Chemistry Data Tables

Table F.1 Ionic Charges of Representative Elements

IA 1	IIA 2	IIIA 13	IVA 14	VA 15	VIA 16	VIIA 17	VIIIA 18
H^+						H^-	noble
Li^+	Be^{2+}			N^{3-}	O^{2-}	F^-	gases
Na^+	Mg^{2+}	Al^{3+}		P^{3-}	S^{2-}	Cl^-	do not
K^+	Ca^{2+}				Se^{2-}	Br^-	ionize
Rb^+	Sr^{2+}					I^-	
Cs^+	Ba^{2+}						

Table F.2 Charges of Some Transition Metal Ions

1+	2+	3+
silver, Ag^+	cadmium, Cd^{2+} nickel, Ni^{2+} zinc, Zn^{2+}	scandium, Sc^{3+}

Table F.3 Common Metal Ions with More Than One Ionic Charge

Formula	Stock Name	Classical Name
Cu^+	copper(I) ion	cuprous ion
Cu^{2+}	copper(II) ion	cupric ion
Fe^{2+}	iron(II) ion	ferrous ion
Fe^{3+}	iron(III) ion	ferric ion
$Hg_2^{2+}(Hg^+)$	mercury(I) ion	mercurous ion
Hg^{2+}	mercury(II) ion	mercuric ion
Pb^{2+}	lead(II) ion	plumbous ion
Pb^{4+}	lead(IV) ion	plumbic ion
Sn^{2+}	tin(II) ion	stannous ion
Sn^{4+}	tin(IV) ion	stannic ion
Cr^{2+}	chromium(II) ion	chromous ion
Cr^{3+}	chromium(III) ion	chromic ion
Mn^{2+}	manganese(II) ion	
Mn^{3+}	manganese(III) ion	
Mn^{4+}	manganese(IV) ion	
Co^{2+}	cobalt(II) ion	cobaltous ion
Co^{3+}	cobalt(III) ion	cobaltic ion

Table F.4 Common Polyatomic Ions

Formula	Name
PO_4^{3-}	phosphate
PO_3^{3-}	phosphite
SO_4^{2-}	sulfate
SO_3^{2-}	sulfite
CO_3^{2-}	carbonate
NO_3^-	nitrate
NO_2^-	nitrite
ClO_4^-	perchlorate
ClO_3^-	chlorate
ClO_2^-	chlorite
ClO^-	hypochlorite
CrO_4^{2-}	chromate
$Cr_2O_7^{2-}$	dichromate
$C_2H_3O_2^-$	acetate or ethanoate

Formula	Name
CN^-	cyanide
OH^-	hydroxide
MnO_4^-	permanganate
$C_2O_4^{2-}$	oxalate
SiO_3^{2-}	silicate
NH_4^+	ammonium
HPO_4^{2-}	hydrogen phosphate or biphosphate
$H_2PO_4^-$	dihydrogen phosphate
HPO_3^{2-}	hydrogen phosphite
$H_2PO_3^-$	dihydrogen phosphite
HSO_4^-	hydrogen sulfate
HSO_3^-	hydrogen sulfite
HCO_3^-	hydrogen carbonate or bicarbonate

Table F.5 Solubility of Compounds at SATP

	aluminum	ammonium	barium	calcium	copper(II)	iron(II)	iron(III)	lithium	magnesium	potassium	silver	sodium	strontium	zinc
acetate	S	S	S	S	S	S	S	S	S	S	ss	S	S	S
bromide	S	S	S	S	S	S	S	S	S	S	I	S	S	S
carbonate	–	S	I	I	–	I	–	ss	I	S	I	S	I	I
chlorate	S	S	S	S	S	S	S	S	S	S	S	S	S	S
chloride	S	S	S	S	S	S	S	S	S	S	I	S	S	S
chromate	I	S	I	S	I	–	I	S	S	S	I	S	ss	S
hydroxide	I	S	S	S	I	I	I	S	I	S	–	S	S	I
iodide	S	S	S	S	S	S	S	S	S	S	I	S	S	S
nitrate	S	S	S	S	S	S	S	S	S	S	S	S	S	S
oxide	I	–	ss	ss	I	I	I	S	I	S	I	S	S	I
perchlorate	S	S	S	S	S	S	S	S	S	S	S	S	S	S
phosphate	I	S	I	I	I	I	I	ss	I	S	I	S	I	I
sulfate	S	S	I	ss	S	S	ss	S	S	S	ss	S	I	S
sulfide	d	S	d	I	I	I	d	S	d	S	I	S	I	I

Legend

S = soluble
ss = slightly soluble
I = insoluble
– = no compound
d = decomposes in water

Table F.6 Chemicals in Everyday Life

Common name	Chemical formula and name (other names)	Physical properties	Safety concerns	Comments
acetone	CH_3COCH_3 2-propanone	clear; evaporates quickly	flammable; toxic by ingestion and inhalation	solvent; contained in some nail polish removers
acetylene	C_2H_2 ethyne	smells sweet	highly explosive	burns very hot, with oxygen, in oxyacetylene welding torches; used to produce a wide range of synthetic products
ASA	$CH_3COOC_6H_4COOH$ o-acetoxy benzoic acid (acetylsalicylic acid)	white crystals with a slightly bitter taste	excessive use may cause hearing loss or Reye's syndrome, especially in young people	used in Aspirin™ and related medicines for pain, fever, and inflammation
baking soda	$NaHCO_3$ sodium hydrogen carbonate (sodium bicarbonate)	tiny white crystals	none	used for baking and cleaning, as an antacid and mouthwash, and in fire extinguishers
battery acid	H_2SO_4 sulfuric acid	clear and odourless	corrosive	used in lead-acid storage batteries (automobile batteries)
bleach	$NaOCl_{(aq)}$ sodium hypochlorite solution	yellowish solution with a chlorine smell	toxic, strong oxidizing agent	household chlorine bleach; used for bleaching clothes and for cleaning
bluestone	$CuSO_4 \cdot 5H_2O$ copper(II) sulfate pentahydrate (cupric sulfate pentahydrate)	blue crystals or blue crystalline granules	toxic by ingestion; strong irritant	used in agriculture and industry, as a germicide, and for wood preservation
borax	$Na_2B_4O_7 \cdot 10H_2O$ sodium borate decahydrate	white crystals	none	main source is mining; used in the glass and ceramics industries; used for making Silly Putty® and for washing clothes
carborundum	SiC silicon carbide	hard, black solid	none	used as an abrasive
citric acid	$(HOOCCH_2)_2C(OH)(COOH)$ 2-hydroxy-1,2,3-propane (tricarboxylic acid)	translucent crystals with a strongly acidic taste	none	used in foods and soft drinks as an acidifying agent and an antioxidant
CFCs	CCl_2F_2, CCl_3F, $CClF_3$ chlorofluorocarbons (freons, Freon-12)	colourless, odourless gas	CFCs are now banned by the Montréal Protocol	in the past, were used as refrigerants and aerosols
charcoal/ graphite	$C_{(s)}$ pure carbon, in a less structured form than diamond	soft grey or black solid that rubs easily onto other substances	none	used as pencil "lead"and artists' charcoal, as a de-colourizing and filtering agent, in gunpowder, and for barbeque briquettes
cream of tartar	$HOOC\ (CHOH)_2\ COOK$ potassium hydrogen tartrate	white, crystalline solid	none	used as a leavening agent in baking powder

dry ice	CO_2 solid carbon dioxide	cold white solid that sublimates	damaging to skin and tissue after prolonged exposure	used as a refrigerant in laboratories when cold temperatures (as low as –79°C) are required
Epsom salts	$MgSO_4 \cdot 7H_2O$ magnesium sulfate heptahydrate	colourless crystals	can cause abdominal cramps and diarrhea	used as a bath salt and in cosmetics and dietary supplements; has industrial uses
ethylene	C_2H_4 ethene	colourless gas with sweet odour and taste	flammable	used to accelerate fruit ripening and to synthesize polymers such as polystyrene; occurs naturally in plants
ethylene glycol	CH_2OHCH_2OH glycol	clear, colourless, syrupy liquid	toxic by ingestion and inhalation	used in antifreeze and cosmetics, and as a de-icing fluid for airport runways
Glauber's salt	$Na_2SO_4 \cdot 10H_2O$ sodium sulfate decahydrate	large, transparent crystals, needles, or granular powder	none	a laxative; used for paper and glass making, and in solar heat storage and air conditioning; energy storage capacity more than seven times that of water
glucose	$C_6H_{12}O_6$ dextrose, grape sugar, corn sugar	white crystals with a sweet taste	none	source of energy for most organisms
grain alcohol	C_2H_5OH ethanol (ethyl alcohol)	clear, volatile liquid with distinctive odour	flammable	beverage alcohol, antiseptic, laboratory/ industrial solvent; produced by the fermentation of grains or fruits
gyp rock	$CaSO_4 \cdot 2H_2O$ gypsum	hard, beige mineral	none	used in plaster of Paris and as a core for drywall
hydrogen peroxide	H_2O_2	clear, colourless liquid	damaging to skin in high concentrations	sold as 3% solution in drugstores; non-chlorine bleach often 6% H_2O_2
ibuprofen	$C_{13}H_{18}O_2$ p-isobutyl-hydratropic acid	white crystals	can conflict with other medications	ingredient in over-the-counter pain relievers
laughing gas	N_2O nitrous oxide, dinitrogen oxide	colourless, mainly odourless, soluble gas	prolonged exposure causes brain damage and infertility	used as a dental anesthetic, an aerosol propellant, and to increase fuel performance in racing cars
lime	CaO calcium oxide (hydrated lime, hydraulic lime, quicklime)	white powder	reacts with water to produce caustic calcium hydroxide, $Ca(OH)_2$, with liberation of heat	used to make cement and to clean and nullify odours in stables
limestone	$CaCO_3$ calcium carbonate	soft white mineral	none	used for making lime and for building; has industrial uses
lye	$NaOH$ sodium hydroxide (caustic soda)	white solid, found mainly in form of beads or pellets; quickly absorbs water and CO_2 from the air	corrosive, strong irritant	produced by the electrolysis of brine or the reaction of calcium hydroxide and sodium carbonate; has many laboratory and industrial uses; used to manufacture chemicals and make soap
malachite	$CuCO_3 \cdot Cu(OH)_2$ basic copper(II) carbonate	clear, hard, bright green mineral	none	ornamental and gem stone; copper found in the ore

milk of magnesia	$Mg(OH)_2$ magnesium hydroxide (magnesia magma)	white powder	harmless if used in small amounts	antacid, laxative
moth balls	$C_{10}H_8$ naphthalene	white, volatile solid with an unpleasant odour	toxic by ingestion and inhalation	used to repel insects in homes and gardens, and to make synthetic resins; obtained from crude oil
MSG	$COOH(CH_2)_2CH(NH_2)$-$COONa$ monosodium glutamate	white, crystalline powder	may cause headaches in some people	flavour enhancer for foods in concentrations of about 0.3%
muriatic acid	$HCl_{(aq)}$ hydrochloric acid	colourless or slightly yellow aqueous solution	toxic by ingestion and inhalation; strong irritant	has many industrial and laboratory uses; used for processing food, cleaning, and pickling
natural gas	about 85% methane, CH_4, 10% ethane, C_2H_6, and some propane, C_3H_8, butane, C_4H_{10}, and pentane, C_5H_{12}	odourless, colourless gas	flammable and explosive; a warning odour is added to household gas as a safety precaution	used for heating, energy, and cooking; about 3% is used as a feedstock for the chemical industry
oxalic acid	HO_2CCO_2H ethanedoic acid	strongly flavoured acid; white crystals	toxic by inhalation and ingestion; strong irritant in high concentrations	occurs naturally in rhubarb, wood sorrel, and spinach; used as wood and textile bleach, rust remover, and deck cleaner; has many industrial and laboratory uses
Pepto-Bismol™	bismuth subsalicylate calcium carbonate	pink solid or solution	may cause stomach upset if taken in excess of recommended dose	relieves digestive difficulties by coating the digestive tract and reducing acidity
PCBs	polychlorinated biphenyls: class of compounds with two benzene rings and two or more substituted chlorine atoms	colourless liquids	highly toxic, unreactive, and persistent; cause ecological damage	used as coolants in electrical transformers
potash	K_2CO_3 potassium carbonate	white, granular, translucent powder	solutions irritating to tissue	laboratory and industrial uses; used in special glasses, in soaps, and as a dehydrating agent
PVCs	$(C_2H_3Cl)_n$ polyvinyl chloride, polychloroethene	tough, white, unreactive solid	none	used extensively as a building material
road salt	$CaCl_2$ calcium chloride	white crystalline compound	none	by-product of the Solvay process
rotten-egg gas	H_2S hydrogen sulfide	colourless gas with an offensive odour	highly flammable, therefore high fire risk; explosive; toxic by inhalation; strong irritant to eyes and mucous membranes	obtained from sour gas during natural gas production

rubbing alcohol	$(CH_3)_2CHOH$ isopropanol (isopropyl alcohol)	colourless liquid with a pleasant odour	flammable, therefore high fire risk; explosive; toxic by inhalation and ingestion	has industrial and medical uses
salicylic acid	HOC_6H_4COOH 2-hydroxybenzoic acid	white crystalline solid	damages skin in high concentrations	can be used in different amounts in foods and dyes, and in wart treatment
sand	SiO_2 silica	large, glassy cubic crystals	toxic by inhalation; chronic exposure to dust may cause silicosis	occurs widely in nature as sand, quartz, flint, and diatomite
slaked lime	$Ca(OH)_2$ calcium hydroxide	white powder that is insoluble in water	none	used to neutralize acidity in soils and to make whitewash, bleaching powder, and glass
soda ash	Na_2CO_3 sodium carbonate	white powdery crystals	none	used to manufacture glass, soaps, and detergents
sugar	$C_{12}H_{22}O_{11}$ sucrose (cane or beet sugar)	cubic white crystals	none	used in foods as a sweetener; source of metabolic energy
table salt	NaCl sodium chloride (rock salt, halite)	cubic white crystals	none	produced by the evaporation of natural brines and by the solar evaporation of sea water; also mined from underground sources; used in foods and for de-icing roads
Tylenol™	$CH_3CONHC_6H_4OH$ N-acetyl-p-aminophenol (acetaminophen, APAP)	colourless, slightly bitter crystals	can be toxic if an overdose is taken	pain reliever (analgesic)
TSP	Na_3PO_4 trisodium phosphate (sodium phosphate, sodium orthophosphate)	white crystals	toxic by ingestion; irritant to tissue; pH of 1% solution is 11.8 to 12	used as a water softener and cleaner (for example, to clean metals and to clean walls before painting); has many industrial uses
vinegar	5% acetic acid, CH_3COOH, in water	clear solution with a distinctive smell	none	used for cooking and household cleaning
vitamin C	$C_6H_8O_6$ ascorbic acid	white crystals or powder with a tart, acidic taste	none	required in diet to prevent scurvy; found in citrus fruits, tomatoes, potatoes, and green leafy vegetables
washing soda	$Na_2CO_3 \cdot H_2O$ sodium carbonate monohydrate (soda ash)	white powdery crystals	may be irritating to skin	used for cleaning and photography, and as a food additive; has many industrial and laboratory uses
wood alcohol	CH_3OH methanol (methyl alcohol)	clear, colourless liquid with faint alcoholic odour	flammable; toxic by ingestion, skin absorption, and inhalation; causes blindness and death	has many industrial and household uses; used in gasoline antifreeze and as a thinner for shellac and paint; can be mixed with vegetable oil and lye to make diesel