Arenes

Question Paper 4

Level	International A Level
Subject	Chemistry
Exam Board	CIE
Topic	Hydrocarbons
Sub-Topic	Arenes
Paper Type	Theory
Booklet	Question Paper 4

Time Allowed: **47 minutes**

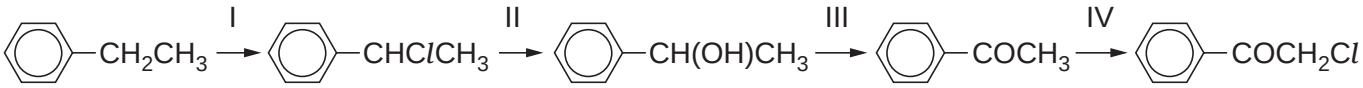
Score: **/39**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	777.5%	70%	62.5%	57.5%	45%	<45%

1 Chloroacetophenone (compound **D**, below) was formerly the most widely used tear gas, under the codename *CN*. It was used in warfare and in riot control. It can be synthesised from ethylbenzene, **A**, by the following route.

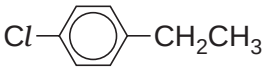


A **B** **C** **D**

(a) Suggest reagents and conditions for step I.

.....[1]

(b) Suggest reagents and conditions for converting ethylbenzene into compound **E**, an isomer of **B**.



E

.....[1]

(c) Draw the structure of the product obtained by heating ethylbenzene with $KMnO_4$.

[1]

(d) Describe a test (reagents and observations) that would distinguish compound **C** from compound **F.**

F

reagents

.....

observation with **C**

.....

observation with **F**

.....
[2]

(e) The efficiency of a tear gas is expressed by its 'intolerable concentration', I.C. The I.C. of the tear gas *CN* has been measured as 0.030 g m^{-3} of air.
How many moles of chloroacetophenone need to be sprayed into a room of volume 60 m^3 in order to achieve this concentration?

.....

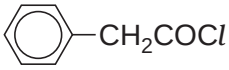
.....

.....[2]

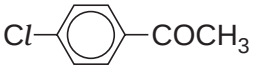
(f) Residues of *CN* can be destroyed by hydrolysis with an aqueous alkali.

D

Compounds **G** and **H** are isomers of compound **D**.



G



H

(i) Arrange the three isomers **D, G** and **H** in order of increasing ease of hydrolysis.

.....

(ii) Explain the reasoning behind your choice.

.....

.....

.....
[3]

[Total : 10]

2 Because of the lack of reactivity of the nitrogen molecule, extreme conditions need to be used to synthesise ammonia from nitrogen in the Haber process.

(a) Suggest an explanation for the lack of reactivity of the nitrogen molecule, N_2.

.....

.....

[1]

(b) Under conditions of high temperature, nitrogen and oxygen react together to give oxides of nitrogen.

(i) Write an equation for a possible reaction between nitrogen and oxygen.

.....

(ii) State **two** situations, one natural and one as a result of human activities, in which nitrogen and oxygen react together.

.....

.....

(iii) What is the main environmental effect of the presence of nitrogen oxides in the atmosphere?

.....

[4]

(c) Describe and explain how the basicities of ethylamine and phenylamine compare to that of ammonia.

.....

.....

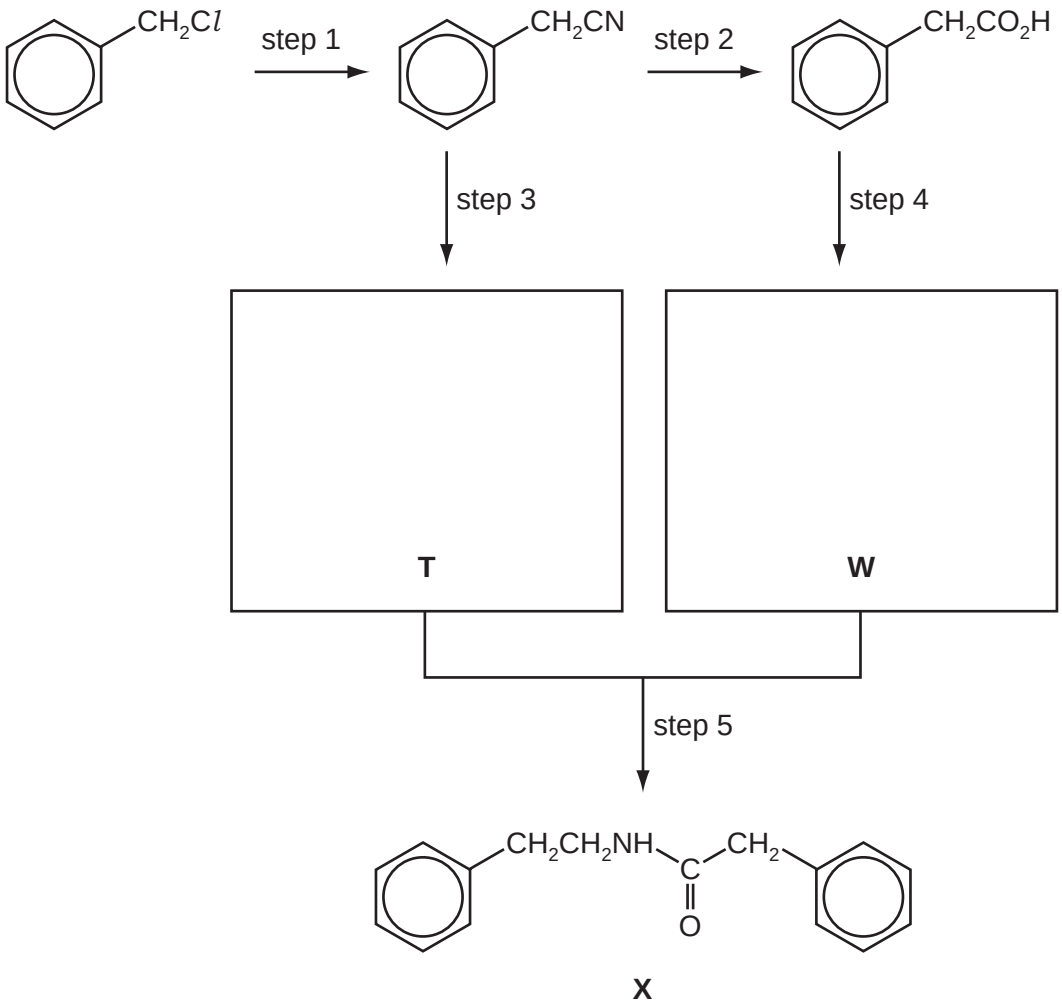
.....

.....

.....

[4]

(d) Compound **X** is a useful intermediate in the synthesis of pharmaceuticals.
X can be synthesised from chloromethylbenzene according to the following scheme.



X

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

step 1 .....

step 2 .....

(ii) Suggest reagents and conditions for

step 1, ...

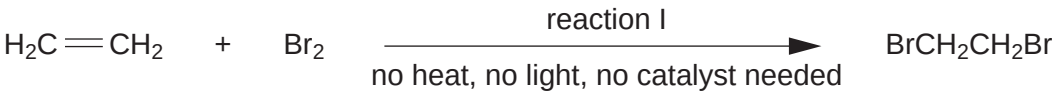
step 2. .....

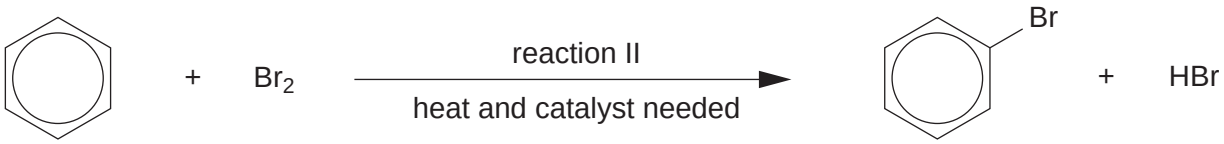
(iii) Draw the structures of the intermediates **T** and **W** in the boxes above.

[6]

[Total: 15]

3 Both ethene and benzene react with bromine, but the mechanisms and the types of products of the two reactions are different.





(a) State the *type of reaction* undergone in each of reactions I and II.

reaction I

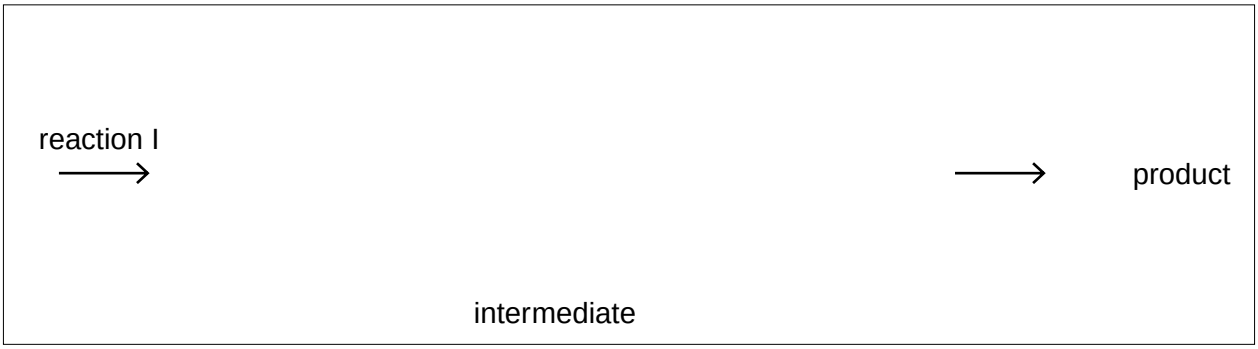
.....

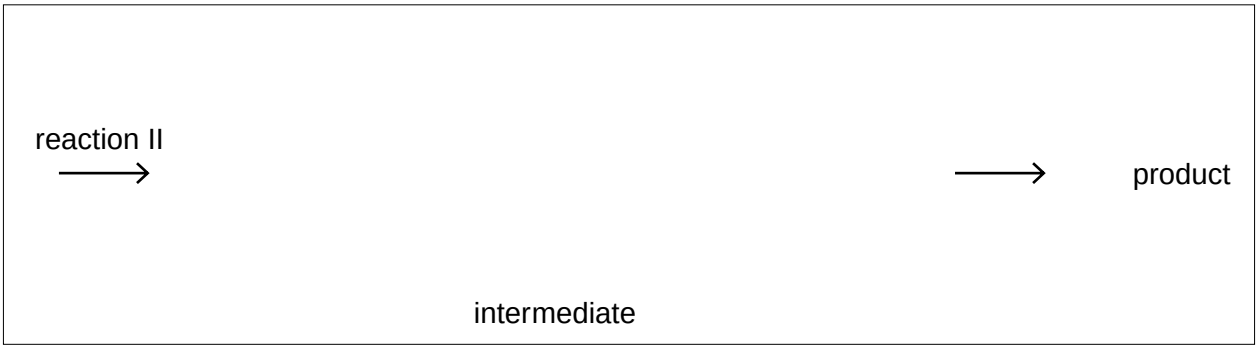
reaction II

.....

[2]

(b) In each of reactions I and II, the intermediate is a bromine-containing cation. In each of the following boxes, draw the intermediate and use curly arrows to show how it is converted into the product.





[4]

(c) Why do ethene and benzene differ in their reaction with bromine?

.....

..... [1]

[Total: 7]

4 Both phenol and phenylamine react similarly with aqueous bromine.

(a) State **two** observations you would make when these reactions take place.

.....

.....

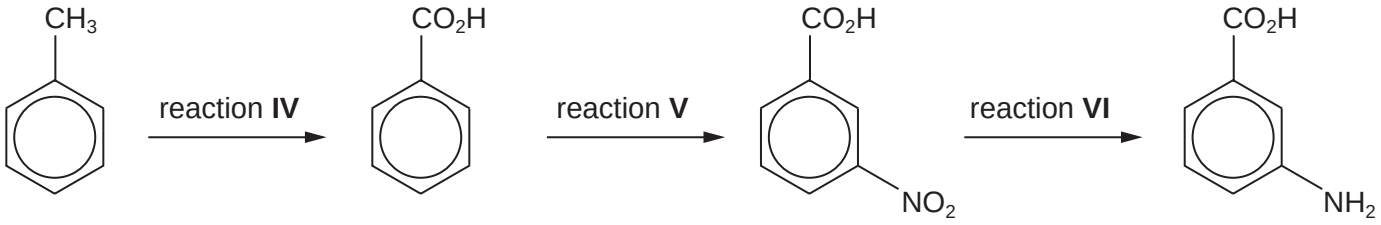
..... [2]

(b) Describe a simple test-tube reaction you could use to distinguish between phenol and phenylamine.

.....

.....[1]

(c) The compound 3-aminobenzoic acid can be prepared by the following series of reactions.



Suggest suitable reagents and conditions for

reaction **IV**, ...

reaction **V**, ...

reaction **VI**. ..... [4]

[Total: 7]