HEAT OF COMBUSTION AND HEAT OF FORMATION

THE STANDARD HEAT OF COMBUSTION ($\blacktriangle H_c^\circ$)

Is the amount of heat released when a carbon-containing compound (hydrocarbon!) burns – *reacts completely with oxygen* – under standard conditions (298 K, 1 atm of pressure).
The more stable the compound, the less heat it gives off on burning. 25°C 101.3kPa
In the graph provided below, we see that isobutane gives off less heat than butane,

C_4H_{10}

which means that isobutane is more stable. Branching increases the stability of an alkane because it increases the intramolecular van der Waals attractions (the forces of attraction within the molecule that stabilize the molecule).

THE STANDARD HEAT OF FORMATION ($\blacktriangle H_f^\circ$)

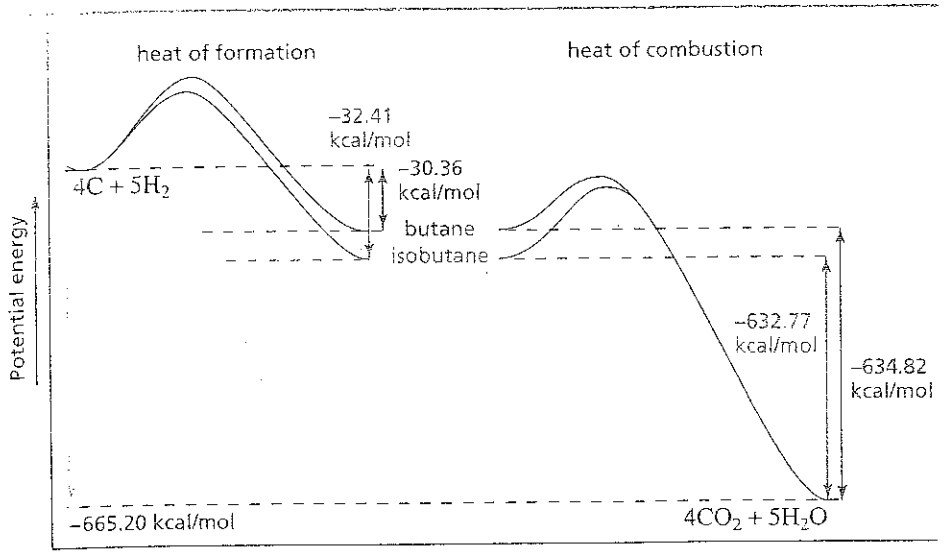
Of a compound is the heat given off when the compound is formed from its elements under standard conditions.
For example, the heat of formation of butane from carbon (graphite) and hydrogen gas is -127.0 kJ/mol.

$4C(s) + 5H_2(g) \longrightarrow CH_3CH_2CH_2CH_3$ (C_4H_{10})

The heat of formation of isobutane is -135.6 kJ/mol.

$4C(s) + 5H_2(g) \longrightarrow CH_3-CH(CH_3)-CH_3$

The observation that isobutane formation releases more heat than butane formation releases tells us that the isobutane is more stable.



◀ Figure 2.3
The more stable compound (left) has the more negative heat of formation. The less stable compound (right) has the more negative heat of combustion.

Enthalpy tutorial: www.wwnorton.com/chemistry/tutorials/ch11.htm click on section 11.11
Hess' Law practice program: http://chemisty2.csudh.edu/lecture_help/Hesslaw.html