Unit 15 · Nitro Compounds

WORKSHEET

Full marks 36

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

1 Key words [3]

Write True or False in the box beside each sentence. Correct each false sentence. Each carries 0.5 mark.

i. In a nitro compound the $-NO_2$ group is bonded to carbon through its nitrogen. ☐

ii. Nitroglycerin is a nitro compound. ☐

iii. Nitromethane boils far higher than butane because its molecules are strongly polar. ☐

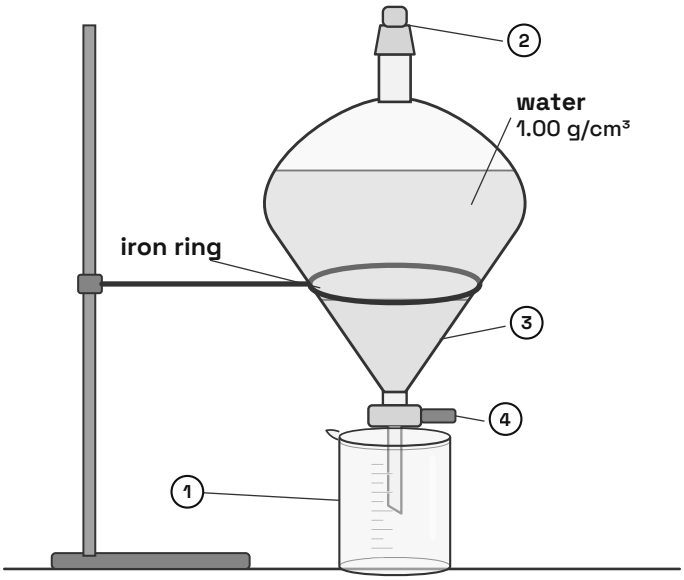
iv. Alkanes are nitrated with the nitrating mixture at 50–60 °C, like benzene. ☐

v. Bromine and $FeBr_3$ with nitrobenzene give mainly 4-bromonitrobenzene. ☐

vi. A primary nitroalkane dissolves in sodium hydroxide solution because it has an acidic α-hydrogen. ☐

2 Label the diagram [2]

The diagram shows nitrobenzene and water left to stand in a separating funnel. 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. Bromoethane heated with silver nitrite in ethanol gives mainly: [1]

a. ethyl nitrite **b.** nitroethane

c. ethanol **d.** ethanamine

ii. Nitroethane warmed with zinc dust and ammonium chloride solution gives: [1]

a. ethanamine
b. N-ethylhydroxylamine
c. ethanol
d. azoethane

iii. Nitrobenzene reduced with zinc and sodium hydroxide in methanol gives: [1]

a. aniline
b. azoxybenzene
c. azobenzene
d. hydrazobenzene

iv. In the nitration of benzene, the electrophile that attacks the ring is: [1]

a. HNO_3
b. NO_2^-
c. NO_2^+
d. HSO_4^-

v. The nitro group makes a benzene ring: [1]

a. more reactive, and directs to ortho and para
b. more reactive, and directs to meta
c. less reactive, and directs to ortho and para
d. less reactive, and directs to meta

4 Short answers [11]

Write short answers to the following questions.

a. Write the IUPAC names of i. $CH_3CH(NO_2)CH_3$ and ii. $(CH_3)_2C(NO_2)CH_2CH_3$, and say whether each is a 1°, 2° or 3° nitroalkane. [2]

b. Why does silver nitrite give two products with a haloalkane? [2]

c. Write balanced equations for the reduction of nitrobenzene i. with tin and concentrated HCl, and ii. with zinc and ammonium chloride solution. [2]

d. Why is the nitration of benzene kept below 60 °C? [2]

e. Write the steps by which the nitrating mixture nitrates benzene. **[3]**

5 Long answer **[4]**

Write a long answer to the following question.

Explain, with the help of resonance, why the nitro group deactivates the benzene ring and directs a second group to the meta position. Write the equation for the nitration of nitrobenzene.

6 Numerical problems **[8]**

Solve the following problems. Show your working. Take H = 1, C = 12, N = 14, O = 16, Br = 80, Ag = 108.

a. 15.6 g of benzene is nitrated with the nitrating mixture at 50–60 °C. i. Write the equation. ii. Find the mass of nitrobenzene formed at 100% yield. iii. The yield is 85%: find the mass of nitrobenzene and its volume (density 1.20 g/cm^3). iv. In a separating funnel with water, which layer is the nitrobenzene, and why? **[4]**

Answer:

b. 5.45 g of bromoethane is heated with silver nitrite in ethanol. i. Write the equation for the main reaction. ii. Find the mass of silver nitrite needed and the mass of silver bromide precipitated. iii. 70% of the bromoethane becomes nitroethane: find its mass. iv. What else is formed, and how? **[4]**

Answer: _____

7 Think **[3]**

Nitromethane and methyl nitrite have the same formula, CH_3NO_2. Nitromethane boils at 101 °C. Would you expect methyl nitrite to boil higher or lower? Give reasons, and name the kind of isomerism.

8 Activity: From nitrobenzene to five products (not marked)

Nitrobenzene gives a different product with each reducer. Use the unit to complete the table, and write how many [H] each product needs for two molecules of nitrobenzene.

Reducer and medium	Product	Formula	[H] for 2 $C_6H_5NO_2$
Sn, conc. HCl (acid)			
Zn, NH_4Cl(aq) (neutral)			
Na_3AsO_3, NaOH (alkaline)			
Zn, NaOH, methanol			
Zn, NaOH(aq)			

What do the azo, azoxy and hydrazo compounds have that aniline does not?