

CHEM131 NOTES

ENERGY is the *capacity to do work*.

- Such capacity is *transferred* to another object for **WORK** to exist. Therefore, work is the act of *transferring* energy.
- Work may also be done while *converting* energy within the system as it is or isn't retained within it.

PHYSICAL CHANGES occurs...

- When a system *absorbs* (endo-) or *releases* (exo-) *thermal energy*.
- By **CHEMICAL REACTION** or **PHASE CHANGE**.
- In *chemistry*, the **SOLUTION** itself is the **THERMODYNAMIC SYSTEM**.

THERMAL ENERGY is denoted by q or Q .

- $q > 0$ implies that process is **ENDOTHERMIC**.
- $q < 0$ implies that process is **EXOTHERMIC**.
- Examples of exothermic processes: Oxidation, Neutralization
- Example of endothermic process: Thermal Decomposition
- Uses the unit, $J = \frac{\text{kg} \cdot \text{m}^2}{\text{s}^2}$, or cal. 1 cal. = 4.184 J.
- In nutrition, cal., is treated as kcal.

POTENTIAL ENERGY: $E_p = mgh$, $g = 9.81 \frac{\text{m}}{\text{s}^2}$

KINETIC ENERGY: $E_k = \frac{1}{2}mv^2$

IONIZING RADIATION starts at $1 \cdot 10^{16} \text{ Hz}$.

FUEL VALUE is *energy released* when 1g of substance is *metabolized* (cellular respiration). It's also measured via calorimetry.

Carbohydrates are converted to glucose, $\text{C}_6\text{H}_{12}\text{O}_6$, upon breakdown. Fats are literally broken down into $\text{CO}_2 + \text{H}_2\text{O}$ upon contact with O_2 .

FUEL EFFICIENCY is *nearly complete conversion of energy* to another form. (lossless conversion) It is denoted by kJ/kg. Gravimetric energy density, in *foods*, share the same *unit* as well.

Gravimetric energy density of general component of foods:

FAT: 9.3 kcal/g, **CARBOHYDRATES**: 4.1 kcal/g, **PROTEIN**: 32.9 kcal/g

FUEL is a *transportable combustible material* used to *produce thermal energy*. They are captured via a **HEAT ENGINE**, which converts thermal energy to mechanical energy.

Types of Fuel:

- **SOLID**: Easy storage, large waste, low prod cost, high handling cost.
- **LIQUID**: Energy-dense, costs more than solid, fossil-derived. **PETROL** and **LPG** are examples. LPG contains *ethyl mercaptan* to detect leakages.
- **GASEOUS**: Naturally-occurring, requires storage tank, prone to leaks, derived from solid or liquid fuel. **SYNGAS**, a gaseous fuel, is made by *coal gasification*. It has potential energy value of 142 kJ/kg.

