

Aluminum (Al), chemical element, a lightweight silvery white metal of main Group 13 (IIIA, or boron group) of the periodic table. Lithium aluminum hydride (LiAlH_4), formed by the reaction of aluminum chloride with lithium hydride, is widely used in organic chemistry—e.g., to reduce aldehydes and ketones to primary and secondary alcohols, respectively. The alums, double salts of formula $\text{MAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ (where M is a singly charged cation such as K^+), also contain the Al^{3+} ion; M can be the cation of sodium, potassium, rubidium, cesium, ammonium, or thallium, and the aluminum may be replaced by a variety of other M^{3+} ions—e.g., gallium, indium, titanium, vanadium, chromium, manganese, iron, or cobalt. The reaction of gaseous chlorine with molten aluminum metal produces aluminum chloride; the latter is the most commonly used catalyst in Friedel–Crafts reactions—i.e., synthetic organic reactions involved in the preparations of a wide variety of compounds, including aromatic ketones and anthraquinone and its derivatives. Of the many other aluminum minerals, alunite and cryolite have some commercial importance. Before 5000 BCE people in Mesopotamia were making fine pottery from a clay that consisted largely of an aluminum compound, and almost 4,000 years ago Egyptians and Babylonians used aluminum compounds in various chemicals and medicines. When electric power became relatively plentiful and cheap, almost simultaneously Charles Martin Hall in the United States and Paul–Louis–Toussaint Heroult in France discovered (1886) the modern method of commercially producing aluminum: electrolysis of purified alumina (Al_2O_3) dissolved in molten cryolite (Na_3AlF_6). The metal and its alloys are used extensively for aircraft construction, building materials, consumer durables (refrigerators, air conditioners, cooking utensils), electrical conductors, and chemical and food-processing equipment. Pure aluminum (99.996 percent) is quite soft and weak; commercial aluminum (99 to 99.6 percent pure) with small amounts of silicon and iron is hard and strong.

Occurrence and history Aluminum occurs in igneous rocks chiefly as aluminosilicates in feldspars, feldspathoids, and micas; in the soil derived from them as clay; and upon further weathering as bauxite and iron-rich laterite. British chemist Sir Humphry Davy had prepared (1809) an iron–aluminum alloy by electrolyzing fused alumina (aluminum oxide) and had already named the element aluminum; the word later was modified to aluminium in England and some other European countries. Because of its great affinity for oxygen, finely divided aluminum, if ignited, will burn in carbon monoxide or carbon dioxide with the formation of aluminum oxide and carbide, but, at temperatures up to red heat, aluminum is inert to sulfur. Crystalline aluminum oxide (emery, corundum), which occurs in a few igneous rocks, is mined as a natural abrasive or in its finer varieties as rubies and sapphires. In aluminum the configuration of the three outer electrons is such that in a few compounds (e.g., crystalline aluminum fluoride [AlF_3] and aluminum chloride [AlCl_3]) the bare ion, Al^{3+} , formed by loss of these electrons, is known to occur. Alumina, which occurs in nature as corundum, is also prepared commercially in large quantities for use in the production of aluminum metal and the manufacture of insulators, spark plugs, and various other products. Pliny refers to alumen, now known as alum, a compound of aluminum widely employed in the ancient and medieval world to fix dyes in textiles. Crude aluminum was isolated (1825) by Danish physicist Hans Christian Orsted by reducing aluminum chloride with potassium amalgam. Bauxite, a mixture of hydrated aluminum oxides, is the principal aluminum ore.