**DUY TAN UNIVERSITY**
DEPARTMENT OF NATURAL SCIENCE

# Temperature and Heat

## (Thermodynamics)

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Da Nang, 2017

# Introduction

- In mechanics we deal with quantities such as mass, position, velocity, acceleration, energy, momentum, etc.

- Question: What happens to the energy of a ball when we drop it on the floor?
- Answer: It goes into heat.

- *Question: What is heat?*

# Temperature and Heat

## Content

1. Some temperature scales

2. Heat and Capacity

# 1. Some Temperature Scales

There are some temperature scales in using daily now, such as:

a/ Celsius Scale: ($T^oC$)

0° : Freezing point of water.

100°C: Water boils.

# 1. Some Temperature Scales

## b/ Fahrenheit Scale: T(F)

| | |
|---|---|
| 32°F | Freezing point of water |
| 212°F | Water Boils |

Note a change of 1°C = a change of 1.8°F.

Conversion between Fahrenheit and Celsius

$$T(F)=1.8^* T(^oC) + 32$$

**Example:**

Room Temperature: 27$^o$C, what value is this temperature in Fahrenheit scale?

## c/ Absolute or Kelvin Scale.T(K)

- The lowest possible temperature on the Celsius Scale is -273°C.
- The Kelvin Scale just takes this value and calls it 0K, or absolute zero.
- Note: the “size” of 1K is the same as 1°C.
- To convert from C to K just add 273.

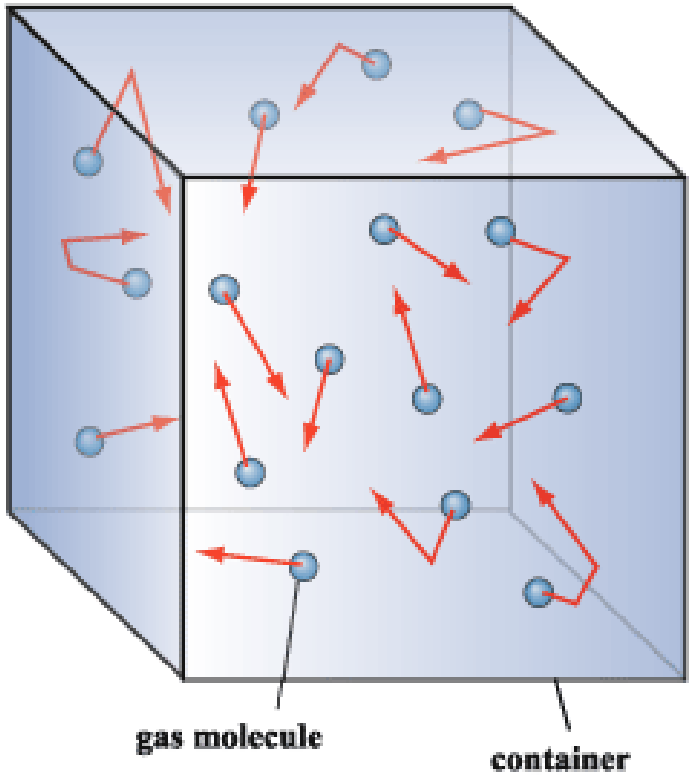
$$T(K)=T(^{o}C) + 273$$

Example:

The room temperature is 30$^{o}$C, in Kelvin scale this temperature is 303K

# 2.Heat and Capacity

- Heat is the random motion of the particles in the gas.




- The higher the temperature, the faster the particles (atoms/molecules) are moving.

- We will take heat to mean the thermal energy in a body OR the thermal energy transferred into/out of a body.

# 2.Heat and Capacity

The amount of heat (Q) added into a body of mass m to change its temperature an amount $\Delta T$ is given by:

$$Q=m.c.\Delta T \quad (3)$$

Unit of Heats:

In the SI units: J (Joule)

- c is called the specific heat and depends on the material: The specific heat is defined as amount of energy needed to raise the temperature of that sample in 1 kg by $1^{o}C$.

# 2.Heat and Capacity

$$Q = m.c.\Delta T$$

| Substance | Specific Heat $c$ J/kg · °C | Specific Heat $c$ cal/g · °C |
|---|---|---|
| **Elemental Solids** | | |
| Aluminum | 900 | 0.215 |
| Beryllium | 1 830 | 0.436 |
| Cadmium | 230 | 0.055 |
| Copper | 387 | 0.092 4 |
| Germanium | 322 | 0.077 |
| Gold | 129 | 0.030 8 |
| Iron | 448 | 0.107 |
| Lead | 128 | 0.030 5 |
| Silicon | 703 | 0.168 |
| Silver | 234 | 0.056 |

Where:

Q: is the heat in J

m: is the mass in Kg

c: is the specific heat in J/kg.K or J/kg.C

ΔT: is the change in temperature in Kelvin

# 2.Heat and Capacity

Example1:

Calculating heat needed to raise temperature of 500g water from 27$^{o}$C to 30$^{o}$C? Given c of water is 4186 J/Kg.C.

Answer

According to Equation:

$$Q = m.c.\Delta T = 0,5.4186.3 = 6280J$$

## Example2

- Compare the amount of heat required to raise the temperature of 1 kg of water and 1 kg of iron 20 °C?

$$Q = mC\Delta T$$

For Water

$$Q = 1.4186.20 = 83720J$$

For Iron

$$Q = 1.448.20 = 8960J$$

*Let* $C = \mu.c$ *: the heat capacity*

$\mu$ is the mass of material in 1 molar.

*The heat capacity is defined as amount of energy needed to raise the temperature of that sample in 1 molar by 1°C.*

Equation (1) is writed (1 mole): $Q = C.\Delta T$

In the general case, if the mass of material is m (kg), the heat need to change temperature by ΔT is calculated:

$$Q = \frac{m}{\mu}.C.\Delta T \qquad (J)$$

where the capital letter *C* refers to the ***molar specific heat capacity*** in units of J/(mol·K).

The End.