
Reagents, Buffers, and Indicators

Throughout the monographs in this book, the term *reagent solution* is used to designate solutions described in this section. The tests and limits in the monographs are based on the use of the solutions in the strength indicated below.

Wherever the use of ammonium hydroxide or an acid is prescribed with no indication of strength or dilution, the reagent is to be used at full strength as described in its monograph. Dilutions are indicated either by the percentage of some constituent or by the volumes of reagents and water mixed to prepare a dilute reagent. Dilute acid or ammonium hydroxide (1 + x) means a dilute solution prepared by mixing 1 volume of the strong acid or ammonium hydroxide with x volumes of reagent water.

Unless otherwise indicated, the reagent solutions are prepared and diluted with reagent water by using standard class A volumetric pipets and flasks. Weights are measured on a four-place calibrated balance.

For reference purposes, Table 3-1 presents reagents useful in the preparation of buffers for a given pH.

Reagent Water

Throughout the monographs for reagent chemicals, the term *water* means distilled water or deionized water that meets the requirements of Water, Reagent, page 716. However, for specific applications—such as UV determinations or liquid and ion chromatography—ASTM Type I reagent water (ASTM, 1999) or water for which the suitability has been determined should be used. In tests for nitrogen compounds, water should be “ammonia-free” or “nitrogen-free”. Water for use in analysis of ultratrace metals must meet the requirements on page 718. For some tests, freshly boiled water must be used to ensure freedom from material absorbed from the air, such as ammonia, carbon dioxide, or oxygen.

Carbon Dioxide-Free Water. Carbon dioxide-free water can be prepared by purging reagent water with carbon dioxide-free air (using a gas dispersion tube) or nitrogen for at least 15 min or by boiling reagent water vigorously for at least 5 min and allowing it to cool while protected from absorption of carbon dioxide from the atmosphere; alternatively, fresh 18-M Ω deionized water can be used.

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Table 3-1. Reagents Useful in Preparing Buffers of a Specific pH Range

<i>pH Range</i>	<i>pK_a</i>	<i>Reagent</i>
0–2		Hydrochloric acid; nitric acid; perchloric acid
0.3–5.3	1.3, 4.4	Oxalic acid, dihydrate; sodium oxalate; potassium tetroxalate, dihydrate
0.9–2.9, 5.2–7.2	1.9, 6.2	Maleic acid
1.1–1.8		Potassium chloride
1.1–3.1, 6.2–10.1	2.1, 7.2, 12.4	Phosphoric acid; potassium phosphate, monobasic; potassium phosphate, dibasic; potassium phosphate, tribasic, <i>n</i> -hydrate; sodium phosphate, monobasic, monohydrate; sodium phosphate, dibasic, 7-hydrate; sodium phosphate, tribasic, 12-hydrate
1.8–3.8	2.8	Monochloroacetic acid; chloroacetic acid, sodium salt
1.9–6.4	2.9, 5.4	Phthalic acid; potassium biphthalate
2.0–5.4	3.0, 4.4	<i>d</i> -Tartaric acid; potassium tartrate, 1/2-hydrate
2.1–7.4	3.1, 4.8, 6.4	Citric acid, anhydrous; citric acid, monohydrate; potassium citrate, monohydrate
2.8–4.8	3.8	Formic acid; sodium formate
3.2–6.6	4.2, 5.6	Succinic acid
3.6–5.6	4.6	Acetic acid; sodium acetate, trihydrate
4.1–6.1	5.1	Hexamethylenetetramine
5.3–7.3, 9.3–11.3	6.3, 10.3	Carbonic acid; potassium bicarbonate; potassium carbonate, anhydrous; sodium bicarbonate; sodium carbonate, anhydrous; sodium carbonate, monohydrate
6.5–8.5	7.5	Imidazole
6.8	4.6 (acetic acid); 9.3 (ammonium hydroxide)	Ammonium acetate
6.8–8.8	7.8	Triethanolamine; TRIS hydrochloride
7.1–9.1	8.1	<i>N,N</i> -bis(2-hydroxyethyl)glycine (bicine); 4-(2-hydroxyethyl)-1-piperazineethanesulfonic acid (HEPES)
7.8–9.8	8.8	2-Amino-2-methyl-1,2-propanediol (AMP)
8.2–10.2	9.2	Boric acid; sodium borate, 10-hydrate
8.3–10.3	9.3	Ammonium hydroxide; ammonium chloride
12–14		Potassium hydroxide, 45% solution; sodium hydroxide, 50% solution
12.4 (saturated solution)		Calcium hydroxide

Source: Reproduced courtesy of Mallinckrodt Baker, Inc.

Water (Suitable for LC Gradient Elution Analysis)

Analyze the sample by using the following gradient elution conditions. Use ACS reagent-grade or better acetonitrile.

Column: Octadecyl (C-18 polymeric phase), 250 × 4.6 mm i.d., 5 μm, 12% C loading, endcapped

Mobile Phase: A. Water to be tested
B. ACS reagent-grade acetonitrile

Conditions: Detector: Ultraviolet at 254 nm
Sensitivity: 0.02 AUFS

Gradient Elution:

1. Program the liquid chromatograph to develop a water–acetonitrile gradient as follows:

<i>Time (min)</i>	<i>Flow (mL/min)</i>	<i>% A (water)</i>	<i>% B (acetonitrile)</i>
0	2.0	100	0
20	2.0	100	0
40	2.0	0	100
50	2.0	0	100

2. Equilibrate the system at 100% water. Start the program after achieving a stable baseline. Repeat the gradient program, and use these results to evaluate the water. No peak should be greater than 10% of full scale (0.002 absorbance units).

Solutions and Mixtures

Note: Required quantities may be made having the same concentrations as below.

Acetic Acid, 1 N. Dilute 29 mL of glacial acetic acid with water to 500 mL.

Alcohol. *Alcohol* refers to the monograph for ethyl alcohol, page 308. This is distinguished from the monograph for reagent alcohol, page 567, which is a denatured form of ethyl alcohol.

Alizarin Red S, 1%. Dissolve 0.250 g of alizarin red S in water, dilute with water to 250 mL, filter, and store in glass.

Ammonia–Cyanide, Lead-Free, 2%. In a well-ventilated fume hood, dissolve 2.0 g of potassium cyanide in 15 mL of ammonium hydroxide, and dilute with water to 100 mL. Remove lead by shaking the solution with small portions of dithizone extraction solution until the dithizone retains its original green color; discard the extraction solution. Store the ammonia–cyanide solution in a polyethylene bottle.

Ammoniacal Buffer, pH 10. Dissolve 90 g of ammonium chloride in 375 mL of 28–30% ammonium hydroxide, and dilute to 500 mL with water. (The pH of a 1 + 10 dilution with water should be about 10.)

Ammonium Acetate–Acetic Acid Buffer. Dissolve 40 g of ammonium acetate in water, add 29 mL of glacial acetic acid, and dilute with water to 500 mL. (The pH of a 1 + 10 dilution with water should be about 4.5.)

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Ammonium Acetate Buffer. Dissolve 30 g of ammonium acetate in water, and dilute to 100 mL with water.

Ammonium Citrate, Lead-Free, 40%. Dissolve 40 g of citric acid in 100 mL of water, and make alkaline to phenol red with ammonium hydroxide. Remove lead by shaking the solution with small portions of dithizone extraction solution until the dithizone solution retains its original green color; discard the extraction solution. Store the ammonium citrate solution in a polyethylene bottle.

Ammonium Hydroxide, 2.5% NH_3 . Dilute 50 mL of ammonium hydroxide with water to 500 mL.

Ammonium Hydroxide, 10% NH_3 . Dilute 200 mL of ammonium hydroxide with water to 500 mL.

Ammonium Metavanadate, 0.25%. Dissolve 1.25 g of ammonium metavanadate in 250 mL of boiling water, cool, and add 10 mL of nitric acid. Dilute with water to 500 mL, and store in a polyethylene or Teflon bottle.

Ammonium Molybdate, 5%. Dissolve 5 g of ammonium molybdate tetrahydrate in water, and dilute with water to 100 mL. Store in a polyethylene bottle. Discard if a precipitate forms.

Ammonium Molybdate, 10%. Dissolve 5 g of ammonium molybdate in water, and dilute to 50 mL.

Ammonium Molybdate–Nitric Acid Solution. Mix thoroughly 50 g of molybdic acid, 85%, in 120 mL of water, and add 70 mL of ammonium hydroxide. Filter, and add 30 mL of nitric acid. Cool, and pour, with constant stirring, into a cool mixture of 200 mL of nitric acid and 480 mL of water. Add 0.1 g of ammonium phosphate dissolved in 5 mL of water, allow to stand for 24 h, and filter through glass wool.

Ammonium Molybdate–Sulfuric Acid Solution, 5%. (For determination of phosphate.) Dissolve 5.0 g of ammonium molybdate tetrahydrate in 50 mL of 10% sulfuric acid, and dilute with water to 100 mL.

Ammonium Nitrate, 10%. Dissolve 10.0 g of ammonium nitrate in water, and dilute with water to 100 mL.

Ammonium Oxalate, 4%. Dissolve 20 g of ammonium oxalate monohydrate in water, and dilute with water to 500 mL.

Ammonium Phosphate, 13%. Dissolve 65 g of dibasic ammonium phosphate in water, and dilute with water to 500 mL.

Ammonium Thiocyanate, 30%. Dissolve 150 g of ammonium thiocyanate in water, and dilute with water to 500 mL.

Aqua Regia. In a fume hood, cautiously mix 5 mL of nitric acid in 15 mL of hydrochloric acid. Store in a Teflon or glass bottle.

Ascorbic Acid, 5%. Dissolve 5.0 g of ascorbic acid in water, and dilute with water to 100 mL. Prepare fresh solution daily.

Barium Chloride, 12%. (For determination of sulfate.) Dissolve 60 g of barium chloride dihydrate in water, filter, and dilute with water to 500 mL.

Barium Chloride, 40%. (For determination of sulfate in phosphate salts.) Dissolve 40 g of barium chloride dihydrate in 80 mL of water, filter, and dilute with water to 100 mL.

Barium Nitrate, 0.1 M. Dissolve 0.654 g of barium nitrate in water, and dilute with water to 25.0 mL.

Benedict's Solution. Dissolve 87 g of sodium citrate dihydrate and 50 g of anhydrous sodium carbonate in 400 mL of water. Heat to aid dissolution, filter if necessary, and dilute with water to 425 mL. Dissolve 8.65 g of copper sulfate pentahydrate in 50 mL of water. Add this solution, with constant stirring, to the alkaline citrate solution, and dilute with water to 500 mL.

Bromine Water. (A saturated aqueous solution of bromine.) In a well-ventilated fume hood, add about 10 mL of liquid bromine to 75 mL of water in a 100-mL bottle so that when the mixture is shaken, undissolved bromine remains in a separate phase. Store in an amber glass bottle.

Bromphenol Blue Indicator, 0.10%. Dissolve 0.10 g of the sodium salt form of bromphenol blue in water, and dilute with water to 100 mL (pH 3.0–4.6).

Bromthymol Blue Indicator, 0.10%. Dissolve 0.10 g of bromthymol blue in 100 mL of dilute alcohol (1 + 1), and filter if necessary (pH 6.0–7.6).

Brucine Sulfate. Dissolve 0.30 g of brucine sulfate in dilute ACS Reagent-grade sulfuric acid (2 + 1), previously cooled to room temperature, and dilute to 500 mL with the dilute acid. If necessary, nitrate-free acid should be prepared as follows: In a well-ventilated fume hood, dilute the concentrated sulfuric acid (about 96% H_2SO_4) to about 80% H_2SO_4 by adding it to water, heat to dense fumes of sulfur trioxide, and cool. Repeat the dilution and fuming three or four times.

Cadmium Nitrate, 3%. Dissolve 3.0 g of cadmium nitrate tetrahydrate in water, and dilute with water to 100 mL.

Chloramine-T. Dissolve 10.0 mg of chloramine-T (sodium *p*-toluenesulfonchloramide) trihydrate in 100.0 mL of water. Prepare fresh.

Chromotropic Acid, 0.01%. Dissolve 0.02 g of recrystallized chromotropic acid (see below) in concentrated, nitrate-free sulfuric acid, and dilute to 200 mL with the acid. Store in an amber bottle.

To recrystallize chromotropic acid. Add solid sodium sulfate to a saturated aqueous solution of chromotropic acid. Filter the resultant crystals using suction with a Buchner funnel, wash with ethyl alcohol, and air dry. Transfer the crystals to a beaker, add sufficient water to redissolve, and then add just enough sodium sulfate to repre-

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precipitate the salt. Filter as before, wash with ethyl alcohol, and dry at a temperature no higher than 80 °C. Store in an amber bottle.

Note: If an orange or red precipitate forms in the solution of the sample before the addition of the reagent, discard the solution and start again. Immediate addition of the reagent should prevent formation of such a precipitate.

Chromotropic Acid, 1%. Dissolve 1.0 g of chromotropic acid in water, and dilute with water to 100 mL.

Cobalt Chloride, 6%. Dissolve 5.95 g of cobalt chloride hexahydrate and 2.5 mL of hydrochloric acid in 20 mL of water, and dilute to 100 mL with water.

Crystal Violet Indicator, 1%. Dissolve 100 mg of crystal violet in 10 mL of glacial acetic acid.

Cupric Sulfate, 6%. Dissolve 6.24 g of cupric sulfate pentahydrate and 2.5 mL of hydrochloric acid in 20 mL of water, and dilute to 100 mL with water.

Dichlorofluorescein Indicator, 0.1%. Dissolve 100 mg of dichlorofluorescein in 50 mL of alcohol, add 2.5 mL of 0.1 N sodium hydroxide, mix, and dilute with water to 100 mL.

5,5-Dimethyl-1,3-cyclohexanedione, 5% in Alcohol. Dissolve 5.0 g of 5,5-dimethyl-1,3-cyclohexanedione in alcohol, and dilute with alcohol to 100 mL.

Dimethylglyoxime, 1%. Dissolve 1.0 g of dimethylglyoxime in alcohol, and dilute with alcohol to 100 mL.

***N,N*-Dimethyl-*p*-phenylenediamine.** Add 50 mL of sulfuric acid to approximately 175 mL of water. Cool to room temperature, add 0.25 g of *N,N*-dimethyl-*p*-phenylenediamine (*p*-aminodimethylaniline) monohydrochloride, and dilute with water to 250 mL.

Diphenylamine. Dissolve 10 mg of colorless diphenylamine in 100 mL of sulfuric acid. In a separate beaker, dissolve 2 g of ammonium chloride in 200 mL of water. Cool both solutions in an ice bath, and cautiously add the sulfuric acid solution to the water solution, taking care to keep the resulting solution cold. The solution should be nearly colorless.

Dithizone Extraction Solution. Dissolve 15 mg of dithizone in 500 mL of chloroform and 5 mL of alcohol. Store the solution in a refrigerator.

Dithizone Indicator Solution. Dissolve 26 mg of dithizone in 100 mL of alcohol. Store in a refrigerator, and use within 2 months.

Dithizone Test Solution. Dissolve 5 mg of dithizone in 500 mL of chloroform. Keep the solution in a polyethylene bottle, protected from light and stored in a refrigerator.

Eosin Y, 0.50%. Dissolve 50 mg of eosin Y in 10 mL of water.

Eriochrome Black T Indicator. Grind 0.20 g of Eriochrome Black T to a fine powder with 20 g of potassium chloride.

(Ethylenedinitrilo)tetraacetic Acid, Disodium Salt, 0.2 M. Dissolve 37.2 g of (ethylenedinitrilo)tetraacetic acid, disodium salt, dihydrate, in 475 mL of water, and dilute with water to 500 mL.

Ferric Ammonium Sulfate Indicator, 8%. Dissolve 8.0 g of crystals of ferric ammonium sulfate dodecahydrate in water, and dilute with water to 100 mL. A few drops of sulfuric acid may be added, if necessary, to clear the solution.

Ferric Chloride, 4.5%. Dissolve 4.50 g of ferric chloride hexahydrate and 2.5 mL of hydrochloric acid in water, and dilute to 100 mL with water.

Ferric Chloride, 5%. Dissolve 50 g of ferric chloride hexahydrate in dilute hydrochloric acid (1 + 99), and dilute with the dilute acid to 500 mL.

Ferric Nitrate, 17%. Dissolve 17 g of ferric nitrate nonahydrate in 100 mL of water.

Ferric Sulfate, 12%. Add 13 mL of sulfuric acid to 60 g of ferric sulfate *n*-hydrate. Add about 350 mL of water, digest on a hot plate ($\approx 100\text{ }^{\circ}\text{C}$) to dissolve, cool to room temperature, and dilute with water to 500 mL.

Ferroun Indicator, 0.025 M. Dissolve 0.70 g of ferrous sulfate heptahydrate and 1.5 g of 1,10-phenanthroline in 100 mL of water.

Hexamethylenetetramine Solution, Saturated. Dissolve about 20 g of hexamethylenetetramine in 100 mL of water.

Hydrazine Sulfate, 2%. Dissolve 2.0 g of hydrazine sulfate in water, and dilute with water to 100 mL.

Hydrochloric Acid, 10%. Dilute 118 mL of hydrochloric acid with water to 500 mL.

Hydrochloric Acid, 20%. Dilute 235 mL of hydrochloric acid with water to 500 mL.

Hydrochloric Acid, 6 M. Dilute 250 mL of hydrochloric acid with water to 500 mL.

Hydrogen Peroxide, 3%. Dilute 10 mL of hydrogen peroxide to 100 mL with water. Prepare fresh at time of use.

Hydrogen Sulfide Water. In a well-ventilated fume hood, saturate 100 mL of water by bubbling hydrogen sulfide gas for 1 min. This solution must be freshly prepared. Store in a fume hood. Securely close container immediately after use.

Hydroxy Naphthol Blue Indicator. Use the mixture with sodium chloride that is commercially supplied, or grind 0.20 g of hydroxy naphthol blue with 30 g of sodium chloride.

Hydroxylamine Hydrochloride, 10%. Dissolve 10.0 g of hydroxylamine hydrochloride in water, and dilute with water to 100 mL.

Hydroxylamine Hydrochloride for Dithizone Test. Dissolve 20 g of hydroxylamine hydrochloride in about 65 mL of water, and add 0.15 mL of thymol blue indicator solution. Add ammonium hydroxide until a yellow color appears. Add 5 mL of a 4% solu-

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tion of sodium diethyldithiocarbamate. Mix thoroughly, and allow to stand for 5 min. Extract with successive portions of chloroform until no yellow color is developed in the chloroform layer when the extract is shaken with a dilute solution of a copper salt. Add hydrochloric acid until the indicator turns pink, and dilute with water to 100 mL.

Indigo Carmine, 0.10%. Dissolve 0.10 g of sample indigo carmine, dried at 105 °C, in a mixture of 80 mL of water and 10 mL of sulfuric acid, and dilute with water to 100 mL.

Jones Reductor. In a well-ventilated fume hood, cover a 250-g portion of 20-mesh zinc with reagent water in a 1-L suction flask (see apparatus description below). Pour a solution containing 11 g of mercuric chloride in 100 mL of hydrochloric acid into the flask; slowly mix and shake the system for about 2 min. Pour off the solution, and wash the amalgam thoroughly with hot tap water, and then with reagent water. The column is charged with six 250-g portions.

Apparatus. Use a dispensing buret, about 22 in. long and 2 in. in diameter, equipped with a glass stopcock and a delivery tube, 6 mm wide and 3.5 in. long. The reductor is charged with an 8-in. column of 20-mesh amalgamated zinc (1500 g) and, on top of this, a 6-in. column of larger (1–2 cm) amalgamated zinc (about 750 g). The delivery tube is connected to a 1-L flask through a two-hole rubber stopper. One hole is used as an inlet; the other functions as an outlet for carbon dioxide gas.

Karl Fischer Volumetric Reagent. (Before making Karl Fischer reagent, see the discussion of commercial reagents starting on page 30.) In a well-ventilated fume hood, dissolve 254 g of iodine in 807 mL of pyridine in a 3-L glass-stoppered bottle, and add 2 L of methanol. To prepare the active reagent, add 1 L of foregoing stock to a 2-L bottle, and cool by placing the bottle in a slurry of ice pieces. Add carefully about 45 mL of liquid sulfur dioxide, collected in a calibrated cold trap, and stopper the bottle. Shake the mixture until it is homogeneous, and set aside for 24 h before use.

Lead Acetate, 10%. Cautiously dissolve 25 g of lead acetate trihydrate in water. If necessary, add a few drops of acetic acid to clear the solution, and dilute with water to 250 mL.

Lithium Chloride, 30%. Dissolve 6.1 g of lithium chloride in water, and dilute with water to 20 mL. Prepare fresh.

Metalphthalein-Screened Indicator, 0.2%. Dissolve 0.18 g of metaphthalein and 0.02 g of naphthol green B in water containing 0.5 mL of ammonium hydroxide, and dilute to 100 mL with water.

Methyl Orange Indicator, 0.10%. Dissolve 0.10 g of methyl orange in 100 mL of water (pH 3.2–4.4).

Methyl Red Indicator, 0.10%. Dissolve 0.10 g of methyl red in 100 mL of alcohol. See page 443 for a description of the three forms of methyl red (pH 4.2–6.2).

4-(Methylamino)phenol Sulfate, 2%. (For determination of phosphates.) Dissolve 2.0 g of 4-(methylamino)phenol sulfate in 100 mL of water. To 10 mL of this solution, add

90 mL of water and 20 g of sodium bisulfite. Confirm the suitability of the reagent solution by the following test: Add 1 mL of this reagent solution to each of four solutions containing 25 mL of 0.5 N sulfuric acid and 1 mL of ammonium molybdate–sulfuric acid reagent solution. Add 0.005 mg of phosphate ion (PO_4) to one of the solutions, 0.01 mg to a second, and 0.02 mg to a third. Allow to stand at room temperature for 2 h. The solutions in the three tubes should show readily perceptible differences in blue color corresponding to the relative amounts of phosphate added, and the one to which 0.005 mg of phosphate was added should be perceptibly bluer than the blank.

Methylthymol Blue Indicator. Grind 0.20 g of methylthymol blue to a fine powder with 20 g of potassium nitrate.

Murexide Indicator. Grind 0.20 g of murexide to a fine powder with 20 g of potassium nitrate.

Nessler Reagent. In a well-ventilated fume hood, dissolve 72 g of sodium hydroxide in 350 mL of water. Dissolve 25 g of red mercuric iodide and 20 g of potassium iodide in 100 mL of water. Pour the iodide solution into the hydroxide solution, and dilute with water to 500 mL. Allow to settle, and use the clear supernatant liquid. Nessler reagent prepared by any of the recognized methods may be used, provided that it has equal sensitivity. *Note:* After testing is done, the solutions should be kept separate as mercury waste, following local and state laws.

Nitric Acid, 1%. Dilute 5.3 mL of nitric acid with water to 500 mL.

Nitric Acid, 10%. Dilute 53 mL of nitric acid with water to 500 mL.

Oxalic Acid, 4%. Dissolve 20 g of oxalic acid dihydrate in water, and dilute with water to 500 mL.

PAN Indicator, 0.10%. Dissolve 0.05 g of 1-(2-pyridylazo)-2-naphthol in 50 mL of reagent alcohol.

PAR Indicator, 0.10%. Dissolve 0.10 g of 4-(2-pyridylazo)resorcinol in 100 mL of alcohol.

pH 6.5 Buffer. Dissolve 10.1 g of anhydrous sodium phosphate, dibasic, and 3.05 g of citric acid monohydrate in water, and dilute with water to 500 mL.

1,10-Phenanthroline, 0.10%. Dissolve 0.10 g of 1,10-phenanthroline monohydrate in 100 mL of water containing 0.1 mL of 10% hydrochloric acid reagent solution.

Phenol Red Indicator I, 0.10%. Dissolve 0.10 g of phenol red in 100 mL of alcohol, and filter if necessary (pH 6.8–8.2)

Phenol Red Indicator II, pH 4.7. (For determination of bromide.) Dissolve 33 mg of phenol red in 1.5 mL of 2 N sodium hydroxide solution, dilute with water to 100 mL (this is solution A). Dissolve 25 mg of ammonium sulfate in 235 mL of water; add 105 mL of 2 N sodium hydroxide solution and 135 mL of 2 N acetic acid (this is solution B). Add 25 mL of solution A to solution B, and mix. Using a pH meter, adjust the pH of this solution to 4.7 if necessary.

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Phenoldisulfonic Acid. In a well-ventilated fume hood, dissolve 5 g of phenol in 30 mL of sulfuric acid, add 15 mL of fuming sulfuric acid (15% SO₃), and heat at 100 °C for 2 h. Cool, and store in a glass bottle.

Phenolphthalein Indicator, 1%. Dissolve 1.0 g of phenolphthalein in 100 mL of alcohol (pH 8.0–10.0).

Potassium Chloride, 2.5%. Dissolve 2.5 g of potassium chloride in water, and dilute with water to 100 mL.

Potassium Chromate, 10%. Dissolve 10.0 g of potassium chromate in water, and dilute with water to 100 mL.

Potassium Cyanide, Lead-Free, 2.5%. In a well-ventilated fume hood, dissolve 5.0 g of potassium cyanide in sufficient water to make 10 mL. Remove lead by shaking with portions of dithizone extraction solution. Part of the dithizone remains in the aqueous phase but can be removed, if desired, by shaking with chloroform. Dilute the potassium cyanide solution with water to 50 mL.

Potassium Dichromate, 10%. Dissolve 10.0 g of potassium dichromate in water, and dilute with water to 100 mL.

Potassium Ferricyanide, 5%. Dissolve 2.0 g of potassium ferricyanide in 40 mL of water. Prepare the solution at the time of use.

Potassium Ferrocyanide, 10%. Dissolve 4.0 g of potassium ferrocyanide trihydrate in 40 mL of water. Prepare the solution at the time of use.

Potassium Hydroxide, 0.5 N in Methanol. Dissolve 18 g of potassium hydroxide in 10 mL of water, and dilute with methanol to 500 mL. Allow the solution to stand in a stoppered bottle for 24 h. Decant the clean supernatant solution into a bottle provided with a tight-fitting stopper. Store in a polyethylene or Teflon bottle.

Potassium Iodide, 10%. (For determination of free chlorine.) Dissolve 1.0 g of potassium iodide in water, and dilute with water to 10 mL. Prepare the solution at the time of use.

Potassium Iodide, 16.5%. (For determination of arsenic.) Dissolve 16.5 g of potassium iodide in water, and dilute with water to 100 mL.

Potassium Permanganate, 5%. Dissolve 2.5 g of potassium permanganate in 50 mL of water.

Silver Diethyldithiocarbamate, 0.5%. Dissolve 1.0 g of silver diethyldithiocarbamate in 200 mL of freshly distilled pyridine.

Silver Nitrate, 1.7%. Dissolve 8.5 g of silver nitrate in 500 mL of water. Store in an amber bottle.

Sodium Acetate, 10%. Dissolve 10 g of sodium acetate trihydrate in water, and dilute with water to 100 mL.

Sodium Borohydride, 0.6%. Dissolve 0.6 g of sodium borohydride and 1.0 g of 50% sodium hydroxide, and dilute with stirring to 100 mL with water.

Sodium Carbonate, 1%. Dissolve 5.0 g of sodium carbonate, anhydrous, in 450 mL of water, and dilute with water to 500 mL. Store in a plastic bottle.

Sodium Citrate, 1 M. Dissolve 147 g of sodium citrate dihydrate in 450 mL of water, and dilute with water to 500 mL.

Sodium Cyanide, 10%. In a well-ventilated hood, dissolve 10 g of sodium cyanide in water, and dilute with water to 100 mL.

Sodium Diethyldithiocarbamate. Dissolve 0.25 g of sodium diethyldithiocarbamate in water, and dilute with water to 250 mL.

Sodium Hydroxide, 10%. Dissolve 50 g of sodium hydroxide in water, and dilute with water to 500 mL. Store in a polyethylene or Teflon bottle.

Sodium Hydroxide, Ammonia-Free, 6 N. Dissolve 24 g of sodium hydroxide in 100 mL of water.

Sodium Sulfite, 10%. Dissolve 2.5 g of sodium sulfite in water, and dilute with water to 20 mL. Keep in a tightly closed bottle. This solution should be freshly prepared.

Stannous Chloride, 2%. Dissolve 0.50 g of stannous chloride dihydrate in hydrochloric acid, and dilute with hydrochloric acid to 25 mL. Store in a polyethylene or Teflon bottle.

Stannous Chloride, 40%. Dissolve 20.0 g of stannous chloride dihydrate in 50 mL of hydrochloric acid. Store this solution in a polyethylene or Teflon container, and use within 3 months.

Starch Indicator, 0.5%. Mix 1.0 g of soluble starch with 10 mg of red mercuric iodide and enough cold water to make a thin paste, add 200 mL of boiling water, and boil for 1 min while stirring. Cool before use.

Sulfuric Acid, 0.5 N. In a well-ventilated fume hood, slowly add 7.5 mL of sulfuric acid to 375 mL of water, and dilute to 500 mL.

Sulfuric Acid, 4 N. In a well-ventilated fume hood, slowly add 60 mL of sulfuric acid to 375 mL of water, and dilute to 500 mL.

Sulfuric Acid, 10%. In a well-ventilated fume hood, slowly add 30 mL of sulfuric acid to 375 mL of water, cool, and dilute with water to 500 mL.

Sulfuric Acid, 25%. In a well-ventilated fume hood, slowly add 70 mL of sulfuric acid to 375 mL of water, cool, and dilute with water to 500 mL.

Sulfuric Acid, Chloride- and Nitrate-Free. In a well-ventilated fume hood, gently fume sulfuric acid in a crucible or dish for at least 30 min. Allow to cool, and transfer to a tightly capped glass bottle for storage.

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Tartaric Acid, 10%. Dissolve 50 g of tartaric acid in 400 mL of water, dilute with water to 500 mL, and filter into a plastic bottle.

Thymol Blue Indicator, 0.10%. Dissolve 0.10 g of thymol blue in 100 mL of alcohol (acid range, pH 1.2–2.8; alkaline range, pH 8.0–9.2).

Thymolphthalein Indicator, 0.10%. Dissolve 0.10 g of thymolphthalein in 100 mL of alcohol (pH 8.8–10.5).

Titanium Tetrachloride. In a well-ventilated fume hood, cool separately, in small beakers surrounded by crushed ice, 5 mL of 20% hydrochloric acid and 5 mL of clear, colorless titanium tetrachloride. Add the titanium tetrachloride dropwise to the chilled hydrochloric acid. Allow the mixture to stand at ice temperature until all of the solid dissolves, and then dilute the solution with 20% hydrochloric acid to 500 mL.

Triton X-100, 0.20%. Dissolve 0.20 g of Triton X-100 (polyethylene glycol ether of isooctylphenol) in water, and dilute with water to 100 mL.

Variamine Blue B Indicator, 1%. Dissolve 0.20 g of variamine blue B in 20 mL of water, and stir for 5 min.

Xylenol Orange Indicator Mixture. Grind 0.20 g of xylenol orange (either free acid or sodium salt form) to a fine powder with 20 g of potassium nitrate. Alternatively, use a solution of 0.1 g of xylenol orange in 100 mL of alcohol (for the acid form) or water (for the salt form), depending on the solution matrix.