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CHEMISTRY

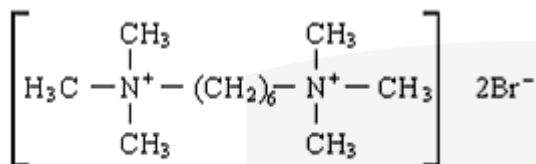
INORGANIC CHEMISTRY II

Level & Board	AQA (A-LEVEL)
TOPIC:	AMINES
PAPER TYPE:	QUESTION PAPER - 3
TOTAL QUESTIONS	10
TOTAL MARKS	61

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Amines - 3

1. Compounds like $\text{H}_2\text{N}(\text{CH}_2)_6\text{NH}_2$ are used to make ionic compounds such as X, shown below.



Compound X

- (a) X belongs to the same type of compound as $(\text{CH}_3)_4\text{N}^+\text{Br}^-$. Name this type of compound.

(1)

- (b) State a reagent which could produce X from $\text{H}_2\text{N}(\text{CH}_2)_6\text{NH}_2$ and give a necessary condition to ensure that X is the major product.

(2)

- (c) Name the mechanism involved in this reaction to form X.

(2)

2. Which compound is the strongest base?

- A. Ammonia
B. Ammonium chloride

- C. Methylamine
- D. Phenylamine

(1)

3. This question is about amines.

- (a) There are three secondary amines that contain four carbon atoms per molecule.

Draw the skeletal formulas of these three secondary amines.

(2)

- (b) Primary amines can be prepared by the reaction of halogenoalkanes with ammonia or by the reduction of nitriles.

Justify the statement that it is better to prepare primary amines from nitriles rather than from halogenoalkanes.

(2)

- (c) Draw the structure of a primary amine with four carbon atoms that cannot be formed from a nitrile.

(1)

- (d) A student dissolves a few drops of propylamine in 1 cm³ of water in a test tube.

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Give an equation for the reaction that occurs.

Describe what is observed when Universal Indicator is added to this solution.

(2)

(e) Phenylamine can be prepared by a process involving the reduction of nitrobenzene using tin and an excess of hydrochloric acid.

Give an equation for the reduction of nitrobenzene to form phenylamine.

Use [H] to represent the reducing agent.

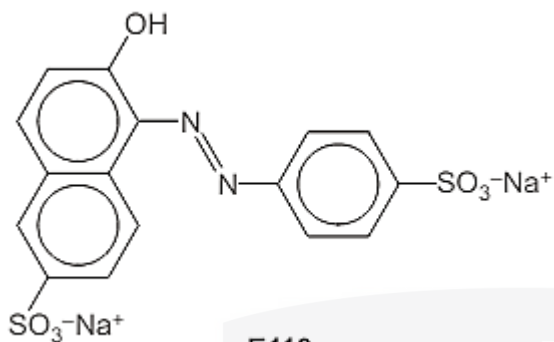
Explain why an aqueous solution is obtained in this reduction even though phenylamine is insoluble in water.

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(2)

4. The structure of E110 is shown below.

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(a) On the structure above, draw a circle around the functional group that identifies this molecule as an azo dye.

(1)

(b) Deduce how many carbon and hydrogen atoms are in a molecule of E110.

(2)

(c) The solubility of E110 in water can be improved by converting the phenolic -OH group into a charged -O- group.

Suggest a suitable reagent that will convert the -OH group in E110 into an -O- group.

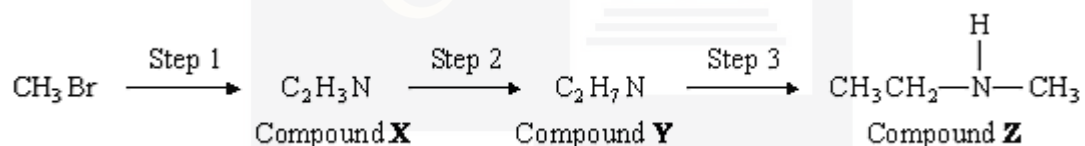
(1)

(d) Draw the structures of a phenol and an amine that could be used to make E110 by the method in part (a).

Assume that the SO_3^-Na^+ groups do not change during the process.

(2)

5. Compound Z can be formed via compounds X and Y in the three step synthesis shown below.



Identify compounds X and Y and give reagents and conditions for Steps 1 and 2.

State the type of compound of which Z is an example.

Compound Z reacts with a large excess of bromomethane to form a solid product.

Draw the structure of this product and name the type of mechanism for this reaction.

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(9)

6. Name and outline a mechanism for the reaction of $\text{CH}_3\text{CH}_2\text{NH}_2$ with $\text{CH}_3\text{CH}_2\text{COCl}$. Name the amide formed.

(6)

7. Haloalkanes such as CH_3Cl are used in organic synthesis.

Outline a three-step synthesis of $\text{CH}_3\text{CH}_2\text{NH}_2$ starting from methane.

Your first step should involve the formation of CH_3Cl .

In your answer, identify the product of the second step and give the reagents and conditions for each step.

Equations and mechanisms are not required.

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(6)

**Y**

8. Compound Y is used in the production of the polymer Kevlar. Y is first reduced to the diamine shown below.



- (a) Identify a suitable reagent or mixture of reagents for the reduction of Y to form this diamine.

Write an equation for this reaction using [H] to represent the reducing agent.

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(2)

- (b) This diamine is then reacted with benzene-1, 4-dicarboxylic acid to form Kevlar.

Draw the repeating unit of Kevlar.

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(2)

(c) Kevlar can be used as the inner lining of bicycle tyres.

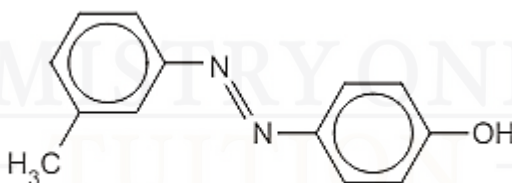
The rubber used for the outer part of the tyre is made of polymerised alkenes.

State the difference in the biodegradability of Kevlar compared to that of rubber made of polymerised alkenes.

Use your knowledge of the bonding in these polymer molecules to explain this difference.

(4)

9. Compound A, shown below, is being considered as an azo dye by a chemical company.



compound A

A chemist planned a two-stage synthesis of compound A starting from an aromatic amine.

The aromatic amine is first converted into a diazonium ion.

- Draw the displayed formula of the aromatic amine and of the diazonium ion.
- State the reagents and conditions for each stage in the synthesis of compound A from an aromatic amine.

(5)

10. Coloured organic compounds also include azo dyes.

Describe how an azo dye can be made from phenylamine.

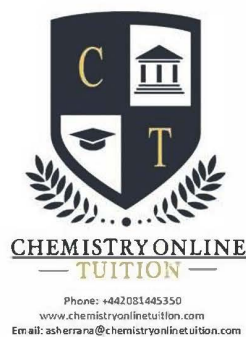
Show the structure of the azo dye and the organic intermediate in your answer.

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