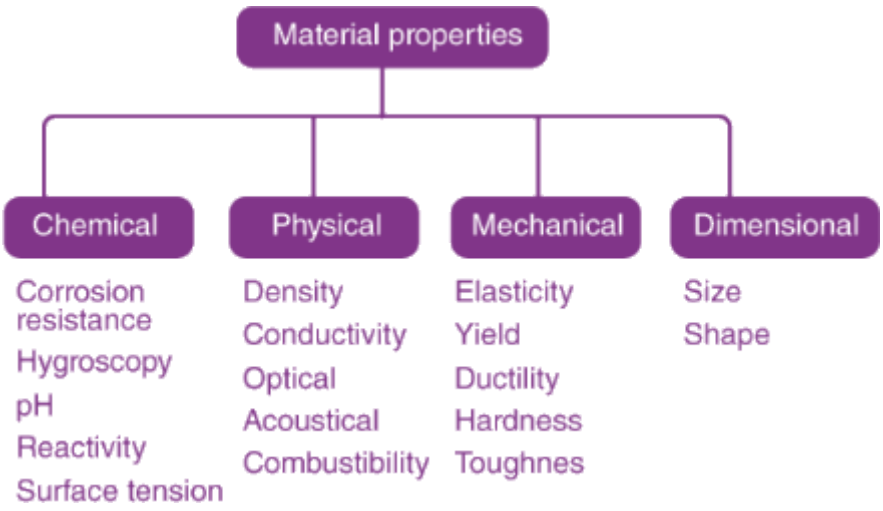
Thermal Properties of Matter: Heat Capacity, Thermal Expansion (For CBSE, ICSE, IAS, NET, NRA 2022)

- Heat is the form of energy transferred between two (or more) systems or a system and its surroundings by virtue of temperature difference.
- The SI unit of heat energy transferred is expressed in joule (J) . In CGS system, unit of heat is calorie and kilocalorie (kcal) .

Material properties



- 1 cal = 4.186 J and 1 kcal = 1000 cal = 4186 J.
- Temperature of a substance is a physical quantity which measures the degree of hotness or coldness of the substance.

- SI unit of temperature is kelvin (K) and °C is a commonly used unit of temperature.
- A branch of science which deals with the measurement of temperature of a substance is known as thermometry.
- A device used to measure the temperature of a body is called thermometer.
- A thermometer calibrated for a temperature scale is used to measure the value of given temperature on that scale.
- For the measurement of temperature, two fixed reference points are selected.
- The two convenient fixed reference points are the ice point and the steam point of water at standard pressure, which are known as freezing point and boiling point of water at standard pressure.
- By definition, matter or material is anything that has mass and occupies space.
- Everything we see around us is matter. For example, a water bottle is made up of plastic or any metal, both of which are examples of matter.
- The matter has properties or characteristics, by which they can be identified.
- The major properties of materials can be categorized under:
  - Mechanical properties of materials
  - Chemical properties of materials
  - Physical properties of materials
  - Dimensional properties of materials
  - Classification Of Material Property

Thermal Properties of Matter

- Thermal properties are those properties of a material which is related to its conductivity of heat.
- While, these are the properties which are exhibited by a material when heat is passed through it.
- Thermal properties of a material decide how it reacts when it is subjected to heat fluctuation.
- It comes under the broader topic of physical properties of materials.
- The major components of thermal properties are:
  - Heat capacity
  - Thermal Expansion
  - Thermal conductivity

- Thermal stressHeat Capacity

Heat Capacity

- It can be defined as the amount of heat required to change the temperature of the material by one degree.
- The amount of heat is generally expressed in joules or calories and the temperature in Celsius or Kelvin.
- In order to calculate the heat capacity of materials with a given dimension, Molar heat capacity or Specific heat capacity is used.

Thermal Expansion

Effect of thermal expansion on railway track

- When heat is passed through a material, its shape changes. Generally, a material expands when heated.
- This property of a material is called Thermal Expansion.
- There can be a change in the area, volume and shape of the material.
- As an example, railway tracks often expand and as a result, get misshapen due to extreme heat.

Thermal Conductivity

- It is the property of a material to conduct heat through itself.
- Materials with high thermal conductivity will conduct more heat than the ones with low conductivity.
- Some materials do not conduct heat at all because of the insulating properties of materials.

Thermal Stress

- Stress experienced by a body due to either thermal expansion or contraction is called thermal stress. It can be potentially destructive in nature as it can make the material explode.