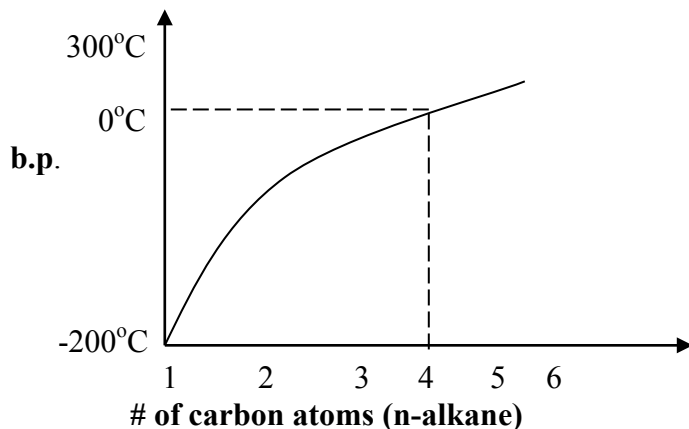


Physical Properties of Alkanes:**Boiling Point**

Intermolecular forces are dominated by London forces

- Alkanes are non-polar because H and C have similar electronegativity leading them to interact with themselves through London Forces which causes a trend in boiling point:

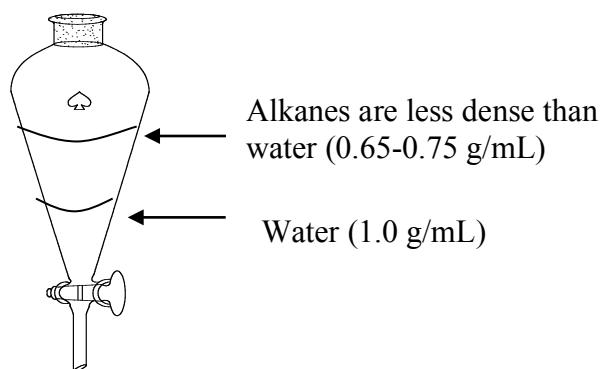


The boiling point increases as the size of the alkane increases because the longer carbon chains have greater surface area to experience London Forces. As the boiling point increases, the graph reaches a plateau where alkane starts to decompose ($\text{\#C} > 20$)

Solubility

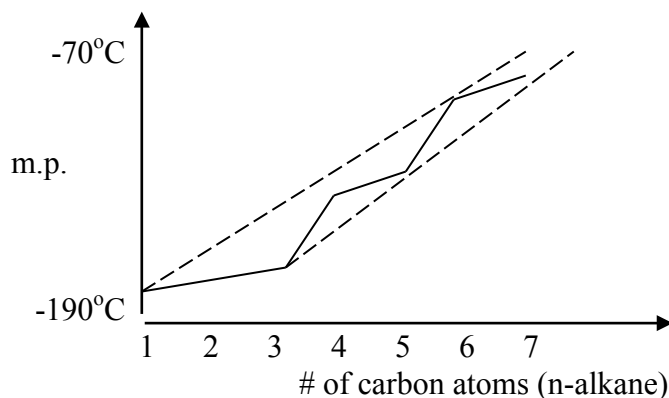
- Soluble in other organic solvents (like dissolves like)
- Not miscible with water → floats due to lower density
- Low density ($\rho = \text{rho} = \text{g/cm}^3$)
 - ρ water $\sim 1 \text{ g/cm}^3$
 - ρ alkanes $\sim 0.7 \text{ g/cm}^3$

Separatory Funnel (*density separation*)


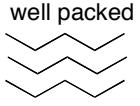

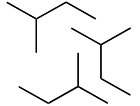



Melting point

- Melting points are related to the crystal structure packing efficiency
- The predicted line (dotted line) is not what we observe, but a zig zag line (continuous) resulting from crystal structure packing.
- Alkanes are flammable and will combust into CO_2 and H_2O



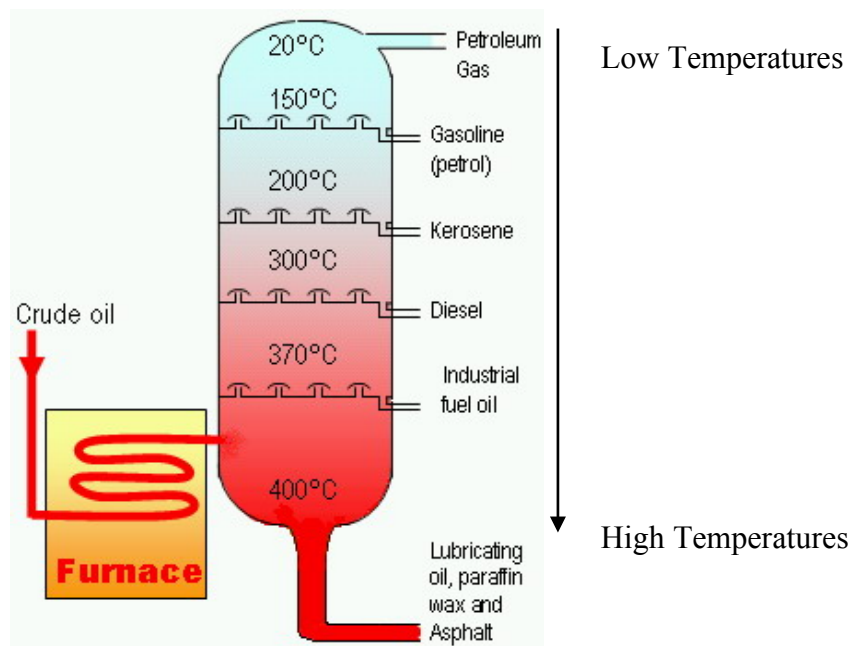
e.g. Pentane

	mp (°C)	bp (°C)		
 n-Pentane	-129	36	 well packed	<ul style="list-style-type: none"> • n-pentane has high bp due to multiple contacts of straight chains (London Forces)
 Isopentane 2-methylbutane	-160	28	 less well packed	less well packed, less interacting surface area
 Neopentane 2,2-dimethylpropane	-13	9	"ball-like" shape, so B.P. comes down	mp of neopentane determined by good crystal packing of spherical shape. Ball-like shape means surface contact area small and boiling point lower

Source of Hydrocarbons

- Petroleum

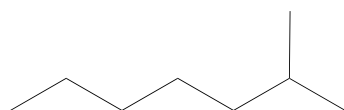
Distillation of Petroleum:



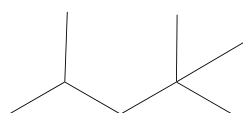
- Petroleum is a mixture of alkanes and other hydrocarbons (>>200 compounds)

Fuel (gasoline)

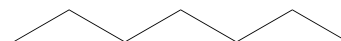
A fuel composed of 100% “isooctane” (incorrect name) will have an octane rating of 100. Heptane is bad for knocking (explosive burning). A fuel that knocks like a mixture of 90:10 “isooctane” to heptane has a 90 octane rating



isooctane



incorrectly also called
“isooctane”

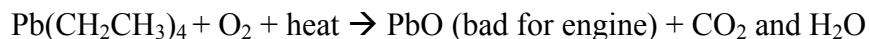


heptane

At the pump you typically see an octane rating between 88 and 94.

$\text{Pb}(\text{CH}_2\text{CH}_3)_4$ is known as tetraethyl lead

- Anti-knocking compound
- Toxic



To mitigate this problem: 1,2-dibromoethane ($\text{Br}-\text{CH}_2-\text{CH}_2-\text{Br}$) can be included. It reacts with PbO to form PbBr_2 , which at high temperature is a gas that escapes into the atmosphere, harming the environment but leaving your vehicle unharmed