REAGENTS

AND

Volumetric Solutions

PROPOSED FOR THE

U. S. Pharmacopœia,

TOGETHER WITH SOME

Specimens of the Text Proposed.

Published by the
Committee of Revision and Publication of the
Pharmacopœia of the U. S. of America,
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These pages are intended to aid the members of the Committee of Revision of the U. S. P. and the friends who have kindly volunteered their assistance, in such of their work as refers to the application of reagents in making tests of identity, purity or percentage of strength. The annexed table of multiples will be found convenient for them in calculating molecular weights. It is much easier to refer to a printed page than to the written sheets in which the matter has heretofore been circulated among the Committee.

The pamphlet is at the same time designed to show the arrangement and general style of typographical execution proposed to be adopted in the next edition of the Pharmacopœia, and to elicit expressions of opinion, relating to both matter and form of any subject connected with it, so that the editor may profit by them in the final preparation of the work for the press.

With this view a few specimen pages of the proposed text have been appended and have been arranged in the general appearance of type, in the separation of individual tests into paragraphs, grouping together directions for preparation, description, tests of identity, tests of purity, tests of percentage of strength, etc., in such a manner as to make reference easy, and to show by these few examples how the subject has been treated by the revisers.

REAGENTS.

I. PRELIMINARY REMARKS.

1. Official Substances as Reagents.—Some official substances (chemicals, chemical solutions, etc.) are sufficiently pure to be used as reagents, if they comply with the tests of purity prescribed by the pharmacopœia. In the case of others, the presence of certain impurities, though immaterial for their use as medicines, renders their employment as reagents unsuitable. All such official substances, for which a greater degree of purity is required, when they are to be used as reagents, are included in the several lists below following.

2. Nomenclature.—In the tests contained in the text of the pharmacopœia and in the present list of reagents, the names of chemicals are given, usually, so that the name of the base (alkali, metal, etc.) is placed first. Thus: "silver nitrate," instead of "nitrate of silver"; "ferrous sulphate," instead of "sulphate of iron." In other cases the official title has been altered to a form more in harmony with the chemical views of the present time, for instance, "Bichromate of Potassium" has been named "Potassium Dichromate."

3. Keeping of Reagents.—Reagents should be kept in bottles made of glass free from lead and arsenic, and proof against corrosion by acids and alkalies, preferably in those made of Bohemian glass.

The bottles should be closed by well-ground glass-stoppers. Stoppers of bottles containing alkali hydrates, ammonium sulphide, ammonia water, tannic acid, and other substances rapidly attacking ground glass surfaces, should be lubricated with a thin film of petrolatum.

Reagents easily affected by light, such as hydrogen sulphide T.S., ammonium sulphide T.S., chlorine water, etc., should be kept in bottles made of dark amber-colored glass.

4. Abbreviations Used:

T.S. = Test-solution.
V.S. = Volumetric solution.
$\frac{N}{1}$ = Normal (see under "Volumetric Solutions" in the succeeding list).
$\frac{N}{2}$ = Seminormal; $\frac{N}{10}$ = Decinormal; $\frac{N}{100}$ = Centinormal.
$\frac{2}{N}$ = Double normal.

Note.—As some of the following test-solutions are in many cases directed in definite quantities in lieu of the regular volumetric solutions, it is important that they should always be prepared of the *exact strength prescribed.*

II. LIST OF REAGENTS AND TEST-SOLUTIONS.

Note.—The reagents are arranged in alphabetical order. The test-solutions are mentioned in connection with the principal chemical or other substance from which they are prepared. The volumetric solutions will be found in the list No. III.

Whenever *water* is required or mentioned as a solvent in the tests given in the pharmacopœia, or in the preparation of any reagent, it is understood that *distilled water* be used.

1. **Absolute Alcohol.**—Ethyl alcohol, $C_2H_5OH = 45.9$, as free from water as possible. Absolute alcohol of 100 per cent. has the spec. grav. 0.7946 at 15.5° C. (60° F.) It attracts water so rapidly that it is difficult to obtain it of higher concentration than about 99 per cent., corresponding to a spec. grav. of 0.7976. Absolute alcohol should be entirely neutral to blue and red litmus paper; and if it is poured upon white, anhydrous copper sulphate, the latter should not acquire a blue color (absence of more than 2 per cent. of water).

2. **Acetic Acid.**—$H.C_2H_3O_2 = 59.86$. See *Acidum Aceticum*, U. S. P.

3. **Albumen Test-Solution.**—Carefully separate the white of a hen's egg from the yolk, shake it thoroughly with 100 Cc. of water and filter. This solution should be freshly made when required.

4. **Aluminum.**—Metallic Aluminum, $Al = 27.04$, in the form of foil, wire, or ribbon. It should be tested for arsenic by Fleitmann's method (see below, No. 12, *c.*) when no color should be imparted to the silver nitrate within two hours.

5. **Ammonia Water,** $NH_3 = 17.01$.—See *Aqua Ammoniae*, U. S. P.

6. **Ammonium Carbonate Test-Solution.**—Dissolve 10 Gm. of ammonium carbonate, $NH_4HCO_3 \,.\, NH_4CO_2NH_2 = 156.77$, [*ammonii carbonas*, U. S. P.] in a mixture of 10 Cc. of ammonia water and 40 Cc. of water.

For detecting arsenic sulphide in presence of antimony sulphide, the addition of ammonia water is omitted, and 10 Gm. of the salt are dissolved in 100 Cc. of water.

7. **Ammonium Chloride Test-Solution.**—Dissolve 10 Gm. of ammonium chloride, $NH_4Cl = 53.38$ [*ammonii chloridum*, U. S. P.] in water so as to make 100 Cc.

8. **Ammonium Molybdate Test-Solution.**—Dissolve 1 Gm. of finely powdered ammonium molybdate, $(NH_4)_2 MoO_4 = 195.76$, in 6.7 Cc. of hot water, using a little ammonia water, if necessary, to effect solution. Then gradually pour the

liquid into a mixture of 3.3 Cc. of nitric acid (spec. grav. 1.414) and 3.4 Cc. of water. Preserve the test-solution in the dark, and if a sediment should form in it after some days, carefully decant the clear solution from it.

9. Ammonium Oxalate Test-Solution.—Dissolve 5 Gm. of pure, crystallized ammonium oxalate, $(NH_4)_2C_2O_4 + H_2O = 141.76$, in enough water to make 100 Cc. Or, dissolve 5 Gm. of pure oxalic acid (see below No. 95) in 100 Cc. of water, add 20 Cc. of ammonia water, boil to expel excess of ammonia, and bring the volume to 112.8 Cc.

On evaporating a portion of the test-solution, and igniting the residue, it should be completely volatilized (abs. of *fixed impurities*). The test-solution should not be rendered turbid by hydrogen sulphide T.S., nor by ammonium sulphide T.S. (abs. of *metals*). The precipitate produced in it by silver nitrate T.S., or by barium chloride T.S. should dissolve without residue upon addition of nitric acid (abs. of *chloride, and sulphate*, respectively).

10. Ammonium Phosphate Test-Solution.—Dissolve 1 Gm. of ammonium phosphate, $(NH_4)_2HPO_4 = 131.82$, together with 2 Cc. of ammonia water, in enough water to make 100 Cc. This solution does not keep well. It should be freshly made when required, or renewed from time to time.

11. Ammonium Sulphide Test-Solution.—Saturate 3 parts of pure ammonia water with pure, washed hydrogen sulphide, and add to the solution (which now contains ammonium sulphhydrate, $NH_4HS = 50.99$) 2 parts of ammonia water, which converts the greater portion of the ammonium sulphhydrate into ammonium sulphide, $(NH_4)_2S = 68.0$. The solution should be perfectly clear and colorless, and, on being evaporated, leave no residue. It should not be rendered turbid either by magnesium sulphate T.S. (abs. of *free ammonia*), or by calcium chloride T. S. (abs. of *ammonium carbonate*). It should be protected against air and light by being kept in small, dark amber-colored bottles, in a dark place. It should be rejected as soon as a notable deposit of sulphur has made its appearance.

Ammonium polysulphide test-solution is occasionally required This is a yellow liquid, prepared by dissolving a small quantity of pure sulphur in the preceding colorless test solution.

12. ARSENIC, TESTS FOR.

a. **Bettendorff's Test for Arsenic.**—To a small quantity of the liquid to be tested, which should contain much pure concentrated hydrochloric acid, or, be a solution of the substance to be tested in pure concentrated hydrochloric acid, add an equal volume of a saturated solution of freshly prepared stannous chloride in pure concentrated hydrochloric acid, together with a small piece of pure tin-foil. The presence of arsenic is revealed by the production of a brown color or brown precipitate, the appearance of which is hastened by a gentle heat. (See Stannous Chloride No. 86.)

b. **Gutzeit's Test.**—Into a test-tube of *at least* 30 Cm. (6 inch.) in length, and

15 to 18 Mm. (about $\frac{5}{8}$–$\frac{3}{4}$ inch.) in diameter, place a single, solid piece of zinc (see below, No. 93), weighing about 1 to 1.25 Gm., and add about 5 Cc. of a mixture, previously prepared and kept in readiness for this purpose, of 10 Cc. of pure sulphuric acid of spec. grav. 1.840, and 200 Cc. of water, the ingredients having previously been proven free from arsenic by having been subjected, *alone*, to the test about to be described, during at least two hours, with negative result. Now add the liquid to be tested, which should not be alkaline, nor materially increase the volume of the contents of the test-tube. Immediately secure over the mouth of the test-tube a previously prepared cap made of three thicknesses of pure filter paper free from dust, and apply to the upper one a drop of a saturated, aqueous solution of silver nitrate, acidulated with nitric acid. (See Silver Nitrate T.S. No. 74.) Place the tube at once into a box rigidly excluding light, and permit the reaction to proceed for such a time as may be specially prescribed in each case. The presence of arsenic is revealed by the production, upon the moistened paper-cap, of a bright yellow stain which becomes black or brown by application of water. (Antimony colors the spot black or brown at once without a previous yellow color. In this case, small quantities of arsenic may be overlooked; it is therefore advisable to subject a fresh specimen of the solution to be tested, previously made alkaline, to Fleitmann's test—see No. 12, *c.*,—which responds only to arsenic). If any stain is produced, repeat the test, substituting for the silver nitrate a drop of lead acetate T.S. If this spot remains colorless, it shows the absence of hydrogen sulphide or phosphide, and makes the presence of arsenic (or antimony) certain.

c. **Fleitmann's Test for Arsenic.**—Into a test-tube of *at least* 30 Cm. (6 inch.) in length, and 15 to 18 Mm. (about $\frac{5}{8}$–$\frac{3}{4}$ inch.) in diameter, place a single, solid piece of zinc (see below, No. 90), weighing about 1 to 1.25 Gm., and add about 5 Cc. of solution of potassa [*liquor potassae*, U. S. P.], both ingredients having previously been proven free from arsenic by having been subjected, *alone*, to the test about to be described, during at least two hours, with negative result. Now add the liquid to be tested, which must not contain any free acid, nor very materially increase the volume of the contents of the test-tube. Immediately secure over the mouth of the test-tube a previously prepared cap made of three thicknesses of pure filter paper free from dust, and apply to the upper filter paper a drop of a saturated, aqueous solution of silver nitrate acidulated with nitric acid. Then place the tube at once, upright, into a box containing sand heated to about 90° C. (194° F.), and fitted with a cover, so as to exclude light and dust, and permit the reaction to proceed for such a time as may be specially prescribed in each case. The presence of arsenic (but not of antimony) is revealed by the production, upon the moistened paper cap, of a brown or black stain. In absence of arsenic, if the test has been carefully conducted, the spot will remain colorless.

In place of zinc, metallic aluminum, best in form of wire, cut into small pieces, may be employed (*Gatehouse's* modification). The method of testing, and the results are the same as in Fleitmann's test.

13. Barium Carbonate.—Pure barium carbonate, $BaCO_3 = 196.75$, prepared by dissolving 12 parts of pure crystallized barium chloride in 20 parts of boiling water, then adding a solution of 5 parts of ammonium carbonate in 10 parts of boiling water, and afterwards 5 parts of ammonia water; finally washing the precipitate thoroughly and drying it.

14. Barium Chloride Test-Solution.—Prepared from pure barium chloride, $BaCl_2+2H_2O = 243.56$. The aqueous solution of the salt should be perfectly neutral, and should not yield any precipitate with hydrogen sulphide T.S. or ammonium sulphide T.S. (abs. of *metals, etc.*). The aqueous solution, after being precipitated by diluted sulphuric acid in slight excess, yields a filtrate which should not leave any permanent residue when evaporated and heated on platinum foil (abs. of *other fixed bases and salts*). Diluted alcohol, after remaining in contact with it for several hours, should, upon ignition, show a pure yellowish-green color, without red streaks (abs. of *traces of strontium*). To prepare the *test-solution*, dissolve 12.2 grammes of the salt in water to make 100 Cc. (This solution is of normal strength $= \frac{N}{1}$ V.S.)

15. Barium Nitrate Test-Solution.—Prepared from pure barium nitrate, $Ba(NO_3)_2 = 260.68$. This salt should respond to the same tests as barium chloride (see No. 14); in addition, its aqueous solution, slightly acidulated with nitric acid, should not be rendered turbid by nitrate of silver T.S. (abs. of *chloride*). To prepare the *test-solution*, dissolve 1 Gm. of the salt in 15.3 Cc. of water. ($= \frac{N}{2}$ V.S.)

16. Benzin, or Petroleum Ether.—A purified distillate from American petroleum, consisting of various hydrocarbons, having a spec. grav. of 0.670 to 0.675 at 15° C. (59° F.), and boiling between 50° and 60° C. (122-140° F.) It is a colorless, transparent, diffusive liquid, of a characteristic odor, somewhat resembling that of petroleum, but not offensive; neutral to test papers, and volatilizing from the hand without leaving a residue or odor.

17. Benzol, or Benzene.—Benzol, $C_6H_6 = 77.82$, is a colorless, transparent liquid of a peculiar, aromatic odor, of a spec. grav. of 0.8846 at 15°C. (59° F.), congealing at 0°C. (32° F.), and boiling at 80.37° C. (176.7° F.) It is insoluble in water, but soluble in 4 parts of alcohol, and in ether. In concentrated sulphuric acid it should dissolve without producing a color. On shaking 2 Cc. of benzol with 0.5 Cc. of sulphuric acid and 1 drop of red fuming nitric acid, no green or blue tint should be produced (abs. of *thiophene*).

18. Bromine Water, (Bromine Test-Solution), $Br = 79.76$.—An aqueous solution of bromine [*Bromum*, U. S. P.], prepared by dissolving 1 Cc. of bromine in water to make 100 Cc. See also Bromine Volumetric Solution No. 96.

19. Calcium Chloride Test-Solution.—Dissolve 10.95 Gm. of crystallized calcium chloride, $CaCl_2+6H_2O = 218.41$, in water to make 100 Cc. ($= \frac{N}{1}$ V.S.)

20. Calcium Hydrate Test-Solution, (Lime water), $Ca(OH)_2 = 73.83$.—Use the Liquor Calcis of the preceding text of the pharmacopœia.

21. Calcium Sulphate Test-Solution.—Introduce transparent crystals of native gypsum (selenite) $CaSO_4 + 2H_2O = 171.65$, into a flask filled with water, and decant the clear, saturated solution when required. One part of gypsum requires at 15° C. (59° F.) 398 parts of water for solution.

22. Chlorine Water, (Chlorine Test-Solution) $Cl = 35.37$.—Use the chlorine water (*Aqua Chlori*) of the preceding text of the pharmacopœia. Since it rapidly deteriorates by keeping, it should be frequently renewed, or freshly prepared when required.

23. Chloroform, $CHCl_3 = 119.08$.—Use the official chloroform.

24. Cochineal Test-Solution.—See under *Indicators* (No. 40, *a*.)

25. Copper, (Metallic Copper), $Cu = 63.18$, in form of wire, foil, or turnings. The commercial article, brightened, if necessary, by scouring with diluted hydrochloric acid, is suitable for all purposes except testing for arsenic. If required for this purpose, a small portion (about 0.5 Gm.) of the copper is to be dissolved in hot, concentrated sulphuric acid, and this solution subjected to Gutzeit's test (see No. 12, *b*.) No color should be imparted to the silver nitrate within two hours (abs. of *arsenic*).

26. Copper Ammonium Sulphate Test-Solution.—A solution of cupritetrammonium sulphate, $Cu(NH_3)_4SO_4 + H_2O = 245.00$. To copper sulphate T.S. add ammonia water, until the precipitate first formed is nearly, but not completely, redissolved; then filter. This solution is apt to decompose on keeping. It should be made freshly when required.

27. Copper Sulphate Test-Solution, [*Cupri Sulphas*, U. S. P.], $CuSO_4 + 5H_2O = 248.8$.—Dissolve 10 Gm. of copper sulphate in water to make 100 Cc.

28. Copper Tartrate Test-Solution.—See below, under volumetric solutions, No. 91.

29. Coralline Test-Solution.—See under *Indicators*, (No. 40, *b*.)

30. Diphenylamine, and Diphenylamine Test-Solution.—See under *Indicators*, (No. 40, *c*.)

31. Eosin Test-Solution.—See under *Indicators*, (No. 40, *d*.)

32. Ferric Chloride Test-Solution, [*Ferri Chloridum*, U. S. P.] $Fe_2Cl_6 + 12H_2O = 539.50$.—Dissolve 10 Gm. of ferric chloride, in water to make 100 Cc.

33. Ferrous Sulphate Test-Solution, [*Ferri Sulphas*, U. S. P.] $FeSO_4 + 7H_2O = 277.42$.—Dissolve a clear crystal of ferrous sulphate in about 10 parts of water previously boiled to expel air. This solution should be freshly prepared immediately before use.

34. Ferrous Sulphide, FeS = 87.86.—A heavy solid, in form of black or brownish-black irregular masses, or fused into sticks, soluble in sulphuric, hydrochloric, etc., acids with copious evolution of hydrogen sulphide. On dissolving 2 Gm. of ferrous sulphide in pure nitrohydrochloric acid diluted with a little water, evaporating the solution to dryness and testing the residue by Gutzeit's method (see No. 12, *b.*), no color should be imparted to the silver nitrate within two hours.

35. Gelatin Test-Solution.—Dissolve 1 Gm. of isinglass [*Ichthyocolla*, U. S. P.] in 50 Cc. of water, by the aid of a gentle heat, and filter if necessary. This solution should be freshly made when wanted for use.

36. Gold Chloride Test-Solution.—The commercial chloride of gold, usually prepared by dissolving gold in nitro-hydrochloric acid and carefully evaporating to dryness, mostly consists of aurochloric acid, $HAuCl_4 + 2H_2O$ = 375.1, which is converted into neutral auric chloride, $AuCl_3$ = 302.81, by fusing at a temperature not exceeding 150° C. (302° F.), moistening the residue (now consisting of auric and aurous chloride) with enough hot water to produce a syrupy liquid (whereby the aurous chloride is decomposed into auric chloride and metallic gold) and then pouring off the clear liquid from the precipitate. To prepare the *test-solution*, dissolve the liquid finally obtained in the before-mentioned process in 20 volumes of water. Or, dissolve 1 Gm. of dry auric chloride in 30 Cc. of water.

37. Hydrochloric Acid, Pure, for Tests, HCl = 36.37.—In addition to the tests prescribed for this acid in the text of the pharmacopœia, it is required to stand the following more rigorous tests, before it can be employed as a reagent: The addition of 1 Cc. of barium chloride T.S. to 1 Cc. of the acid, diluted with 9 Cc. of water, should cause no turbidity within twenty-four hours (abs. of *sulphuric acid*). A crystal of diphenylamine dropped into the acid should not turn blue (abs. of *free chlorine*). On substituting it for sulphuric acid in Gutzeit's test, as described under No. 12, *b.*, no color should be imparted to the silver nitrate within two hours (abs. of *arsenic or antimony*).

38. Hydrogen Sulphide, H_2S = 33.98.—A gas generated by treating ferrous sulphide with diluted sulphuric acid, and washing the gas by passing it through water.

39. Hydrogen Sulphide Test-Solution, or Hydrosulphuric Acid, H_2S = 33.98.—A saturated solution of hydrogen sulphide in water. To prepare about 1 litre of the solution, treat 20 Gm. of ferrous sulphide, in a suitable apparatus, with a mixture of 20 Cc. of pure sulphuric acid, spec. grav. 1.840, and 250 Cc. of water, pass the gas through a small quantity of water, and conduct it into a bottle of the capacity of about 1½ litres, containing 1 litre of water. When the gas is no longer absorbed, transfer the solution to small, dark amber-colored bottles, to be filled nearly to the top, pass a stream of hydrogen sulphide for a few minutes through each, and then at once stopper them tightly, and preserve them afterwards in a cool and dark place. Before putting them aside, introduce into one of these bottles a few drops of pure hydrochloric acid, and keep it in a warm place during twenty-four hours, after which time no precipitate should be found in it (abs. of *arsenic*). Before any of the solution is used, it should be ascertained that it retains a strong odor of hydrogen sulphide, and that, when it is added to an equal volume of ferric chloride T.S., a copious precipitate of sulphur is formed at once.

40. INDICATORS FOR ACIDIMETRY, ALKALIMETRY, ETC.

a. **Cochineal Test-Solution.**—Macerate 1 Gm. of unbroken cochineal [*Coccus*, U. S. P.] during four days, with 20 Cc. of alcohol and 60 Cc. of water. Then filter. The color of this test-solution turns violet with alkalies, and yellowish-red with acids. As an indicator it is used chiefly when ammonia or alkaline earths are present.

b. **Coralline Test-Solution.**—Dissolve 1 Gm. of coralline (a coloring matter derived from coal-tar, and containing rosolic and para-rosolic acids,) in 10 Cc. of alcohol and enough water to make 100 Cc.

c. **Diphenylamine,** $(C_6H_5)_2NH = 168.65$, is in form of grayish-white or colorless crystals, of a peculiar aromatic odor, melting at 54° C. (129.2° F.), slightly soluble in water, more soluble in acids. It is either used in the dry state, or in solution in dilute sulphuric acid, as a test for nitric acid (in sulphuric acid, water, etc.), or for chlorine (in hydrochloric acid). To test a solution for the presence of nitric acid, a small portion of it is mixed with 1 or 2 drops of diphenylamine T.S., and then concentrated sulphuric acid, *free from nitrose*, is poured in so as to form a layer beneath the solution. The presence of nitric acid is shown by a deep blue coloration of the zone of contact.

Diphenylamine test-solution is prepared by dissolving 0.1 Gm. of diphenylamine in 50 Cc. of diluted sulphuric acid. The solution should be colorless.

d. **Eosin Test-Solution.**—Dissolve 1 Gm. of commercial "yellowish" eosin in 30 Cc. of water. This solution is red by transmitted light, and shows a strong green fluorescence by reflected light. Acids destroy the fluorescence, and alkalies restore it.

e. **Litmus Paper and Test-Solution.**—Exhaust coarsely powdered litmus with boiling alcohol (which removes a peculiar red coloring matter, erythrolitmin), and digest the residue with about an equal weight of cold water, so as to dissolve the excess of alkali present. The blue solution thus obtained, after being acidulated, may be used to make *red litmus paper*. Finally extract the residue with about five times its weight of boiling water, and filter. Preserve the filtrate, as *test-solution*, in wide-mouthed bottles stoppered with loose plugs of cotton to exclude dust but to admit air.

Litmus Paper, Blue.—Impregnate with the test-solution just described, strips of unsized, white paper, free from wood-pulp, but not too porous, and dry them by suspending them on strings of clean twine.

Litmus Paper, Red.—Prepare this with the same kind of paper, and in the same manner as described in the preceding paragraph. To impregnate the paper, either use the blue solution obtained from litmus, by treating the mass, after extraction by alcohol, with cold water, acidulating the same with just enough hydrochloric acid to impart to it a distinct onion-red tint. Or, use the regular test-solution, after acidulating it in the same manner.

Neither blue nor red litmus paper should have a very intense color.

Preserve the test paper in paper boxes or bottles, so as to exclude dust, and acid or ammoniacal vapors.

f. **Methyl-Orange Test-Solution.**—Dissolve 1 Gm. of methyl-orange [Dimethylamido-azobenzol-sulphonic acid, $(CH_3)_2 C_6H_4 . N : N.C_6H_4. SO_3H = 304.47$; also known as helianthin, or tropæolin D, or Poirier's Orange III] in 1000 Cc. of water. The solution acquires a yellow color when brought in contact with alkaline hydrates, carbonates; or bicarbonates. Carbonic acid does not affect it, but sulphuric, hydrochloric and other acids change its color to crimson. It is not suited for use with organic acids.

g **Phenolpthalein Test-Solution.**—Dissolve 1 Gm. of phenolphtalein in 100 Cc. of diluted alcohol. The solution is colored deep purplish-red by alkali hydrates or carbonates, bicarbonates and most other salts do not produce such color; acids render the reddened solution colorless. It is not suitable as an indicator for ammonia or bicarbonates.

Phenolphtalein Paper is prepared by impregnating white unsized paper with the test-solution and drying it.

h. **Rosolic Acid Test-Solution.**—Dissolve 1 Gm. of commercial rosolic acid (chiefly $C_{20}H_{16}O_3 = 303.28$) in 10 Cc. of alcohol, and add enough water to make 100 Cc. The solution turns violet-red with alkalies, yellow with acids. In place of rosolic acid, commercial aurin (chiefly $C_{19}H_{14}O_3 = 286.31$) may be employed.

i. **Turmeric Tincture.**—Digest any convenient quantity of ground curcuma root [from *Curcuma longa* L.] repeatedly with small quantities of water, and throw this liquid away. Then digest the dried residue for several days with 6 times its weight of alcohol and filter.

Turmeric Paper.—Impregnate white unsized paper with the tincture, and dry it. The tincture as well as the paper turns brown with alkalies, and the yellow color is restored by acids. Boric acid, however, even in presence of hydrochloric acid turns the color red-brown and this is changed to bluish-black by ammonia.

41. Indigo Test-Solution.—Place 6 Gm. (3.3 Cc.) of fuming sulphuric acid into a beaker, well cooled by immersion in water, and stir into it, very gradually, 1 Gm. of finely powdered Bengal indigo. Set the mixture aside for two days, then pour it into 20 Cc. of water, and decant. Or, dissolve 1 gm. of commercial indigo-carmine (the sodium or potassium salt of sulphindigotic acid) in 150 Cc. of water.

42. Iodine Test-Solution.—For preparing the ordinary test-solution (as a reagent for starch, alcohol by iodoform test, etc.), iodine fulfilling the requirements of the pharmacopœia [*Iodum*, U. S. P.], I = 126.53 is sufficiently pure. For this purpose dissolve 1 Gm. of iodine and 3 Gm. of iodide of potassium in 50 Cc. of water.

For use in volumetric analysis, or in other cases where the ordinary impurities present in medicinal iodine are objectionable, *Purified Iodine* must be employed. See under No. 98.

43. Iron, Metallic, Fe = 55.88.—Bright and perfectly clean iron in the form of wire, sheet or filings, according to the uses to be made of it. For making solutions of pure iron salts, fine thin, bright wire (so-called florists' wire) should be used. For detecting copper, bright pieces of sheet iron or knitting needles are used; for detecting nitric acid, by reducing it to ammonia, iron-filings are preferable.

44. Lead Acetate Test-Solution, $Pb(C_2H_3O_2)_2 + 3H_2O = 378.0$.—Dissolve 10 Gm. of clear, transparent crystals of lead acetate [*Plumbi Acetas*, U. S. P.], free from adhering lead carbonate, in enough water to make 100 Cc. Preserve the solution in well stoppered bottles.

45. Litmus Paper and Test-Solution.—See under *Indicators*, (No. 40 *e*.)

46. Magnesia Mixture.—Dissolve 10 Gm. of magnesium sulphate [*Magnesii Sulphas*, U. S. P.], and 20 Gm. of ammonium chloride [*Ammonii Chloridum*, U. S. P.], in 80 Cc. of water, add 42 Cc. of ammonia water, set aside for a few days in a well stoppered vessel, and filter. It should never be used freshly made.

47. Magnesium Sulphate Test-Solution, $MgSO_4 + 7H_2O = 245.84$.—Dissolve 10 Gm. of magnesium sulphate [*Magnesii Sulphas*, U. S. P.] in water to make 100 Cc.

48. Mercuric Chloride Test-Solution, $HgCl_2 = 270.54$.—Dissolve 5 Gm. of mercuric chloride [*Hydrargyri Chloridum Corrosivum*, U. S. P.], in water to make 100 Cc.

49. Mercurous Nitrate Test-Solution, $Hg_2(NO_3)_2 + 2H_2O = 559.3$.—Into a porcelain capsule put 1 Gm. of pure quicksilver with 0.5 Cc. of pure nitric acid and 0.5 Cc. of distilled water and place it for 24 hours into a cool, dark room. Separate and drain the crystals and dissolve them in 100 Cc. of water. Preserve the solution in an amber colored bottle, into which a small globule of quicksilver has been placed.

50. Alkaline Mercuric-Potassium Iodide Test-Solution.—(*Nessler's Solution*). Dissolve 5 Gm. of potassium iodide [*Potassii Iodidum*, U. S. P.], in 5 Cc. of hot water, and add to this a hot solution of 2.5 Gm. of mercuric chloride [*Hydrargyri Chloridum Corrosivum*, U. S. P.], in 10 Cc. of hot water. To the turbid red mixture add 16 Gm. of potassium hydrate [*Potassa*, U. S. P.], dissolved in 40 Cc. of water, and finally make up the volume to 100 Cc. A surplus of red mercuric iodide deposits on cooling, and may be left in the bottle, the clear solution being decanted as needed.

51. Methyl-Orange Test-Solution.—See under *Indicators*, (No. 40, *f*.)

52. Nitric Acid, Pure, for Tests, $HNO_3 = 62.89$.—In addition to the tests prescribed for this acid in the text of the pharmacopœia, it is required to stand the following more rigorous test before it can be used as reagent: On supersaturating 0.5 Cc. of the acid with pure potassium hydrate T.S., and testing a portion of this solution by Fleitmann's method (see under No. 12, *c*.), no color should be imparted to the silver nitrate within two hours (abs. of *arsenic*).

53. Red Fuming Nitric Acid.—The commercial article will answer if of spec. grav. 1.450 or over. It should be carefully kept in glass-stoppered bottles in a cool place.

54. Oxalic Acid.—See below, under No. 100.

55. Phenolphtalein Test-Solution.—See under *Indicators*, (No. 40, *g*.)

56. Picric Acid Test-Solution.—Dissolve 1 Gm. of pure, distinctly crystalline picric acid (or Trinitrophenol) $C_6H_2(NO_2)_3OH = 228.57$, in 100 Cc. of water, cool the solution, and filter, if necessary.

57. Platinic Chloride Test-Solution.—Heat 1 Gm. of pure platinum, in chips, with 6 Cc. of concentrated hydrochloric acid to 80° C. (186° F.), and very gradually add 1 Cc. of strong nitric acid (spec. grav. 1.414) until very nearly all the platinum is dissolved. Evaporate the solution to dryness, moisten it with a few drops of hydrochloric acid, and again evaporate to expel the excess of acid. Dissolve the residue in 20 Cc. of water. The *Test-Solution* may also be prepared by dissolving 1.7 Gm. of neutral platinic chloride, $PtCl_4 = 335.78$, or 2.6 Gm. of chloroplatinic acid, $H_2PtCl_6 + 6H_2O = 516.28$, in 20 Cc. of water. On evaporating a small portion of the solution to dryness and igniting the residue, pure, metallic platinum should be left behind which should yield nothing soluble to nitric acid.

58. Potassium Acetate Test-Solution, $KC_2H_3O_2 = 97.89$.—Dissolve 1 Gm. of acetate of potassium [*Potassii Acetas*, U. S. P.] in water to make 5 Cc. This solution should be freshly made when wanted for use.

59. Potassium Carbonate Test-Solution, $K_2CO_3 = 137.91$.—Dissolve 10 Gm. of anhydrous carbonate of potassium [*Potassii Carbonas*, U. S. P.] in water to make 100 Cc.

60. Potassium Chromate Test-Solution.—Dissolve 1 Gm. of potassium chromate, $K_2CrO_4 = 193.9$, in water to make 10 Cc. On adding silver nitrate T.S. to a little of the solution, a red precipitate is produced which should be completely dissolved by nitric acid (abs. of *chloride*). Another portion of the solution mixed with an equal volume of diluted hydrochloric acid should yield no precipitate with barium chloride T.S. (abs. of *sulphate*.)

61. Potassium Dichromate, $K_2Cr_2O_7$ = 293.78.—The dry salt [*Potassii Bichromas*], corresponding to the tests of purity given in the preceding text of the pharmacopœia.

62. Potassium Dichromate Test-Solution.—Dissolve 10 Gm. of potassium dichromate [*Potassii Bichromas*, U. S. P.] in water to make 100 Cc.

63. Potassium Ferricyanide Test-Solution.—Dissolve 1 part of potassium ferricyanide, $K_6Fe_2(CN)_{12}$ = 657.72, in about 10 parts of water. This solution should be made freshly when wanted for use, as it is rapidly decomposed by light A freshly prepared aqueous solution, when mixed with some ferric chloride T.S. and diluted, should show a brown tint, free from turbidity or a shade of green.

64. Potassium Ferrocyanide Test-Solution.—Dissolve 10 Gm. of potassium ferrocyanide, $K_4Fe(CN)_6 + 3H_2O$ = 421.76, in water to make 100 Cc.

65. Potassium Hydrate Test-Solution, KOH = 55.69.—Use the solution of potassa [*Liquor Potassae*] of the preceding text of the pharmacopœia. For use in Fleitmann's test for arsenic (see above, No. 12, *c.*), it should have previously been subjected, by itself, to this test, for at least two hours, with negative result (abs. of *arsenic.*)

66. Potassium Iodide Test-Solution, KI = 165.56.—Dissolve 10 Gm. of potassium iodide [*Potassii Iodidum*, U. S. P.] in water to make 100 Cc. and keep the solution in well stoppered bottles to prevent formation of iodate. The solution should be frequently renewed, or freshly prepared when required.

67. Potassium Nitrate, KNO_3 = 100.92.—The dry salt, responding to the tests of purity required by the pharmacopœia, particularly to those for absence of chloride and sulphate.

68. Potassium Permanganate, $KMnO_4$ = 157.67.—See below, under No. 104.

69. Potassium Sulphate Test-Solution, K_2SO_4 = 173.88.—Dissolve 1 Gm. of potassium sulphate [*Potassii Sulphas*, U. S. P.] in water to make 120 Cc.

70. Potassium Sulphocyanate Test-Solution, KCNS = 96.99.—Dissolve 1 Gm. of potassium sulphocyanate, KCNS = 97.2, (also called Potassium Thiocyanate or Rhodanate) in 10 Cc. of water.

71. Pyrogallic Acid, $C_6H_3(OH)_3$ = 125.7.—Use the pyrogallic acid or pyrogallol, [*Acidum Pyrogallicum*] of the preceding text of the pharmacopœia.

72. Rosolic Acid.—See under *Indicators*, (No. 40, *h.*)

73. Silver Ammonium Nitrate Test-Solution.—Dissolve 1 Gm. of silver nitrate [*Argenti Nitras*, U. S. P.] in 20 Cc. of water and add ammonia water, drop by drop, until the precipitate first produced is almost, but not entirely, redissolved. Filter the solution, and preserve it in dark amber-colored, and well stoppered bottles.

74. Silver Nitrate Test-Solution, $AgNO_3 = 169.55$.—For ordinary purposes, use the decinormal volumetric solution (see under No. 105.) For Gutzeit's Test (No. 12, *b*) use a saturated solution of silver nitrate in water acidulated with about 1 per cent. of nitric acid.

75. Silver Sulphate Test-Solution.—Dissolve 1 Gm. of silver nitrate [*Argenti Nitras*, U. S. P.] in 0.5 Cc. of warm water, and add 1.5 Cc. of pure concentrated sulphuric acid. On cooling, small transparent crystals of silver sulphate, $Ag_2SO_4 = 311.14$, separate. Carefully pour off the acid liquid, wash the crystals repeatedly with cold water, by decantation, transfer them to a bottle, add 100 Cc. of water and agitate so as to produce a saturated solution. For use, decant a sufficient quantity of the latter.

76. Sodium Bitartrate Test-Solution.—Dissolve 150 Gm. of tartaric acid [*Acidum Tartaricum*, U. S. P.] in 100 Cc. of hot water, and divide the solution into two equal portions. Neutralize one of these accurately with sodium bicarbonate (which will require about 84 Gm. of this salt), and then add the other portion of the acid solution. On cooling, crystals of sodium bitartrate, $NaHC_4H_4O_6 + H_2O = 189.6$, will separate. Remove these, dry them, and keep them in well stoppered bottles. The test-solution is freshly prepared when required by dissolving 1 Gm. of the salt in 4 Cc. of water.

77. Sodium Carbonate.—The anhydrous salt, $Na_2CO_3 = 105.85$, responding to the tests of purity of the pharmacopœia, but absolutely free from chloride or sulphate.

78. Sodium Carbonate Test-Solution.—Dissolve 10.6 Gm. of dry sodium carbonate, $Na_2CO_3 = 105.85$, or 28.55 Gm. of the crystallized salt [*Sodii Carbonas*, U. S. P., $Na_2CO_3 + 10H_2O = 285.45$] in water to make 100 Cc. ($= \frac{2}{N}$ V.S.)

79. Sodium Cobaltic Nitrite Test Solution.—$Co_2(NO_2)_6 . 6NaNo_2 + H_2O = 824.32$. Dissolve 4 Gm. of cobaltous nitrate, $Co(NO_3)_2 . 6H_2O = 290.14$, and 10 Gm. of sodium nitrite, $NaNO_2 = 68.93$, in about 50 Cc. of water, add 2 Cc. of acetic acid, and dilute with water to make 100 Cc. Should any of the nitrous acid be lost by keeping the solution, a few drops of acetic acid may be added.

80. Sodium Hydrate Test-Solution, $NaOH = 39.96$.—Use the solution of soda [*Liquor Sodae*] of the preceding text of the pharmacopœia.

81. Sodium Hyposulphite, or Thiosulphate, $Na_2S_2O_3 + 5H_2O = 247.64$.—See below, under No. 103.

82. Sodium Molybdate, $Na_2MoO_4 + 2H_2O = 241.66$.—Used in the preparation of several tests for certain alkaloids:

Froehde's Reagent: Dissolve 0.05 Gm. of sodium molybdate in 10 Cc. of concentrated sulphuric acid. This solution should be freshly prepared, when required.

Sonnenschein's Reagent: Dissolve 1.5 Gm. of sodium molybdate and 0.36 Gm. of sodium phosphate [*Sodii Phosphus* U. S. P., $Na_2HPO_4 + 12H_2O = 357.32$] in 14 Cc. of boiling water, and add enough nitric acid, of spec. grav. 1.420 to make 16 Cc. This solution should be freshly prepared, when required.

83. Sodium Nitrite, $NaNO_2 = 68.93$.—The purest commercial variety, generally cast into pencils, is sufficiently pure.

84. Sodium Nitroprusside Test-Solution.—Dissolve 1 part of sodium nitroprusside, $Na_2Fe(NO)(CN)_5 . 2H_2O = 297.67$, in 10 parts of water immediately before using.

85. Sodium Phosphate Test-Solution, $Na_2HPO_4 + 12H_2O = 357.32$.—Dissolve 10 Gm. of sodium phosphate [*Sodii Phosphus*, U. S. P.] in water to make 100 Cc.

86. Stannous Chloride Test-Solution.—Heat pure tin (see No. 87) in form of foil or granules, with concentrated hydrochloric acid, taking care that the metal be in excess. When the acid is saturated, crystals of stannous chloride, $SnCl_2 + 2H_2O = 225.46$, begin to form. Remove and drain these, dissolve them in 10 parts of water, and preserve the solution in well stoppered bottles into each of which a granule of pure tin, or piece of pure tin-foil has previously been introduced.

For *Bettendorff's Test* (see above, No. 12, *a.*), pure concentrated hydrochloric acid is saturated with the freshly prepared crystals.

87. Starch Test-Solution.—Mix 1 Gm. of starch with 10 Cc. of cold water, and then add enough boiling water, under constant stirring, to make about 200 Cc. of a thin, transparent jelly. If it is desired to preserve this test-solution for any length of time, 10 Gm. of zinc chloride [*Zinci Chloridum*, U. S. P., $ZnCl_2 = 135.84$], should be added to it, and the solution transferred to small bottles, which should be well stoppered.

88. Sulphuric Acid, Pure, for Tests, $H_2SO_4 = 97.82$.—In addition to the tests prescribed for this acid in the text of the pharmacopœia, it is required to stand the following more rigorous tests before it can be employed as a reagent. If 1 Cc. of diphenylamine T.S. (see No. 40, *c.*) be carefully poured, as a separate layer, upon 5 Cc. of sulphuric acid, contained in a test-tube, no distinct blue color should appear in the zone of contact (abs. of *Nitric Acid*). If a few crystals of pyrogallic acid [*Acidum Pyrogallicum*, U. S. P.] be dissolved in about 1 Cc. of pure water, and this solution be carefully poured, as a separate layer, upon some of the sulphuric acid contained in a test-tube, no brown color should appear in the zone of contact (abs. of *Nitric* or *Nitrous Acids*). If a small portion of the acid be subjected to Gutzeit's test, as described under No. 12, *b.*, no color should be imparted to the silver nitrate within two hours (abs. of *Arsenic*, etc.)

If it is impossible to obtain any sulphuric acid which will comply with each one of these requirements, such an acid may be selected for the several tests, as is proven to be free from the particular impurity to be detected by it.

89. Tannic Acid Test-Solution, $H . C_{14}H_9O_9 = 321.22$.—Dissolve 1 Gm of tannic acid [*Acidum Tannicum*, U. S. P.] in 1 Cc. of alcohol and enough water to make 10 Cc., immediately before use.

90. Tartaric Acid Test-Solution, $H_2.C_4H_4O_6 = 149.64$.—Dissolve 1 part of tartaric acid [*Acidum Tartaricum*, U. S. P.] in 2 or 3 parts of water, as may be required, immediately before use. In the volumetric estimation of soda in potassa, directed by the preceding text of the pharmacopœia, the tartaric acid test-solution employed for precipitating the potassa should contain 3 Gm. of the acid in 20 Cc.

91. Tin.—Pure metallic tin, $Sn = 118.8$, in form of granules. Its solution in hydrochloric acid should not be precipitated by potassium sulphate T.S. (abs. of *lead*) and when examined by Gutzeit's test, as described under No. 12, *b*, it should not cause the silver nitrate to become colored within two hours (abs. of *arsenic*.)

92. Turmeric Paper and Tincture.—See under Indicators (No. 40, *i*.)

93. Zinc, $Zn = 65.1$.—Metallic zinc, preferably in the form of thin pencils (about 5 millimetres in diameter) prepared by fusing the metal and casting it in moulds, or in form of thin sheets. It should respond to all the tests required by the text of the pharmacopœia, and in addition, when examined by Gutzeit's test, as described under No. 12, *b*., it should not cause the silver nitrate to become colored within two hours (abs. of *arsenic*).

94. Zinc-Iodide-Starch Test-Solution.—To 100 Cc. of freshly prepared starch test-solution (see No. 83.) add 5 Gm. of zinc chloride [*Zinci Chloridum*, U. S. P.] and a solution of zinc iodide, $ZnI_2 = 318.16$, prepared by digesting 1 Gm. of pure zinc, in small fragments, and 2 Gm. of iodine with 10 Cc. of water and filtering. Preserve the colorless solution carefully in dark amber-colored and well stoppered bottles.

III. VOLUMETRIC SOLUTIONS.

Note.—Since most of the volumetric instruments (burettes, pipettes, mixing cylinders, flasks, etc.) which are for sale in the market, are graduated to hold the number of cubic centimetres indicated, by weighing into them the number of grammes of water at the temperature of 15° C. (59° F.), it is necessary not to deviate materially from this temperature in making the volumetric solutions, or using them in testing.

All measuring vessels employed for volumetric determinations should agree, among themselves, in accuracy of graduation.

Solutions are designated as normal ($\frac{N}{1}$) when they contain in 1 litre the molecular weight of the active reagent, expressed in grammes, and reduced to the valency corresponding to one atom of hydrogen.

Thus hydrochloric acid, $HCl = 36.37$, having but one H atom replaceable by a basic element, has 36.37 Gm. in 1,000 Cc. of the normal volumetric solution; while sulphuric acid, $H_2SO_4 = 97.82$, having two replaceable H atoms, contains only one-half this number, or 48.91 grammes in 1,000 Cc. of its normal solution. Potassium hydrate, $KOH = 55.99$, has but one K to replace one H in acids, hence its normal solution contains 55.99 grammes in one litre; potassium dichromate, $K_2Cr_2O_7 = 293.78$, having 2 K atoms in the molecule, requires one-half its molecular weight, or 146.89 grammes, for 1 litre of normal solution.

Solutions containing in 1 litre one-tenth of the quantity of the active reagent in the normal solution are called: decinormal ($\frac{N}{10}$); those containing one one-hundredth: centinormal $\left(\frac{N}{100}\right)$; those containing twice the amount: double normal $\left(\frac{2}{N}\right)$; half the amount: seminormal $\left(\frac{N}{2}\right)$.

Solutions containing quantities of the active reagent having *no* simple relation to the molecular weight, are called empirical.

In the following list full decimals are given, which however (especially when delicate balances and weights are not at hand) are in practice frequently abbreviated or rounded off, as e. g. oxalic acid: 63 Gm. instead of 62.85, etc.

95. Alkaline Cupric Tartrate Volumetric Solution.

[FEHLING'S SOLUTION.]

A. **The Copper Solution.**—Dissolve 34.64 Gm. of carefully selected, small crystals of pure copper sulphate, which show no trace of efflorescence or of adhering moisture, in a sufficient quantity of water to make the solution measure, at or near 15° C. (59° F.), exactly 500 Cc.

Preserve this solution in small, well-stoppered bottles.

B. **The Rochelle Salt Solution.**—Dissolve 173 Gm. of potassium and sodium tartrate, and 125 Gm. of potassium hydrate [*Potassa*, U. S. P.] in a sufficient quantity of water to make the solution measure, at or near 15° C. (59° F.), exactly 500 Cc.

Preserve the solution in small well-stoppered bottles.

For use mix exactly equal volumes of the two solutions at the time required.

One cubic centimetre of the mixed solution is the equivalent of:

	Gramme.
Cupric Sulphate, crystallized, $CuSO_4 + 5H_2O$	0.03464
Cupric Tartrate, $CuC_4H_4O_6 + 3H_2O$	0.03685
Glucose, anhydrous, $C_6H_{12}O_6$.	0.00500

The following articles are tested with this solution:

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(List to be supplied by Sub-Committee on Organic Chemicals.)

96. Bromine Volumetric Solution.

[KOPPESCHAAR'S SOLUTION.]

$Br = 79.76.$ $\frac{6N}{10}$ $Br = 47.86$ Gm. in 1 Litre.
($NaBrO_3 = 150.64$; $NaBr = 102.76$.)
($KBrO_3 = 166.67$; $KBr = 118.79$.)

Dissolve 16 Gm of sodium bromate and 62 Gm. of sodium bromide (or 18 Gm. potassium bromate and 70 Gm. of potassium bromide) in enough water to make, at or near 15° C. (59° F.), 900 Cc. Of this solution transfer 5 Cc by means of a pipette, into a bottle of about 250 Cc capacity, provided with a glass-stopper; add 75 Cc. of water, next 5 Cc. of pure hydrochloric acid, and immediately insert the stopper Shake the bottle a few times, then remove the stopper just sufficiently to quickly introduce 5 Cc. of potassium iodide T. S., and immediately stopper the bottle. Agitate the bottle thoroughly, remove the stopper and rinse it and the neck of the bottle with a little water so that the washings flow into the bottle, and then add from a burette decinormal sodium hyposulphite (thiosulphate) V. S. until the iodine tint is exactly discharged, using towards the end a few drops of starch T.S. as indicator. Note the number of cubic centimetres of the sodium hyposulphite (thiosulphate) V S. thus consumed, and then dilute the bromine solution so that each Cc. of it will exactly correspond to six (6) cubic centimetres of the sodium hyposulphite (thiosulphate) V. S.

EXAMPLE.—Assuming that the 5 Cc. of the bromine solution had required 34.1 Cc. of the hyposulphite to completely discharge the iodine tint, calculation shows that 4.4 Cc. of the bromine solution would have required 30 Cc. of the hyposulphite. The bromine solution must therefore be diluted in the proportion of 4.4 to 5. Thus if 850 Cc. of it are remaining, they must be diluted with water to measure 955 Cc.

After the solution is thus diluted, a new trial should be made in the manner above described in which 30 Cc. of the decinormal sodium hyposulphite (thiosulphate) V. S. should exactly discharge the tint of the iodine liberated by the bromine set free from the 5 Cc. of bromine solution.

Keep the solution in glass-stoppered bottles.

Note.—This solution is six-tenths normal ($\frac{6N}{10}$), being thus adjusted for the purpose of the volumetric valuation of phenol.

97. Normal Hydrochloric Acid.

$HCl = 36.37.$ 36.37 Gm 1 Litre.

Mix one hundred and thirty (130) cubic centimetres of hydrochloric acid of spec. grav. 1.160 with enough water to make it measure, at or near 15° C. (59° F.), one thousand (1000) cubic centimetres.

Of this liquid (which is still too concentrated) carefully measure ten (10) cubic centimetres into a flask, add a few drops of phenol-phthalein T.S., and gradually add, from a burette, potassium hydrate V. S., until the red tint produced by it no longer disappears on vigorous shaking, without being more than faintly pink. Note the number of cubic centimetres of potassium hydrate V.S. consumed, and then dilute the acid solution so that equal volumes of this and of the potassium hydrate V.S. neutralize each other.

Example.—Assuming that ten (10) cubic centimetres of the acid solution first prepared required exactly eleven (11) cubic centimetres of potassium hydrate V.S., each ten (10) cubic centimetres of the former must be diluted to eleven (11) cubic centimetres, or the whole of the remaining acid solution in the same proportion. Thus, if nine hundred and fifty (950) cubic centimetres are remaining, ninety-five (95) cubic centimetres of water must be added.

After the liquid is thus diluted, a new trial should be made in the manner above described, in which fifty (50) cubic centimetres of the acid solution should require for neutralization exactly fifty (50) cubic centimetres of potassium hydrate V S. If necessary a new adjustment should then be made to render the correspondence perfect.

One cubic centimetre of Normal Hydrochloric Acid is the equivalent of:

Hydrochloric Acid, absolute, HCl	0.03637 Gramme.

Note.—Normal hydrochloric acid is in every respect equivalent in neutralizing power to normal sulphuric acid (see below, No. 109), and may be employed, if more convenient, for the same purposes.

98. Decinormal Iodine Volumetric Solution.

I = 126.53. 12.653 Gm. in 1 Litre.*

Dissolve 12.653 Gm * of pure iodine (see below) in a solution of 18 Gm of pure iodide of potassium in 900 Cc. of water. Then add enough water to make the solution measure, at or near 15° C. (59° F.) exactly 1,000 Cc

Transfer the solution to small, glass-stoppered vials, which should be kept in a dark place.

Preparation of Pure Iodine. — Heat powdered iodine in a porcelain dish placed over a boiling water-bath, and stir it constantly with a glass rod, so that the adhering moisture, together with any iodide of cyanogen and most of the bromide and chloride of iodine that may be present may be vaporized. After twenty minutes transfer the iodine to a porcelain or other non-metallic mortar and triturate it with about 5 per cent of its weight of pure, dry iodide of potassium, so as to decompose any remaining bromide and chloride of iodine. Then return the mass to the dish, cover it with a clean glass funnel, and heat the dish on a sand-bath. Detach the sublimed, pure iodine, and keep it in well-stoppered bottles, in a cool place.

One cubic centimetre of Decinormal Iodine V. S. is the equivalent of:

	Gramme
Iodine, I	0.012653
Arsenic Trioxide, (arsenous acid), As_2O_3	0.004942
Potassium Sulphite, crystallized, $K_2SO_3 + 2H_2O$	0.009692
Sodium Bisulphite, $NaHSO_3$	0.005193
Sodium Hyposulphite, (Thiosulphate), crystals, $Na_2S_2O_3 + 5H_2O$	0.024764
Sodium Sulphite, crystallized, $Na_2SO_3 + 7H_2O$	0.012579
Sulphur Dioxide, SO_2	0.003195
Tartrate of Antimony and Potassium, cryst., $2K(SbO)C_4H_4O_6 + H_2O$	0.016605

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*Instead of 12.653, the number of grammes is often rounded off to 12.65 or even still more, to 12.7, but whenever a delicate balance is at hand, it is better to use the full decimals.

The following articles are tested with this solution:

	Gm. taken.	Cc. required.	Per. cent. of strength indicated.
Acidum Arsenosum	0.1	20.	99 of As_2O_3.
Acidum Sulphurosum	1.28	14.	3.5 of SO_2
Antimonii et Potassii Tartras,(cryst.)	0.332	20.	100 of crystals.
Liquor Acidi Arsenosi	24.70	48.5	0.97 of As_2O_3.
Liquor Potassii Arsenitis	24.70	48.5	0.97 of As_2O_3.
Sodii Bisulphis.	0.26	45.	90 of salt.
Sodii Sulphis	0.63	48.	96 of crystall.salt.

99. Decinormal Mercuric Potassium Iodide Volumetric Solution.

[MAYER'S SOLUTION.]

$HgI_2 + 2KI = 783.98$. 39.2 Gm. in 1 Litre.

Dissolve 13.546 Gm. of pure mercuric chloride in 600 Cc. of water, and 49.8 Gm. of pure potassium iodide in 100 Cc. of water. Mix the two solutions, and then add enough water to make the mixture measure, at or near 15° C. (59° F.), exactly 1000 Cc.

One cubic centimetre of Decinormal Mercuric Potassium Iodide V. S. is the equivalent of:

Mercuric Potassium Iodide, $HgI_2 + 2KI$ .... 0.0392 Gramme.

The following articles are tested with this solution:

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(List to be supplied by Sub-Committee on Proximate Principles, Alkaloids, etc., and Sub-Committee on Assay Processes of Opium, Cinchona, etc.)

100. Normal Oxalic Acid Volumetric Solution.

$H_2C_2O_4 + 2H_2O = 125.7$ 62.85 Gm. in 1 Litre*.

Dissolve 62.85 Gm of pure oxalic acid (see below) in enough water to make, at or near 15° C. (59° F.), exactly 1,000 Cc.

Pure Oxalic Acid, crystallized, is in form of colorless, transparent, clinorhombic crystals which, on ignition upon platinum foil, leave no residue. One part of it is completely soluble in 14 parts of water at 15° C (59° F.). Oxalic acid which leaves a residue on ignition, or on solution in water, must be purified, which may be done as follows: To 1 part of the acid add 10 parts of cold water, and shake until the latter is saturated. Filter off the solution from the undissolved crystals, evaporate the filtrate to about three-fourths of its volume, and set it aside so that the fixed salts which it contains may crystallize out. Carefully de-

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*This is frequently rounded off to 63 Gm. when a delicate balance and exact weights are not at hand.

cant the liquid from the crystals, concentrate it by evaporation and set it aside to crystallize, stirring occasionally to prevent the formation of large crystals which might enclose moisture. Drain the crystals in a funnel, dry them carefully on blotting paper, and preserve them in well-stoppered bottles.

Note.—Normal oxalic acid volumetric solution is in every respect equivalent in neutralizing power to *normal sulphuric acid* (No. 109), or *normal hydrochloric acid* (No. 97), and may be employed, if more convenient, for the same purposes. The solution, however, has a tendency to crystallize at the point of the burette.

One cubic centimetre of Normal Oxalic Acid V. S. is the equivalent of:

	Gramme.
Oxalic Acid, crystallized, $H_2C_2O_4 . 2H_2O$	0.06285
Ammonia Gas, NH_3	0.01701
Potassium Hydrate, KOH	0.05599
Sodium Hydrate, NaOH	0 03996
Potassium Permanganate, $KMnO_4$	0.03153

101. Decinormal Oxalic Acid Volumetric Solution.

$H_2C_2O_4 + 2H_2O = 125.7.$ 6.285 Gm. in 1 Litre*.

Dissolve 6.285 Gm*. of pure oxalic acid (see under No. 100) in enough water to make, at or near 15° C. (59° F.) exactly 1,000 Cc.

One cubic centimetre of Decinormal Oxalic Acid V. S. is the equivalent of:

	Gramme.
Oxalic Acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.006285
Potassium Permanganate, $KMnO_4$	0.003153
Ammonia Gas, NH_3	0.001701
Potassium Hydrate, KOH	0.005599
Sodium Hydrate, NaOH	0.003996

The following articles are tested with this solution;

	Gm. taken.	Cc. required.	Per cent. of strength indicated.
Potassii Permanganas	0.1	31.3	98.98 of pure $KMnO_4$.

102. Decinormal Potassium Dichromate Volumetric Solution.

$K_2Cr_2O_7 = 293.78.$ 14.689 Gm. in 1 Litre**.

Dissolve 14.689 Gm.** of pure potassium dichromate (see below) in enough water to make, at or near 15° C. (59° F.), exactly 1,000 Cc.

Pure Potassium Dichromate for use in volumetric analysis, besides responding to the tests given in the text of the pharmacopœia, must conform to the following tests. In a solution of 0.5 Gm. of the salt in 10 Cc. of water, rendered acid by 0.5 Cc. of nitric acid, no visible change should be produced either by bar-

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*Generally rounded off to 6.3 Gm. when a delicate balance and exact weights are not at hand, ut whenever possible the accurate figures should be preferred

**Generally rounded off to 14.7 Gm. when a delicate balance and exact weights are not at hand.

ium chloride T.S. (abs. of *sulphate*), or by silver nitrate T S. (abs. of *chloride*). In a mixture of 10 Cc. of the aqueous solution (1 in 20) with 1 Cc. of ammonia water, no precipitate should be produced by ammonium oxalate T. S. (abs. of *calcium*)

Note.—Decinormal potassium dichromate V. S. may be employed, if more convenient, in place of decinormal potassium permanganate volumetric solution, for titrating iron in *ferrous* compounds, in the following manner. Introduce the aqueous solution of the ferrous salt into a flask and acidify it, if it is not already so, with sulphuric acid. Now add, gradually, decinormal potassium dichromate V. S. from a burette, until a drop taken out upon a white surface no longer shows a blue color with a drop of freshly prepared potassium ferricyanide T. S.

With phenolphtalein T. S. as an indicator, decinormal potassium dichromate V. S. may be employed as the exact equivalent of any decinormal acid V. S. for the titration of alkalies, baryta, etc.

Also, by employing it in conjunction with potassium iodide (from which it liberates iodine) and sulphuric acid, for adjusting the titre of sodium hyposulphite (thiosulphate) V. S. and, by its means, that of the iodine V. S.

One cubic centimetre of Decinormal Potassium Dichromate V. S. is the equivalent of:

	Gramme.
Potassium Dichromate, $K_2Cr_2O_7$	0.014689
Iron, in ferrous compounds	0.016764
Ferrous Carbonate, $FeCO_3$	0.034719
Ferrous Sulphate, anhydrous, $FeSO_4$	0.045510
Ferrous Sulphate, crystallized, $FeSO_4 + 7H_2O$	0.083226
Ferrous Sulphate, dried, $2FeSO_4 + 3H_2O$	0.053592
Barium Hydrate, $Ba(OH)_2$	0.008541
Potassium Hydrate, KOH	0.005599
Iodine, I	0.037959
Sodium Hyposulphite (Thiosulphate), $Na_2S_2O_3 + 5H_2O$	0.074292

The following articles are tested with this solution:

	Gm. taken.	Cc. required.	Per cent. of strength indicated.
Ferri Carbonas Saccharatus	3.47	15	15 of iron.
Ferri Sulphas	4.1613	50	100 of pure crystals.
Ferri Sulphas Granulatus	4.1613	50	100 of pure crystals.

103. Normal Potassium Hydrate Volumetric Solution.

KOH = 55.99. 55.99 Gm.[*] in 1 Litre.

Dissolve 75 Gm. of potassium hydrate [*Potassa*, U. S. P.] in enough water to make, at or near 15° C. (59° F.), about 1050 Cc., and fill a burette with a portion of this liquid.

Put 0.6285 Gm.[**] of pure oxalic acid (see No. 100) into a flask of the capacity of

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[*] This figure is frequently rounded off to 56 Gm. in calculations.

[**] If the balance will not allow such exact weighing, the amount may be rounded off to 0.63 Gm., but whenever possible the exact figures should be preferred.

about 100 Cc., and dissolve it with about 10 Cc. of water. Add a few drops of phenolphtalein T. S., and then carefully add, from the burette, the potassium hydrate solution, frequently agitating the flask, and regulating the flow to drops towards the end of the operation, until the red color produced by its influx no longer disappears on shaking, without being more than pale pink. Note the number of cubic centimetres of the potassium hydrate solution consumed, and then dilute the remainder of the solution so that exactly 10 Cc. of the diluted liquid shall be required to neutralize 0.6285 Gm.* of oxalic acid.

EXAMPLE.—Assuming that 8.0 Cc of the stronger solution of potassium hydrate first prepared had been consumed in the trial, then each 8.0 Cc. must be diluted to 10 Cc., or the whole of the remaining solution in the same proportion. Thus if 1000 Cc. should be still remaining, this must be diluted with water to 1250 Cc.

After the liquid is thus diluted, a new trial should be made in the manner above described, in which 10 Cc. of the diluted solution should exactly neutralize 0.6285 Gm.* of oxalic acid. If necessary, a new adjustment should then be made to render the correspondence perfect.

One cubic centimetre of Normal Potassium Hydrate V. S. is the equivalent of:

	Gramme.
Potassium Hydrate, KOH	0.05599.
Sodium Hydrate, NaOH	0.03996
Ammonia Gas, NH_3	0.01701
Ammonium Chloride, NH_4Cl	0.05338
Acetic Acid, absolute, $H.C_2H_3O_2$	0.05986
Citric Acid, crystallized, $H_3.C_6H_5O_7 + H_2O$	0.06983
Hydrobromic Acid, absolute, HBr	0.08076
Hydrochloric Acid, absolute, HCl	0.03637
Hydriodic Acid, absolute, HI	0.12753
Hypophosphorous Acid, $H.PH_2O_2$	0.06588
Lactic Acid, absolute, $H.C_3H_5O_3$	0.08989
Nitric Acid, absolute, HNO_3	0.06289
Oxalic Acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.06285
Potassium Dichromate, $K_2Cr_2O_7$	0.14689
Sulphuric Acid, absolute, H_2SO_4	0.04891
Tartaric Acid, crystallized, $H_2C_4H_4O_6$	0.07482

The following articles are tested with this solution:

	Gm. taken.	Cc required.	Per cent. of strength indicated.	
Acidum Aceticum	6.0	36	36	of absolute acid.
Acidum Aceticum Dilutum	24.0	24. to 24.5	6 to 6.13	of absolute acid.
Acidum Aceticum Glaciale	3.0	4.95	99	of absolute acid.
Acidum Citricum	3.5	50.	100	of crystall. acid.
Acidum Hydrobromicum Dil.	8.08	10.	10	of absolute acid.
Acidum Hydrochloricum	3.64	31.9	31.9	of absolute acid.
Acidum Hydrochloricum Dil.	3.64	10.	10	of absolute acid.

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*If the balance will not allow such exact weighing, the amount may be rounded off to 0.63 Gm., but whenever possible the exact figures should be preferred.

	Gm. taken.	Cc. required.	Per cent. of strength indicated.	
Acidum Hypophosphorosum Dil.	6.6	10.	10	of absolute acid.
Acidum Lacticum	4.50	37.5	75	of absolute acid.
Acidum Nitricum	3.15	34.	68	of absolute acid.
Acidum Nitricum Dil.	6.29	10.	10	of absolute acid.
Acidum Sulphuricum	0.49	9.6	96	of absolute acid.
Acidum Sulphuricum Arom.	4.9	18.	18	of total acid.
Acidum Sulphuricum Dilutum	4.9	10.	10	of absolute acid.
Acidum Tartaricum	3.75	50.	100	of crystall. acid.
Vinum Album Vinum Rubrum	50.	3.0 to 5.1	0.45 to 0.78	of acid.

(Figures for Wines have to be supplied by Sub Committee having them in charge.)

104. Decinormal Potassium Permanganate Volumetric Solution.

$2KMnO_4 = 315.34.$ 3.1534 Gm. in 1 Litre.*

Place 3.5 Gm. of pure, crystallized potassium permanganate in a flask, add 1000 Cc. of boiling water, and boil until the crystals are dissolved. Then set the flask aside for two days, so that any suspended matters may deposit. This is the *stronger solution.*

Prepare another, *weaker solution*, in the same manner, using 6.6 Gm. of the salt and 2200 Cc. of water, and set this also aside for two days. After the lapse of this time, pour off the clear portion of both solutions into separate vessels provided with glass-stoppers, and then proceed to test each separately.

Introduce into a flask 10 Cc. of decinormal oxalic acid V. S., and 1 Cc. of pure, concentrated sulphuric acid, and before this mixture cools, gradually add from the burette small quantities of the weaker permanganate solution, shaking the flask after each addition and reducing the flow to drops towards the end of the operation. When the last drop of the permanganate solution added is no longer decolorized but imparts a pinkish tint to the liquid, note the number of cubic centimetres consumed. In the same manner ascertain the titre of the stronger solution, and likewise note down the number of cubic centimetres of the latter consumed. Finally mix the two solutions in such proportions that exactly 50 Cc. of the mixture will correspond to an equal volume of decinormal oxalic acid V. S.

Note.—To obtain the accurate proportions for mixing the two solutions, deduct 10 from the number of Cc. of the weaker solution required to decompose 10 Cc. of decinormal oxalic acid V. S. With this difference multiply the number of Cc. of the stronger solution required for the same purpose. The product shows the proportion of the *stronger solution* needed for the mixture.

Next deduct the number of Cc. of the stronger solution required to decompose 10 Cc. of decinormal oxalic acid V. S. from 10, and with the difference multiply the number of Cc. of the weaker solution required for the same purpose. The product shows the proportion of the *weaker solution* needed for the mixture.

Or, designating by S the number of Cc. of the stronger solution, and by W the number of Cc. of the weaker solution required to decompose 10 Cc. of decinormal

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*This quantity is never directly weighed, but adjusted either by Oxalic Acid or by Iron; in calculations it is often abbreviated.

oxalic acid V. S., the following formula will give the proportions in which the solutions must be mixed:

Stronger Solution:		Weaker Solution:
$(W - 10)\ S$	+	$(10 - S)\ W$

Example.—Assuming that 9 Cc. of the stronger (S) and 10.5 of the weaker (W) solution had been required, then, substituting these values in the above given formula we obtain:

$(10.5 - 10)\ 9$	+	$(10 - 9)\ 10.5$
or, 4.5	+	or, 10.5

making 15 Cc. of final solution.

The bulk of the two solutions is now mixed in the same proportion, 450 Cc. of the stronger, and 1050 Cc. of the weaker, or 900 Cc. of the stronger and 2100 Cc. of the weaker solution.

After the mixture is thus prepared, a new trial should be made, when 10 Cc. of the solution should exactly decompose 10 Cc. of the decinormal oxalic acid V. S. If necessary, a new adjustment should be made to render the correspondence perfect.

This solution should be kept in small, dark amber-colored and glass-stoppered bottles, (or in bottles provided with tubes, especially designed for the purpose). Thus prepared, this solution will hold its titre for months; yet it should be tested occasionally, and when it is found reduced, the liquid should be brought back to normal strength by the addition of such an amount of the stronger solution as may be determined in the manner above described.

One cubic centimetre of Decinormal Potassium Permanganate V. S. is the equivalent of:

	Gramme.
Potassium Permanganate, $KMnO_4$	0.0031534
Iron, in ferrous compounds, Fe	0.005588
Ferrous Carbonate, $FeCO_3$	0.011573
Ferrous Oxide, FeO	0.007195
Ferrous Sulphate, anhydrous, $FeSO_4$	0.015170
Ferrous Sulphate, crystals, $FeSO_4 + 7H_2O$	0.027753
Ferrous Sulphate, dried, $2FeSO_4 + 3H_2O$	0.017864
Hydrogen Dioxide, H_2O_2	0.001696
Oxalic Acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.006285

The following articles are tested with this solution:

	Gm. taken.	Cc. required.	Per cent. of strength indicated.
Ferri Carbonas Saccharatus	1.16	15	15 of iron.
Ferri Sulphas	1.3871	50	100 of pure crystals.
Ferri Sulphas Granulatus	1.3871	50	100 of pure crystals.
Ferrum Reductum	0.056	8	80
Hydrogen Dioxide	1.	18	3

105. Centinormal Potassium Permanganate Volumetric Solution.

$2KMnO_4 = 315.34$. 0.31534 Gm. in 1 Litre.

Dilute 10 Cc. of the decinormal potassium permanganate V. S., after having ascertained that it possesses its exact titre, with enough distilled water, strictly complying with the tests given in the text of the pharmacopœia for Aqua Destillata, to make 100 Cc.

This solution should be freshly made when wanted for use.

One cubic centimetre of Centinormal Potassium Permanganate V. S. is the equivalent of:

	Gramme.
Potassium Permanganate, $KMnO_4$	0.00031534
Oxalic Acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.0006285
Oxygen (derived from the permanganate) available for oxidation	0.0000798

106. Decinormal Silver Nitrate Volumetric Solution.

$AgNO_3 = 169.55$. 16.955 Gm. in 1 Litre*.

Dissolve 16.955 Gm.* of pure silver nitrate in enough water, to make, at or near 15° C. (59° F.), exactly 1000 Cc.

Keep the solution in small, dark amber-colored, glass-stoppered bottles, carefully protected against the access of dust.

One cubic centimetre of Decinormal Silver Nitrate V. S. is the equivalent of:

	Gramme.
Silver Nitrate, $AgNO_3$	0.016955
Ammonium Bromide, NH_4Br	0.009777
Ammonium Chloride, NH_4Cl	0.005338
Ferrous Bromide, $FeBr_2$	0.010775
Ferrous Iodide, FeI_2	0.015425
Hydrocyanic Acid, absolute, HCN, with indicator	0.002698
Hydrocyanic Acid, absolute, HCN, to first formation of precipitate	0.005396
Hydriodic Acid, HI	0.012753
Hydrobromic Acid, HBr	0.008076
Potassium Bromide, KBr	0.011879
Potassium Chloride, KCl	0.007440
Potassium Cyanide, KCN, with indicator	0.006501
Potassium Cyanide, KCN, to first formation of precipitate	0.013002
Sodium Bromide, $NaBr$	0.010276
Sodium Chloride, $NaCl$	0.005837
Sodium Iodide, NaI	0.014953
Zinc Bromide, $ZnBr_2$	0.011231
Zinc Chloride, $ZnCl_2$	0.006792
Zinc Iodide, ZnI_2	0.015908

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*Frequently rounded off to 16.96 Gm. when a delicate balance and exact weights are not at hand.

The following articles are tested with this solution:

	Gm taken.	Cc. required.	Per cent. of strength indicated.	
Acidum Hydrocyanicum Dilutum	1.35	10.	2	of absolute acid.
Ammonii Bromidum	0.3	30.9	99	of bromide.
Ferri Iodidum Saccharatum	1.5447	20.	20	of iodide.
Potassii Bromidum	0.5	42.5	98	of bromide.
Potassii Cyanidum, (to first precip.)	0.65	45.	90	of cyanide.
Potassii Iodidum	0.5	30.25	99.5	of iodide.
Sodii Bromidum	0.3	29.4	98.5	of bromide.
Sodii Iodidum	0.5	33.9 to 33.3	98.85	of iodide.
Syrupus Acidi Hydriodici	31.88	25.	1	of absolute acid.
Syrupus Ferri Bromidi	5.385	50.	10	of bromide.
Syrupus Ferri Iodidi	7.723	50.	10	of iodide.
Zinci Bromidum	0.3	26.7	99.95	of $ZnBr_2$.
Zinci Chloridum	0.3	44.1	99.84	of $ZnCl_2$.
Zinci Iodium	0.5	31.4	99.9	of ZnI_2.

107. Decinormal Sodium Chloride Volumetric Solution.

$NaCl = 58.37$. 5.837 Gm. in 1 Litre.*

Dissolve 5.837 Gm.* of pure sodium chloride (see below) in enough water to make, at or near 15° C. (59° F.), exactly 1000 Cc.

Pure Sodium Chloride may be prepared by passing a current of dry hydrochloric acid gas into a saturated aqueous solution of the purest commercial sodium chloride, separating the crystalline precipitate, and drying it at a temperature sufficiently high to expel all traces of free acid.

In place of this, transparent crystals of pure rock-salt may be employed.

One cubic centimetre of Decinormal Sodium Chloride V. S. is the equivalent of:

	Gramme.
Sodium Chloride, $NaCl$	0.005837
Silver, Ag	0.010766
Silver Nitrate, $AgNO_3$.	0.016955
Silver Oxide, Ag_2O	0.011564

The following articles are tested with this solution:

	Gm. taken.	Cc. required.	Per cent. of strength indicated.	
Argenti Nitras	0.34	20	99.97	of silver nitrate.
Argenti Nitras Dilutus	1.	19.5	33.14	of silver nitrate.
Argenti Nitras Fusus	0.34	19	95	of silver nitrate.

108. Decinormal Sodium Hyposulphite (Thiosulphate) Volumetric Solution.

$Na_2S_2O_3 . 5H_2O = 247.64$. 24.764 Gm. in 1 Litre.

Dissolve 30 Gm. of selected crystals of sodium hyposulphite (sodium thiosulphate) in enough water to make, at or near 15° C. (59° F.), 1100 Cc. Of this so-

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*Rounded off to 5.84 when balance and weights do not permit more exact weighing.

lution transfer 10 Cc. into a flask, add a few drops of starch T. S., and then gradually add, from a burette, decinormal iodine V. S. in small portions at a time, shaking the flask after each addition, and regulating the flow to drops towards the end of the operation. As soon as the color produced by the influx of the iodine solution no longer disappears on shaking, without being more than very pale blue, note the number of cubic centimetres of the iodine solution consumed. Then dilute the sodium hyposulphite solution so that equal volumes of it and of decinormal iodine V. S. will exactly correspond to each other under the conditions mentioned above.

Example.—Assuming that the 10 Cc. of the stronger sodium hyposulphite solution first prepared had required 10.7 Cc. of the decinormal iodine V. S. to produce a faint reaction with starch, the hyposulphite solution must be diluted in the proportion of 10 Cc. to 10.7 Cc., or 1000 Cc. to 1070 Cc.

After the solution is thus diluted, a new trial should be made in the manner above described, in which 50 Cc. of the decinormal sodium hyposulphite V. S. should require exactly 50 Cc. of the decinormal iodine V. S. to produce a faint reaction with starch. If necessary, a new adjustment should then be made to render the correspondence perfect.

Keep the solution in small, dark amber-colored, glass stoppered bottles, carefully protected against the access of dust.

Note.—When this solution is to be used, fill a burette with it, place the liquid to be tested either for the free iodine it already contains, or for that which it liberates from an excess of potassium iodide added to it, into a flask, and gradually add small portions of the solution from the burette, shaking after each addition, and regulating the flow to drops towards the end of the operation, until the brown color of the iodine has nearly, but not entirely, disappeared. Now add a few drops of starch T. S. which will produce a blue color, and then continue to add the hyposulphite solution in drops, until the blue tint is exactly discharged.

One cubic centimetre of Decinormal Sodium Hyposulphite V. S. is the equivalent of:

	Gramme.
Sodium Hyposulphite (Thiosulphate) $Na_2S_2O_3 + 5H_2O$	0.024764
Bromine, Br	0.007976
Chlorine, Cl	0.003537
Iodine, I	0.012653
Iron, Fe, in ferric salts	0.005588

The following articles are tested with this solution:

	Gm. taken.	Cc. requred.	Per cent. of strength indicated.	
Aqua Chlori	35.4	40	0.4	of chlorine.
Calx Chlorata	0.354	30	30	of chlorine.
Ferri Chloridum	0.56	20	20	of iron.
Ferri Citras	0.56	16	16	of iron.
Ferri Citras Solubilis	0.56	16	16	of iron.
Ferri et Ammonii Sulphas	0.50	11.6	11.6	of iron.
Ferri et Ammonii Tartras	0.56	17	17	of iron.

	Gm. taken.	Cc. required.	Per cent. of strength indicated.	
Ferri et Potassii Tartras	0.56	15	15	of iron.
Ferri et Quininae Citras	0.56	1.45	14.5	of iron.
Ferri et Quininæ Citras Solubilis	0.56	14.5	14.5	of iron.
Ferri et Strychninæ Citras	0.56	16	16	of iron.
Ferri Phosphas Solubilis	0.56	12	12	of iron.
Ferri Pyrophosphas Solubilis	0.56	10	10	of iron.
Ferri Valerianas	0.56	20	20	of iron.
Ferrum Reductum	0.056	8	80	of iron.
Iodum	0.3163	25	99.94	of iodine.
Liquor Iodi Compositus	12.66	50	5	of iodine.*
Liquor Sodae Chloratae	8.88	50	2	of chlorine.*
Tinctura Iodi	6.33	40	8	of iodine.*

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*Figures of 1880, subject to report of Sub-Committee having charge of Liquores.

109. Normal Sulphuric Acid.

$H_2SO_4 = 97.82$. 48.91 Gm. in 1 Litre.

Carefully mix 30 Cc. of pure, concentrated sulphuric acid (spec. grav. 1.840) with enough water to make about 1050 Cc., and allow the liquid to cool to about 15° C. (59° F.). Place 10 Cc. of this liquid (which is yet too concentrated) into a flask, add a few drops of phenolphtalein T. S., and afterwards, from a burette, normal potassium hydrate V. S., shaking after each addition, and regulating the flow to drops towards the end of the operation, until the red color produced by its influx no longer disappears on shaking, without being more than pale pink. Note the number of cubic centimetres of potassium hydrate consumed. Then dilute the Sulphuric Acid Solution so that equal volumes of this and of normal potassium hydrate solution exactly neutralize each other.

EXAMPLE.—Assuming that 10 Cc. of the acid solution first prepared required exactly 11.2 Cc. of normal potassium hydrate V. S., each 10 Cc. of the former must be diluted to 11.2 Cc., or each 1000 Cc. to 1120 Cc.

After the liquid is thus diluted, a new trial should be made in the manner above described, in which 50 Cc. of the acid solution should require for neutralization exactly 50 Cc. of potassium hydrate V. S. If necessary, a new adjustment should be made to render the correspondence perfect.

One cubic centimetre of Normal Sulphuric Acid is the equivalent of:

	Gramme.
Sulphuric Acid, absolute, H_2SO_4	0.04891
Ammonia Gas, NH_3	0.01701
Ammonium Carbonate, $NH_4HCO_3 + NH_4NH_2CO_2$	0.05226
Lead Acetate, crystallized, $Pb(C_2H_3O_2)_2 + 3H_2O$	0.1890
Lead Subacetate, as $Pb_2O(C_2H_3O_2)_2$	0.13662
Lithium Carbonate, Li_2CO_3	0.036935
Lithium Citrate, $Li_3C_6H_5O_7$; after ignition	0.06986
Potassium Acetate, $KC_2H_3O_2$; after ignition	0.09789
Potassium Bicarbonate, $KHCO_3$	0.09988

	Gramme.
Potassium Carbonate, anhydrous, K_2CO_3	0.068955
Potassium Citrate, cryst., $K_3C_6H_5O_7 + H_2O$; after ignition	0.10789
Potassium Hydrate, KOH	0.05599
Potassium Sodium Tartrate, $KNaC_4H_4O_6 + 4H_2O$; after ignition	0.14075
Sodium Bicarbonate, $NaHCO_3$	0.08385
Sodium Borate, crystallized, $Na_2B_4O_7 + 10H_2O$	0.19096
Sodium Carbonate, anhydrous, Na_2CO_3	0.052925
Sodium Carbonate, crystallized, $Na_2CO_3 + 10H_2O$	0.142725
Sodium Hydrate, NaOH	0.03996

The following articles are tested with this solution:

	Gm. taken.	Cc. required.	Per cent. of strength indicated.	
Ammonii Carbonas	2.613	50.	100	of salt.
Aqua Ammoniae	3.4	20.	10	of dry gas.
Aqua Ammoniae Fortior	1.7	28.	28	of dry gas.
Liquor Plumbi Subacetatis	13.67	25.	25	of basic salt.*
Liquor Potassae	28.00	25.	5	of hydrate.*
Liquor Sodae	20.00	25.	5	of hydrate.*
Lithii Carbonas	0.37	9.9	98.85	of pure salt.
Lithii Citras, after ignition	0.7	10.	99.8	of pure salt.
Potassa	0.56	9.	90	of hydrate.
Potassii Acetas, after ignition	1.	10.	98	of salt.
Potassii Bicarbonas	1.0	10.	100	of salt.
Potassii Carbonas	0.69	9.5	95	of anhydrous.
Potassii Citras, after ignition	1.08	10.	100	of crystall. salt
Pot. et Sod. Tart., after ignition	1.41	10.	100	of salt.
Soda	0.4	9.	90	of hydrate.
Sodii Acetas, after ignition	1.36	10.	100	of salt.
Sodii Bicarbonas.	0.85	10.	99.18	of salt.
Sodii Carbonas, anhydrous	1.	18.7	99.2	of salt.
Sodii Carbonas Exsiccatus	1.	13.8	99.9	of salt.
Spiritus Ammoniae.	3.4	20.	10	of ammonia.

Note.—It is recommended that, in alkalimetric determinations, when an acid of normal strength is required, normal sulphuric acid be employed, in place of normal oxalic acid V. S.

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*Figures of 1880, subject to report of Sub-Committee.

Note.—As the work of revision progresses, and further reports from sub-committees are received, additions may be made to the list of reagents. The following have been added since the foregoing was in type:

23. *a.* **Cobaltous Nitrate Test-Solution.**—$Co(NO_3)_2 + 6H_2O = 290.14$. The crystallized commercial salt is sufficiently pure, if after dissolving it in water and completely precipitating the cobalt by ammonium sulphide T. S., the filtrate, on evaporation, leaves no fixed residue. To make the test solution dissolve 1 Gm. in 10 Cc. of water.

60. *a.* **Potassium Cyanide Test-Solution.**—$KCN = 65.01$. This is freshly prepared as required, by dissolving 1 Gm. of *Potassii Cyanidum*, U. S. P., in 4 parts of water.

ALPHABETICAL LIST OF VOLUMETRIC ASSAYS DIRECTED BY THE U. S. PHARMACOPŒIA.

NAME.	Gm. Taken.	Cc. Required.	Volumetric Solution.	Indicator.	Percentage of Strength.
Acidum Aceticum	6.	36.	Normal KOH	Phenolphtalein	36. of abs. acid.
Acidum Aceticum Dilutum	24.	24. to 24.5	Norm. KOH	Phenolphtalein	6. to 6.13 of abs. acid.
Acidum Aceticum Glaciale	3.	49.5	Norm. KOH	Phenolphtalein	99. of abs. acid.
Acidum Arsenosum	0.1	20.	DeciN. Iodine	Starch	99. of As_2O_3.
Acidum Carbolicum			Bromine		
Acidum Citricum	3.5	50.	Norm. KOH	Phenolphtalein	100. of pure acid.
Acidum Hydrobromicum Dilut.	8.08	10.	Norm. KOH	Phenolphtalein	10. of abs. acid.
Acidum Hydrochloricum	3.64	31.9	Norm. KOH	Phenolphtalein	31.9 of abs. acid.
Acidum Hydrochloricum Dilut.	3.64	10.	Norm. KOH	Phenolphtalein	10. of abs. acid.
Acidum Hydrocyanicum Dilut.	1.35	10.	DeciN. $AgNO_3$	K_2CrO_4	2. of abs. acid.
Acidum Hypophosphorosum Dilutum	6.59	10.	Norm. KOH	Phenolphtalein	10. of abs. acid.
Acidum Lacticum	4.5	37.5	Norm. KOH	Phenolphtalein	75. of abs. acid
Acidum Nitricum	3.145	34.	Norm. KOH	Phenolphtalein	68. of abs. acid.
Acidum Nitricum Dilutum	6.29	10.	Norm. KOH	Phenolphtalein	10. of abs. acid.
Acidum Phosphoricum	0.978	10.	Norm. KOH	Phenolphtalein	50 of abs. acid.
Acidum Phosphoricum Dilutum.	4.89	10.	Norm. KOH	Phenolphtalein	10. of abs. acid.
Acidum Sulphuricum	0.489	9.6 at least	Norm. KOH	Phenolphtalein	96 of abs. acid.
Acidum Sulphuricum Aromaticum	4.89	18.	Norm. KOH	Phenolphtalein	18. of abs. acid.
Acidum Sulphuricum Dilutum	4.89	10.	Norm. KOH	Phenolphtalein	10. of abs. acid.
Acidum Sulphurosum	1.28	14. at least	DeciN. Iodine	Starch	3.5 of SO_2.
Acidum Tartaricum	3.75	50.	Norm. KOH	Phenolphtalein	100. of pure acid.
Ammonii Bromidum	0.3	30.9	DeciN. $AgNO_3$	K_2CrO_4	99. of KBr.
Ammonii Carbonas	2.613	50.	Norm H_2SO_4	Rosolic Acid	100. of pure salt.

Antimonii et Potassii Tartras	0.331	20.	DeciN. Iodine	Starch	100.	of pure salt.
Aqua Ammoniae	3.4	20.	Normal H_2SO_4	Rosolic Acid	10.	of NH_3.
Aqua Ammoniae Fortior	1.7	28.	Norm. H_2SO_4	Rosolic Acid	28.	of NH_3.
Aqua Chlori	17.7	20.	DeciN. $Na_2S_2O_3$	Starch	0.4	of chlorine.
Argenti Nitras	0.34	20.	DeciN. NaCl	K_2CrO_4	99.97	of $AgNO_3$.
Argenti Nitras Fusus	0.34	19.	DeciN. NaCl	K_2CrO_4	95.	of $AgNO_3$.
Argenti Nitras Dilutus	1.	19.5	DeciN. NaCl	K_2CrO_4	33.14	of $AgNO_3$.
Calx Chlorata	0.354	30.	DeciN. $Na_2S_2O_3$	Starch	30.	of chlorine.
Ferri Carbonas Saccharatus	3.47	15.	DeciN. $K_2Cr_2O_7$	Ferricyanide	15.	of iron.
Ferri Carbonas Saccharatus	1.16	15.	DeciN. $KMnO_4$		15.	of iron.
Ferri Chloridum	0.56	20.	DeciN. $Na_2S_2O_3$	Starch	20.	of iron.
Ferri Citras	0.56	16.	DeciN. $Na_2S_2O_3$	Starch	16.	of iron.
Ferri Citras Solubilis	0.56	16.	DeciN. $Na_2S_2O_3$	Starch	16.	of iron.
Ferri et Ammonii Sulphas	0.56	11.6	DeciN. $Na_2S_2O_3$	Starch	11.6	of iron.
Ferri et Ammonii Tartras	0.56	17.	DeciN. $Na_2S_2O_3$	Starch	17.	of iron.
Ferri et Potassii Tartras	0.56	15.	DeciN. $Na_2S_2O_3$	Starch	15.	of iron.
Ferri et Quininae Citras	0.56	14.5	DeciN. $Na_2S_2O_3$	Starch	14.5	of iron.
Ferri et Quininae Citras Solubilis	0.56	14.5	DeciN. $Na_2S_2O_3$	Starch	14.5	of iron.
Ferri et Strychninae Citras	0.56	16.	DeciN. $Na_2S_2O_3$	Starch	16.	of iron.
Ferri Iodidum Saccharatum	1.5447	20.	DeciN. $AgNO_3$	K_2CrO_4	20.	of FeI_2.
Ferri Phosphas Solubilis	0.56	12.	DeciN. $Na_2S_2O_3$	Starch	12.	of iron.
Ferri Pyrophosphas Solubilis	0.56	10.	DeciN. $Na_2S_2O_3$	Starch	10.	of iron.
Ferri Sulphas	1.3871	50.	DeciN. $KMnO_4$		100.	of pure crystals.
Ferri Sulphas	4.1613	50.	DeciN. $K_2Cr_2O_7$	Ferricyanide	100.	of pure crystals.
Ferri Sulphas Granulatus	1.3871	50.	DeciN. $KMnO_4$		100.	of pure crystals.
Ferri Sulphas Granulatus	4 1613	50.	DeciN. $K_2Cr_2O_7$	Ferricyanide	100.	of pure crystals.
Ferri Valerianas	0.56	20.	DeciN. $Na_2S_2O_3$	Starch	20.	of iron.
Ferrum Reductum	0.056	8.	DeciN. $KMnO_4$		80.	of iron.
Ferrum Reductum	0.056	8.	DeciN. $Na_2S_2O_3$	Starch	80.	of iron.
Hydrogenii Dioxidum	1 Cc.	18.	DeciN. $KMnO_4$		3.	of H_2O_2.

ALPHABETICAL LIST OF VOLUMETRIC ASSAYS.—*Continued.*

NAME.	Gm. Taken.	Cc. Required.	Volumetric Solution.	Indicator.	Percentage of Strength.	
Iodum	0.3163	25.	DeciN. $Na_2S_2O_3$	Starch	100.	of iodine.
Liquor Ferri Acetatis						
Liquor Ferri Chloridi						
Liquor Ferri Nitratis						
Liquor Ferri Subsulphatis						
Liquor Ferri Tersulphatis						
Liquor Iodi Compositus	12.66	50.	DeciN. $Na_2S_2O_3$	Starch	5.	of iodine.
Liquor Plumbi Subacetatis	13.67	25.	Normal H_2SO_4	Phenolphtalein	25	of basic salt.
Liquor Potassae.	28.	25.	Normal H_2SO_4	Phenolphtalein	5.	of KOH.
Liquor Potassii Arsenitis	24.7	48.5 to 50	DeciN. Iodine	Starch	1.	of As_2O_3.
Liquor Sodae	20.	25.	Normal H_2SO_4	Phenolphtalein	5.	of NaOH.
Liquor Sodae Chloratae	8 88	50.	DeciN. $Na_2S_2O_3$	Starch	2.	of chlorine.
Mangani Oxidum Nigrum						
Potassa	0.56	9.	Normal H_2SO_4	Phenolphtalein	90.	of KOH.
Potassii Acetas (after ignition)	1.	10.	Normal H_2SO_4	Methyl Orange	98.	of pure salt.
Potassii Bicarbonas	1.	10.	Normal H_2SO_4	Methyl Orange	99.8	of pure salt.
Potassii Bitartras	1.88	9.9	Normal KOH	Phenolphtalein	99.	of pure salt.
Potassii Bromidum	0.5	42.5	DeciN. $AgNO_3$	K_2CrO_4	98.	of pure salt.
Potassii Carbonas	0.69	9.5	Normal H_2SO_4	Methyl Orange	95.	of pure salt.
Potassii Citras, (after ignition)	1.081	10.	Normal H_2SO_4	Methyl Orange	100.	of pure salt.
Potassii Cyanidum	0.65	45.	DeciN. $AgNO_3$	Precipitate	90.	of KCN.
Potassii et Sodii Tartras, (after ignition)	1.41	10.	Normal H_2SO_4	Methyl Orange	100.	of pure salt.
Potassii Iodidum	0.5	30.25	DeciN. $AgNO_4$	K_2CrO_4	99.5	of KI.
Potassii Iodidum, (alkalinity)	1.	0.05	DeciN. $C_2H_2O_4$	Phenolphtalein	0.034	of alkali.

Potassii Permanganas	0.1	31.3	DeciN. $C_2H_2O_4$		98.98	of $KMnO_4$.
Potassii Sulphas, (after decomposition with $BaCO_3$)	0.87	10.	Normal H_2SO_4	Methyl Orange	100.	of pure salt.
Soda	0.4	9.	Normal H_2SO_4	Phenolphtalein	90.	of NaOH.
Sodii Acetas, (after ignition)	1.36	10.	Normal H_2SO_4	Methyl Orange	100.	of pure salt.
Sodii Bicarbonas	0.85	10.	Normal H_2SO_4	Methyl Orange	99.18	of pure salt.
Sodii Bisulphis	0.26	45.	DeciN. Iodine	Starch	90.	of pure salt.
Sodii Bromidum	0.3	29.4	DeciN. $AgNO_3$	K_2CrO_4	98.5	of pure salt.
Sodii Carbonas, anhydrous	1.	18.7	Normal H_2SO_4	Methyl Orange	99.2	of pure salt.
Sodii Carbonas Exsiccatus	1.	13.8	Normal H_2SO_4	Methyl Orange	73.2	of dry salt.
Sodii Chloridum	0.195	33.3	DeciN. $AgNO_3$	K_2CrO_4	99.9	of pure salt.
Sodii Hyposulphis	0.25	9.9	DeciN. Iodine	Starch	98.3	of pure salt.
Sodii Iodidum	0.5	33.9 to 33.3	DeciN. $AgNO_3$	K_2CrO_4	98.85	of pure salt.
Sodii Sulphis	0.63	48.	DeciN. Iodine	Starch	96.	of pure salt.
Spiritus Ammoniae	3.4	20.	Normal H_2SO_4	Rosolic Acid	10.	of NH_3.
Syrupus Acidi Hydriodici	31.98	25.	DeciN. $AgNO_3$	K_2CrO_4	1.	of HI.
Syrupus Ferri Bromidi	5.385	50.	DeciN. $AgNO_3$	K_2CrO_4	10.	of $FeBr_2$.
Syrupus Ferri Iodidi	7.713	50.	DeciN. $AgNO_3$	K_2CrO_4	10.	of FeI_2.
Tinctura Iodi	6.33	40.	DeciN. $Na_2S_2O_3$	Starch	8.	of iodine.
Vinum Album	50.	3. to 5.1	Normal KOH	Phenolphtalein	0.45 to 0.78	of acid.
Vinum Rubrum	50.	3. to 5.1	Normal KOH	Eosin	0.45 to 0.78	of acid.
Zinci Bromidum	0.3	26.7	DeciN. $AgNO_3$	K_2CrO_4	99.95	of $Zn Br_2$.
Zinci Chloridum	0.3	44.1	DeciN. $AgNO_3$	K_2CrO_4	99 84	of $Zn Cl_2$.
Zinci Iodidum	0.5	31.4	DeciN. $AgNO_3$	K_2CrO_4	99 9	of $Zn I_2$.

Note.—Other articles to be inserted as reported by the respective sub-committees.

TABLE OF ATOMIC WEIGHTS.

Names of Elements occurring in pharmacopœial and medicinal chemicals, or in Reagents used for pharmacopœial tests, are printed in heavy-faced type.

NAME.	SYMBOL.	ATOMIC WEIGHT.	NAME.	SYMBOL.	ATOMIC WEIGHT.
Aluminum	**Al**	27.04	**Molybdenum**	**Mo**	95.9
Antimony	**Sb**	119.6	Nickel	Ni	58.6
Arsenic	**As**	74.9	**Nitrogen**	**N**	14.01
Barium	**Ba**	136.9	Osmium	Os	190.3
Beryllium[1]	Be	9.03	**Oxygen**	**O**	15.96
Bismuth	**Bi**	208.9	Palladium	Pd	106.35
Boron	**B**	10.9	**Phosphorus**	**P**	30.96
Bromine	**Br**	79.76	**Platinum**	**Pt**	194.3
Cadmium	Cd	111.5	**Potassium**	**K**	39.03
Caesium	Cs	132.7	Rhodium	Rh	102.9
Calcium	**Ca**	39.91	Rubidium	Rb	85.2
Carbon	**C**	11.97	Ruthenium	Ru	101.4
Cerium	**Ce**	139.9	Samarium	Sm	149.62
Chlorine	**Cl**	35.37	Scandium	Sc	43.97
Chromium	**Cr**	52.0	Selenium	Se	78.87
Cobalt	**Co**	58.6	**Silicon**	**Si**	28.3
Columbium[2]	Cb	93.7	**Silver**	**Ag**	107.66
Copper	**Cu**	63.18	**Sodium**	**Na**	23.0
Didymium[3]	Di	142.0	Strontium	Sr	87.3
Erbium	Er	166.0	**Sulphur**	**S**	31.98
Fluorine	F	19.0	Tantalum	Ta	182.0
Gallium	Ga	69.9	Tellurium	Te	125.0
Germanium	Ge	72.3	Terbium	Tb	159.1
Gold	**Au**	196.7	Thallium	Tl	203.7
Hydrogen	**H**	1.0	Thorium	Th	231.9
Indium	In	113.6	**Tin**	**Sn**	118.8
Iodine	**I**	126.53	Titanium	Ti	48.0
Iridium	Ir	192.5	Tungsten	W	183.6
Iron	**Fe**	55.88	Uranium	U	238.8
Lanthanum	La	138.2	Vanadium	V	51.1
Lead	**Pb**	206.4	Ytterbium	Yb	172.6
Lithium	**Li**	7.01	Yttrium	Yt	88.9
Magnesium	**Mg**	24.3	**Zinc**	**Zn**	65.1
Manganese	**Mn**	54.8	Zirconium	Zr	90.4
Mercury	**Hg**	199.8			

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[1] Also called Glucinum, Gl 9.03.

[2] Also called Niobium, Nb 93.7.

[3] Composed of Neo-and Praseo-Didymium.

MULTIPLES OF SOME ATOMIC AND MOLECULAR WEIGHTS IN FREQUENT USE.

1.	H	1	2	3	4	5	6	7	8	9	H	1.
2.	O	15.96	31.92	47.88	63.84	79.80	95.76	111.72	127.68	143.64	O	2.
3.	OH	16.96	33.92	50.88	67.84	84.80	101.76	118.72	135.68	152.64	OH	3.
4.	H_2O	17.96	35.92	53.88	71.84	89.80	107.76	125.72	143.68	161.64	H_2O	4.
5.	N	14.01	28.02	42.03	56.04	70.05	84.06	98.07	112.08	126.09	N	5
6.	NH_2	16.01	32.02	48.03	64.04	80.05	96.06	112.07	128.08	144.09	NH_2	6.
7.	NH_3	17.01	34.02	51.03	68.04	85.05	102.06	119.07	136.08	153.09	NH_3	7.
8.	NH_4	18.01	36.02	54.03	72.04	90.05	108.06	126.07	144.08	162.09	NH_4	8.
9.	NO_2	45.93	91.86	137.79	183.72	229.65	275.58	321.51	367.44	413.37	NO_2	9.
10.	NO_3	61.89	123.78	185.67	247.56	309.45	371.34	433.23	495.12	557.01	NO_3	10.
11.	C	11.97	23.94	35.91	47.88	59.85	71.82	83.79	95.76	107.73	C	11.
12.	CO_3	59.85	119.70	179.55	239.40	299.25	359.10	418.95	478.80	538.65	CO_3	12.
13.	CN	25.98	51.96	77.94	103.92	129.90	155.88	181.86	207.84	233.82	CN	13.
14.	Cl	35.37	70.74	106.11	141.48	176.85	212.22	247.59	282.96	318.33	Cl	14.
15.	Br	79.76	159.52	239.28	319.04	398.80	478.56	558.32	638.08	717.84	Br	15.
16.	I	126.53	253.06	379.59	506.12	632.65	759.18	885-71	1012.24	1138.77	I	16.
17.	S	31.98	63.96	95.94	127.92	159.90	191.88	223.86	255.84	287.82	S	17.
18.	SO_4	95.82	191.64	287.46	383.28	479.10	574.92	670.74	766.56	862.38	SO_4	18.
19.	PO_4	94.80	189.60	284.40	379.20	474.00	568.80	663.60	758.40	853.20	PO_4	19.
20.	PH_2O_2	64.88	129.76	194.64	259.52	324.40	389.28	454.16	519.04	583.92	PH_2O_2	20.
21.	Na	23.00	46.00	69.00	92.00	115.00	138.00	161.00	184.00	207.00	Na	21.
22.	K	39.03	78.06	117.09	156.12	195.15	234.18	273.21	312.24	351.27	K	22.
		1	2	3	4	5	6	7	8	9		

ACIDUM HYDROCHLORICUM.

HYDROCHLORIC ACID.

[MURIATIC ACID.]

A liquid composed of 31.9 per cent. of absolute Hydrochloric Acid ($HCl = 36.37$) and 68.1 per cent. of water

Hydrochloric Acid should be kept in glass-stoppered bottles.

A colorless, fuming liquid, of a pungent, suffocating odor and an intensely acid taste, even when much diluted. Fumes and odor disappear on dilution with a double volume of water. Spec. grav. 1.160; miscible in all proportions with water and with alcohol.

When Hydrochloric Acid is heated, at first a stronger acid passes off, until at 110° C. (230° F.) an acid containing 20.18 per cent. of HCl remains (of sp. gr. 1.101 at 15° C.), which distils unchanged, leaving no residue if the acid was pure.

With test-papers it shows an intensely acid reaction, even after great dilution.

Heated with black oxide of manganese, it gives off chlorine.

With silver nitrate T. S. it yields a white, curdy precipitate, insoluble in nitric acid, readily soluble in ammonia water, forming a colorless liquid.

If 10 Cc. of the acid be evaporated from a platinum or porcelain capsule, only a bare trace of residue should be left (abs. of *non-volatile impurities*).

A few drops of chloroform, added to 1 Cc. of Hydrochloric Acid diluted with 3 Cc. of water, should not become colored, either at once, or after addition of a few drops of freshly prepared chlorine water, or of a granule of potassium chlorate (abs. of *bromine* or *iodine*)

On adding 1 Cc. of stannous chloride T. S. (see List of Reagents, Bettendorff's test), together with a small piece of pure tin foil, to 1 Cc. of the acid and applying a gentle heat, no coloration should occur within one hour (abs. of *arsenic*).

If 1 Cc. of the acid be diluted with 5 Cc. of water, and 0.5 Cc of barium chloride T. S. be added, no precipitate or even turbidity should appear within an hour (abs. of *sulphuric acid*), nor should the addition to this mixture of a few drops of decinormal iodine V. S. produce any turbidity (abs. of *sulphurous acid*).

When a few Cc. of freshly prepared hydrogen sulphide T. S. are poured carefully on top of an equal volume of Hydrochloric Acid, no color should appear at the zone of contact (abs. of *thallium, lead, arsenic*, etc).

If 1 Cc. of the acid be diluted with 5 Cc. of water and 0.5 Cc. zinc-iodide-starch T. S. be added, no blue color should appear (abs. of *free chlorine* or *bromine*).

If 3.64 Gm. of Hydrochloric Acid be diluted with 10 Cc of water and a few drops of phenolphtalein T. S. be added, it should require 31.9 Cc. of normal potassium hydrate V. S. to neutralize the acid as indicated by the color remaining a pale pink after agitation. Each Cc. of the V. S. used indicates 1 per cent. of HCl.

Preparations: Acidum Hydrochloricum Dilutum. Acidum Nitrohydrochloricum. Acidum Nitrohydrochloricum Dilutum.

AQUA.

WATER.

$H_2O = 17.96.$

Natural Water in its purest attainable state.

A colorless, limpid liquid, without odor or taste at ordinary temperatures, and remaining colorless while being heated to boiling.

Water should be perfectly neutral to test-paper, and its transparency should not be affected, nor should any color be imparted to it by hydrogen sulphide T. S., or ammonium sulphide T. S. (abs. of *metallic impurities*).

It should also remain unaffected by mercuric chloride T. S. (limit of *ammonia*).

On evaporating 1000 Cc. of water on a water-bath, it should not leave a residue weighing more than 0.25 Gm. (limit of *soluble salts*), and this residue, when ignited, should not carbonize, or evolve ammoniacal or acid vapors.

If 200 Cc. of Water be acidulated with hydrochloric acid, and heated to boiling, and 0.5 Cc. of barium chloride T. S. added, the liquid, when allowed to cool and then filtered, should give no further precipitate on the addition of a few drops of barium chloride T. S., even on standing (limit of *sulphates*).

If 200 Cc. of Water be acidulated with nitric acid and 0.5 Cc. of decinormal silver nitrate V. S. be added, the filtered liquid should not be affected by the subsequent addition of a few drops of silver nitrate T. S. (limit of *chlorides*).

If to 5 Cc. of Water, contained in a test-tube, a few drops of diphenylamine T. S. be added, and then about 3 Cc. of sulphuric acid (free from nitric acid) poured into the liquid so as to form two layers, no blue color should at once be formed at the line of contact of the two liquids (limit of *nitrates*).

If 100 Cc. of Water be acidulated with diluted sulphuric acid, and a few drops of zinc-iodide-starch T. S. subsequently added, the liquid should not at once assume a blue or violet color (abs. of *nitrites*).

On heating 100 Cc. of Water, acidulated with 10 Cc. of diluted sulphuric acid, to boiling, and subsequently adding 0.5 Cc. of decinormal potassium permanganate V. S., the color of the liquid should not be completely destroyed by boiling for ten minutes (limit of *organic* or other *oxidizable matters*).

Preparation: Aqua Destillata.

FERRI CITRAS.

CITRATE OF IRON.

Solution of Citrate of Iron, *a convenient quantity.*

Evaporate the solution on a water bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales.

Citrate of iron should be preserved in well-stoppered bottles, in a dark place.

Thin, transparent, garnet-red scales, without odor, and having a slightly ferruginous taste. Slowly but completely soluble in cold water, and readily soluble in hot water, but insoluble in alcohol. When strongly heated, the salt chars, emits fumes having an odor resembling burning sugar, and finally leaves a residue of ferric oxide, which should not have an alkaline reaction to test-paper (abs. of *citrates* or *tartrates of the fixed alkalies*).

The aqueous solution of the salt has an acid reaction, and is not precipitated, but rendered darker in color, by ammonia water.

With potassium ferrocyanide T. S. it affords a bluish-green color or precipitate, which is increased and rendered dark blue by the subsequent addition of hydrochloric acid (difference from *soluble citrate of iron*).

If heated with potassium hydrate T. S., it affords a brownish-red precipitate without evolving any vapor of ammonia.

If a 10 per cent. solution of the salt be deprived of its iron by boiling with an excess of potassium hydrate T. S., and the filtrate slightly acidulated with acetic acid, a portion of the liquid, when allowed to stand for some time, should not afford a white crystalline precipitate (abs. of *tartrate*). If to another portion of the acidulated and cooled liquid a little calcium chloride T. S. be added, and it be again heated to boiling, it should gradually afford a white crystalline precipitate (identity as a *citrate*).

If 0.56 (0.5588) Gm. of the salt be dissolved, in a glass-stoppered bottle (having a capacity of about 100 Cc.), in 15 Cc. of water and 2 Cc. of hydrochloric acid, with the aid of a gentle heat, and, after the addition of 1 Gm. of potassium iodide, the mixture be allowed to stand for half an hour at a temperature of 40° C. (104° F.), and then allowed to cool, it should, after the addition of a few drops of starch T. S., require not less than 16 Cc. of decinormal sodium hyposulphite V. S., before the blue or greenish color of the liquid is discharged; each Cc. of the volumetric solution corresponding to 1 per cent of iron.

Preparations: Ferri et Quininae Citras. Ferri et Quininae Citras Solubilis.

POTASSII BROMIDUM.

BROMIDE OF POTASSIUM.

$KBr = 118.79$.

Colorless or white, cubical crystals, or granules; odorless; of a pungent, saline taste; permanent in air. Soluble at 15° C. (59° F.) in about 1.6 parts of water, or in 200 parts of alcohol; at boiling temperature, in less than 1 part of water and in 16 parts of alcohol; also in 4 parts of glycerin.

On heating, the salt decrepitates; near 700° C. (1292° F.) it fuses without decomposing, and at a bright red heat volatilizes, communicating a violet color to the flame.

The aqueous solution (1 in 20) has a neutral or, at most, scarcely preceptible, alkaline reaction.

Addition of tartaric acid T. S. or of sodium bitartrate T. S. produces in it, after some time, a crystalline precipitate of potassium bitartrate.

Sodium cobaltic nitrite T. S. produces in it, at once, a copious yellow precipitate.

If to 10 Cc. of the aqueous solution of the salt a few drops of chloroform be added and then 1 Cc. of chlorine water, and the mixture agitated, the liberated bromine will dissolve in the chloroform, imparting to it a yellow or brownish-yellow color, without a violet tint.

If 1 Gm. of the salt be dissolved in 10 Cc. of a mixture of 100 Cc. of water and 0.2 Cc. of normal sulphuric acid V. S., no red tint should be imparted to the solution by the addition of a few drops of phenolphtalein T. S. (limit of *alkalinity*).

If a little of the salt be held into the flame on a well-cleaned platinum wire, the flame should be colored violet at once without the appearance of yellow (abs. of *sodium*).

If diluted sulphuric acid be dropped upon crushed crystals of the salt, they should not at once assume a yellow color (abs. of *bromate*).

If 10 Cc. of the aqueous solution (1 in 20) be mixed with a little starch T. S., the addition of a drop or two of chlorine water should not produce a blue color (abs. of *iodide*).

10 Cc. of the aqueous solution should not be rendered turbid by the addition of 0.5 Cc. of ammonia water and of 0.5 Cc. of ammonium sulphide T. S. (abs. of *iron, aluminum, etc.*); nor should 10 Cc., after being slightly acidulated with acetic acid, be rendered turbid by an equal volume of hydrogen sulphide T. S. (abs. of *arsenic, lead, copper, etc.*); nor by 0.5 Cc. of ammonium oxalate T. S. (abs. of *calcium*); nor by 0.5 Cc. of potassium sulphate T. S. (abs. of *barium*): nor by 0.5 Cc. of barium chloride T. S. (abs. of *sulphate*); nor be colored blue by 0.5 Cc. of potassium ferrocyanide T. S. (abs. of *iron*).

If 0.5 Gm. of the well-dried salt be dissolved in 10 Cc. of water, and 2 drops of potassium chromate T. S. be added, it should not require more than 42.5 Cc. of decinormal silver nitrate V. S. to produce a permanent red color of silver chromate (abs. of *more than 2 per cent. of chloride*).

SODII ACETAS.

ACETATE OF SODIUM.

$NaC_2H_3O_2 + 3H_2O = 135.74.$

Acetate of Sodium should be kept in well-stoppered bottles.

Colorless, transparent, monoclinic prisms; odorless; of a cooling, saline taste; efflorescent in warm, dry air.

Soluble at 15°C. (59°F.) in 1.4 parts of water, or in 30 parts of alcohol; at the temperature of boiling, in 0.5 parts of water, or in 2 parts of alcohol.

When heated to 60°C. (140° F.), the salt begins to liquefy; at 123° C. (253.4° F.) it becomes dry and anhydrous; at 300° C. (572° F.) it melts again, and above 315° C. (599° F.) it is decomposed with evolution of inflammable, empyreumatic vapors, leaving a black residue of sodium carbonate and carbon, which imparts to the flame an intense yellow color, gives an alkaline reaction with moistened test-papers, and effervesces with acids.

The aqueous solution of the salt (1 in 20) colors litmus paper or litmus T. S. blue, but does not redden phenolphtalein T. S. unless carbonate be present.

If 5 Cc. of the aqueous solution be heated with 1 Cc. of sulphuric acid and 0.5 Cc. of alcohol, acetic ether is formed and easily recognized by its odor.

On addition of a few drops of ferric chloride T. S. the solution assumes a deep red color, and on subsequent boiling, forms a brown precipitate.

The aqueous solution (1 in 20) should be clear, and 5 Cc. of it should not be rendered turbid by the addition of 0.5 Cc. of sodium cobaltic nitrite T. S. (limit of *potassium*).

If to 5 Cc. of the aqueous solution, slightly acidulated with acetic acid, an equal volume of hydrogen sulphide T. S. be added, no color or turbidity should appear, either at once (abs. of *arsenic, lead, zinc, etc.*), or after adding ammonia water in slight excess (abs. of *iron, etc.*)

The aqueous solution, acidulated with acetic acid, should not be rendered turbid by ammonium oxalate T. S. (abs. of *calcium*).

If a solution of 1 Gm. of the salt in 50 Cc. of water be slightly acidulated with nitric acid, and 0.5 Cc. of decinormal silver nitrate V. S. be added, and the precipitate, if any, removed by filtration, the clear filtrate should remain unaffected by the addition of more silver nitrate V. S. (limit of *chloride*).

If to a solution of 2 Gm. of the salt in 10 Cc. of water, acidulated with hydrochloric acid, 0.1 Cc. of barium chloride T. S. be added, and the precipitate, if any, be removed by filtration, the clear filtrate should remain unaffected by the further addition of barium chloride T. S. (limit of *sulphate*).

If 1.36 Gm. of the salt be completely decomposed at a red heat, the residue dissolved in water, and a few drops of methyl-orange T. S. be added, it should require 10 Cc. of normal sulphuric acid V. S. for neutralization.