

Haloalkanes: Physical Properties

The tables below show some physical data for a selection of haloalkanes.

Haloalkane	Formula	Density (g cm ⁻³)	T _b (K)
fluoromethane	CH ₃ F	0.557	194.7
chloromethane	CH ₃ Cl	0.916	248.9
chloroethane	CH ₃ CH ₂ Cl	0.898	285.4
1-chloropropane	CH ₃ CH ₂ CH ₂ Cl	0.891	319.7
2-chloropropane	CH ₃ CHClCH ₃	0.863	308.8
2-chloro-2-methylpropane	(CH ₃) ₂ CClCH ₃	0.842	323.8
bromomethane	CH ₃ Br	1.676	276.7
bromoethane	CH ₃ CH ₂ Br	1.461	311.5
1-bromopropane	CH ₃ CH ₂ CH ₂ Br	1.354	344.1
2-bromopropane	CH ₃ CHBrCH ₃	1.314	332.5
2-bromo-2-methylpropane	(CH ₃) ₂ CBrCH ₃	1.221	346.4
iodomethane	CH ₃ I	2.279	315.5
iodoethane	CH ₃ CH ₂ I	1.936	345.4
1-iodopropane	CH ₃ CH ₂ CH ₂ I	1.748	375.5
2-iodopropane	CH ₃ CHICH ₃	1.703	362.5
2-iodo-2-methylpropane	(CH ₃) ₂ CICH ₃	1.571	373.1

Boiling point comparisons for various haloalkanes

Haloalkane	Formula	T _b (K)
chloromethane	CH ₃ Cl	248.9
dichloromethane	CH ₂ Cl ₂	313.1
trichloromethane	CHCl ₃	334.8
tetrachloromethane	CCl ₄	349.6

Haloalkane	T _b (K)
fluoromethane	194.7
chloromethane	248.9
bromomethane	276.7
iodomethane	315.5

Your task

Study the data above carefully, then answer the following questions:

1. Make lists of the haloalkanes above to show which are liquids and which are gases at room temperature (assume it is 298K). What do you notice?
2. Describe and **explain** the effect on the densities and boiling points of haloalkanes in the following cases:
 - a) the identity of the halogen present in the haloalkane is altered; and
 - b) the number of carbon atoms in the haloalkane is increased.
3. What effect does increasing the number of halogen atoms present in a haloalkane have on the boiling point? Explain your answer.