

**A LABORATORY MANUAL,
CONTAINING DIRECTIONS FOR A
COURSE OF EXPERIMENTS IN GENERAL
CHEMISTRY; SYSTEMATICALLY
ARRANGED TO ACCOMPANY THE
AUTHOR'S "ELEMENTS OF CHEMISTRY"**

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A Laboratory Manual, Containing Directions for a Course of Experiments in General Chemistry; Systematically Arranged to Accompany the Author's "Elements of Chemistry" by Ira Remsen

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IRA REMSEN

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Systematically Arranged

TO ACCOMPANY

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BY

IRA REMSEN

Professor of Chemistry in the Johns Hopkins University



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NOTE FOR TEACHERS.

On comparing the experiments described in this Manual with those described in my Elements of Chemistry it will be found that some of the more difficult ones have been omitted here. As many as possible of those omitted should be performed by the teacher in the presence of the class ; and the points of importance should be drawn out by questions put to the members of the class. Afterwards the pupils should write a full account of what they have seen, and draw such conclusions as the experiments may lead to.

THE AUTHOR.

APPARATUS AND CHEMICALS.

For the benefit of those who have no laboratory at command, and who may wish to make arrangements for performing the experiments described in this book, the following lists have been drawn up. In them is included everything necessary to perform the experiments on a small scale. Should it be desired to fit up a room with conveniences for students, the amount of apparatus necessary will depend upon the number of students, but for each individual the expense will be small, as some of the pieces of apparatus, such as the magnet, weights, scales, etc., need not be multiplied. In place of some of the pieces of apparatus described in the book, ordinary kitchen utensils will answer. Thus, for example, instead of the trough for collecting gases, a tin pan or a deep earthenware dish may be used; instead of the water-bath, a stew-pan, fitted with two or three different-sized tin or sheet-iron rings; in place of glass cylinders for working with gases, wide-mouthed cheap bottles; and in place of Wolff's bottles, wide-mouthed bottles fitted with a cork having two holes. In case of need nearly everything necessary can be procured at an ordinary drug store, though nowadays there is no difficulty in getting the simpler forms of chemical apparatus at little cost.

The publishers do not deal in chemicals and apparatus, nor, they may as well say, receive commissions on them. Any orders should be sent direct to the dealers.

Messrs. Eimer & Amend, Nos. 205 to 211 Third Avenue, New York, whom the publishers take the responsibility of recommending as thoroughly reliable, will furnish each of the following articles at the price given.

If several pieces of the apparatus in List No. 1 are taken, a discount of 10 per cent will be made; on a complete set

20 per cent discount will be allowed; on three or more sets, 25 per cent.

A discount of 10 per cent will be given on a complete set of the chemicals, and of 15 per cent on three or more sets.

For a class of 12 three or four times the amount of apparatus included in List No. 1 could be made to answer, particularly if the pupils are not all required to do the same thing at the same time. As there is, however, always more or less breakage of glass- and porcelain-ware, it is well to have extra pieces of all such apparatus on hand.

As regards chemicals, List No. 2 gives quantities required for a class of 12 as nearly as can be estimated. It is better to have somewhat larger quantities, as some of the experiments may have to be repeated a number of times.

For most items less than the whole set, there will have to be a small additional charge for packing. It should be borne in mind, however, that usually the charge for packing one article must be as large as for several. Some articles can, of course, be mailed without any charge for packing.

LIST No. 1.

A list of apparatus and chemicals necessary for performing all the experiments described in this book.

<i>APPARATUS.</i>			
1 Nest Beakers, 1-3.....	\$0 40	2 Funnel Tubes, one 10 in., one 15 in.....	\$0 35
1 Jeweller's Blowpipe, 8 in.....	15	1 Gas Bottle, 8 oz., with 2-hole R Stopper.....	40
7 Wide-mouth Flint Bottles, two each, 2, 4, 8 oz., and one 32 oz.	50	$\frac{1}{2}$ lb. Assorted Glass Tubing, 4-7.....	15
1 Bunsen's Burner with regulator, or 5 oz. glass alcohol lamp, same price.....	50	2 Sheets each Red and Blue Litmus-paper.....	20
1 5-in. U-tube.....	25	1 Horseshoe Magnet, 3 in.....	20
2 doz. Assorted Corks.....	30	1 Porcelain Mortar and Pestle, $3\frac{1}{2}$ in.....	45
1 Set Cork Borers, 1-5.....	1 00	1 Piece Platinum Foil, $1 \times 1\frac{1}{4}$ in.....	60
1 Nest Hessian Crucibles, "threes".....	6	6 in. Medium Platinum Wire.....	20
1 $1\frac{1}{4}$ -in. Porcelain Crucible.....	15	1 Plain Retort, 8 oz.....	30
1 25 CC Grad. Cylinder.....	50	1 Stopped Retort, 16 oz.....	55
1 Deflagrating Spoon.....	25	3 ft. Rubber Tubing for gas, $\frac{1}{4}$ in. (Only needed if Bunsen's Burner is used.)	20
1 each Evaporating Dish, $2\frac{1}{2}$ and $3\frac{1}{4}$ in.....	40	2 ft. Rubber Tubing (for connections).....	20
1 Lead Dish, 2 in.....	25	1 $2\frac{1}{2}$ in. Sand Bath.....	15
1 Round File, 6 in.....	25	1 Hand Scale, with weights.....	35
1 Triangular File, 6 in.....	25	1 Test Tube Stand.....	20
1 Pack White Filters, 4 in.....	12	12 Test Tubes, 5 in.....	30
4 Flasks: one 4 oz., two 8 oz., one 16 oz.....	80	1 Test Tube Brush.....	5
1 Steel Forceps.....	20	1 Test Tube Clamp.....	20
2 Funnels, $2\frac{1}{4}$ in.....	24	1 Iron Tripod.....	30
		2 2-in. Watch-glasses.....	10

1 5-in. Water-bath	\$1 00
2 Wire Clamp Supports	2 00

\$15 74

CHEMICALS.

4 oz. Acid Acetic, pure (bottle 5 cents extra)	\$0 10
4 oz. Acid Arsenious	10
16 oz. " Hydrochloric (bottle 15 cents extra)	10
8 oz. Acid Nitric (bottle 12 cents extra)	10
8 oz. Acid Oxalic	10
16 oz. " Sulphuric (bottle 12 cents extra)	10
1 oz. Acid Tartaric	10
2 oz. Alcohol, for experiments only (bottle 4 cents extra)	10
8 oz. Alum	10
4 oz. Ammon. Chloride	10
8 oz. " Hydrate, concentrated (bottle 10 cents extra)	10
4 oz. Ammon. Nitrate	10
2 oz. Antimony, powdered	10
2 oz. " and Potassium Tartrate	20
2 oz. Barium Chloride	10
4 oz. Calcium Chloride, fused	10
4 oz. " Sulphate	10
4 oz. Carbon Disulphide (bottle 5 cents extra)	10
8 oz. Animal Charcoal, powdered	10
8 oz. Copper Foil	20
4 oz. " Sulphate	10
1 oz. " Oxide	15
4 oz. Fluorspar, powdered	10
1 oz. Indigo	10
1 oz. Iodine (bottle 2 cents extra)	25
4 oz. Iron Filings, fine	10

8 oz. Iron Sulphide	\$0 10
4 oz. " Sulphate	10
4 oz. Lead Sheet	10
4 oz. " Acetate	10
2 oz. " Nitrate	10
1 oz. " Peroxide	10
2 oz. " Sesquioxide	10
1 oz. Litmus	10
3/4 dram Magnesium Ribbon	10
1 lb. Manganese Dioxide, powdered	10
1 oz. Mercury Red Oxide	10
1 oz. Nutgalls, powdered	10
2 oz. Paraffine	10
1 oz. Phosphorus (bot. 10c. extra)	15
1 dram Potassium	20
2 oz. " Bromide	10
1 oz. " Carbon, (bottle 5 cents extra)	10
4 oz. Potassium Chlorate	10
4 oz. " Dichromate	10
2 oz. " Ferrocyanide	10
4 oz. " Hydrate Sticks (bottle 5 cents extra)	20
1 oz. Potassium Iodide (bottle 5 cents extra)	25
4 oz. Potassium Nitrate	10
2 oz. " Permanganate	10
1 dram Sodium (bot. 3c. extra)	10
2 oz. " Acetate	10
2 oz. " Bicarbonate	10
4 oz. " Biorate (Borax)	10
4 oz. " Hydrate (bottle 5 cents extra)	20
4 oz. Sodium Nitrate	10
4 oz. " Sulphate	10
8 oz. Sulphur, roll	10
4 oz. Tin, granulated	10
16 oz. Zinc, granulated	20
2 oz. " Sulphate	10

\$7 50

LIST No. 2.

4 oz. Acetic Acid (pure) (bottle 5 cents extra)	\$0 10
4 oz. Acid Arsenious	10
6 lbs. Acid Hydrochloric (bottle 25 cents extra)	20
4 lbs. Acid Nitric (bottle 20 cents extra)	45
8 oz. Acid Oxalic	10
9 lbs. Acid Sulphuric (bottle 25 cents extra)	45
2 oz. Acid Tartaric	10
4 oz. Alcohol (bottle 5 cents extra)	15
2 lbs. Alum	15
1 lb. Ammonium Chloride	20
1 lb. Ammon. Hydrate (Conc.) (bottle 15 cents extra)	20

1 lb. Ammon. Nitrate (bottle 10 cents extra)	\$0 20
4 oz. Antimony (powd.)	15
2 oz. Antimony and Potassium Tartrate	20
2 oz. Barium Chloride	10
8 oz. Calcium Chloride	12
1 lb. Calcium Sulphate	15
1 lb. Carbon Disulphide (bottle 10 cents extra)	20
2 lbs. Animal Charcoal	20
2 lbs. Copper Foil	1 20
1/4 lb. Copper Sulphate	10
2 oz. Copper Oxide	20
8 oz. Fluorspar (powd.)	10
1 oz. Indigo	10
1 oz. Iodine (bottle 2 cents extra)	25

8 oz. Iron Filings.....	90	10	4 oz. Potassium Ferrocyanide.....	\$0	10
2 lbs. Iron Sulphide.....	80		¼ lb. Potassium Hydrate (bottle		90
8 oz. Iron Sulphate.....	10		8 cents extra).....		
1 lb. Lead Sheet.....	40		2 oz. Potassium Iodide.....		40
¼ lb. Lead Acetate.....	10		¼ lb. Potassium Nitrate.....		10
4 oz. Lead Nitrate.....	10		4 oz. Potassium Permanganate..		15
2 oz. Lead Peroxide.....	15		1 oz. Sodium (bottle 4 cents extra)		30
4 oz. Lead Sesquioxide.....	10		8 oz. Sodium Acetate (bottle 8		
2 oz. Litmus.....	10		cents extra).....		25
2 lbs. Manganese Dioxide (coarse-			¼ lb. Sodium Bicarbonate.....		10
ly granulated).....		80	4 oz. Sodium Borate.....		10
4 oz. Mercury Red Oxide.....		30	3 lbs. Sodium Hydrate (sticks)...		1 00
1 oz. Nuzalls, powdered.....		10	1 lb. Sodium Nitrate.....		12
4 oz. Phosphorus.....		45	4 oz. Sodium Sulphate.....		10
2 drams Potassium.....		50	1 lb. Roll Sulphur.....		10
4 oz. Potassium Bromide.....		15	¼ lb. Granulated Tin.....		25
1 lb. Potassium Carbonate (bottle			3 lbs. Granulated Zinc.....		90
10 cents extra).....		12	4 oz. Zinc Sulphate.....		10
2 lbs. Potassium Chlorate.....		50			
¼ lb. Potassium Dichromate.....		10			
					\$14 04

LIST OF EXPERIMENTS.

1. Decomposition of sugar by heat.
2. Change of mercuric oxide by heat.
3. Action of hydrochloric acid on calc-spar or marble.
4. Action of nitric acid on copper.
5. Action of sulphuric acid on zinc.
6. Action of nitric acid on tin
7. Action of tartaric acid on bicarbonate of soda, dry and wet.
8. Action of iron sulphate on potassium ferrocyanide, dry and wet.
9. Mechanical mixture (iron filings and sulphur).
10. Mechanical mixture examined.
11. Effect of heating a mechanical mixture of iron and sulphur.
12. Heating lead in the air.
13. Heating zinc in the air.
14. Heating tin in the air.
15. Heating lead, zinc, and tin protected from the air.
16. Burning a candle in a closed space.
17. Filling vessels with a gas by displacing water.
18. Oxygen from mercuric oxide.
19. Oxygen from potassium chlorate.
20. Oxygen from potassium chlorate and manganese dioxide.
21. Action of oxygen at ordinary temperature.
22. Burning sulphur in oxygen.
23. Burning charcoal in oxygen.
24. Burning phosphorus in oxygen.
25. Burning a steel watch-spring in oxygen.
26. Nitrogen: preparation and properties.
27. Water from wood and from meat.
28. Crystallization of alum, and presence of water of crystallization in the crystals.
29. Water of crystallization from gypsum.
30. Water of crystallization in copper sulphate.
31. Efflorescence as illustrated by sodium sulphate.
32. Deliquescence as illustrated by calcium chloride.
33. Decomposition of water by sodium.
34. Preparation of hydrogen.
35. Preparation and properties of hydrogen.
36.)
37.) Lightness of hydrogen.
38.)
39. Hydrogen burns, but does not support combustion.