جامعة المستقبل
AL MUSTAQBAL UNIVERSITY

كلية العلـــوم
قـســـــــم الادلة الجنائية

Lecture (3)

Temperature and Temperature Scales

Second stage

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Thermodynamics is the branch of science which deals with the energy interactions. In order to find whether energy interactions are taking place or not some measurable mathematical parameters are needed. These parameters are called thermodynamic properties. Out of a number of thermodynamic properties discussed earlier the 'temperature' is one property. Observations at the molecular level show that upon heating the molecular activity inside the bar gets increased. This may be attributed to the more agitated state of molecules as energy is given to them in the form of heating of the bar. From the physiological sensations it can be felt that this has resulted in an increase in the degree of hotness of the bar. This qualitative indication of the relative hotness can be exactly defined by using a thermodynamic property known as temperature. Temperature is thus the intensive parameter and requires reference states. These acceptable known thermal states are such as the boiling point of water commonly called steam point, freezing point of water commonly called ice point etc. These easily reproducible and universally acceptable states of the substance are known as reference states and the temperature values assigned to them are called reference temperatures. Since these reference points and reference temperatures maintain their constant value, therefore these are also called fixed points and fixed temperatures respectively.

Temperature Scales

A number of temperature measuring scales came up from time to time. Different temperature scales have different names based on the names of persons who originated them and have different numerical values assigned to the reference states.

1. Celsius Scale or Centigrade Scale: Anders Celsius gave this Celsius or Centigrade scale using ice point of 0°C as the lower fixed point and steam point of 100ºC as upper fixed point for developing the scale. It is denoted by the letter C. Ice point refers to the temperature at which freezing of water takes place at standard atmospheric pressure. Steam point refers to the temperature of water at which its vaporization takes place at standard atmospheric pressure. The interval between the two fixed points was equally divided into 100 equal parts and each part represented 1ºC or 1 degree Celsius.

2. Fahrenheit Scale: Daniel Gabriel Fahrenheit gave another temperature scale known as Fahrenheit scale and has the lower fixed point as 32ºF and the upper fixed point as 212ºF. The interval between these two is equally divided into 180 parts. It is denoted by the letter F. Each part represents 1ºF. Fahrenheit Scale is related to Celsius scale as follows:

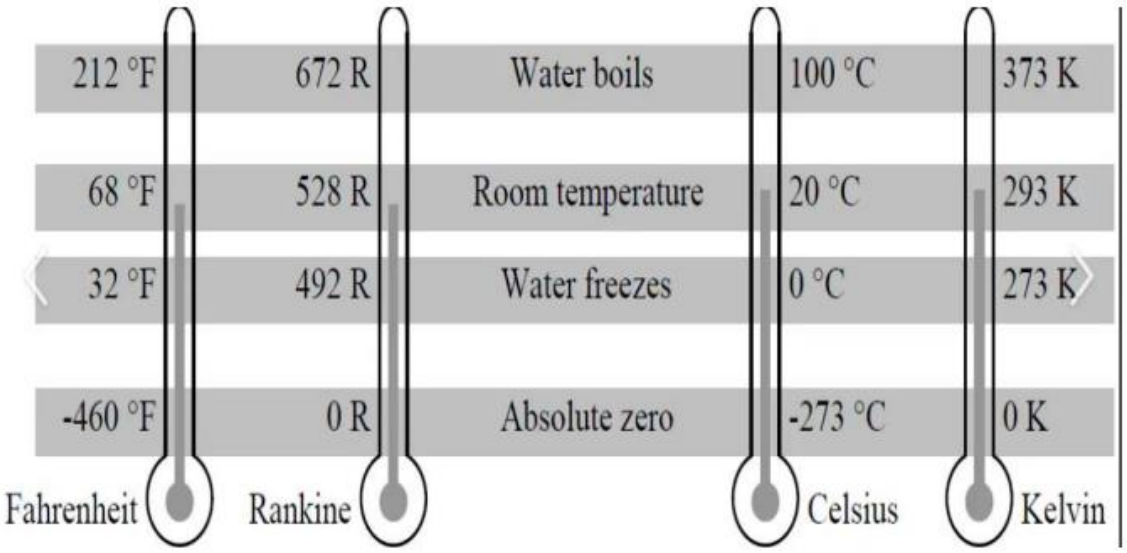
$$T_F = (9/5\ T_C) + 32$$

3. Kelvin Scale: Kelvin scale proposed by Lord Kelvin is very commonly used in thermodynamic analysis. It also defines the absolute zero temperature. Zero degree Kelvin or absolute zero temperature is taken as –273ºC. It is denoted by the letter K. It is related to Celsius scale as given below:

$$T_K = T_C + 273$$

4. Rankine Scale: Rankine scale was developed by William John Macquorn Rankine, a Scottish engineer. It is denoted by the letter R. It is related to Fahrenheit scale as given below:

$$T\,R = T\,F + 460$$



Thermometers :

A mechanical or electrical device for measuring temperature , most thermometers have these three parts:

a - Sensor : A material which is affected by the change in temperature

b- The sensor produces a Signal – information about the temperature , ex. water rising up/down the tube

c- The signal affects a Responder – light, pointer, or other mechanism that use the signal, ex. water is read on the scale.

Four Types of Thermometers

1. Thermocouple
2. Bimetallic Strips
3. Recording Thermometer
4. Infrared Thermograms

Fig(a): Show some of thermometers devices

Medical thermometer

A medical thermometer or clinical thermometer is a device used for measuring human or animal body temperature. The tip of the thermometer is inserted into the mouth under the tongue (oral or sub-lingual temperature), under the armpit (axillary temperature), into the rectum via the anus (rectal temperature), into the ear (tympanic temperature), or on the forehead (temporal temperature).

Classification by location

The temperature can be measured in various locations on the body which maintain a fairly stable temperature (mainly oral, axillary, rectal, tympanic, or temporal). The normal temperature varies slightly with the location; an oral reading of 37 °C does not correspond to rectal, temporal, etc. readings of the same value. When a temperature is quoted the location should also be specified. If a temperature is stated without qualification (e.g., typical body temperature) it is usually assumed to be sub-lingual. The differences between core temperature and measurements at different locations, known as clinical bias, is discussed in the article on normal human body temperature. Measurements are subject to both site-dependent clinical bias and variability between a series of measurements (standard deviations of the differences). For example, one study found that the clinical bias of rectal temperatures was greater than for ear temperature measured by a selection of thermometers under test, but variability was less.

Oral

Armpit

Rectal

Ear

Forehead

Temporal artery

Normal body temperature range

Most people probably grew up being told a body's normal temperature was 98.6 degrees Fahrenheit (or 37 degrees Celsius). That widely accepted number originated from a study done in the mid-1800s.

But newer studies suggest the average person today actually runs a little cooler than that somewhere between 97.5 F (36.4 C) and 97.9 F (36.6 C).The truth is that your body temperature can move up and down and all around though, it usually stays within a certain window. "Typically, anything in the range of 97 to 99 degrees Fahrenheit is considered normal," he says. "But there are times when a perfectly healthy person might have a body temperature that's slightly higher or slightly lower than that.

Age and average body temperature

Your "normal" body temperature changes throughout your life. It often rises from childhood into adulthood before dipping during the later years of life. By stages, it looks like this:

For younger children

The typical body temperature range for children between birth and 10 years old goes from 95.9 F (35.5 C) to 99.5 F (37.5 C). This would be a temperature measured through an oral reading.

For adults and older children

The typical body temperature range for people ages 11 to 65 is 97.6 F (36.4 C) to 99.6 F (37.6 C).

For older adults 8 The typical body temperature range for people older than 65 is 96.4 F (35.8 C) to 98.5 F (36.9 C).

Questions

1. **What is the reference point for the Celsius scale?**

a) Absolute zero

b) Freezing point of water

c) Boiling point of water

d) Both freezing point and boiling point of water

e) None of the above

2-Which scale uses absolute zero as its zero point?

a) Celsius
b) Fahrenheit
c) Kelvin
d) Rankine
e) None of the above

3-How is temperature in the Rankine scale related to the Fahrenheit scale?

a) $T_R = T_F + 273$
b) $T_R = T_F - 460$
c) $T_R = T_F + 460$
d) $T_R = T_F \times 460$
e) $T_R = T_F \times 273$

4-Which of the following temperature scales is most commonly used in thermodynamic analysis?

a) Celsius
b) Fahrenheit
c) Kelvin
d) Rankine
e) None of the above

5-Which thermometer works by using the expansion of a liquid in a glass tube? a) Thermocouple
b) Bimetallic strip
c) Clinical thermometer
d) Recording thermometer
e) Infrared thermometer

6-What is the typical body temperature range for adults (ages 11 to 65)?

a) 95.9°F to 99.5°F
b) 97.6°F to 99.6°F
c) 97°F to 98°F
d) 96°F to 97°F
e) 97°F to 100°F

7-What does the clinical bias in temperature measurements refer to?

a) Variability in temperature readings
b) Difference between rectal and ear temperature
c) Differences in temperature based on location of measurement
d) Both a and b
e) None of the above

8-Which temperature scale has 100 equal divisions between the freezing and boiling points of water?
a) Fahrenheit
b) Celsius
c) Kelvin
d) Rankine
e) None of the above

9-Which type of thermometer is most commonly used to measure body temperature in a clinical setting?

a) Clinical thermometer

b) Thermocouple
c) Bimetallic thermometer
d) Recording thermometer
e) Infrared thermometer

10-What is the relationship between Fahrenheit and Celsius temperature scales?

a) $T_F = 5/9\ T_C + 32$
b) $T_F = 9*5\ T_C + 32$_
c) $T_F = T_C + 273$
d) $T_F = 9/5\ T_C + 32$
e) None of the above