

12.7: Properties of Alkanes

Learning Objectives

- To identify the physical properties of alkanes and describe trends in these properties.

Because alkanes have relatively predictable physical properties and undergo relatively few chemical reactions other than combustion, they serve as a basis of comparison for the properties of many other organic compound families. Let's consider their physical properties first.

Table 12.7.1 describes some of the properties of some of the first 10 straight-chain alkanes. Because alkane molecules are nonpolar, they are insoluble in water, which is a polar solvent, but are soluble in nonpolar and slightly polar solvents. Consequently, alkanes themselves are commonly used as solvents for organic substances of low polarity, such as fats, oils, and waxes. Nearly all alkanes have densities less than 1.0 g/mL and are therefore less dense than water (the density of H₂O is 1.00 g/mL at 20°C). These properties explain why oil and grease do not mix with water but rather float on its surface.

Table 12.7.1: Physical Properties of Some Alkanes

Molecular Name	Formula	Melting Point (°C)	Boiling Point (°C)	Density (20°C)*	Physical State (at 20°C)
methane	CH ₄	-182	-164	0.668 g/L	gas
ethane	C ₂ H ₆	-183	-89	1.265 g/L	gas
propane	C ₃ H ₈	-190	-42	1.867 g/L	gas
butane	C ₄ H ₁₀	-138	-1	2.493 g/L	gas
pentane	C ₅ H ₁₂	-130	36	0.626 g/mL	liquid
hexane	C ₆ H ₁₄	-95	69	0.659 g/mL	liquid
octane	C ₈ H ₁₈	-57	125	0.703 g/mL	liquid
decane	C ₁₀ H ₂₂	-30	174	0.730 g/mL	liquid

*Note the change in units going from gases (grams per liter) to liquids (grams per milliliter). Gas densities are at 1 atm pressure.



Figure 12.7.1: Oil Spills. Crude oil coats the water's surface in the Gulf of Mexico after the *Deepwater Horizon* oil rig sank following an explosion. The leak was a mile below the surface, making it difficult to estimate the size of the spill. One liter of oil can create a slick 2.5 hectares (6.3 acres) in size. This and similar spills provide a reminder that hydrocarbons and water don't mix. Source: Photo courtesy of NASA Goddard / MODIS Rapid Response Team, [NASA.gov, Topics, Earth Features, Oil Spill](https://www.nasa.gov/topics/earth/features/oil_spill/)(opens in new window) [www.nasa.gov].

