UNIT – I

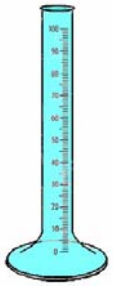
The Nature of Matter

Chapter 1:– *Physical Properties*

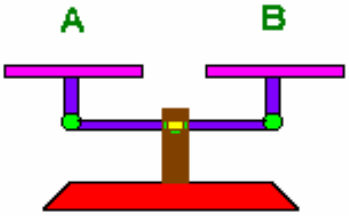
These days, SI units are commonly used by the scientists to make measurements. A unit that is defined by a physical standard is called base unit, for example -- meter. While a unit that is formed by a combination of base units is called derived unit, for example – density. The Following table shows seven SI base units and their abbreviations:

Quantity	Basic Unit
Length	Meter(m)
Mass	Kilogram(kg)
Temperature	Kelvin(K)
Time	Second(s)
Amount of a substance	Mol(mol)
Electric current	Ampere(A)
Luminous intensity	Candela(cd)

Using the correct tool for the measurement is very important. The following are some of the common tools used for scientific investigation.



Graduated cylinder



Pan balance

Thermometer

Stopwatch

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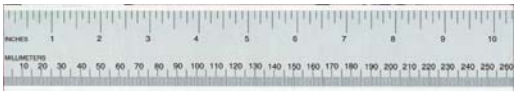
Spring scale

Hand lens

Microscope



Metric ruler

Tools	Uses
Graduated cylinder	Used to measure how much space something occupies.
Pan balance	Measures the amount of matter in an object
Thermometer	Measures how hot or cold something is.
Stopwatch	Measures how fast something occurs.
Spring scale	Measures the force with which an object is pushed or pulled.
Metric ruler	Measures the length of an object.
Hand lens	Enlarges the image
Microscope	Can produce an image that is up to 2000 times larger than the actual object.

READING CHECK:

What are base units?

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READING CHECK:

What are derived units?

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READING CHECK:

Which tool is used for measuring the amount of matter in an object?

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READING CHECK:

Which tool is used to measure how much space something occupies?

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READING CHECK:

Which tool is used to produce an image that is many thousand times larger than the actual object?

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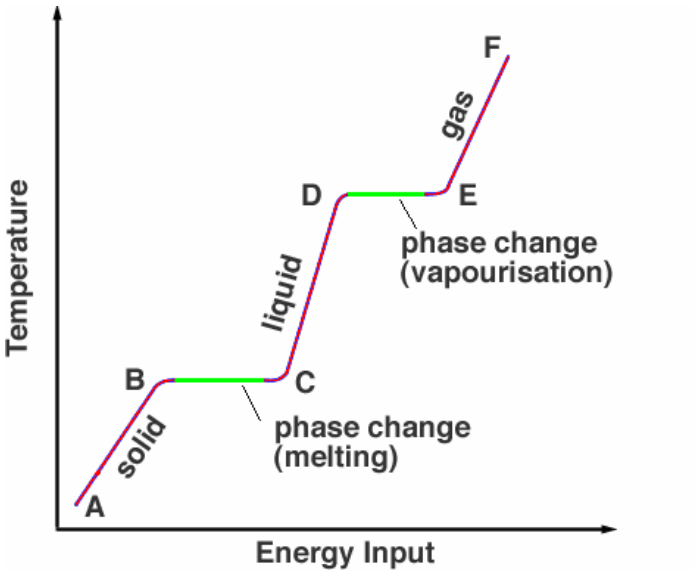
Chapter 2 *Particles and Temperature*

Matter is made up of particles. The particles in the matter are constantly moving. But the particles in the different substances are moving with a different speed. The temperature of a substance affects the movement of the particles in a substance. It also affects the physical state of the substance.

Temperature measures the average motion of the particles in a substance. A thermometer is used to measure the temperature of a substance on various scales. The
Fahrenheit, Celsius, and Kelvin are the commonly used scales.

Heat is the amount of energy transferred between substances. Energy will flow between different matters at different temperatures.



The increase or decrease in the temperature changes the position and the motion of the atoms in liquid, solid, or gas. Increase in the temperature increases the motion of the atoms in an object. Similarly, decrease in the temperature decreases the motion of the atoms in an object. Heat energy always flows from a warm substance to a cool substance. Addition of the heat increases the motion of the atoms in a substance. Addition or removal of enough heat results in a phase change in the matter. Heat energy increases when a substance moves from solid, to liquid, to gas.

READING CHECK:

What is temperature?

READING CHECK:

What is heat?

READING CHECK:

What is the affect of change in the temperature on the motion of the atoms in an object?

READING CHECK:

How temperature changes affect the phase change in a substance?

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READING CHECK:

How the flow of the heat energy takes place?

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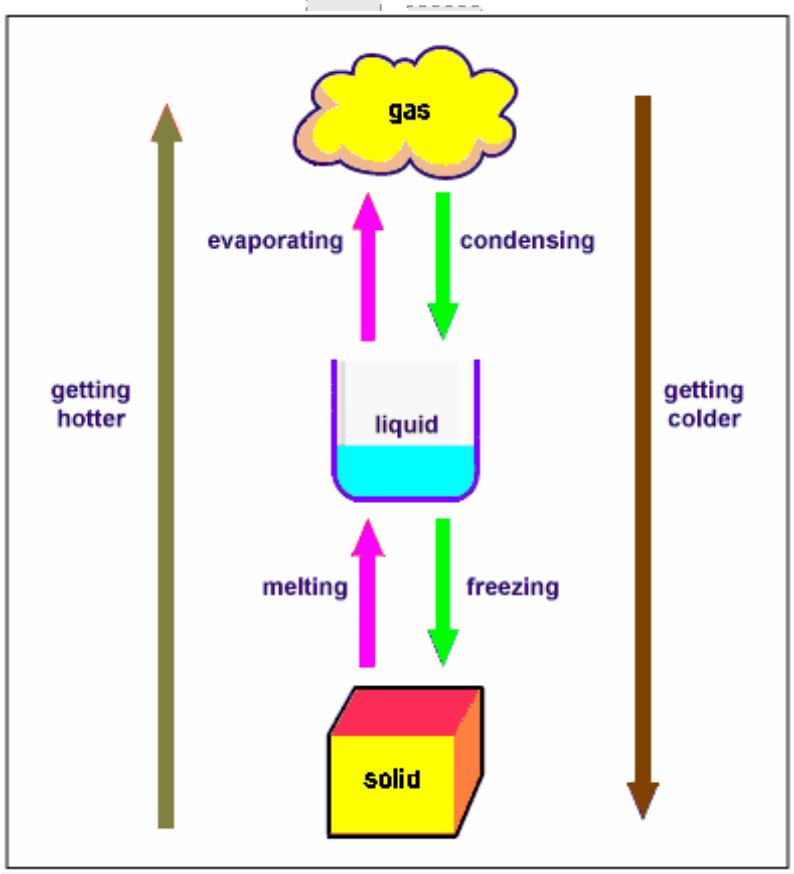
Lesson 3 *Physical Changes*

There are three states of matter– solid, liquid, and gas. Matter can change from one state to another. These state changes are types of physical changes because the composition of the material is not changed during these changes. Increases or decreases in the amount of heat are responsible for these changes.



State changes

Original States	New States	Name of Change	Examples
Solid	Liquid	Melting	Melting of ice
Liquid	Solid	Freezing	Formation of ice
Liquid	Gas	Evaporation/Boiling	Drying of clothes
Gas	Liquid	Condensation	Formation of drops of water on a glass containing a cold drink
Solid	Gas	Sublimation	Conversion of dry ice into vapors

Mass tells the amount of matter present in an object. Mass of an object is measured by using a pan balance. In the metric system, some common units of mass are the milligram, gram, and kilogram. State changes in matter obey the law of conservation of mass which says that mass will remain same during physical changes in a closed system.

READING CHECK:

What are the different states of matter?

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READING CHECK:

Why state changes are called physical changes?

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READING CHECK:

Which factor is responsible for the change in the state of the matter?

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READING CHECK:

What information is obtained from the mass of an object?

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READING CHECK:

What is the law of mass conservation?

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Chapter 4 *Chemical Changes*

Chemical changes are the changes which alter the composition or the molecular structure of a compound. It is very difficult to reverse a chemical change. Chemical changes occur all around us. Some examples of chemical changes are burning of wood, formation of rust, digestion of food in our stomach, photosynthesis by plants, etc.

In every chemical change starting materials called reactants react to form new substances called products. Chemical changes also obey the law of conservation of mass, that is in a chemical reaction total mass of the reactants is always equal to the total mass of the products.

READING CHECK:

What are chemical changes?

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READING CHECK:

What is the difference between a physical change and a chemical change?

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READING CHECK:

What are the reactants?

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READING CHECK:

What are the products?

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READING CHECK:

Do chemical changes obey the law of conservation of mass?

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Lesson 5 *Determining Volume*

The amount of matter in an object is called its mass. Two objects can have same mass but they may not have the same volume.

Volume is the amount of space occupied by an object. The unit of the volume represents the length, width and height of an object. These can be measured in meters, centimeters, or millimeters. A unit of volume is shown by multiplying these measurements together. A cubic meter is a cube 1.0 meter deep, by 1.0 meter long, by 1.0 meter wide.

Density of an object is the mass of that object per unit volume. It is usually expressed in grams per cubic centimeter (g/cm^3)

Density = Mass/Volume

READING CHECK:

Will two objects having same mass always have same volume?

READING CHECK:

What are the units of volume?

READING CHECK:

What is the relation between mass and volume of an object?

READING CHECK:

What are the units of density?

Lesson 6 *Particles and Waves*

All the matter is made up of atoms. Atoms contain small particles – electrons, protons and neutrons. Electrons are negatively charged, protons are positively charged and neutrons are negatively charged. Electrons can move through matter. Objects can gain or lose electrons. An object will be positively charged if the atoms in that object contain more protons as compared to that of electrons. An object will be negatively charged if the atoms in that object contain more electrons as compared to protons. An object will have no charge if the atoms present in it contain equal number of protons and electrons. Objects with unlike charges attract each other while the objects with like charges repel each other.

Energy is also transferred through matter or space by waves. The disturbance of particles follows a pattern that creates a wave. The motion of a wave is characterized by the properties such as wavelength, frequency and amplitude. Wavelength is the length of each wave crest to crest or trough to trough. Frequency is the number of waves which passes through a given point in one second. Frequency of a wave is inversely proportional to its wavelength. The amplitude of a wave is the height of its crest or the depth of its troughs. Amplitude is the measure of energy in a wave. Waves with different frequencies or wavelengths can have the same amplitude.

READING CHECK:

What are the constituents of an atom?

READING CHECK:

What are the charges present on the various constituents of the atom?

READING CHECK:

Which constituents of atoms move through the matter?

READING CHECK:

When an object does has positive charge on itself?

READING CHECK:

When an object does has negative charge on itself?

READING CHECK:

When an object does not has any charge on itself?

READING CHECK:

What is the wavelength of a wave?

READING CHECK:

What is the frequency of a wave?

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READING CHECK:

What is the amplitude of a wave?

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READING CHECK:

What is the relationship between frequency and wavelength of a wave?

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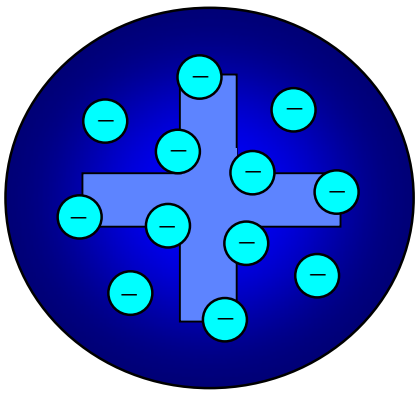
Lesson 7 *Bohr's Model of an Atom*

J.J. Thomson was the scientist who discovered electrons. He was aware of the fact that atoms had to be neutral. He proposed a model of atom in which it is considered that atom is a sphere of positive charge in which negatively charged electrons are embedded as shown below



Ernest Rutherford took this theory one step further in 1911. He performed an experiment in which a stream of positively charged particles was directed at an extremely thin sheet of gold. Some of these particles bounced back. This observation led to the discovery of positively charged protons. Rutherford said that majority of the mass of the atom had to be concentrated in the centre of the atom. This central mass was called **nucleus**.

In 1913, Bohr suggested that electrons could only follow certain paths. These paths were named **energy levels**. An electron can move up or down a level by absorbing or releasing a specific amount of energy. On gaining energy, electrons jump to higher energy levels. This is called an excited **state**. On releasing energy, electrons can return to its usual state.

Nowadays, the **electron cloud** model is used to describe the electron location. The area of the atom where the electrons are likely to be found is called the electron cloud.

In 1932, James Chadwick named a third subatomic particle, the neutron. Neutron does not contain any charge, i.e. it is neutral. The force which holds the protons and neutrons together in the atom's nucleus is called the **strong force.** The number of protons present in the atom is called the **atomic number** which identifies what element the matter is. The total number of protons and neutrons in an atom is called the **mass number.** Some atoms of an element may have more neutrons than others. These are called **isotopes.** Isotopes of an element have same atomic number but different mass number because of varying number of neutrons. Isotopes of an element have similar chemical properties but different physical properties.

READING CHECK:

What was discovered by J.J. Thomson?

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READING CHECK:

Describe the Rutherford's model of an atom?

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READING CHECK:

Who gave the concept of energy levels?

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READING CHECK:

What are excited states?

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READING CHECK:

What do you mean by electron cloud?

READING CHECK:

What holds the protons and neutrons together in a nucleus?

READING CHECK:

Describe the atomic number and the mass number.

READING CHECK:

What are isotopes?