



Temperature

Chapter 10, Section 1

Temperature

- “Hot” and “cold” are NOT scientific terms
- Use temperature to describe the state of a substance

What is Temperature?

- Temperature is a measure of the average kinetic energy of the particles in an object.

Temperature and Kinetic Energy

- o All matter is made of particles that are always moving.
- o Particles in motion have kinetic energy.
- o Faster motion = more kinetic energy
- o More kinetic energy of particles = higher temperature

Average Kinetic Energy of Particles

- o Individual particles have different amounts of kinetic energy.
- o Temperature is a measurement of the average kinetic energy of the particles in a substance; it does not depend on how much of the substance you have

Measuring Temperature

- o You use a thermometer to measure temperature.

Using a Thermometer

- Thermometers are often a glass tube filled with a liquid.
- Alcohol is (and mercury was) used because it remains in a liquid form over a large temperature range and it expands at a constant amount for a given change in temperature.
- *Thermal expansion* is the increase in volume of a substance because of an increase in temperature. As temperature increases, a substances particles speed up and spread out.

Temperature Scales

- Weather reports are often given in degrees Fahrenheit.
- Scientists (and most of the rest of the world) use Celsius.
 - The temperature between the freezing and boiling point of water is divided into 100 equal parts called degrees Celsius.
- Kelvin is the official SI temperature scale.
 - The lowest temperature is 0K-absolute zero.
 - Absolute zero is the temperature at which all molecular motion stops (about -459°F).
 - It is not possible to actually reach absolute zero, but labs can get very close.

Benchmark Temperatures

	Fahrenheit	Celsius	Kelvin
Water boils	212	100	373
Body Temperature	98.6	37	310
Room Temperature	68	20	293
Water Freezes	32	0	273

Temperature Conversion

Conversion	Equation
Celsius to Fahrenheit	$F = 1.8C + 32$
Fahrenheit to Celsius	$C = (F-32)/1.8$
Celsius to Kelvin	$K = C + 273$
Kelvin to Celsius	$C = K - 273$

- A change of 1 Kelvin is equal to a change of 1 degree Celsius.
- A change of 1 degree Celsius is equal to a change of **1.8** degrees Fahrenheit.

Why are these formulas different than the book?

$$9/5 = 1.8$$

multiplying by $5/9$ is the same as dividing by 1.8

More About Thermal Expansion

- Thermal expansion can be dangerous, useful, and fun!

Expansion Joints on Highways

- Expansion joints are the small gaps in a bridge that make the “thuh-thunk” sound.
- They keep segments of the bridge apart so that they have room to expand without the bridge breaking.

Bimetallic Strips in Thermostats

- o A thermostat controls the heater in your home.
- o Some contain a *bimetallic strip*-two different metals stacked in a thin strip.
 - o One expands more than the other when the strip gets hot.
 - o The strip coils and uncoils in response to temperature changes, closing and opening a circuit that turns the heater on and off.

Thermal Expansion in Hot-Air Balloons

- Hot air (not heat) rises.
- When a gas is heated, the particles have more kinetic energy.
- The gas expands and becomes less dense, rising above the denser air below it.