Properties of Matter

Chapter 4

Physical properties

- Characteristics that can be evaluated without changing the composition of the material.

- Examples
  - color
  - odor
  - taste
  - feel
  - density
  - melting point
  - boiling point
  - compressibility

Examples of Physical Properties

Substance	Color	Odor	Taste	Physical state	Melting point (°C)	Boiling point (°C)
Chlorine	Yellowish-green	Sharp, suffocating	Sharp, sour	Gas (20°C)	−101.6	−34.6
Water	Colorless	Odorless	Tasteless	Liquid	0.0	100.0
Sugar	White	Odorless	Sweet	Solid	—	Decomposes 170–186
Acetic acid	Colorless	Like vinegar	Sour	Liquid	16.7	118.0

Chemical Properties

- Result in a change in the composition of a material.
- Chemical Reaction - how the change occurs.
- Example A chemical property of wood is it's ability to burn - combustion.

  (Reactants and Products are very different)

Changes

- Physical Changes - can be carried out without changing the composition of a substances.
- Chemical Changes – are changes that change the composition of a substance.

Process taking place	Type of change	Accompanying observations
Rusting of iron	Chemical	Shiny, bright metal changes to reddish-brown rust.
Boiling of water	Physical	Liquid changes to vapor.
Burning of sulfur in air	Chemical	Yellow, solid sulfur changes to gaseous, choking sulfur dioxide.
Boiling an egg	Chemical	Liquid white and yolk change to solids.
Combustion of gasoline	Chemical	Liquid gasoline burns to gaseous carbon monoxide, carbon dioxide, and water.
Digestion of food	Chemical	Food changes to liquid nutrients and partially solid wastes.
Sawing of wood	Physical	Smaller pieces of wood and sawdust are made from a larger piece of wood.
Burning of wood	Chemical	Wood burns to ashes, gaseous carbon dioxide, and water.
Heating of glass	Physical	Solid becomes pliable during heating, and the glass may change its shape.

Which are chemical or physical changes?

- Mulching leaves
- Milk turning sour
- Making wine
- Making ice water
- Beer going flat
- Leaves changing color

Energy

- Energy is the capacity to do work.

- Types of energy
  - Kinetic energy
  - Potential energy
  - Thermal energy

- Measured in Joules or Calories

Temperature and Heat

- Temperature is a measure of average kinetic energy
- Heat is a measure of total energy

Specific Heat

- the amount of heat required to change the temperature of a substance by a specified amount.

  - Specific heats
    - water 1.0 cal/g ^{o}C or 4.184 J/g ^{o}C
    - Al 0.216 cal/g ^{o}C or 0.902 J/g ^{o}C
    - Cu 0.092 cal/g ^{o}C or 0.385 J/g ^{o}C
    - Fe 0.113 cal/g ^{o}C or 0.473 J/g ^{o}C
    - Au 0.031 cal/g ^{o}C or 0.131 J/g ^{o}C

Law of Conservation of Energy

- Energy can be neither created nor destroyed.

Law of conservation of Mass and Energy

- The sum on mass and energy is conserved.

Energy and Food

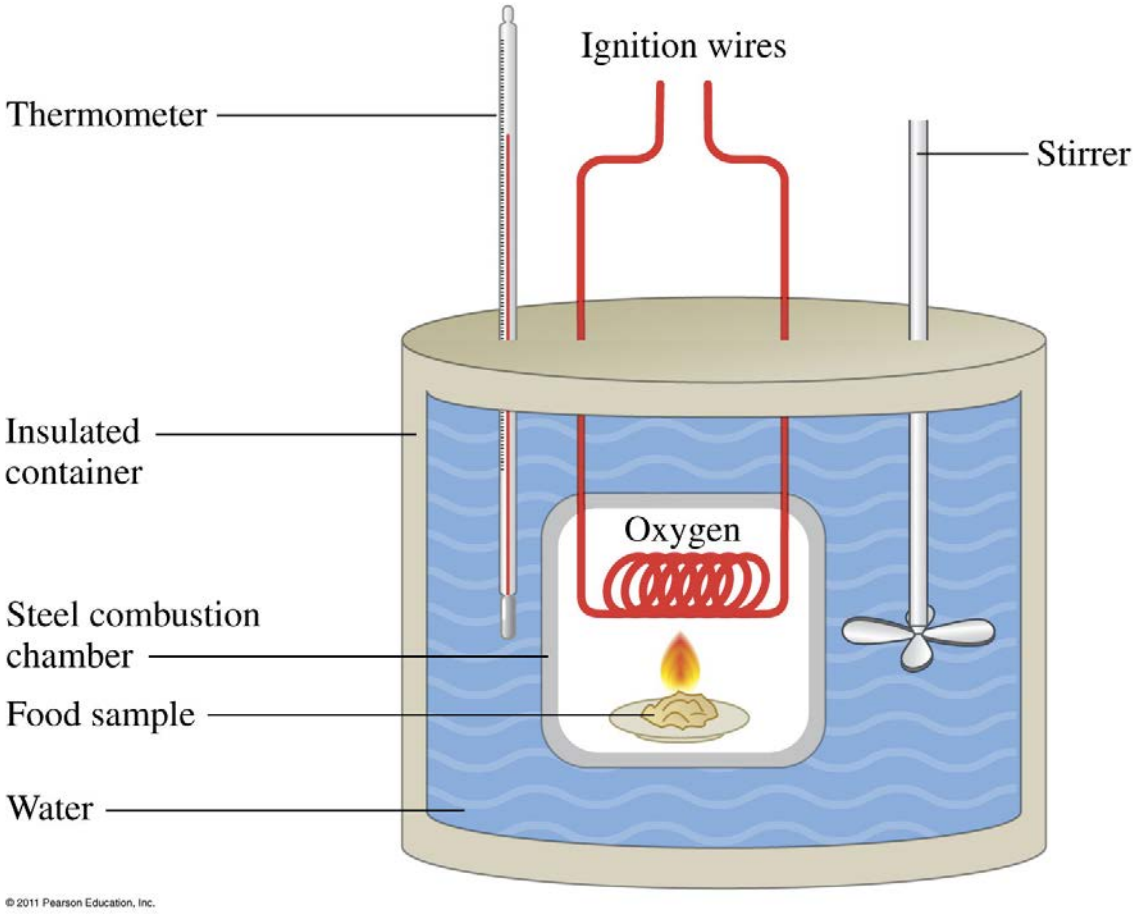


TABLE 3.10 Typical Energy (Caloric) Values for the Three Food Types

Food Type	kJ/g	kcal/g
Carbohydrate	17	4
Fat	38	9
Protein	17	4

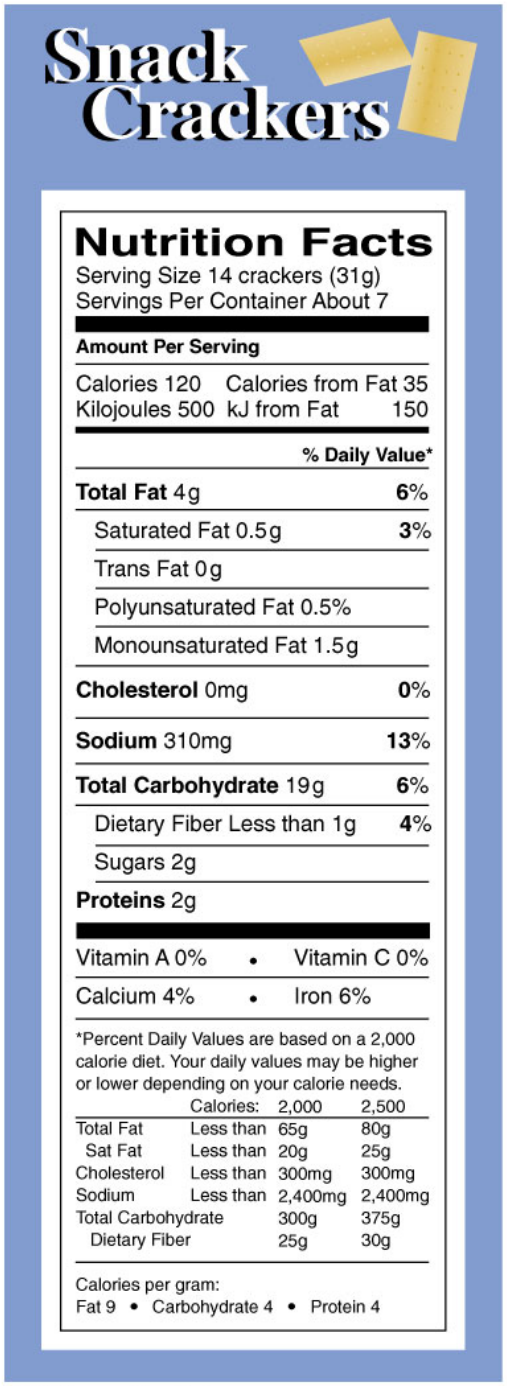
How many calories will you get from eating one slice of pizza?

Item	Protein (g)	Fat (g)	Carbohydrate (g)
Pizza	13	10	29
Cola	0	0	51
Ice cream	8	28	44

TABLE 3.13 Energy Expended by a 70.0-kg (154-lb) Adult

Activity	Energy (kcal/h)	Energy (kJ/h)
Sleeping	60	250
Sitting	100	420
Walking	200	840
Swimming	500	2100
Running	750	3100

- How long must you swim to use up the energy that you get from a piece of pizza?



Does the calories from fat make sense?