

1. Nov/2023/Paper_9701/42/No.9

- (a) State the reactants and conditions for two different types of reactions that both produce diethylamine, $\text{CH}_3\text{CH}_2\text{NHCH}_2\text{CH}_3$.

reaction one

.....

reaction two

.....

[4]

- (b) Describe the relative basicities of diethylamine, phenylamine and ammonia in aqueous solution.

Explain your answer in terms of structure.

.....

least basic

most basic

explanation

.....

.....

.....

.....

[3]

- (c) Phenylamine reacts with $\text{HNO}_2(\text{aq})$ at 4°C to form compound **P**. Compound **P** reacts with phenol under alkaline conditions at 4°C . The product of this reaction is acidified, forming azo compound **Q**.

Draw the structure of compound **Q**.

Circle the azo group on your structure.

State one use of an azo compound such as **Q**.

compound **Q**:

An azo compound can be used

[2]

(d) $\text{CH}_3\text{CH}_2\text{NHCH}_2\text{CH}_3$ reacts with ethanoyl chloride, CH_3COCl , to give the amide N,N -diethylethanamide, $\text{CH}_3\text{CON}(\text{C}_2\text{H}_5)_2$.

An incomplete description of the mechanism of this reaction is shown in Fig. 9.1.

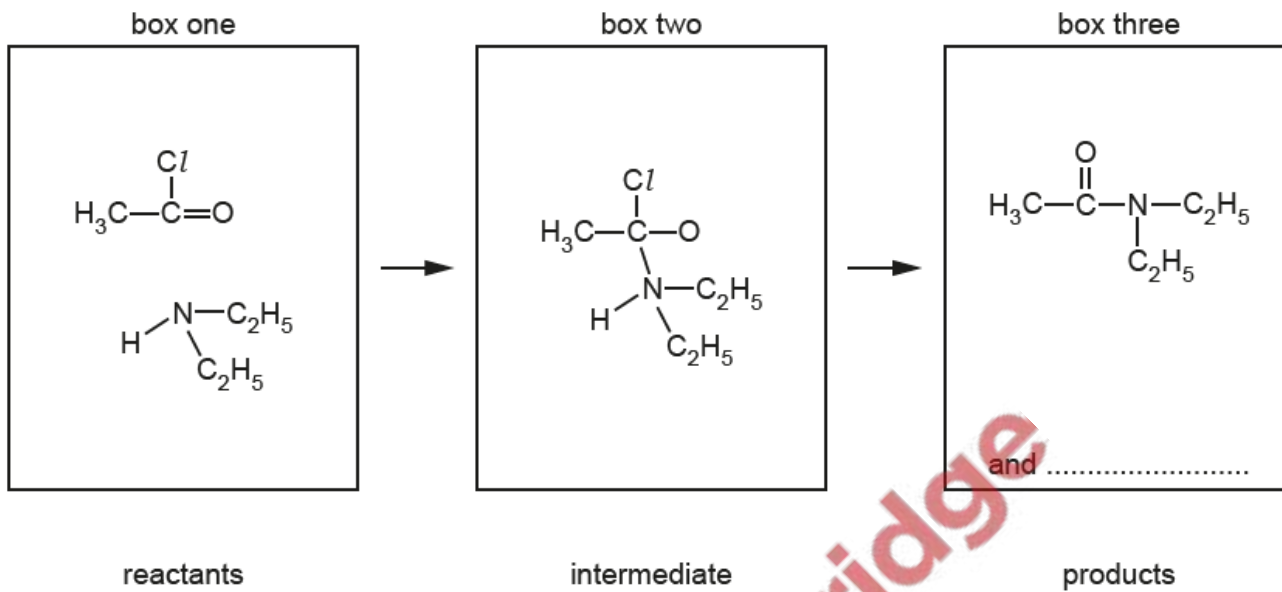


Fig. 9.1

(i) Complete the mechanism in Fig. 9.1. You should include:

- all relevant dipoles (δ^+ and δ^-) and full electric charges (+ and -) on the species in box one and in box two
- all relevant lone pairs on the species in box one and in box two
- all relevant curly arrows to show the movement of electron pairs in box one and in box two
- the formula of the second product in box three.

[4]

(ii) Name this mechanism.

..... [1]

[Total: 14]

(a) Perindopril is a drug used to treat heart disease.

perindopril

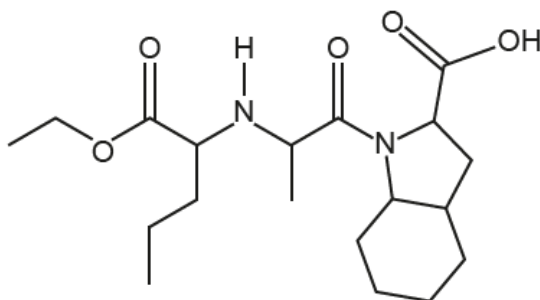


Fig. 6.1

(i) State the number of chiral carbon atoms present in one molecule of perindopril.

..... [1]

(ii) Suggest **one** benefit and **one** disadvantage of producing a drug such as perindopril as a single pure optical isomer.

benefit

.....

disadvantage

.....

[2]

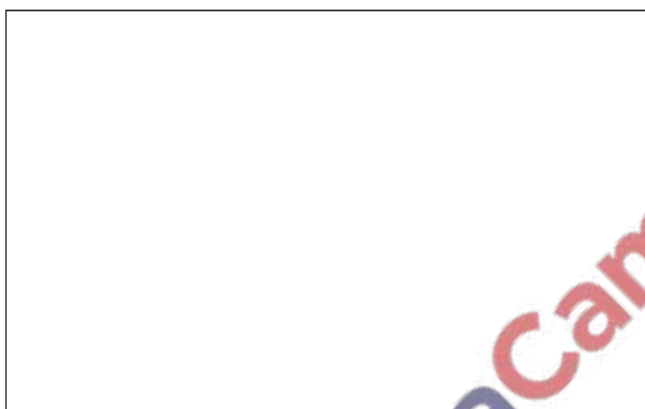
(b) (i) Name all the functional groups in perindopril.

.....

..... [2]

(ii) A sample of perindopril is hydrolysed with hot aqueous acid.

Draw the structures of the **three** organic products of the **complete** acid hydrolysis of perindopril.



PapaCambridge

[3]

[Total: 8]

3. June/2023/Paper_9701/41/No.4(b,c)

(b) Compound Z can be synthesised from benzene in three steps by the route shown in Fig. 4.1.

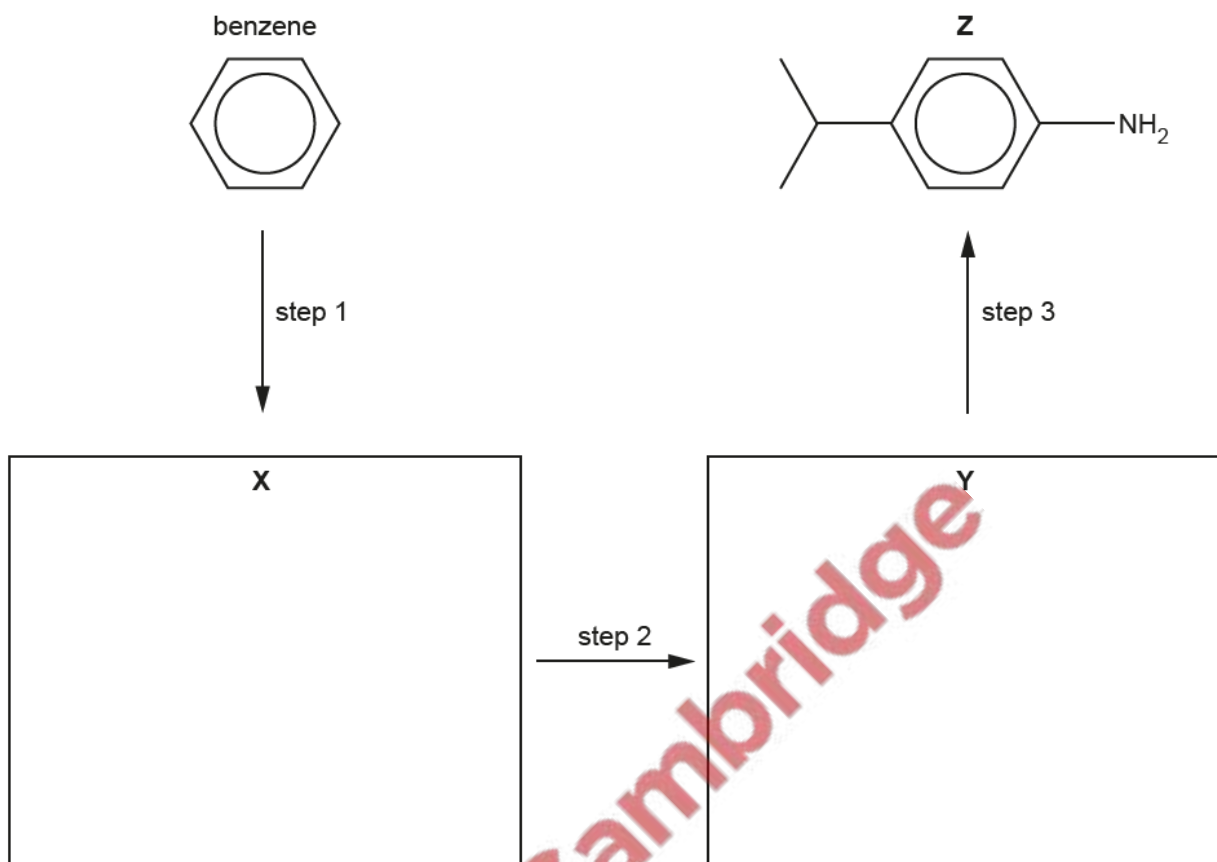


Fig. 4.1

(i) Draw structures for X and Y in Fig. 4.1. [2]

(ii) Give the reagents and conditions for steps 1, 2 and 3.

step 1

step 2

step 3

[3]

(c) Compound **W** is an isomer of **Z**.

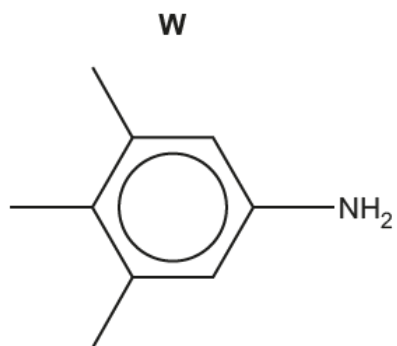
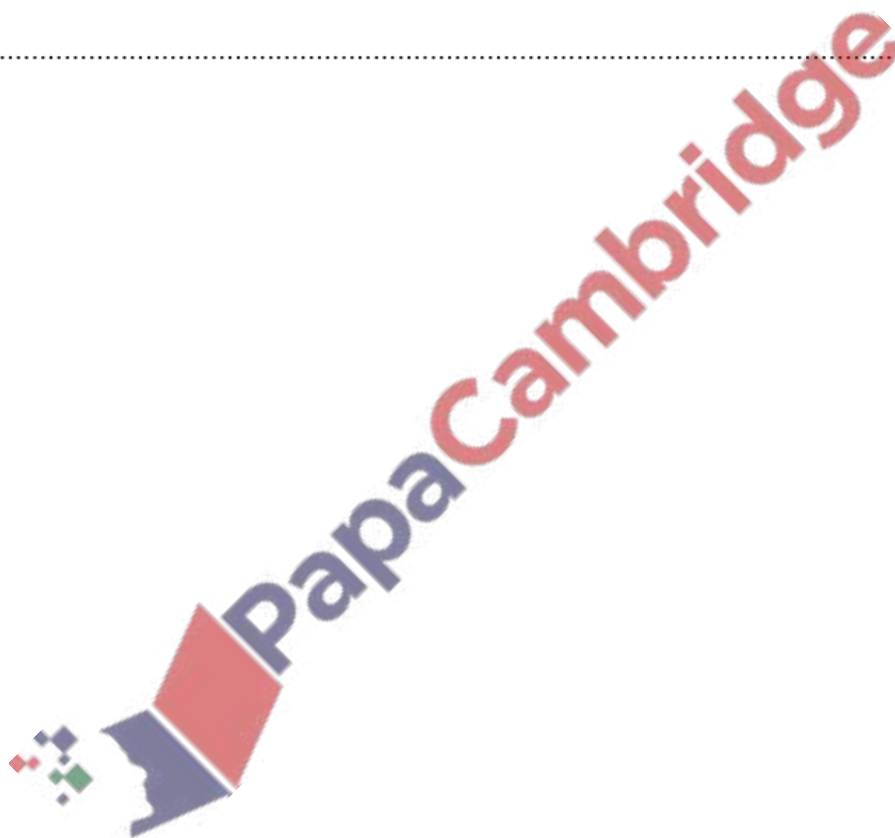


Fig. 4.2

Give the systematic name of **W**.

..... [1]



(a) State the relative basicities of ethanamide, diethylamine and ethylamine in aqueous solution.

Explain your answer.

..... > >
 most basic least basic

.....

.....

.....

.....

.....

[4]

(b) The amino acid alanine, $\text{H}_2\text{NCH}(\text{CH}_3)\text{COOH}$, can act as a buffer.

(i) Define a buffer solution.

.....

.....

..... [2]

(ii) Write **two** equations to show how an aqueous solution of alanine can act as a buffer solution.

.....

..... [2]

(c) Glutamic acid is another amino acid that acts as a buffer.

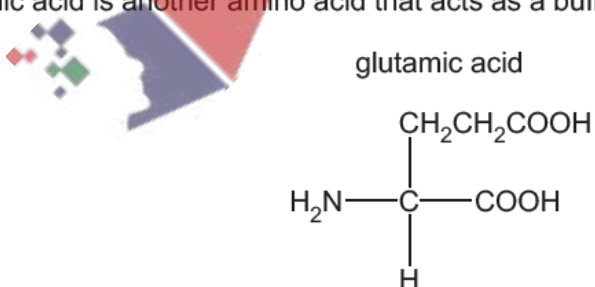


Fig. 7.1

(i) Draw the **skeletal** formula for glutamic acid.

[1]

- (ii) Draw the structure for the dipeptide, ala-glu, formed from one molecule of alanine and one molecule of glutamic acid.

The peptide bond formed should be displayed.

[2]

- (d) The isoelectric point of alanine is 6.0 and of glutamic acid is 3.2.

A mixture of the dipeptide, ala-glu, and its two constituent amino acids, alanine and glutamic acid, is analysed by electrophoresis using a buffer at pH 6.0.

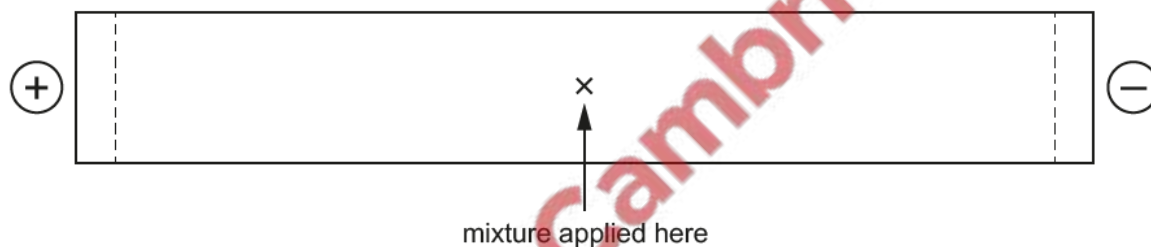


Fig. 7.2

Draw and label **three** spots on Fig. 7.2 to indicate the predicted position of each of these three species after electrophoresis.

Explain your answer.

.....

.....

.....

.....

.....

.....

[3]

Ethylamine and phenylamine are primary amines.



Fig. 4.1

These two compounds are synthesised by different methods.

(a) Several methods can be used to form ethylamine.

(i) Ethylamine forms when ethanamide, CH_3CONH_2 , is reduced by LiAlH_4 .

Write an equation for this reaction. Use [H] to represent one atom of hydrogen from the reducing agent.

..... [1]

(ii) Ethylamine is a product of the reaction of bromoethane with ammonia.

Name the mechanism of this reaction and state the conditions used.

mechanism

conditions

[2]

(iii) The reaction in (a)(ii) also forms secondary and tertiary amines.

Suggest the identity of a secondary or tertiary amine formed by the reaction in (a)(ii).

..... [1]

(b) Ethylamine is a weak base.

State the relative basicities of ammonia, ethylamine and phenylamine.

Explain your answer.

..... < <
least basic most basic

.....
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.....
.....
.....
.....
.....
.....
..... [4]

(c) Pure phenylamine, $C_6H_5NH_2$, can be prepared from benzene in two steps.

Draw the structure of the intermediate compound.

Suggest reagents and conditions for each step.

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.....
.....
.....
..... [3]

(d) Fig. 4.2 shows some reactions of phenylamine.

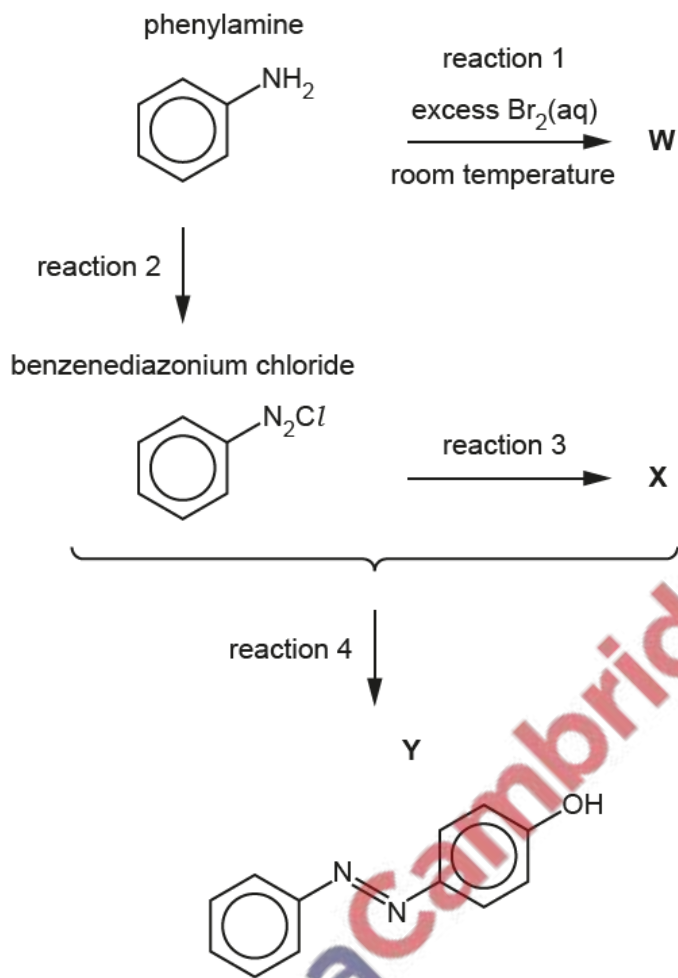


Fig. 4.2

(i) Draw the structure of **W**, the organic product of reaction 1.

[1]

(ii) State the reagents used in reaction 2.

..... [1]

Benzenediazonium chloride, $C_6H_5N_2Cl$, and **X** react together in reaction 4 to form **Y**, an azo compound.

(iii) Name **X**, the organic product of reaction 3.

..... [1]

(iv) State the necessary conditions for reaction 4 to occur.

..... [1]

(v) Suggest a use for **Y**.

..... [1]

