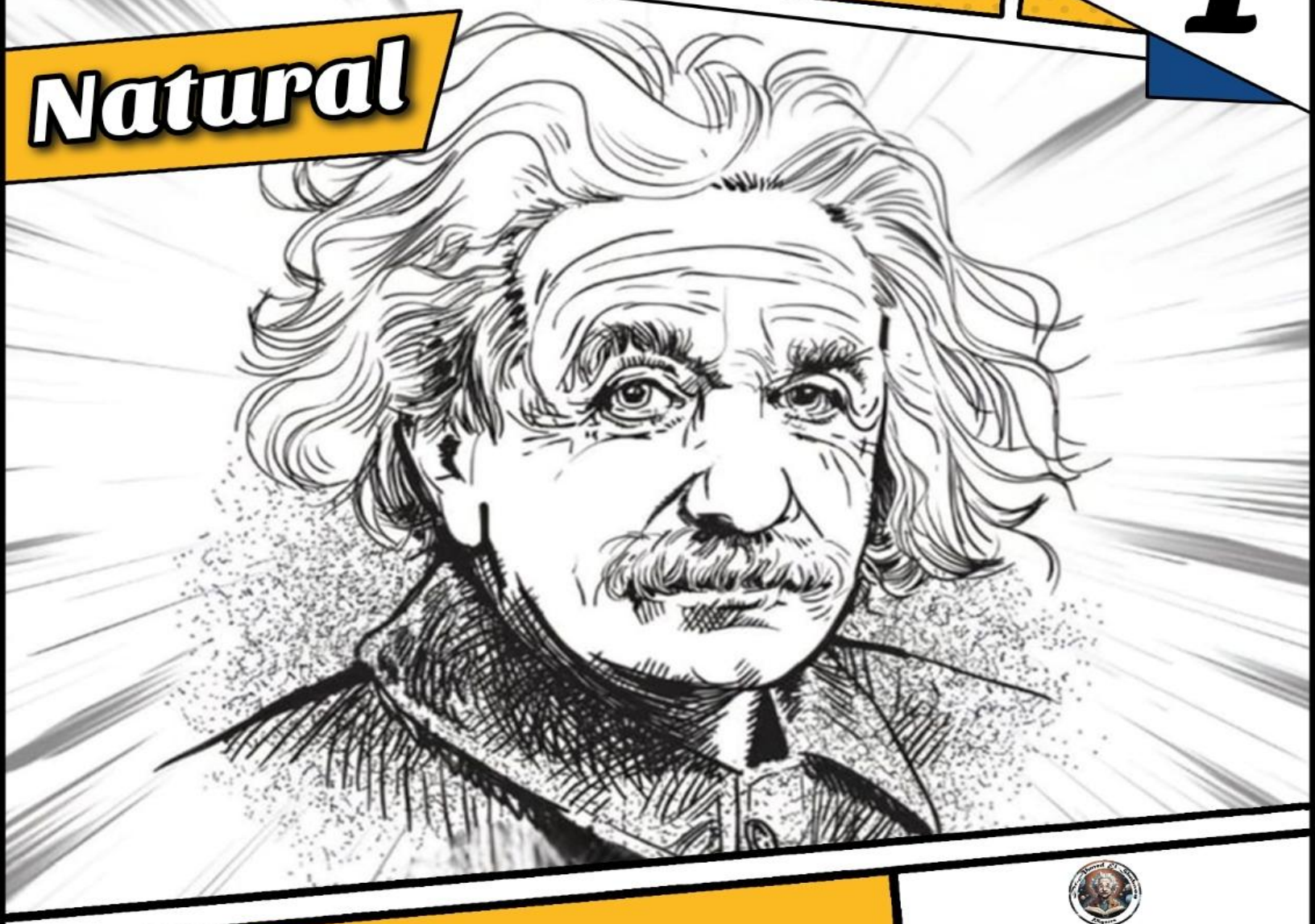
Dr/A.Elshabasy physics

2025

NO 1

Natural



Heat
(Heat & Tempreture)

Physics 1 Dr.Elsahbasy

WhatsApp group

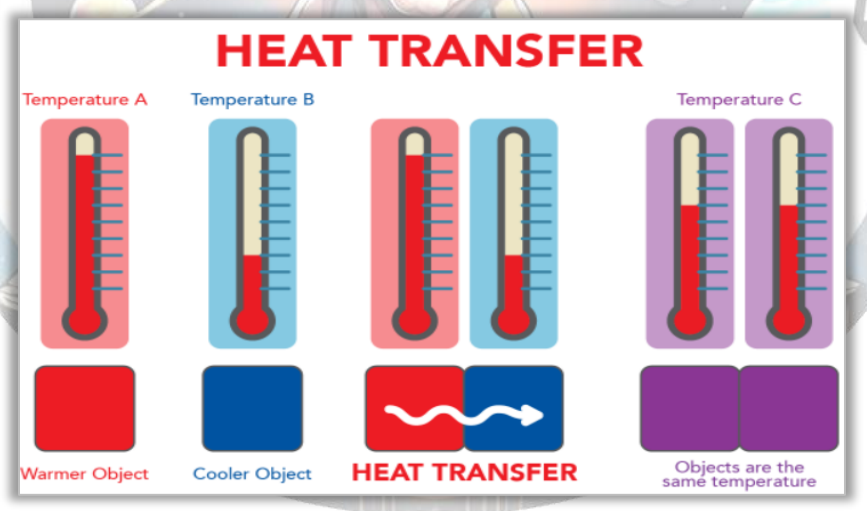
Heat and Temperature

introduction

☞ Heat (Q):

- It is a form of energy that transfers from one object to another due to a difference in temperature.
- Heat flows from the hotter object to the cooler one.
- measured in ***joule*** *and* ***Calorie***

$$1\ cal\ =\ 4.18\ joule$$



☞ Temperature (T):

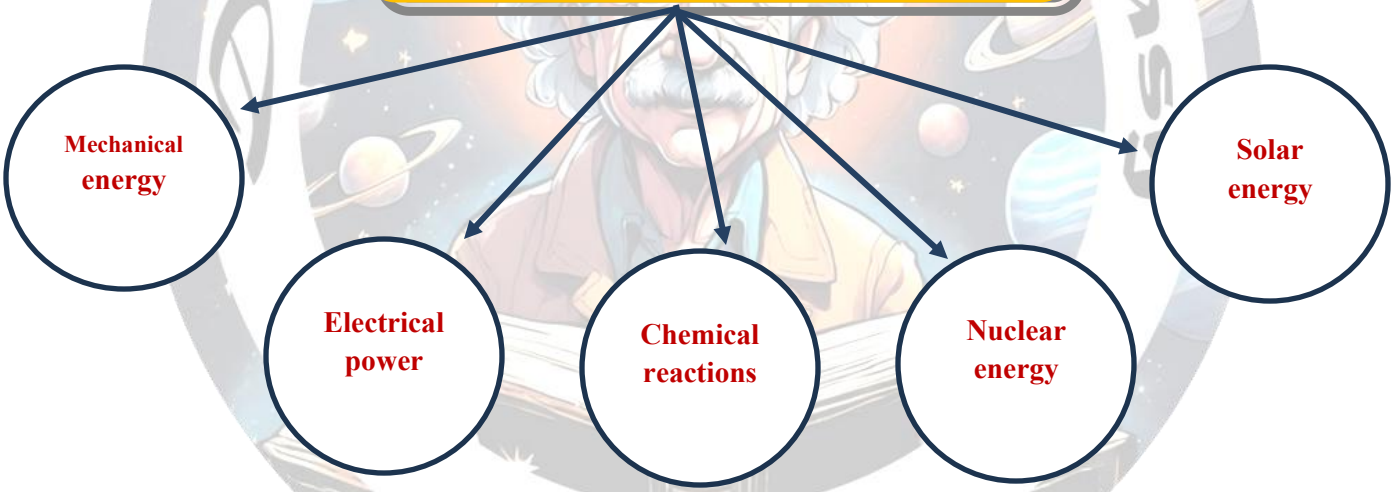
- is a relative measure for the degree of ***hotness*** or ***coldness*** of bodies.
- is a measure of average kinetic energy of molecules of body.

Temperature Units:

Temperature is measured in variety of different units.

1. Celsius scale → (℃)
2. Fahrenheit scale → (℉)
3. Kelvin scale → (K)

Thermal Energy Sources



1- Mechanical energy: thermal energy generated by external or internal friction of object moving.

الجسم عندما يتحرك، يحدث احتكاك بين جزيئاته أو بينه وبين الأسطح الأخرى. هذا الاحتكاك يحول جزءًا من طاقة الحركة إلى **طاقة حرارية**، مما يؤدي إلى زيادة درجة حرارة الجسم أو الأسطح التي يحتك بها.

2- Electrical power: when electric current passes through a wire resistance produce heat and electrical energy is converted into heat.

3- Chemical reactions: when two substances combine chemically and this interaction results in absorption or starting temperature.

4- Nuclear energy: nuclear reactions lead to large amount of heat as a result of converting small part of mass of material to reactive energy.

5- Solar energy: type of nuclear power has types of radioactive heat from sun.

Thermometers

Devices used to measure the temperature of substance.

- All thermometer depends on physical properties

Physical properties

الخواص البتتغير مع تغير درجة الحرارة

Natural properties which high change regularly with temperature

1- Dimensions

تمدد المعادن عند تسخينها - مثل تمدد قضيب معدني عندما يتعرض للحرارة.

2- Resistance of metal

الأسلاك الكهربائية ترتفع مقاومتها عندما تسخن - مثل ارتفاع حرارة الأجهزة الكهربائية عند الاستخدام المطول.

3- Pressure of gas at const volume

ضغط الإطارات يرتفع في الصيف عندما تزداد درجة الحرارة

4- Volume of gas at constant pressure

إذا وضعت زجاجة بلاستيكية مغلقة تحتوي على هواء في ماء ساخن، ستلاحظ انتفاخ الزجاجة نتيجة تمدد الهواء داخلها.

5- electromotive force

في بعض الأنظمة الحرارية، تتولد كهرباء عندما يسخن اللوح بفعل الشمس، مستفيدًا من اختلاف درجات الحرارة بين سطح اللوح والخلفية.

6- Radiation emitted from object

لمبة تتوهج بشكل أكثر وضوحًا عندما ترتفع درجة حرارة الفتيل بداخلها.

Types of Thermometers

1. Mercurial
2. Liquid
3. Gas
4. Metal
5. Thermocouple

Conditions to make thermometer

- determine the **physical property**
- determine the **start and end point**
- determine the **number of sections**

The Temperature Scale

Have two types:

1- Relative (depends on the water)

- Celsius scale
- Fahrenheit scale

2- Absolute (depends on the internal energy of substance)

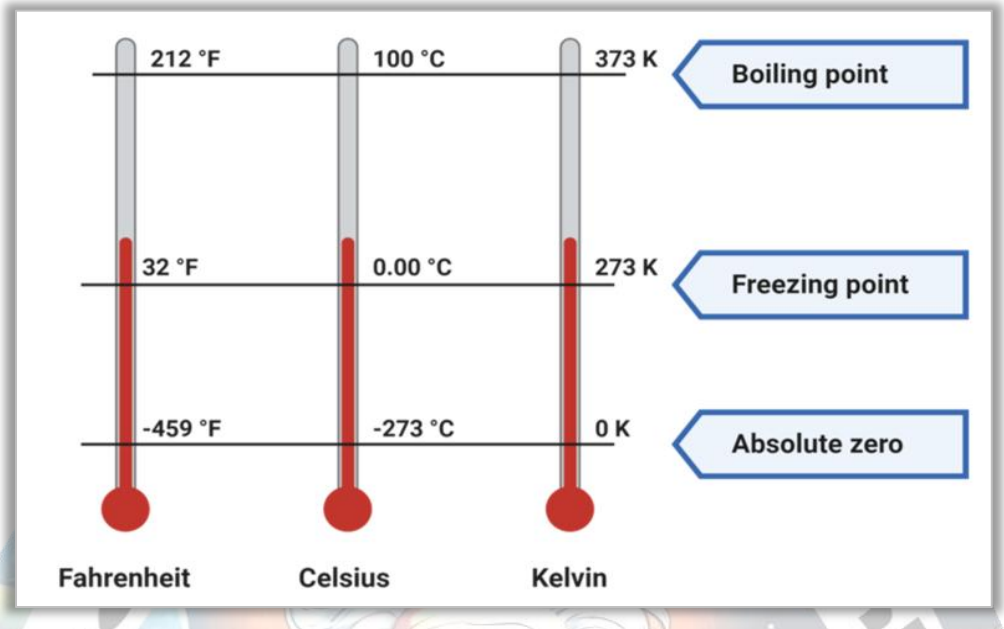
- Kelvin scale

To make temperature scales we must have two fixed points.

1- Melting point of ice (freezing point)

2- Boiling point of water

Temperature scale	Celsius	Fahrenheit	kelvin
Melting point of ice	0°C	32°F	273K
Boiling point of water	100°C	212°F	373K



The Temperature Scale

Relation between temperature scales

① Relation between T_C & T_F : –

$$T_C = \frac{5}{9}(T_F - 32)$$

$$\Delta T_C = \frac{5}{9}\Delta T_F$$

Where,

$$\Delta T_C = (T_C)_2 - (T_C)_1$$

$$\Delta T_F = (T_F)_2 - (T_F)_1$$

② Relation between T_C & T_K : –

$$T_K = T_C + 273$$

$$\Delta T_C = \Delta T_K$$

Where,

$$\Delta T_C = (T_C)_2 - (T_C)_1$$

$$\Delta T_K = (T_K)_2 - (T_K)_1$$

③ Relation between T_F & T_K : –

$$T_K = \left\{\frac{5}{9}(T_F - 32)\right\} + 273$$

$$\Delta T_K = \frac{5}{9}\Delta T_F$$

Where,

$$\Delta T_K = (T_K)_2 - (T_K)_1$$

$$\Delta T_F = (T_F)_2 - (T_F)_1$$

Summary

$$T_C = \frac{5}{9}(T_F - 32)$$

$$T_K = T_C + 273$$

$$\Delta T_C = \frac{5}{9}\Delta T_F$$

$$\Delta T_C = \Delta T_K$$

$$\Delta T_K = \frac{5}{9}\Delta T_F$$

Example 1

Converting the following Temperatures from Fahrenheit scale to Celsius Scale?

(1) 78 °F **(2) 300 °F**

Solution

$$\because T_C = \frac{5}{9}(T_F - 32)$$

1) $T_C = \frac{5}{9}(78 - 32)$ $\therefore T_C = 25.56\ ℃$

2) $T_C = \frac{5}{9}(300 - 32)$ $\therefore T_C = 148.89\ ℃$

Example 2

Convert the following Temperatures from Celsius scale to Kelvin scale?

(1) 20°C **(2) -65°C**

Solution

$$\because T_K = T_C + 273$$

1) $\therefore T_K = 20 + 273$

$\therefore T_K = 293°K$

2) $\therefore T_K = -65 + 273$

$\therefore T_K = 208°K$

Example 3

Convert the following Temperatures from Fahrenheit scale to Kelvin scale?

(1) 82 °F **(2) 272 °F**

Solution

$$\because T_K = \left\{\frac{5}{9}(T_F - 32)\right\} + 273$$

1) $\therefore T_K = \left\{\frac{5}{9}(82 - 32)\right\} + 273$

$\therefore T_K = 300.78\,°K$

2) $\therefore T_K = \left\{\frac{5}{9}(272-32)\right\} + 273$

$\therefore T_K = 406.33\ °K$

Example 4

A block of material is heated from 30℃ to 90℃. Calculate the change in Temperature in:

1) Celsius scale

2) Fahrenheit scale

3) Kelvin scale

Solution

1) $\Delta T_C = (T_C)_2 - (T_C)_1$

$\Delta T_C = 90 - 30 = 60℃$

2) $\Delta T_C = \frac{5}{9}\Delta T_F$

$\Delta T_F = \frac{9}{5} \times 60 = 108℉$

3) $\Delta T_C = \Delta T_K$

$\Delta T_K = 60°K$