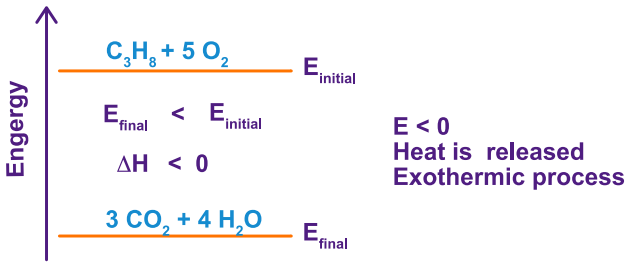
Energy, Heat, and Work

1. Draw an energy diagram, and write a balanced chemical equation for the combustion reaction of propane. Label the initial and final energies. What is the sign of ΔE?

$C_3H_8\ (g) + 5\ O_2\ (g) \rightarrow 3\ CO_2\ (g) + 4\ H_2O\ (g)$ $\Delta E < 0$



2. Calculate the work done, in J, by a chemical reaction if the volume increases from 3.8 L to 4.1 L against a constant pressure of 2.9 atm. What is the sign of the change in energy?

$\Delta V = 4.1\ L - 3.8\ L = 0.3\ L$
$P = 2.9\ atm$
$W = -P\Delta V = -2.9\ atm \times 0.3\ L = -0.87\ L \cdot atm$
$1\ L \cdot atm = 101.3\ J$
$-0.87\ L \cdot atm \times \frac{101.3\ J}{1\ L \cdot atm} = \mathbf{-88.1\ J}$

3. A Big Mac has a caloric content of 550 Calories. How many hours would a 275 watt 46 inch plasma TV run with this amount of energy? (1 W = 1 J/s)

$550\ kcal \times \frac{4.184\ kJ}{1\ kcal} = 2301\ kJ = 2.30 \times 10^6\ J$

$$2.30 \times 10^6 J \times \frac{s}{275\ J} \times \frac{1\ hr}{3600\ s} = 2.32\ hr$$

4. A system receives 626 J of heat from the surroundings. The system delivers 626 J of work to the surroundings. What is the change in the internal energy, ΔE, of the system (in J)?

$\Delta E = q + w$ $q = +626\ J$ $w = -626\ J$
$\Delta E = +626\ J + -626\ J = \mathbf{0\ J}$