Amines

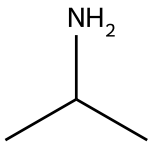
OCR A H432 · A level

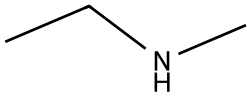
Show your working where needed. Check the worked answers when you finish.

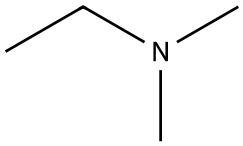
Name _____ Date _____

1. Classify the amines shown

Classify A, B and C as primary, secondary or tertiary amines. State what you counted.

A 

B 

C 

2. Form a salt

Write an equation for propylamine, $CH_3CH_2CH_2NH_2$, reacting with dilute hydrochloric acid. Explain the role of the nitrogen lone pair.

3. Control the products of substitution

Bromoethane reacts with excess ethanolic ammonia. Write a balanced equation for forming the primary amine and explain why excess ammonia helps.

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Amines

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4. A reaction of butanenitrile

Butanenitrile, $CH_3CH_2CH_2C{\equiv}N$, is treated with hydrogen over nickel. Draw the organic product and give a balanced equation using H_2. Track the nitrile carbon in the product.

5. The reduction mixture

Nitrobenzene is heated with tin and concentrated hydrochloric acid. Give an equation using [H] for the overall conversion to the free amine. Explain why adding sodium hydroxide is necessary to obtain it.

6. Make a secondary amine

Choose a haloalkane and a primary amine to make N-methylpropan-1-amine. Give the solvent and write the product’s condensed structure.

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Amines

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7. Check a functional-group claim

A student calls $CH_3C(=O)NHCH_2CH_3$ a secondary amine. Name the compound, explain your classification using the bond to nitrogen and give two reactants that could make it by acylation.

8. Choose a route to a tertiary amine

N-Methylethanamine reacts with bromoethane. Name the new amine, write its condensed formula and classify it. Identify the atom that forms the new bond.

9. Extra challenge · Plan a route and check the salt

Make N-ethylbutan-1-amine from 1-bromopropane in three steps. Bromoethane is available. State the reagents, solvent where relevant and structures for each step.

Then add dilute HCl to the target. Draw the organic ion that forms.

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Worked answers

Amines · OCR A H432 · A level

1. Classify the amines shown

A, B and C are primary, secondary and tertiary respectively. Count the carbon groups directly bonded to N. The isopropyl group in A counts as one group, and the ethyl group in B and in C counts as one group each.

2. Form a salt

$CH_3CH_2CH_2NH_2 + HCl \rightarrow CH_3CH_2CH_2NH_3^+ Cl^-$. The nitrogen lone pair accepts H^+ to form the propylammonium ion.

3. Control the products of substitution

$CH_3CH_2Br + 2NH_3 \rightarrow CH_3CH_2NH_2 + NH_4Br$. The new ethylamine can react further with bromoethane. Excess ammonia makes reaction with ammonia more likely, helping favour the primary amine.

4. A reaction of butanenitrile

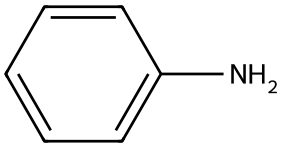
$CH_3CH_2CH_2C{\equiv}N + 2H_2 \rightarrow CH_3CH_2CH_2CH_2NH_2$. The product is butan-1-amine.

The C≡N carbon becomes the CH_2 carbon bonded to NH_2. The product still has four carbons.

5. The reduction mixture

$C_6H_5NO_2 + 6[H] \rightarrow C_6H_5NH_2 + 2H_2O$. The equation gives the overall conversion to free phenylamine.

The amine is protonated to $C_6H_5NH_3^+$ in the acidic mixture. Hydroxide removes its extra proton, forming water and free phenylamine.



Phenylamine

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Worked answers

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6. Make a secondary amine

One route uses 1-bromopropane with excess methylamine in ethanol. The product is $CH_3CH_2CH_2NHCH_3$. Another uses bromomethane with excess propan-1-amine in ethanol.

7. Check a functional-group claim

It is a secondary amide, N-ethylethanamide. The nitrogen is bonded directly to the carbonyl carbon.

Ethanoyl chloride supplies CH_3CO- and ethylamine supplies -$NHCH_2CH_3$.

8. Choose a route to a tertiary amine

N-Ethyl-N-methylethanamine, $(CH_3CH_2)_2NCH_3$, is a tertiary amine. The nitrogen of N-methylethanamine bonds to the carbon that held Br.

9. Extra challenge · Plan a route and check the salt

Use KCN or NaCN in ethanol to make $CH_3CH_2CH_2C{\equiv}N$. Reduce it using H_2 over nickel to make $CH_3CH_2CH_2CH_2NH_2$.

React bromoethane with the amine in ethanol. Excess butan-1-amine helps favour $CH_3CH_2CH_2CH_2NHCH_2CH_3$ over further substitution. Dilute HCl protonates N to give $[CH_3CH_2CH_2CH_2NH_2CH_2CH_3]^+$.

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