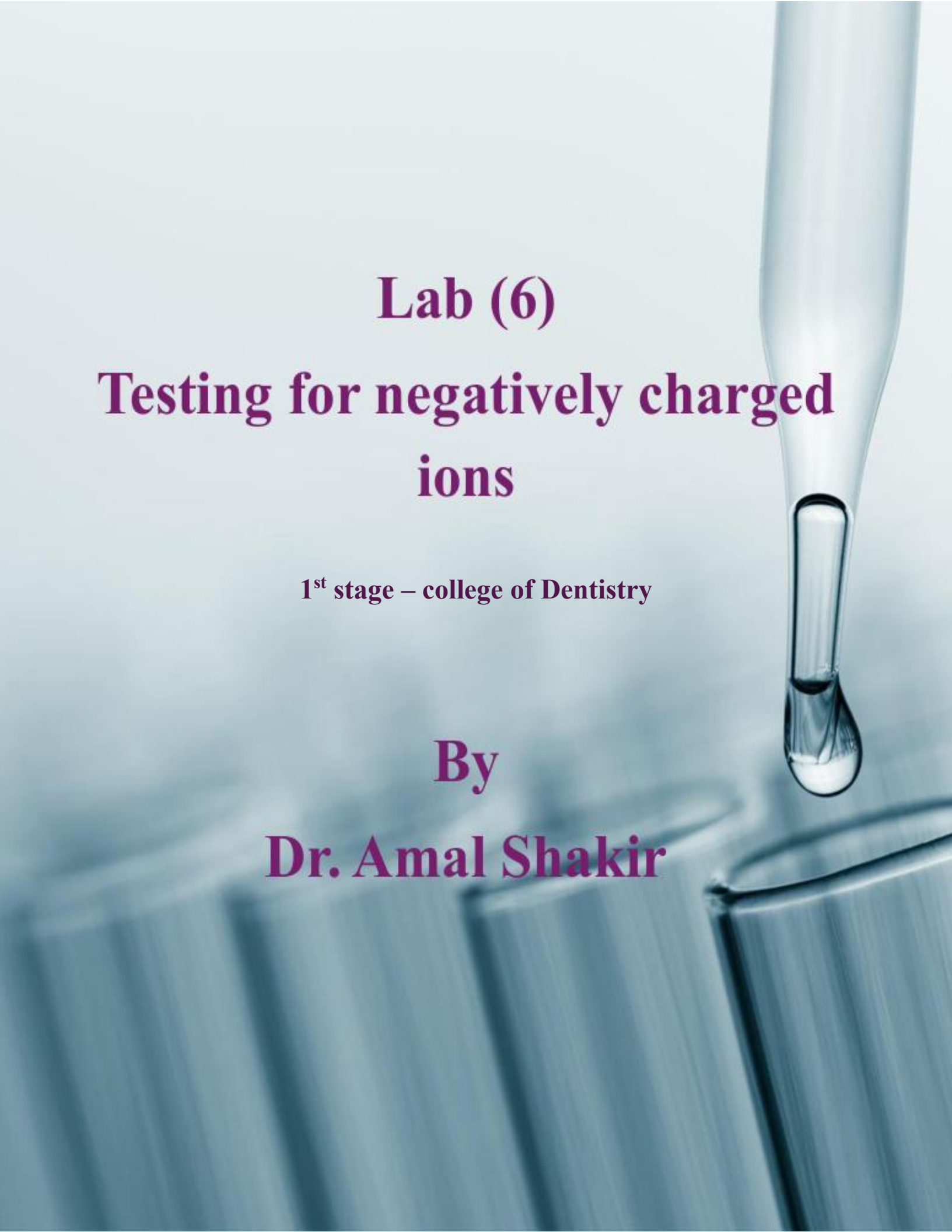
Lab (6)

Testing for negatively charged ions

1st stage – college of Dentistry

By

Dr. Amal Shakir



Testing for negatively charged ions

The chemical identity of a given sample must often be analyzed in various circumstances. In the case of ionic compounds, the identification involves tests to determine the exact cation and anion in the compound. These analyses are routinely conducted in medical (blood/urine tests), environmental (water/sewer/waste), pharmaceutical (drugs), and chemical research laboratories. While the exact analytical technique may be different from that described here, the basic principles of these analyses are often the same.

In this experiment, the formation of different precipitates or special colors or a gas specific for anion using certain solutions of specific chemical substance called (reagents), allows us to identify different negatively charged ions in solution.

The differences in the solubility of ions and the characteristic colors of their precipitates will be used to identify the anions. The anions explored in this experiment are chloride (Cl^-), bromide (Br^-), iodide (I^-), carbonate (CO_3^{2-}), sulfate (SO_4^{2-}), and nitrate (NO_3^-).

1-Testing for halide ions

Silver ions react with halide ions (Cl^-, Br^- or I^- ions) to form insoluble precipitates. The table shows the colours of these silver halide precipitates.

Halide ion	Precipitate colour
Chloride, Cl^-	White
Bromide, Br^-	Cream
Iodide, I^-	Yellow

1) chloride ions (Cl^-):

$NaCl + AgNO_3 \longrightarrow AgCl\downarrow + NaNO_3$ (The precipitate is soluble in ammonia solution)

White ppt.

2) Bromides ions (Br^-):

$KBr + AgNO_3 \longrightarrow AgBr\downarrow + KNO_3$ (The ppt. is slightly soluble in ammonia solution)

Cream ppt.

3) Iodides ions (I^-):

$KI + AgNO_3 \longrightarrow AgI\downarrow + KNO_3$ (The ppt. is insoluble in ammonia solution)

Yellow ppt.

To test for halide ions:

- Put 10 drops of halide solution in test tube
- add a few drops of dilute nitric acid to the sample
- add a few drops of dilute silver nitrate solution

Observe and record the colour of any precipitate that forms.

2- Testing for Carbonate Co_3^{-2} ions:

Carbonate Co_3^{-2} ions react with dilute acid to form effervescence and carbon dioxide produced.

$Na_2CO_3^{-2} + HCl \longrightarrow NaCl\downarrow + H_2O + CO_2\uparrow$

White ppt. gas

To test for Carbonate ions:

• Put 10 drops from $Na_2CO_3^{-2}$ solution in test tube

• add 5 drops of dilute hydrochloric acid (HCl) to the sample

Observe and record the results.

3-Testing for sulfate ion (SO_4^{2-}):

The sulfate ion is the conjugate base of a strong acid (sulfuric acid). As a result, a precipitate of sulfate is insoluble in strong acids. Sulfate salts are generally soluble except when the cation is Ca^{2+}, Ba^{2+}, Sr^{2+}, Ag^{+}, Pb^{2+}. When aqueous barium chloride is added to an acidified solution containing sulfate ions, an insoluble precipitate of $BaSO_4$ results. This precipitate is white in color and confirms the presence of sulfate.

$$(NH_4)_2SO_4^{-2} + BaCl_2 \longrightarrow \underset{\text{White ppt.}}{BaSO_4\downarrow} + NH_4Cl$$

To test for sulfate ions:

• Put 10 drops from ammonium sulphate solution in the test tube

• add 5 drops of barium chloride to the sample

Observe and record the results.

4- Testing for Nitrate NO_3^- {brown ring test}

Nitrate is reduced to nitric oxide in the presence of Fe^{2+} in an acidic medium.

The nitric oxide forms a complex with excess Fe^{2+}. This appears as a brown ring at the interface of the concentrated acid layer and the aqueous medium containing Fe^{2+}.

$$NO_3^- + Fe^{2+} + H_3O^+ \longrightarrow Fe^{3+} + NO + H_2O$$

$$NO + FeSO_4 \longrightarrow FeSO_4NO \text{ (Brown ring)}$$

To test for Nitrate ions:

(Reagent: ferrous sulphate solution and concentrated sulfuric acid).

• Put 10 drops from sodium nitrate solution in the test tube

• add few amounts of $FeSO_4$ to the sample

• Old the test tube in an inclined position. Then carefully pour concentrated sulfuric acid into the tube.

Observe and record the results.