Unit 16 · Amines

WORKSHEET

Full marks 36

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 36

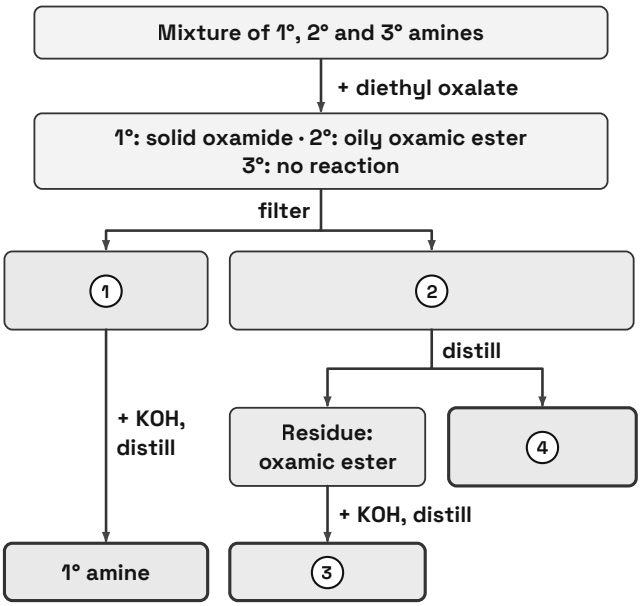
1 Key words [3]

Match each test or reagent in Column A with what it shows or does in Column B. One item in Column B is not needed. Each carries 0.5 mark.

Column A		Column B
1. chloroform and alcoholic KOH	☐	**a.** benzenediazonium chloride
2. cold $NaNO_2$ and dilute HCl with a secondary amine	☐	**b.** gives a primary amine with one carbon more than the haloalkane
3. diethyl oxalate	☐	**c.** a primary amine with the same number of carbons
4. Br_2 and aqueous KOH with an amide	☐	**d.** a foul-smelling isocyanide from a primary amine only
5. $LiAlH_4$ with an amide	☐	**e.** a yellow oily N-nitrosamine
6. $NaNO_2$ and HCl with aniline at 0–5 °C	☐	**f.** separates 1°, 2° and 3° amines
		g. a primary amine with one carbon fewer

2 Label the diagram [2]

The flow chart shows Hofmann's method of separating a mixture of amines. Write what belongs in place of 1 to 4. Each carries 0.5 mark.



1. _____ **2.** _____

3. _____ **4.** _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. N-Methylethanamine, $CH_3CH_2NHCH_3$, is a: [1]

a. primary amine
b. secondary amine
c. tertiary amine
d. quaternary ammonium salt

ii. Which order of boiling points is correct for these compounds of molar mass about 59 g/mol? [1]

a. 3° amine > 2° amine > 1° amine
b. 1° amine > 2° amine > 3° amine
c. 2° amine > 1° amine > 3° amine
d. all three boil at the same temperature

iii. In water, which is the weakest base? [1]

a. methanamine
b. ammonia
c. aniline
d. N-methylmethanamine

iv. Bromine water added to aniline at room temperature gives at once: [1]

a. 4-bromoaniline only
b. 2-bromoaniline and 4-bromoaniline
c. a white precipitate of 2,4,6-tribromoaniline
d. no reaction without a catalyst

v. Benzenediazonium chloride coupled with phenol in cold alkali gives: [1]

a. a yellow dye, 4-aminoazobenzene
b. an orange dye, 4-hydroxyazobenzene
c. a scarlet dye, 1-phenylazo-2-naphthol
d. phenol and nitrogen

4 Short answers [11]

Write short answers to the following questions.

a. Write balanced equations for the preparation of ethanamine i. from bromoethane, and ii. from ethanenitrile. [2]

b. Why does the reaction of a haloalkane with ammonia give a mixture of amines, and how can a primary amine be made the main product? [2]

c. How would you tell ethanamine from N-ethylethanamine with nitrous acid? Write the equations. [2]

d. Why is aniline a weaker base than ammonia? **[2]**

e. How is acetanilide made from aniline? Write the equation, and give one use of acetanilide and one reason chemists acetylate aniline. **[3]**

5 Long answer **[4]**

Write a long answer to the following question.

Starting from aniline, how would you make i. benzenediazonium chloride, ii. 4-aminoazobenzene, iii. phenyl isocyanide, and iv. N-methylaniline? Give the conditions and write an equation for each.

6 Numerical problems **[8]**

Solve the following problems. Show your working. Take H = 1, C = 12, N = 14, O = 16, K = 39, Br = 80; pKb of methanamine 3.34, of aniline 9.13; $K_w = 1.0 \times 10^{-14}$.

a. 7.30 g of propanamide, $CH_3CH_2CONH_2$, is warmed with bromine and aqueous KOH. i. Write the equation and name the amine formed. ii. Find the mass of amine formed if the yield is 80%. iii. Find the masses of bromine and of KOH used up by the amide. **[4]**

Answer:

b. i. Find Kb of methanamine and of aniline from their pKb values. ii. How many times stronger a base is methanamine than aniline? iii. Find the pH of a 0.10 M solution of methanamine and of a 0.10 M solution of aniline (take $[OH^-] = \sqrt{(Kb\ c)}$). iv. What does the difference in pH tell you? **[4]**

Answer: _____

7 Think **[3]**

In the gas, the order of basic strength is $3° > 2° > 1° > NH_3$, but in water the methylamines come in the order $2° > 1° > 3° > NH_3$. Explain why the tertiary amine drops down the order in water.

8 Activity: Three bottles (not marked)

A teacher has three unlabeled bottles: ethanamine, N-ethylethanamine and N,N-diethylethanamine (all in dilute solution). Plan, on paper, how to tell them apart with cold sodium nitrite and dilute hydrochloric acid, and fill in the table with what you would expect.

Bottle	Class of amine	What you would see with cold $NaNO_2$ + HCl	Product
ethanamine			
N-ethylethanamine			
N,N-diethylethanamine			

Which other test could confirm the primary amine? Why would a teacher show it only in a fume cupboard?