

# **PRACTICAL CHEMISTRY**

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Practical chemistry by J. Campbell Brown

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**J. CAMPBELL BROWN**

**PRACTICAL  
CHEMISTRY**



# PRACTICAL CHEMISTRY;

## ANALYTICAL TABLES

AND EXERCISES

FOR STUDENTS.

BY

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## REACTIONS OF METALS.

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### EXERCISE I.

#### SOLUTION OF SODIUM CHLORIDE.

Take about one cubic centimetre of the solution in a test tube or test glass, and add to it—

1. A few drops of HCl (hydrochloric acid): no ppt.; then
2. A current of the  $H_2S$  gas (hydrosulphuric acid): no ppt. Take another similar quantity of the original solution and add to it—
3.  $NH_4HO$  (ammonium hydrate): no ppt.; then
4.  $(NH_4)_2S$  (ammonium sulphide): no ppt.; then
5.  $(NH_4)_2CO_3$  (ammonium carbonate): no ppt.; then
6.  $(NH_4)_2PO_4$  (ammonium phosphate): no ppt.
7. Take a few drops of the solution on a piece of platinum foil or in a small porcelain dish, and evaporate to dryness over a Bunsen flame or spirit lamp; a white crystalline residue remains; heat this residue to redness; it is not volatile.
8. Moisten the end of a platinum wire with water, pick up by this means a small particle of the ignited salt and insert it into a Bunsen flame or colourless blow-pipe flame; the flame is tinged orange-yellow. Characteristic line of the spectrum  $WL = 5890$ .
9. Make a strong solution of the ignited residue, or take a few drops of the original solution, add to it, on a watch glass, a few drops of HCl, then  $PtCl_4$  (platinic chloride), and stir with a clean glass rod, no ppt. After careful evaporation to dryness the yellow crystals which are formed are soluble in water and in a mixture of alcohol and ether.
10. Chloride of sodium is insoluble in a mixture of alcohol and ether.

## EXERCISE II.

## SOLUTION OF POTASSIUM CHLORIDE.

1 to 6. Take about 1 c.c. of the solution in each of two test tubes, and add to them the same reagents as in experiments 1, 2, 3, 4, 5, and 6 of the last exercise—with similar results.

7. Evaporate a small quantity of the solution to dryness, and heat the residue to red heat. It is not volatile.

8. Place a small portion of the ignited salt or of the original solution in a colourless flame. If the potassium salt is pure the flame is tinged violet; if the salt contains a minute quantity of sodium salt the flame is tinged orange. On viewing the mixed flame through blue glass the orange rays are absorbed, and the violet rays are thus rendered visible. Characteristic lines of spectrum  $WL = 7700, 6950, \text{ and } 4080$ .

9. Make a strong solution of the ignited residue, or take a few drops of the original solution, add to it, on a watch glass, a few drops of  $HCl$ , then a few drops of  $PtCl_4$ , and stir with a glass rod. A yellow crystalline precipitate ( $2KCl, PtCl_4$ ) is formed, which is also insoluble in a mixture of alcohol and ether. If a weak solution is used the solution must be evaporated to dryness and treated with water.

10. To a portion of the solution add  $H_2C_4H_4O_6$  (tartaric acid), and shake vigorously. A white crystalline precipitate ( $KHC_4H_4O_6$ ) is produced, unless the solutions are very weak. The ppt. is increased by the addition of alcohol.

11. To another portion of the solution add trinitrophenol (picric acid): yellow insoluble silky needles ( $C_6H_2(NO_2)_3KO$ ) are produced.

12. Chloride of Potassium is insoluble in a mixture of alcohol and ether.

13.  $H_2SiF_6$  (hydrofluosilicic acid) gives a white gelatinous precipitate ( $K_2SiF_6$ ) with potassium salts.

## EXERCISE III.

## SOLUTION OF CHLORIDE OF LITHIUM.

1. Lithium chloride is soluble in a mixture of alcohol and ether, and may thus be separated from chlorides of potassium and sodium.

2 to 8. Repeat experiments 1 to 7 of the last two exercises, with similar results.\*

9. Place a small portion of lithium chloride in a colourless flame, or set fire to a small quantity of the alcoholic solution. Lithium imparts a bright crimson colour to the flame.

Characteristic lines of spectrum, a red line  $\alpha$ , WL = 6705, and a weaker orange one  $\beta$ , WL = 6101.

#### EXERCISE IV.

##### SOLUTION OF AMMONIUM CHLORIDE.

1 to 6. Repeat experiments 1 to 6 as in exercises I and II.

7. Take a third portion of the solution in a small porcelain dish, evaporate it to dryness, and ignite the residue to redness over a Bunsen flame. White fumes of neutral ammonium chloride are produced by the sublimation of the salt until it has been entirely removed from the hot dish.

8. Introduce a small quantity of the dry residue, obtained by evaporation, into a colourless flame; the flame is temporarily tinged yellow or orange.

9, 10, and 11. Repeat experiments 9 to 11 of the exercise on chloride of potassium, with similar results.

12. Add Nessler's reagent (potassic solution of  $2KI, HgI_2$ ): brown ppt. ( $Hg_2N_2I_2, 2H_2O$ ).

13. Heat in a test-tube a small portion of the solution with solution of caustic soda ( $NaHO$ ) or with lime ( $CaH_2O_2$ ), while a piece of moistened red litmus paper is held over the mouth of the tube; the ammonia gas evolved renders the litmus blue, and may also be detected by its odour.

#### EXERCISE V.

##### SOLUTION OF MAGNESIUM CHLORIDE.

Take about 1 c.c. of the solution, and add to it—

1. A few drops of  $HCl$ : no ppt.; then

2. A current of  $H_2S$  gas: no ppt.

Take another similar quantity of the original solution, and add to it—

3.  $NH_4HO$ : a ppt. may be formed; add now  $NH_4Cl$ : the ppt., if any, dissolves; then

\* The carbonates and phosphates of Lithium are not very soluble in water, therefore if the solutions are very concentrated, carbonates and phosphates of the other alkalis may partially precipitate Lithium salts.



4.  $(\text{NH}_4)_2\text{S}$ : no ppt.; then
5.  $(\text{NH}_4)_2\text{CO}_3$ : no ppt., unless insufficient  $\text{NH}_4\text{Cl}$  is present; then
6.  $(\text{NH}_4)_3\text{PO}_4$  and  $\text{NH}_4\text{HO}$ : a white crystalline ppt. falls ( $\text{MgNH}_4\text{PO}_4 \cdot 6\text{H}_2\text{O}$ ), which is increased on stirring and allowing to stand for some time.
- To other portions of the original solution add—
7.  $\text{H}_2\text{SO}_4$  (sulphuric acid): no ppt.
8. Ammonium hydrate,  $\text{NH}_4\text{Cl}$ , and  $(\text{NH}_4)_2\text{C}_2\text{O}_4$  (ammonium oxalate): no ppt.
9. Evaporate to dryness, and ignite a portion, either on charcoal or otherwise, moisten with  $\text{Co}_2\text{NO}_3$  in blow-pipe flame: dirty pale pink mass is produced.
10. It does not colour a Bunsen flame.

#### EXERCISE VI.

##### SOLUTION OF CALCIUM CHLORIDE.

- 1 to 4. Repeat experiments 1 to 4 of the preceding exercise, with negative results.
- To other portions of the solution add—
5.  $(\text{NH}_4)_2\text{CO}_3$ : a bulky white ppt. ( $\text{CaCO}_3$ ).
6.  $(\text{NH}_4)_3\text{PO}_4$  and  $\text{NH}_4\text{HO}$ : a bulky white ppt. ( $\text{Ca}_3\text{P}_2\text{O}_8$ ).
7.  $\text{NH}_4\text{HO}$  and  $(\text{NH}_4)_2\text{C}_2\text{O}_4$  first to a strong solution, and second to an extremely dilute solution: a white ppt. or cloud ( $\text{CaC}_2\text{O}_4$ ) is at once formed in each case; soluble in  $\text{HCl}$  and  $\text{HNO}_3$ , but insoluble in  $\text{HC}_2\text{H}_3\text{O}_2$  (acetic acid).
8.  $\text{H}_2\text{SO}_4$  first to a strong solution: white ppt. ( $\text{CaSO}_4$ ); and second to a very dilute solution; no ppt.
9. Place a small portion, by means of a chemically clean platinum wire, in a colourless flame. Calcium tinges the flame orange-red. Characteristic lines of spectrum  $\text{WL} = 6170, 5550, 4230$ .

#### EXERCISE VII.

##### SOLUTION OF STRONTIUM CHLORIDE.

- 1 to 8. Repeat experiments 1 to 8 inclusive, of the preceding exercise, with similar results, except that a cloud with very dilute solutions in experiments 7 and 8 appears slowly.
9. Introduce a small portion into a colourless flame. Strontium tinges the flame crimson. Spectrum characteristic blue line  $\text{WL} = 4607$  and red bands.

## EXERCISE VIII.

## SOLUTION OF BARIUM CHLORIDE.

1 to 6. Repeat experiments 1 to 6 of the last two exercises with similar results.

7. Add  $\text{NH}_4\text{HO}$  and  $(\text{NH}_4)_2\text{CO}_3$ : a white ppt. is formed if the solutions are of ordinary strength, but no cloud is formed if the solutions are extremely dilute.

8. Add dilute  $\text{H}_2\text{SO}_4$ : an immediate white ppt. ( $\text{BaSO}_4$ ), even if the solutions are extremely dilute.

9. Add solution of  $\text{CaSO}_4$  (calcium sulphate): an immediate white cloud is formed,  $\text{BaSO}_4$  being more insoluble than  $\text{CaSO}_4$ .

10. Place a small portion in a colourless flame, by means of a clean platinum wire. Barium tinges the flame olive-green. The spectrum consists of red or orange and green bands, from  $\text{WL} = 7000$  to  $4350$ .

In the case of a non-volatile salt, such as sulphate, the wire should be moistened with  $\text{HCl}$ .

11.  $\text{H}_2\text{SiF}_6$  gives a white crystalline ppt. ( $\text{BaSiF}_6$ ).

12.  $\text{K}_2\text{CrO}_4$  gives a yellow ppt. ( $\text{BaCrO}_4$ ) in dilute neutral solutions.

## EXERCISE IX.

## SOLUTION OF ZINC CHLORIDE OR SULPHATE.

1 and 2. Repeat experiments 1 and 2 of the previous exercises: negative results.

To other portions of the original solution add—

3.  $\text{NH}_4\text{HO}$ : colourless ppt. ( $\text{ZnH}_2\text{O}_2$ ) if ammonium salts are absent; soluble in excess; soluble also in ammonium salts.

4.  $(\text{NH}_4)_2\text{S}$ : a white ppt. of  $\text{ZnS}$ ; soluble in mineral acids, but not soluble in acetic acid ( $\text{HC}_2\text{H}_3\text{O}_2$ ).

5.  $\text{NaHO}$ : colourless ppt. ( $\text{ZnH}_2\text{O}_2$ ); soluble in excess.

6.  $(\text{NH}_4)_2\text{CO}_3$ : white ppt.; soluble in excess.

7.  $\text{K}_2\text{Cfy}$ : yellow-white ppt. ( $\text{Zn}_2\text{Cfy}$ ).

*Experiments with Dry Compounds of Zinc.*

8. Heat a portion on charcoal in blow-pipe flame;  $\text{ZnO}$  is reduced, which becomes yellow when hot, white when cold; then

9. Moisten with  $\text{Co}_2\text{NO}_3$ ; and heat again in blow-pipe flame: the mass becomes green (Rinman's green pigment).

## EXERCISE X.

## SOLUTION OF MANGANESE CHLORIDE.

1 and 2. Repeat 1 and 2 of the previous exercises, with negative results.

To other portions of the original solution add—

3.  $\text{NH}_4\text{HO}$ : white ppt. ( $\text{MnH}_2\text{O}_2$ ); soluble in  $\text{NH}_4\text{Cl}$ ; changing by exposure to air into a brown ppt. of  $\text{MnH}_2\text{O}_3$ , not soluble in  $\text{NH}_4\text{Cl}$ .

4.  $(\text{NH}_4)_2\text{S}$ : a pink ppt. of  $\text{MnS}$ , soluble in acetic acid when recently precipitated.

5.  $\text{NaHO}$ : white ppt.; insoluble in excess, becoming brown by exposure to air.

6.  $(\text{NH}_4)_2\text{CO}_3$ : white ppt. of  $\text{MnCO}_3$ , becoming brown by exposure.

7.  $\text{K}_2\text{Cfy}$ : white ppt. of  $\text{Mn}_2\text{Cfy}$ .

*Experiments with Dry Compounds of Manganese.*

8. Make a borax bead, introducing a very small quantity of the original substance, or any of its precipitates: colourless in the inner, amethyst bead in the outer blow-pipe flame.

9. Fuse a portion on platinum foil with  $\text{Na}_2\text{CO}_3$  and  $\text{KNO}_3$ : green mass of alkaline manganates ( $\text{K}_2\text{MnO}_4$ ).

## EXERCISE XI.

## SOLUTION OF NICKEL SULPHATE.

1 and 2. Repeat experiments 1 and 2 of the previous exercises, with negative results.

To another portion of the original solution add—

3.  $\text{NH}_4\text{HO}$ : light green ppt. ( $\text{NiH}_2\text{O}_2$ ); soluble in excess, forming a blue solution.

4. To another portion add  $\text{NH}_4\text{Cl}$  and  $\text{NH}_4\text{HO}$ : no ppt.

5. Then add  $(\text{NH}_4)_2\text{S}$ : black ppt. ( $\text{NiS}$ ); insoluble in  $\text{HCl}$  and in  $\text{HC}_2\text{H}_3\text{O}_2$ .

To other portions of the original solution—

6.  $\text{NaHO}$ : light green ppt. ( $\text{NiH}_2\text{O}_2$ ); insoluble in excess.

7. Solution of  $\text{NaClO}$  (bleaching solution), and boil: black ppt. of  $\text{Ni}_2\text{O}_3$ .

8.  $(\text{NH}_4)_2\text{CO}_3$ : green ppt. ( $\text{NiCO}_3$ ); soluble in excess.

9.  $\text{KCy}$ : greenish ppt. ( $\text{NiCy}_2$ ); soluble in excess, forming a light brown solution of  $2\text{KCy}$ ,  $\text{NiCy}_2$ ; reprecipitated by acids.