Free Energy - capacity to do work

Radiant - energy from the sun.
(primary energy source for earth)
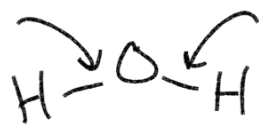
Thermal — motion — movement of atoms
and molecules

kinetic energy $= \frac{1}{2}mv^2$

$$K_E = \frac{1}{2}m\boxed{v^2}$$ — velocity
of
$$E = m\boxed{c^2}$$ — light

chemical — bond energy

H—O—H

Nuclear energy — from nucleus of
atom.

Potential — based on position

$$P_E = mgh$$

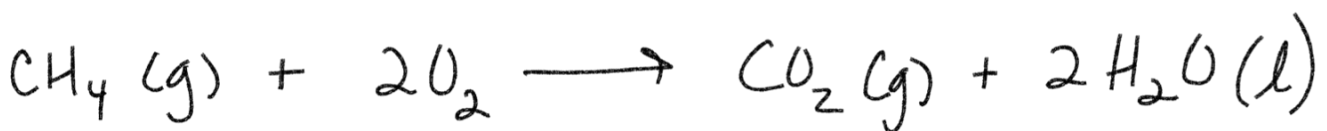$$CH_4 (g) + 2O_2 \longrightarrow CO_2 (g) + 2H_2O (l)$$

Enthalphy $\rightarrow$ bond energy

$\Delta H = -890.4 \text{ kJ/mol}$

$\dfrac{890.4}{4.184} = 212.8 \text{ kcal/mol}$

Calorie $\rightarrow$ Amount of energy required to raise 1 gram of water by 1 °C.

$\boxed{1}$ nutrition calorie $= 1 \text{ kcal}$

$$1 \text{ cal} = 4.184 \text{ J}$$
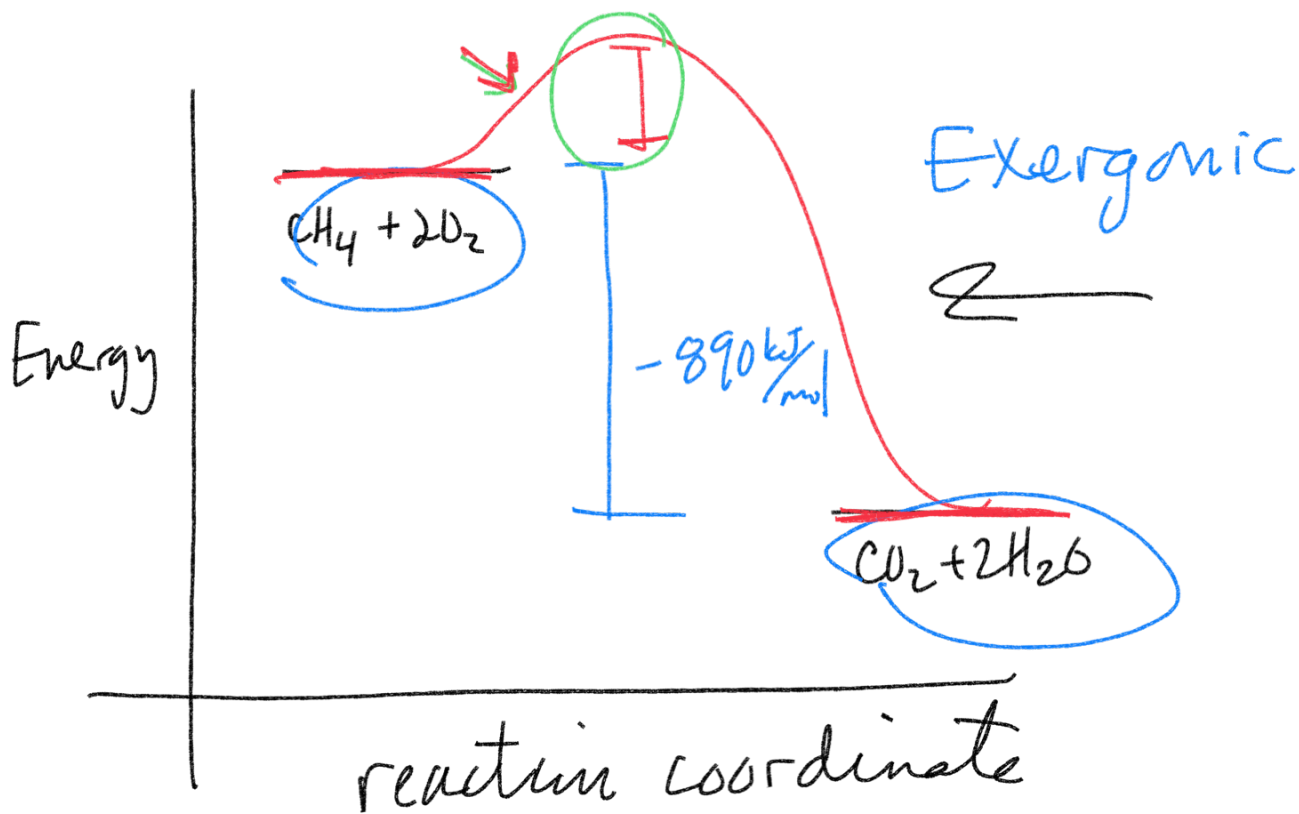$$1 \text{ kcal} = 4.184 \text{ kJ}$$

$$CH_4 (g) + 2O_2 \longrightarrow CO_2 (g) + 2H_2O (l)$$

$$\Delta H = \underset{\uparrow}{-} 890.4 \text{ kJ/mol}$$

Exergonic $\underset{\text{energy}}{\text{Releases}}$ exergonic

$200g$ CH_4

$\dfrac{200g}{16 \text{ g/mol}}$ $12.5 \text{ mol} * -890.4 \text{ kJ/mol}$

$= \boxed{-11130 \text{ kJ/mol}}$

Energy (y-axis), reaction coordinate (x-axis)

$CH_4 + 2O_2$

Exergonic

-890 kJ/mol

$CO_2 + 2H_2O$

Endergonic Reaction — Absorb energy

$$CO_2(g) + 2H_2O(l) \rightarrow CH_4(g) + 2O_2(g)$$
$$\Delta H = +890.4 \text{ kJ/mol}$$

$$N_2(g) + 2O_2(g) \rightarrow 2NO(g)$$
$$\Delta H = +66.4 \text{ kJ/mol}$$

66.4

$$NaOH_{(s)} \longrightarrow Na^{\oplus}_{(aq)} + OH^{\ominus}_{(aq)}$$
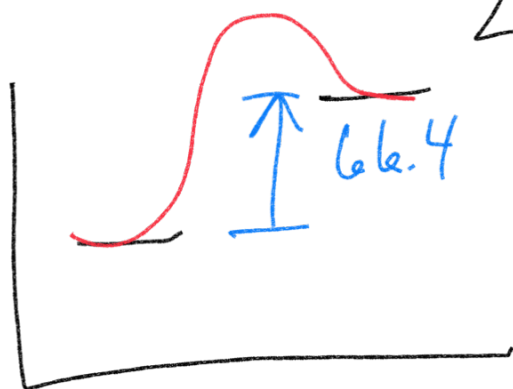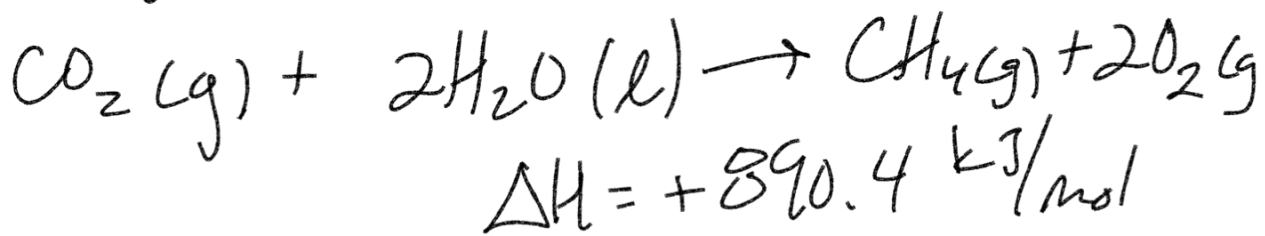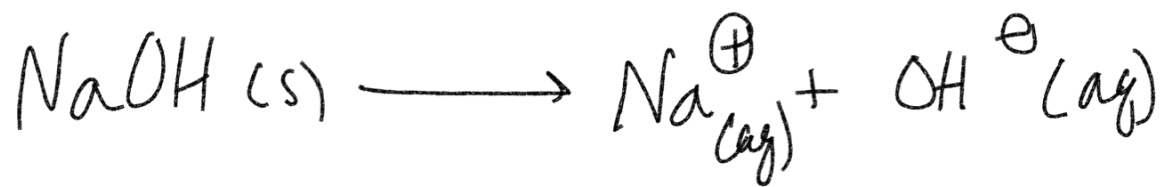
$$\Delta H = -44.51 \text{ kJ/mol}$$

Exothermic releases heat