

because they degrade over time or because the quantities ordered the first time are not adequate for running through the experiments a second time. Still, when you consider that the cost to conduct quantitative chemistry experiments can be spread out over several children, the need for the investment can be much easier to accept.

As mentioned above, a third way to reduce cost is to use, where possible, items you may have on hand. For example, instead of purchasing a dozen test tubes, you could use small plastic bottles or small jars with plastic lids. In the tables below we have indicated some possible substitutions that could help reduce your cost.

Finally, you can recover some of your expense by selling your apparatus to someone else once your family is finished with it. Most of the apparatus can be shipped, so long as glassware is carefully packed. However, note that there are restrictions on shipping and transportation for many of the chemicals, particularly the organic solvents. Do not assume that you can just toss all the leftover chemicals into a box and ship them without checking on these restrictions. Reselling to someone in your local community is one thing; shipping chemicals via the US Postal Service or commercial carrier is challenging, if not impossible.

Equipment and Chemicals Tables

The tables that follow list all the items needed to conduct the experiments in this book, excepting the personal protection gear and the items you may need for storage and work space. Except for the items of general apparatus, we have indicated which experiments the items are needed for so that you only purchase the items you need. Also, you always have the option of reducing costs further by conducting only a few experiments.

Note that the suppliers shown were selected for price and availability, as well as for availability of small quantities of chemicals. For most items, there are other suppliers you can check with. However, we have attempted to identify the best value for each item in advance so that you can save on shipping costs by ordering as many items as possible in a single shipment from a single supplier.

Common Items List

These items are assumed to be available around the home or at minimal expense from local suppliers. Costs for these items are not included in the apparatus and chemicals tables to follow.

Item	Experiment(s)	Notes
aluminum foil	9	
antacid tablets	12	Try Tums, Roloids, Maalox, Milk of Magnesia, Pepcid, various generics at drug stores
aspirin	18	Needs to be pure aspirin (non-buffered).
B-Bs or small marbles	7	
blue painter's tape	10	
butane lighter	19	Common cigarette or charcoal lighters are fine.
copper	5, 17	Small pieces of any kind of copper wire (speaker wire, electrical wire, etc.) will work.
cotton swabs	3	
distilled water		Available at grocery stores. For general use in experiments and for preparing solutions.
iron	5, 17	Use shiny, new, small (1-inch or so) steel nails, non-galvanized.

Item	Experiment(s)	Notes
iron supplements	16	Experiment with three or four different name-brand or generic supplements, or as many as time and budget allow.
paper towel	18	Also used generally for clean up.
pencil	17	
plastic spoons		For general use transferring solid chemical compounds.
polystyrene (Styrofoam) cups with lids	13	These are only needed for students using the CAS or AC texts.
pure cornstarch	14	Available at grocery stores. This is only needed for students using the CAS or AC texts.
rubber bands, small	1	
sand	2	Use fine-grained sand, such as "Play Sand" available from building supply stores.
scissors	17	
soda can	19	Clean, empty.
sodium bicarbonate	9	This is baking soda.
spatula, small	2, 18	
spoon	16	
stopwatch	7, 14	The stopwatch on a smart phone is fine.
straight pin	19	
table salt, non-iodized	2, 3, 10	Pure sodium chloride. Buy the kind without iodine added.
tape, masking		For general use in labeling.
toothpicks	14	

Apparatus List

The needed items of apparatus are listed in the tables on the next five pages. The general items on the first two pages are required for performing many of the experiments, including the Economy Core experiments referred to earlier. Again, kits are available for these experiments at the Home Science Tools website.

We emphasize here an important safety note mentioned repeatedly in the following table: Home-type Pyrex is not safe for heating. Only borosilicate glassware is acceptable. Heating consumer-grade Pyrex glassware can cause the glassware to shatter unexpectedly.

General Items Needed Throughout the Experiments						
Item	Source	Model	Cost	Quan.	Notes	Acceptable Substitutes
alcohol burner	sciencecompany.com	NC-3787	5.95	1	In the absence of a natural gas Bunsen burner, this is the best substitute for general purpose heating. Experiment 3 will need to use a natural gas or propane stove or burner.	None.
balance	homesciencetools.com	BS-DB0200	49.95	1	200 g capacity; 0.01 g resolution. If you can afford a 0.001 g scale, get one. If not, this is the best deal on a 0.01 g scale.	None.
beaker, 50 mL	sciencecompany.com	NC-5584	3.20	2	Lab beakers are needed for heating. Heating items in regular jars or glass can cause the glass to crack.	None. Home-type Pyrex is not safe for heating. Only borosilicate glassware is acceptable.
beaker, 100 mL	sciencecompany.com	NC-7865	3.75	1	Lab beakers are needed for heating. Heating items in regular jars or glass can cause the glass to crack.	None. Home-type Pyrex is not safe for heating. Only borosilicate glassware is acceptable.
beaker, 250 mL	sciencecompany.com	NC-5583	4.50	4	Lab beakers are needed for heating. Heating items in regular jars or glass can cause the glass to crack.	None. Home-type Pyrex is not safe for heating. Only borosilicate glassware is acceptable.
beaker, 400 mL	sciencecompany.com	NC-7866	4.95	1	Lab beakers are needed for heating. Heating items in regular jars or glass can cause the glass to crack.	None. Home-type Pyrex is not safe for heating. Only borosilicate glassware is acceptable.
buret, 25 mL	sciencecompany.com	NC-9825	31.95	1	Purchasing 2 will expedite Experiment 11.	None.
buret clamp	amazon.com		8.00	1	Schools may wish to purchase the American Educational double buret clamp instead for \$15.61.	None.
clamp, 3-finger, with ring stand clamp	amazon.com	Clamp Retort	9.00	1		None.
dropper, glass	sciencecompany.com	NC-0363-PK	2.35	1 pk	Pack contains 4 glass droppers.	Eye dropper.
dropper bottle	sciencecompany.com	NC-0343	1.95	10		Small jars or bottles with non-metallic screw-on lids.
Erlenmeyer flask, 125 mL	sciencecompany.com	NC-9166	3.95	3	For school classrooms, 6 flasks per student group are recommended.	None.
filter funnel, glass, 50 mm	sciencecompany.com	NC-0472	3.75	1	If possible, purchase 2 to expedite Experiments 8 and 11.	None.
filter paper, 9 cm	sciencecompany.com	NC-12142	6.95	1 pk		Coffee filters.
funnel support ring, 2 inch iron ring	onlinesciencemall.com		6.25	1	Search under "cast iron support ring"	None.

General Items Needed Throughout the Experiments						
Item	Source	Model	Cost	Quan.	Notes	Acceptable Substitutes
glass stirring rod, 10 inch	sciencecompany.com	NC-5604	1.35	1		None.
graduated cylinder, 10 mL	sciencecompany.com	NC-7874	2.50	2	If possible, purchase 4.	None.
graduated cylinder, 100 mL	sciencecompany.com	NC-7832	5.50	2	Recommend that schools purchase six of these per student team.	None.
iron burner ring, 3 inch	sciencecompany.com	NC-11223	5.95	1		None.
ring stand	amazon.com	American Educational	12.91	1		None.
test tube set	sciencecompany.com	Z0039	15.95	1 or 2	Purchasing 2 will be convenient, but experiments can be performed with one. Includes 6 test tubes, test tube rack, test tube clamp holder, and test tube brush.	Small jars or bottles with non-metallic screw-on lids.
thermometer	sciencecompany.com	NC-1005	4.15	1	Celsius, 12-inch, alcohol, glass thermometer.	Any thermometer that reads in °C from 0 to 100°C. Glass thermometers will fit better in the two-hole rubber stopper.
tongs	sciencecompany.com	NC-7038	5.95	1	These are general purpose beaker tongs.	None.
volumetric flask, 50 mL	sciencecompany.com	NC-13090	4.95	1	Used repeatedly for preparing the solutions needed for various experiments.	None.
volumetric flask, 250 mL	sciencecompany.com	NC-10977	10.95	1	Used repeatedly for preparing the solutions needed for various experiments.	None.
wash bottle	sciencecompany.com	NC-9129	4.90	1 (or 3, see note)	Schools performing Experiment 18 should purchase 3 wash bottles per student group. (We recommend that students studying at home skip Experiment 18.)	
watch glass, 4 inch	sciencecompany.com	NC-11087	1.95	1	If possible, purchase 2 to expedite the experiments.	Small dish or plate.
weigh boat, medium, approx 3"	sale-fire.com		7.50	1 pk	Weigh boats are also called <i>weighing dishes</i> and <i>pour boat weighing dishes</i> .	Coffee filters.
wire gauze	sciencecompany.com	NC-7859	1.85	1		None.

Apparatus Needed for Specific Experiments							
Item	Exp. Needed	Source	Model	Cost	Quan.	Notes	Acceptable Substitutes
boiling chips	1, 7	amazon.com	—	0.25	(1) 1 g	Aluminum oxide boiling chips. These make boiling smoother.	None.
capillary tubes	1	amazon.com	Dynalon SMP10/1	9.85	(1) 100 pk	Capillary tubes for melting point device, closed on one end.	None.
glass tubing, 6 mm OD	1, 7, 9	sciencecompany.com	NC-10889	6.00	(1) 2 pk	To bend this tubing as required in the experiments requires a propane burner or Bunsen burner. The alcohol burner does not produce a hot enough flame.	None.
rubber stopper, size 4, two-hole	1, 7	sciencecompany.com	NC-0973	1.25	1	If possible, purchase 2 to expedite the experiment.	None.
test tube, 25 mm × 150 mm	1, 7	sciencecompany.com	NC-2592	1.50	1	If possible, purchase 2 to expedite the experiment.	None.
test tube stopper, #000	1, 18	sciencecompany.com	NC-0969	0.35	6	If you have 12 test tubes, purchase 12.	None.
latex tubing, 3/16" ID	1, 7, 9	sciencecompany.com	NC-1243-PK5	7.25	1	This is one 5-ft section of tubing.	None.
evaporating dish, 100 mL	2, 18	amazon.com	SEOH brand	6.75	1		None.
propane stove	3	amazon.com	Coleman PerfectFlow	23.88	1	This stove is not needed if a natural gas stove or other natural gas or propane stove is available.	Natural gas cook stove.
24-well plate	5, 10	onlinesciencemall.com	"polystyrene well plate"	2.95	2		Plastic artist's paint palette.

Apparatus Needed for Specific Experiments							
Item	Exp. Needed	Source	Model	Cost	Quan.	Notes	Acceptable Substitutes
weigh boat, small	9, 13	onlinesciencemall.com		6.95	1 pk	This is a pack of 100, and we only need 1 for Experiment 9. These small weigh boats may also be used for Experiment 13. Weigh boats are also called <i>weighing dishes</i> and <i>pour boat weighing dishes</i> .	Any small, open plastic dish or container small enough to fit through the neck of the Erlenmeyer flask.
graduated cylinder, 500 mL	9	sciencecompany.com	NC-8069	7.50	1	This model is polypropylene for light weight and low cost.	None.
barometer	9	amazon.com	ETA brand	11.18	1	If a barometer is not available, the local barometric pressure in any city is easy to obtain online. However, if the weather is changing at the moment the experiment is performed, online data will probably not accurately reflect laboratory conditions.	Online data.
rubber stopper, #5, 1-hole	9	sciencecompany.com	NC-0974	1.45	1		None.
rubber stopper, #5, solid	11	sciencecompany.com	NC-0960	0.80	1	The solid stopper is used in the preparation of the low-CO ₂ NaOH. See Notes for Experimenters for details.	
12-well plate	14	labdepotinc.com	JSC012	6.29	1		The 24-well plate from Experiment 5, or a plastic artist's paint palette.
digital pH meter	15	amazon.com	Etekcity PH-009	11.81	1	There are many different models of inexpensive pH meters.	None.
magnetic stir plate	15	labdepotinc.com	86152003	110.50	1	This item is completely optional. Schools may wish to consider hot plate stirrers, which are much more expensive but combine heat with stirring functions.	None, but this item is optional.
Erlenmeyer flask, 250 mL	16	sciencecompany.com	NC-7884	4.85	1	Schools should consider providing at least three of these per student lab group.	None.
forceps	17	sciencecompany.com	NC-7830	3.50	1		Large tweezers.
voltmeter	17	frys.com	5427439	11.99	1		Any DC voltmeter that will read to 0.01 VDC.
Petri dish	17	sciencecompany.com	NC-12131	2.95	1		Flat-bottomed plate or dish.

Apparatus Needed for Specific Experiments									
Item	Exp. Needed	Source	Model	Cost	Quan.	Notes	Acceptable Substitutes		
filter paper, 12.5 cm	17, 18	sciencecompany.com	NC-12168	8.85	1 pk		Coffee filters.		
beaker, 600 mL	18	sciencecompany.com	NC-5582	5.95	2		None.		
filter funnel, glass, 75 mm	18	sciencecompany.com	NC-0473	4.50	1	Search under “glass funnel.”	Medium-sized plastic funnel.		
iron burner ring, 4 inch	18	sciencecompany.com	NC-11222	7.95	1	Search under “ring clamp.”	None.		
thermometer clamp	19	onlinesciencemall.com	—	9.95	1		Clamp, 3-finger, with ring stand clamp.		
cork stopper, #16	19	craft store		2.99	1	Price shown is for a pack of 2 #16 cork stoppers from hobbylobby.com.	Any other cork, such as from a wine bottle. However, do not use synthetic wine bottle corks.		

Chemicals List

The chemicals needed are listed in the tables on the next five pages. General notices regarding toxicity and flammability are also indicated.

Note that since the first printing of this book, the supplier hms-beagle.com listed for many chemicals has gone out of business. You can try homesciencetools.com or search for other online suppliers. And once again, we mention that kits are now available from homesciencetools.com for the Economy Core experiments.

Informational note: Throughout this chemicals list, the term “hydrate” means there are water molecules in the compound. For experiments in which the compound is dissolved in water, this is fine. Thus, if you are searching for a compound and a supplier has a hydrate version of it, this is fine if the experiment calls for dissolving it in water.

Chemicals Needed for Specific Experiments									
Item	Use (Exp. No.)	Source	Cat. No.	Cost	Quan.	Toxicity*	Flammability	Notes	
ethanol, C ₂ H ₅ OH (denatured)	1, 7	sciencecompany.com	NC-0026	12.95	1 L	medium	high	This ethanol may also be used in the alcohol burner. See Chemical Notes for info on ethanol.	
acetone, CH ₃ CH ₃ CO	1, 7, 14	sciencecompany.com	NC-0007	14.95	16 oz	low	high	Primary ingredient in old-fashioned fingernail polish remover; quantity adequate for Experiments 1, 7, and 14.	
hexane, C ₆ H ₁₂	1, 7	amazon.com	—	25.00	1 L	low	high	Buy high purity solvent from Univar or Consolidated Chemical and Solvents.	
lauric acid, C ₁₂ H ₂₄ O ₂	1	goodearthspa.com	—	5.05	4 oz.	low	low	A common fatty acid found naturally in oils such as coconut oil.	
toluene, C ₇ H ₈	1	amazon.com	—	\$8	2 x 3 mL	med (1)	high	Common solvent. Purchase 2 3-mL bottles, since the experiment calls for about 6 mL.	
naphthalene, C ₁₀ H ₈	1	homesciencetools.com	UN1334	4.35	15 g	low	med	Primary ingredient in old-fashioned moth balls.	
benzoic acid, C ₇ H ₆ O ₂	2	homesciencetools.com	CH-BENZOIC	3.70	15 g	low	low		
lithium chloride, LiCl	3	homesciencetools.com	CH-LICL	8.50	30 g	low	none		
magnesium chloride, MgCl ₂	3, 6	homesciencetools.com	CH-MGCL2	2.70	30 g	low	none		
potassium chloride, KCl	3	homesciencetools.com	CH-KCL	3.55	30 g	low	none		
calcium chloride, CaCl ₂	3	homesciencetools.com	CH-CACL2	3.85	30 g	low	none		
strontium chloride, SrCl ₂	3	homesciencetools.com	CH-SRCL230	4.10	30 g	low	none		
copper chloride dihydrate, CuCl ₂ · 2H ₂ O	3, 4	amazon.com	—	31.00	300 g	low	none	The hydrate of this compound is needed for Experiment 4. A small quantity (20–30 g) for low price would be better if it could be found.	
zinc chloride	3	cole-parmer.com	UX-78914-67	19.70	100 g	low	none	A small quantity (20–30 g) for low price would be better if it could be found.	

*Refers to general hazard from skin contact or vapors, not to ingestion or hazard to eyes.

Notes:

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Chemicals Needed for Specific Experiments									
Item	Use (Exp. No.)	Source	Cat. No.	Cost	Quan.	Toxicity*	Flammability	Notes	
hydrochloric acid, concentrated, HCl, 11.6 M	4, 5, 9, 11, 12, 13, 14	sciencecompany.com	NC-1193	34.95	1 L	high (1, 2)	none	This concentrated acid is used to prepare the HCl solutions for all experiments requiring HCl. The product is labeled 36–37% strength, which translates to 11.6 M.	
zinc, mossy, Zn	4, 5	sciencecompany.com	NC-9848	9.95	100 g	none	none		
calcium metal, Ca	5	homesciencetools.com	UN1401	13.00	10 g	none	low		
magnesium, Mg	5, 17	homesciencetools.com	UN-MG	1.65	60 cm	none	med	Keep this material away from flames.	
tin, Sn	5	sciencecompany.com	NC-14416	19.95	100 g	none	none	A small quantity (20–30 g) for lower price would be better if it could be found.	
calcium nitrate, Ca(NO ₃) ₂	5	amazon.com or ebay	—	7.99	5 lb	low	none	Fertilizer; some lower prices found on eBay.	
copper sulfate, CuSO ₄	5	homesciencetools.com	CH-CUSO4	4.15	30 g	low	none		
magnesium nitrate hexahydrate, Mg(NO ₃) ₂ ·6H ₂ O	5	carolina.com	873284	7.00	500 mL	low	none	This 0.1 M aqueous solution is the most affordable we could find. Use twice as much as called for in Exp. 5.	
iron(III) nitrate, Fe(NO ₃) ₃	5, 17	sciencecompany.com	NC-11220	13.95	100 g	high (1, 3)	see note	Not flammable itself, but a strong oxidizer. Keep away from flame and organic materials. A small quantity (20–30 g) for lower price would be better if it could be found.	
iron(II) sulfate heptahydrate, FeSO ₄ ·7H ₂ O	5, 8	homesciencetools.com	CH-FESO4	3.55	30 g	low	none		
tin(IV) chloride pentahydrate, SnCl ₄ ·5H ₂ O	5	carolina.com	892352	20.55	500 mL	high (1, 3)	none	This 0.1 M aqueous solution is the most affordable we could find. Use twice as much as called for in Exp. 5.	
zinc nitrate hexahydrate Zn(NO ₃) ₂ ·6H ₂ O	5	This compound is hard to get for home users. Substitute zinc acetate from carollina.com item # 899462		9.35	100 g	high (1, 3)	see note	Not flammable itself, but a strong oxidizer. Keep away from flame and organic materials. Do not subject to shock.	
silver nitrate, AgNO ₃	5, 6, 8, 10, 17	homesciencetools.com	UN1493	16.95	2 g	high (1, 3, 5)	see note	Not flammable itself, but a strong oxidizer. Keep away from flame and organic materials.	

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Chemicals Needed for Specific Experiments									
Item	Use (Exp. No.)	Source	Cat. No.	Cost	Quan.	Toxicity*	Flammability	Notes	
glycerol	7	high end drug store		10.59	177 mL	low	low		
mineral oil	7	grocery store		3.49	473 mL	low	low		
potassium permanganate, KMnO_4	8, 16	sciencecompany.com	NC-0744	10.95	100 g	medium	see note	Not flammable itself, but a strong oxidizer. Keep away from flame and other materials.	
sodium carbonate, Na_2CO_3	8, 10	homesciencetools.com	CH-NA2CO3	3.75	30 g	medium	none		
sulfuric acid, H_2SO_4 , 18 M	8, 16, 18	homesciencetools.com	UN1830	6.75	30 mL	high (1, 2, 3)	none	This concentrated acid (95–98%) will be used to prepare the acid for all experiments requiring H_2SO_4 .	
acetic acid, CH_3COOH	9, 15	homesciencetools.com		4.10	30 mL	high (1, 2, 3)	medium	This glacial (pure) acetic acid is 17.4 M and is used to prepare the solutions in Experiments 9 and 15.	
sodium iodide, NaI	10	carolina.com	889710	34.50	100 g	low	none	A small quantity (20–30 g) for lower price would be better if it could be found.	
sodium sulfate, Na_2SO_4	10	homesciencetools.com	NA2SO4	3.55	30 g	low	none		
barium nitrate, $\text{Ba}(\text{NO}_3)_2$, 0.1 M solution	10	carolina.com	846902	7.05	500 mL	high (1, 5)	see note	Not flammable itself, but a strong oxidizer. Keep away from flame and organic materials.	
lead nitrate, $\text{Pb}(\text{NO}_3)_2$	10	homesciencetools.com	UN1469	5.05	30 g	high (1, 5)	see note	Not flammable itself, but a strong oxidizer. Keep away from flame and organic materials. This is a 0.1 M solution and can be used in Experiment 11 as is.	
copper(II) nitrate trihydrate, $\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$	10, 17	homesciencetools.com	UN1477A	4.55	30 g	high (1)	see note	Not flammable itself, but a strong oxidizer. Keep away from flame and organic materials.	
nitric acid, HNO_3 , 1 M solution	10	carolina.com	877567	15.00	500 mL	high (1, 2, 3)	see note	Not flammable itself, but a strong oxidizer. Keep away from flame and organic materials. This is a 1.0 M solution for use in Experiment 10 as is.	

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Chemicals Needed for Specific Experiments									
Item	Use (Exp. No.)	Source	Cat. No.	Cost	Quan.	Toxicity*	Flammability	Notes	
potassium hydrogen phthalate (KHP)	11	onlinesciencemall.com	—	4.75	10 g	low	none		
sodium hydroxide, NaOH	11, 12, 13, 15	homesciencetools.com	UN1823	5.80	30 g	high (1, 2, 3)	none	This quantity of pellets adequate for 4 experiments. Also known as lye.	
bromothymol blue solution	11	homesciencetools.com	CH-BROMOBL	4.50	100 mL	medium	low		
litmus solution, 0.5%	12	amazon.com		10.00	60 mL	none	none	Search under "litmus 0.5% aqueous solution."	
iodine, 0.08 M solution	14	carolina.com	869091	11.25	100 mL	medium (4, 5)	none		
oxalic acid, $H_2C_2O_4$	15	homesciencetools.com	UN-OXALJC	4.25	30 g	high (1, 2, 3, 5)	low		
phosphoric acid, H_3PO_4 , 14.615 M	16	sciencecompany.com	NC-8682	22.95	16 oz (473 mL)	high (1, 2, 3)	none		
aluminum metal	17	homesciencetools.com	EL-ELECTAL	1.85	4 in	none	none	Any piece of aluminum metal or wire (readily available at hardware stores) will do. Item shown here is an inexpensive source.	
nickel metal	17	sciencecompany.com	NC-5324	5.95	4 in	none	none	Any small strips or pieces of nickel metal will do.	
silver metal	17	goldleafproducts.com		9.00	1 book	none	none	This is for a book of 25 small sheets of real silver leaf.	
aluminum nitrate nonahydrate	17	This compound is hard to obtain for home users. Substitute aluminum sulfate from caroline.com item # 843490		19.15	500 g	medium	see note	Not flammable itself, but an oxidizer. Keep away from flame and organic materials. A small quantity (20–30 g) for lower price would be better if it could be found.	
nickel nitrate hexahydrate	17	ebay.com		26.53	25 g	medium	see note	Not flammable itself, but an oxidizer. Keep away from flame and organic materials.	

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Chemicals Needed for Specific Experiments								
Item	Use (Exp. No.)	Source	Cat. No.	Cost	Quan.	Toxicity*	Flammability	Notes
acetic anhydride	18	carolina.com	841390	11.35	100 mL	high (1, 4)	high	Reacts with water; keep separate. Sold to schools only, not to individuals. Individuals can find this chemical on ebay at 69.50 for 1 L.
absolute ethanol, C ₂ H ₅ OH	18	laballey.com	EAP1000-1PP	30.00	1 pt	medium	high	This ethanol may also be used in the alcohol burner. See Chemical Notes for info on ethanol. This is 200 proof ethanol, which contains traces of benzene.
salicylic acid	18	homesciencetools.com	CH-SALICYL	5.80	30 g	medium (4)	low	
iron chloride hexahydrate, FeCl ₃ ·6H ₂ O	18	homesciencetools.com	UN-FECL3	4.30	30 g	low	none	

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