PRACTICAL PROBLEMS

PROBLEM 1 (practical)

10 numbered test tubes, 20 cm^3 each, contain 0.1 M solutions of the following substances: barium chloride, sodium sulphate, potassium chloride, magnesium nitrate, sodium orthophosphate, barium hydroxide, lead nitrate, potassium hydroxide, aluminium sulphate, sodium carbonate. Using only these solutions as reagents, determine in which of the numbered test tubes each of the above given substances, is found.

Draw up a plan of the analysis and write equations of the reactions to be carried out. Do not forget to leave at least 2 cm^3 of the solutions in each test tube for checking. If in the course of the analysis an additional quantity of a solution is needed, you may ask the teacher to give it to you but in such case you will lose some points.

SOLUTION

Table:

	$BaCl_2$	Na_2SO_4	KCl	$Mg(NO_3)_2$	Na_3PO_4	$Ba(OH)_2$	$Pb(NO_3)_2$	KOH	$Al_2(SO_4)_3$	Na_2CO_3
$BaCl_2$		↓	—	—	↓	—	↓	—	↓	↓
Na_2SO_4	↓		—	—	—	↓	↓	—	—	—
KCl	—	—		—	—	—	↓	—	—	—
$Mg(NO_3)_2$	—	—	—		↓	↓	—	↓	—	↓
Na_3PO_4	↓	—	—	↓		↓	↓	—	↓	—
$Ba(OH)_2$	—	↓	—	↓	↓		↓	—	↓	↓
$Pb(NO_3)_2$	↓	↓	↓	—	↓	↓		↓	↓	↓
KOH	—	—	—	↓	—	—	↓		↓	—
$Al_2(SO_4)_3$	↓	—	—	—	↓	↓	↓	↓		↓
Na_2CO_3	↓	—	—	↓	—	↓	↓	—	↓	

Using the table, the entire problem cannot be solved at once: all the precipitates are white and there are substances that form the same number of precipitates. From the number of precipitates only KCl (1), $Mg(NO_3)_2$ (4), and $Pb(NO_3)_2$ (8) can be determined immediately.

Furthermore, Na_2SO_4 and KOH (giving three precipitates each) can be differentiated via the reaction with $Mg(NO_3)_2$ ($Mg(OH)_2$).

$Ba(OH)_2$ and $Al_2(SO_4)_3$ (giving 6 precipitates each): through the reaction with KOH ($Al(OH)_3$).

$BaCl_2$, Na_3PO_4 and Na_2CO_3 (giving 5 precipitates each): first the reaction with Na_2SO_4 indicates $BaCl_2$. Then the reaction with $BaCl_2$: $Al_2(SO_4)_3$ yields $AlCl_3$ ($BaSO_4$ precipitate is flittered off). Evolution of CO_2 and formation of $Al(OH)_3$ in the reaction with $AlCl_3$ solution indicates Na_2CO_3.

PROBLEM 2 (practical)

Determine the mass of potassium permanganate in the solution you are given. You are provided with hydrochloric acid of a given concentration, a potassium hydroxide solution of an unknown concentration, an oxalic acid solution of an unknown concentration, and a sulphuric acid solution (2 N).

Equipment and reagents:

A burette for titration, indicators (methyl orange, lithmus, phenolphthalein), pipettes (volumes 10, and 15 or 20 cm^3), 2 volumetric flasks (250 cm^3), 2 titration flasks (100 – 150 cm^3).