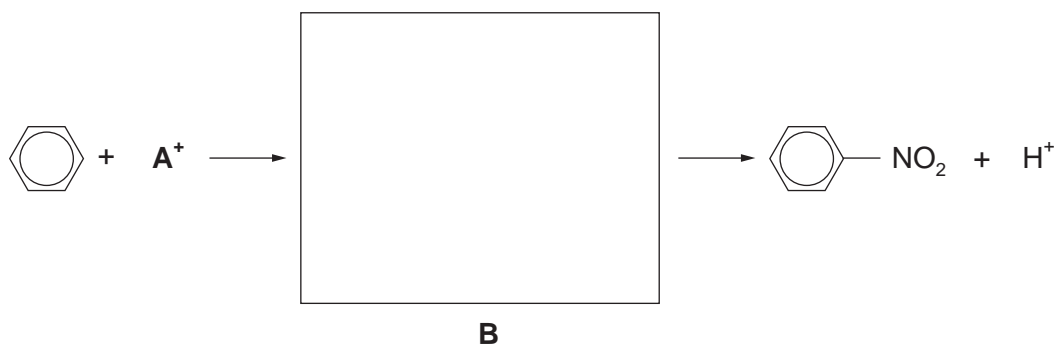
.....

(iii) nitrobenzene.

.....

[4]

(b) The nitration of benzene is a two-step reaction that can be represented as follows.



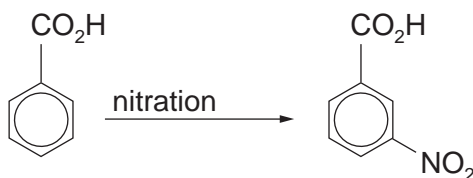
(i) Identify the cation A^+

(ii) Draw the structure of the intermediate **B** in the box.

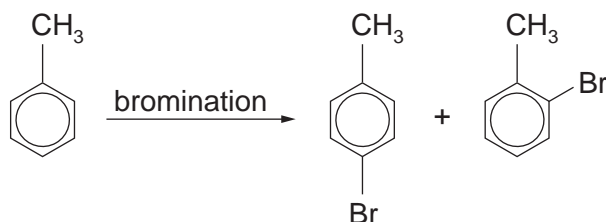
[2]

- (c) The position of substitution during the electrophilic substitution of arenes is determined by the nature of the group already attached to the ring.

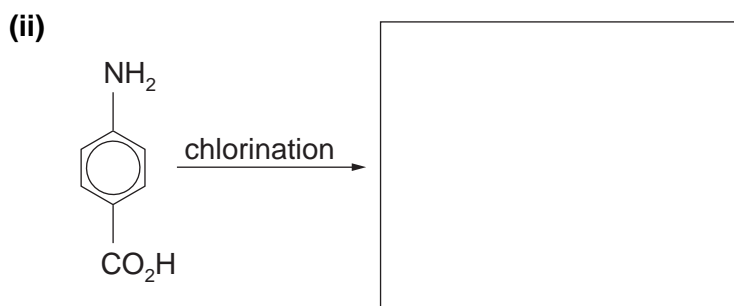
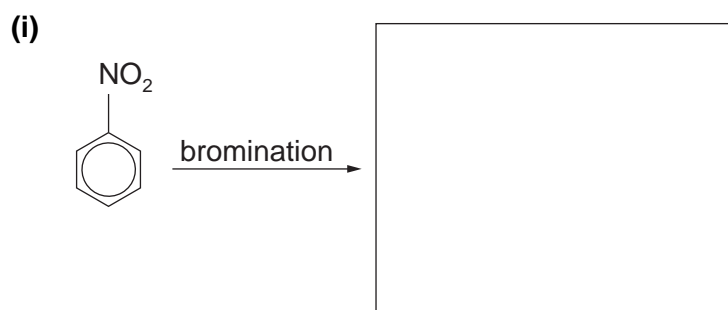
Electron-withdrawing groups such as $-\text{CO}_2\text{H}$ or $-\text{NO}_2$ direct the incoming group to the 3-position.



On the other hand, electron-donating groups such as $-\text{CH}_3$ or $-\text{NH}_2$ direct the incoming group to the 2- or 4- positions.



Use this information to suggest a likely structure for the organic product of each of the following reactions.

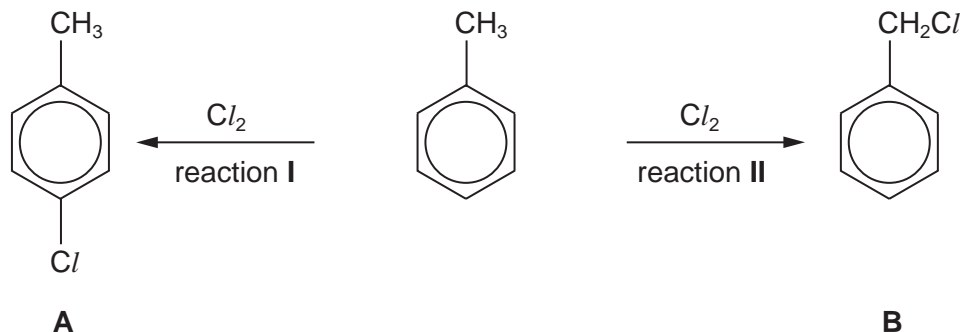


[2]

[Total: 8]

6 This question is concerned with organochlorine compounds.

(a) State the conditions needed to produce the two compounds **A** and **B**.



(i) conditions for reaction I

.....

(ii) conditions for reaction II

..... [2]

(b) State the reagent needed to carry out the following reaction.



reagent for reaction III: [1]

(c) The three chloro-compounds **A**, **B** and **C** vary in their ease of hydrolysis.

(i) Place a tick in the box corresponding to the correct relative rates of hydrolysis. [the symbol '>' means 'faster than']

	place one tick only in this column
A > B > C	
A > C > B	
B > A > C	
B > C > A	
C > B > A	
C > A > B	

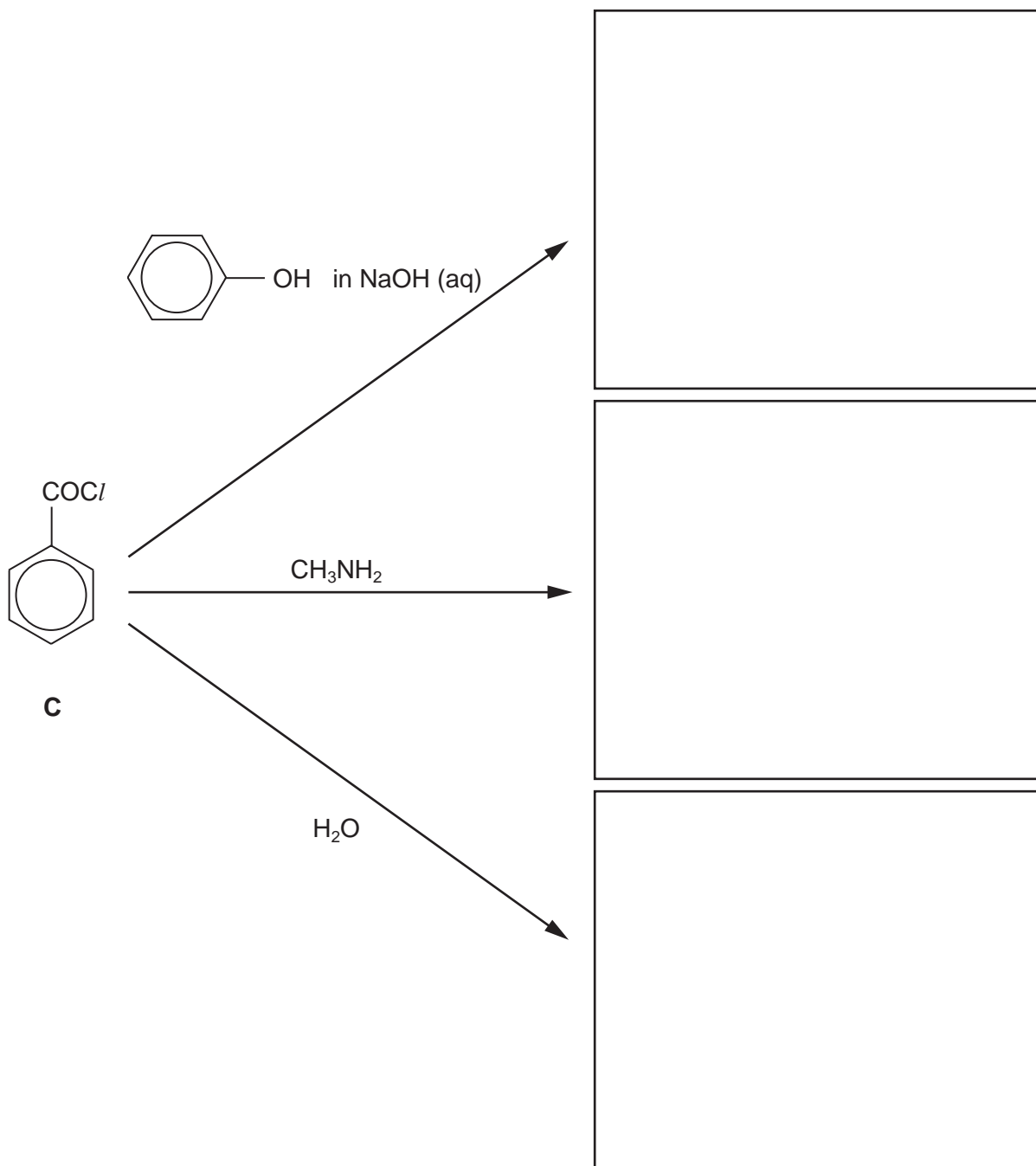
(ii) Suggest an explanation for these differences in reactivity.

.....

.....

..... [3]

- (d) Draw the structural formulae of the organic products of the following reactions of compound **C**.



[3]

[Total: 9]