

Phenol

Question Paper 3

Level	International A Level
Subject	Chemistry
Exam Board	CIE
Topic	Hydroxy Compounds
Sub-Topic	Phenol
Paper Type	Theory
Booklet	Question Paper 3

Time Allowed: 52 minutes

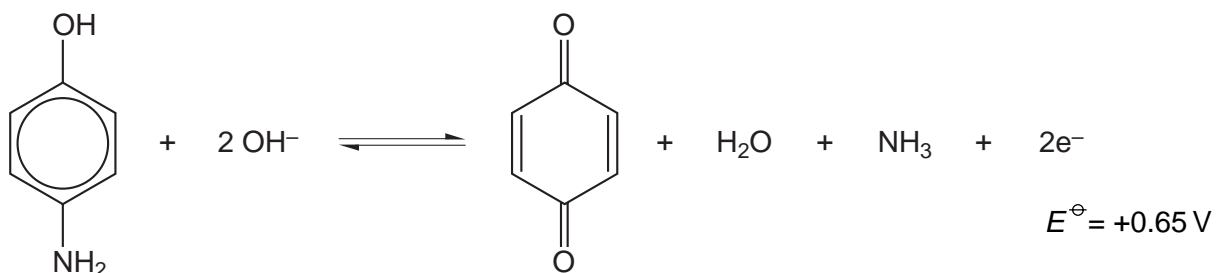
Score: /43

Percentage: /100

Grade Boundaries:

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

- 1 Rodinol is used as a photographic developer. In alkaline solution it is a mild reducing agent, providing electrons according to the following half equation.



rodinol

Rodinol ‘develops’ a latent photographic image by reducing activated silver bromide grains to silver metal and bromide ions.

- (a) Construct a balanced equation for the reaction between rodinol and AgBr.

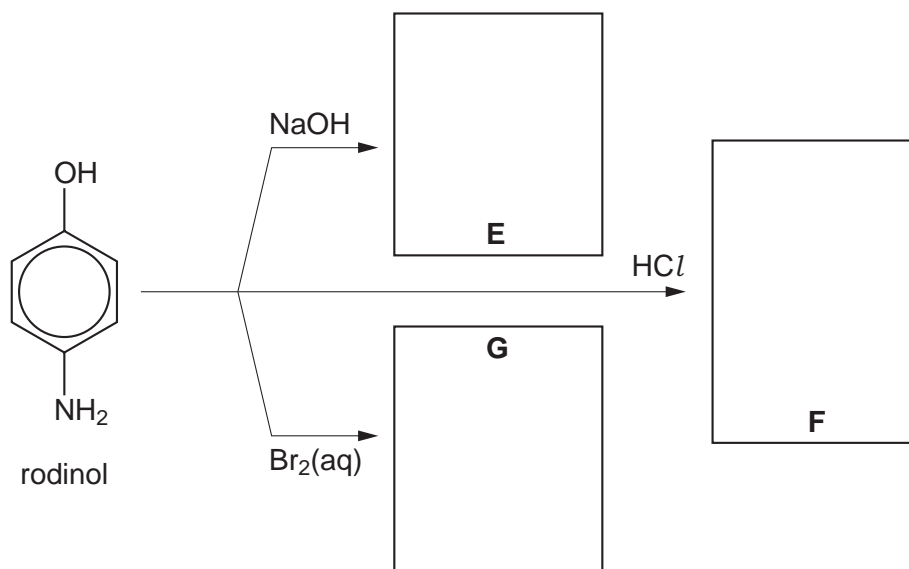
..... [1]

- (b) Suggest, with a reason, how the basicity of rodinol might compare to that of ammonia.

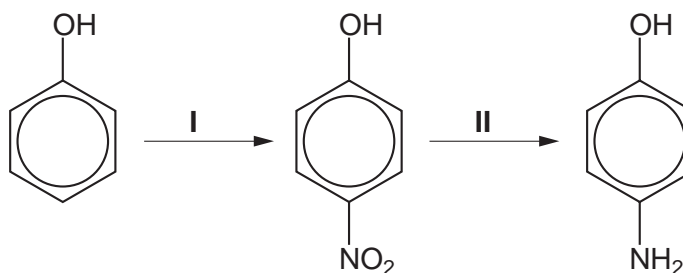
.....

 [2]

- (c) Suggest structural formulae for the compounds **E**, **F** and **G** in the following chart of the reactions of rodinol.



(d) Rodinol can be synthesised from phenol by the following route.



(i) Suggest reagents and conditions for step I.

.....

(ii) What type of reaction is step II?

.....

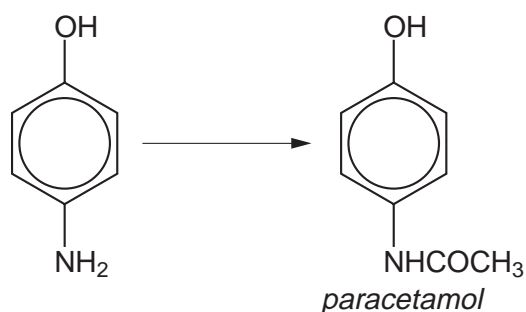
(iii) Place a tick in the box by the most suitable reagent for step II.

(place a tick in one box only)

- | | |
|--|--------------------------|
| H_3O^+ + heat | <input type="checkbox"/> |
| OH^- (aq) + heat | <input type="checkbox"/> |
| $\text{Cr}_2\text{O}_7^{2-}$ + H^+ + heat | <input type="checkbox"/> |
| HNO_3 (aq) | <input type="checkbox"/> |
| Sn + HCl (aq) | <input type="checkbox"/> |
| NH_3 in ethanol + heat/pressure | <input type="checkbox"/> |

[3]

(e) Rodinol is also an important intermediate in the commercial production of the analgesic drug *paracetamol*.



(i) Name **two** functional groups in *paracetamol*.

.....

.....

(ii) Suggest a reagent to convert rodinol into *paracetamol*.

.....

[3]

[Total: 12]

2 Both phenol and phenylamine react similarly with aqueous bromine.

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

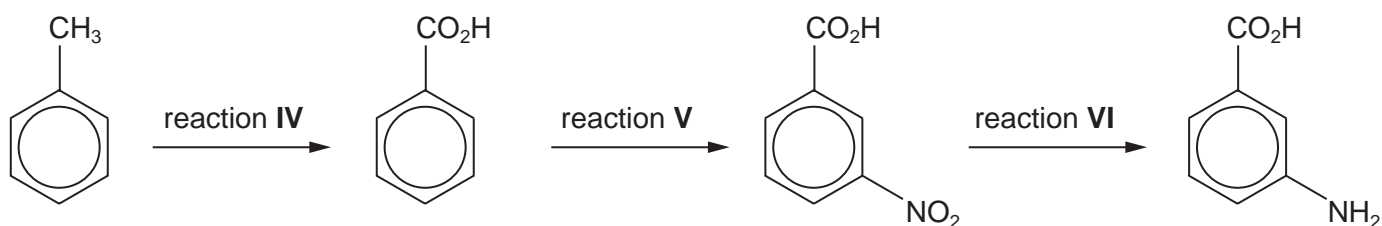
.....

 [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**,

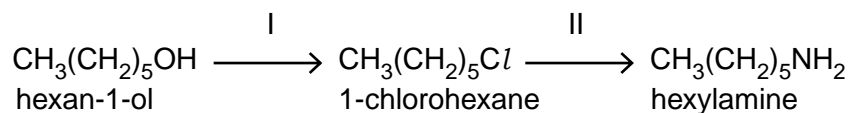
reaction **V**,

reaction **VI**. [4]

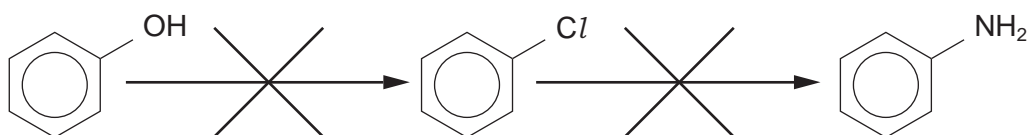
[Total: 7]

- 3 Phenol and chlorobenzene are less reactive towards certain reagents than similar non-aromatic compounds.

Thus hexan-1-ol can be converted into hexylamine by the following two reactions,



whereas neither of the following two reactions takes place.



- (a) (i) Suggest reagents and conditions for

reaction I,

reaction II.

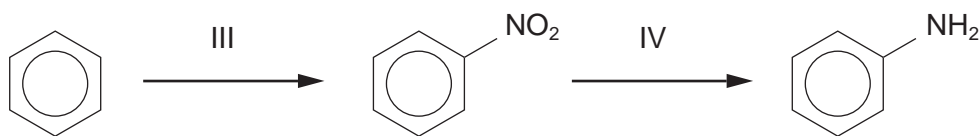
- (ii) What *type of reaction* is reaction II?

- (iii) Suggest a reason why chlorobenzene is much less reactive than 1-chlorohexane.

.....

.....

(b) Phenylamine can be made from benzene by the following two reactions.



(i) Suggest reagents and conditions for

reaction III,

reaction IV.

(ii) State the *type of reaction* for

reaction III,

reaction IV.

[5]

(c) Suggest a reagent that could be used to distinguish phenylamine from hexylamine.

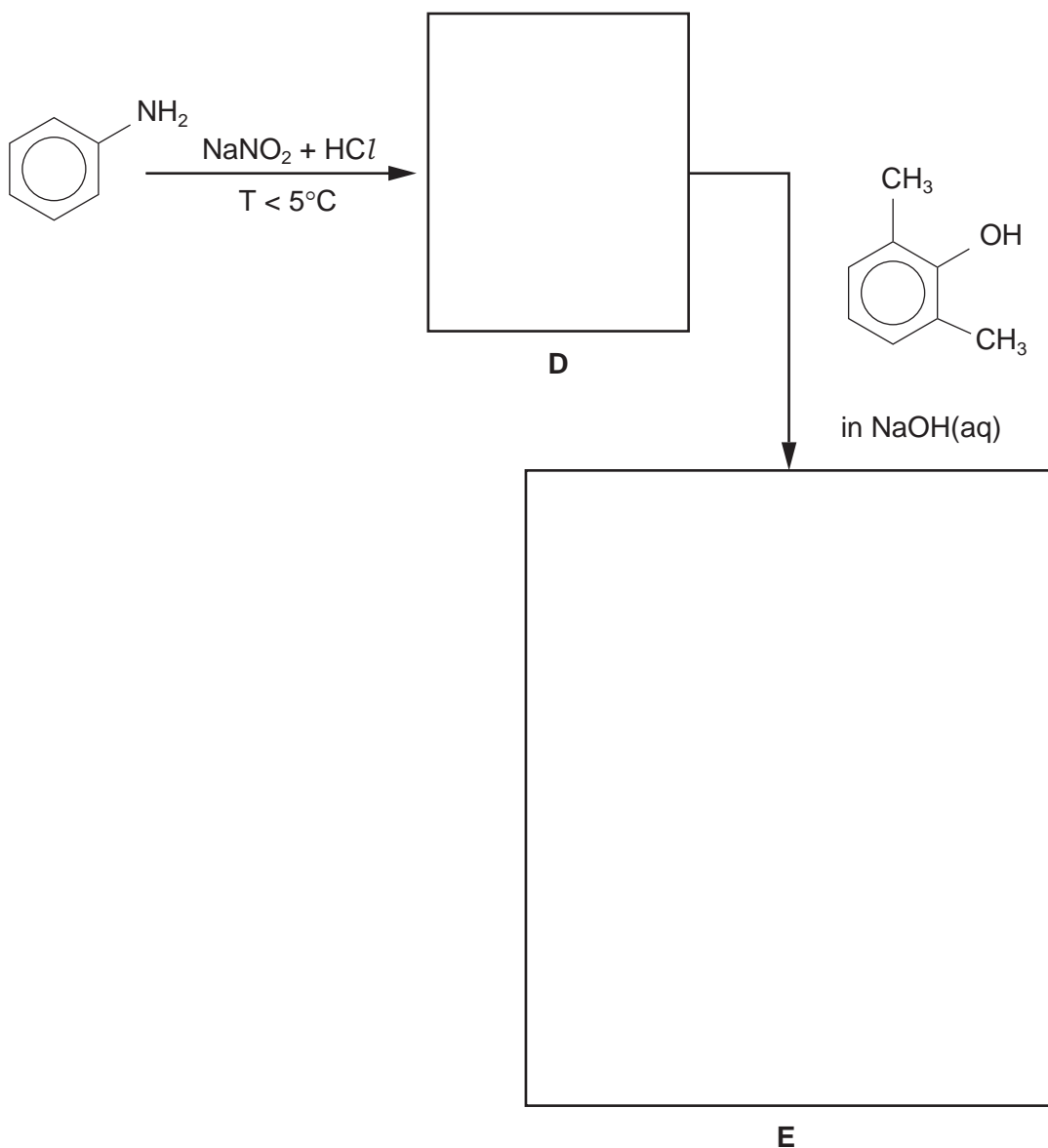
reagent and conditions

observation with phenylamine

observation with hexylamine.....

[2]

- (d) Phenylamine is used to make azo dyes. In the following boxes draw the structural formula of the intermediate **D** and of the azo dye **E**.



[2]

[Total: 13]

- 4 (a) Give an expression for K_a as applied to the weak acid RCO_2H .

.....
 [1]

- (b) The K_a values for three carboxylic acids are listed in the table below.

acid	$K_a / \text{mol dm}^{-3}$
$\text{CH}_3\text{CO}_2\text{H}$	1.8×10^{-5}
$\text{ClCH}_2\text{CO}_2\text{H}$	1.4×10^{-3}
$\text{Cl}_2\text{CHCO}_2\text{H}$	5.5×10^{-2}

- (i) Describe and explain the trend in acid strength illustrated by these values.

.....

- (ii) Calculate the pH of a $0.100 \text{ mol dm}^{-3}$ solution of $\text{ClCH}_2\text{CO}_2\text{H}$.

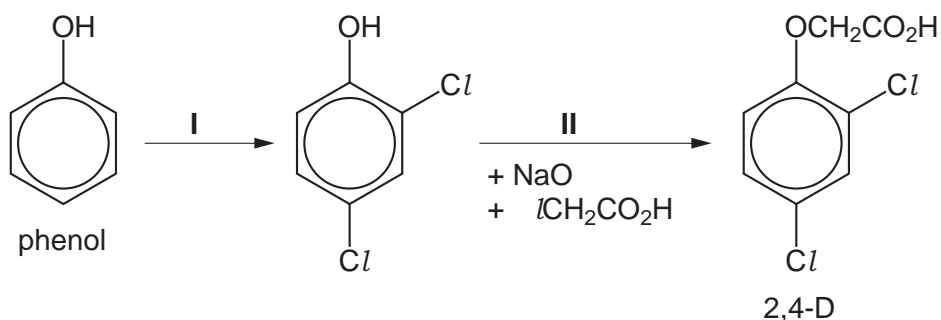
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- (iii) Calculate the $\text{p}K_a$ value for $\text{Cl}_2\text{CHCO}_2\text{H}$.

.....

[5]

- (c) The acid $\text{ClCH}_2\text{CO}_2\text{H}$ features in the industrial synthesis of the important weedkiller 2,4-D.



- (i) Suggest a possible reagent for reaction I.

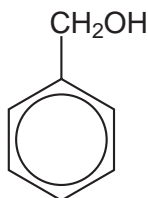
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- (ii) What type of reaction is

reaction I,

reaction II?

- (iii) Describe a test (reagents and observations) that would distinguish phenol from compound A.



compound A

reagents

observation with phenol

observation with compound A

[5]

[Total: 11]