

2.1 Matter:-

Matter :- is what all things are made of, what we see, occupies space, has mass, and is ~~per~~ perceptible to the senses in some way.

Law of conservation, matter cannot be created or destroyed, but it is possible to change its physical state.

When liquid gasoline vaporize and mixes with air, then burns, it might seem that this piece of matter has disappeared and no longer exists.

Although it no longer exists in the state of liquid gasoline, the matter still exists in the form of the gases given off by the burning fuel.

Nature of matter:-

- > All matter is made up of atoms.
- > An atom is the smallest unit of matter that establishes the unique characteristics of a substance.

-> orbiting around the nucleus is a third kind of subatomic particles known as electron.

-> electrons has a negative electrical charge.

-> Electron are configured around the nucleus in orderly concentric rings known as shells.

each atom contains same number of electron and neutron as the atom has proton

For example:-

atom of H has 1 proton, 1 neutron, 1 electron, its simplest element

The number of subatomic particles of each atoms contains defines

1. The type of element it is
2. its inherent properties.

Generally

The number of these particles that each atom contains is what causes the elements to be different.

atom of O₂ has 8 proton, 8 neutron, 8 electron

atom of Cu has 29 of each these subatomic particles.

The mass of an atom is related to

1. how many characteristic subatomic particles make up the atom of each element.

-> there are over 100 different kinds of matter each made up of atoms with different physical attributes.

-> these varied and unique kinds of matter are called "Elements".
-> They cannot be further broken down into simpler substances without losing their unique identity.

Atoms of different element are similar to each other in that

- They contain the same basic parts
- > An atom has a nucleus within the nucleus are subatomic particles.
- > one or more proton are found at the nucleus of all atoms
- > proton has positive electrical charge.
- > one or more neutrons are found at the nucleus of all atoms
- > neutrons has no electrical charge

Elements

- are assigned an **atomic number** : how many protons are found at the nucleus.
- Each element has a distinctive 1, 2 or 3 letter abbreviation.
- The elements are arranged in a table known as the **periodic table**.
- The **table** groups the elements by **periodic horizontally** and by **groups vertically** to show similar characteristics of the elements.

Atoms

of the same or different element may chemically bond to form a molecule.

When two or more atoms of the same element bond to form a molecule, it will have the inherent properties of that element.

When two or more atoms of the different element bond, the molecule has properties and characteristics completely different than those of each individual element that comprise it.

Example: Water molecule H_2O

Water has its own unique properties that are completely different than those of H and O_2 alone.

material with this characteristic are chemically stable.

it takes a large amount of force to move the electrons in this situation from one valence shell to that of another.

Since the movement of electron is called **electric current**.

Substance with complete valence shell known as **good insulators**, because they resist the flow of electron (electricity).

The material is chemically disposed to combine with other material or atoms to fill unstable valence configuration and bring the number of electron in the valence shell to **max**.

In atom with an incomplete valence shell, those without the max number of electrons in their valence shell, the electron are bound less strongly to the nucleus.

When atoms bond to form molecules, they share electrons.

Shell or orbit number	1	2	3	4	5
Maximum Number of electrons	2	8	18	32	50

The closest shell to the nucleus can only contain two orbiting electrons.

if electron more than ten, in third shell take max 18.

Found in the next orbital shell farther away from the nucleus, second shell contains 8 electrons.

Valence Shell :-

The outer most orbital shell of any atom's electrons.

The number of electron in valence shell determines the chemical bonding of material as well as other characteristics such as conductivity.

When the valence electron shell is complete and electrons tend to be bound strongly to the nucleus.

Covalent bond:-

L> Two or more substance may share the electrons in their valence shell and form a covalent bond.

L> It is the method by which atoms complete their valence shell by sharing valence electron with other atoms. The molecules are formed this way.

Electron in incomplete valence shell,

L> May also move freely from valence shell to valence shell of other atoms or compound.

L> In this case, these are known as "free electron".

L> The movement of electrons known as electric current or current flow.

L> When electrons move freely from atom to atom or compound to compound know as "conductor".

Isotopes:-

L> When atoms of the same element have different numbers of neutrons, they are called isotopes.

→ Because how an atom acts is decided by its electronic structure.

L> Isotopes are almost the same chemically, but they are different physically because of their different masses.

Example: Hydrogen has three common isotopes.

1. Protium ${}^1_1\text{H}$

1. proton
no neutrons

2. Deuterium ${}^2_1\text{H}$

1. proton
1. neutron
atomic mass 2

3. Tritium ${}^3_1\text{H}$

1. proton
2. neutron
atomic mass 3

Protium and deuterium are stable isotopes while tritium is radioactive isotopes.

Chemical compounds

L> Materials made up of two or more elements that have chemically bonded are called compounds.

Compound have properties different than the elements from which they are made.

They have unique chemical structure with a fixed ratio of atoms of different elements that are bonded together chemically.

They can only be separated through chemical reaction.

Compound should not be confused with mixture.

→ Because of the different number of neutron, various isotope of same element have different masses.

L> Mass is the factor for
1. how much matter something has

2. How much it weight

L> Because different isotopes have different number of neutron, they do not all weigh the same.

L> Different isotopes of the same element have same atomic number, because they have same number of proton.

L> The atomic number is decided by the number of protons.

L> Isotopes of the same element also have same number of electron and the same electronic structure.

Mixture :-

are atoms and molecules that are physically mixed together but are not chemically bonded.

The properties and characteristics of mixture are closely related and dependent on the properties of the individual constituents.

Mixtures can usually be separated by filtering, evaporation or some other mechanical means.

States of matter :-

Consist of: solid, liquid, gas and plasma.

State of matter: is a physical condition of a substance.

Solid, liquid and gas are the primary state of matter of concern for the aviation maintenance profession.

Proportional resulting in a relatively neutral electric charge.

↳ its particles are close enough together that they act collectively when exposed to a magnetic field.

↳ Plasma is also electrically conductive.

↳ it is ^{found} sustained easily at the extremely high temperature present in stars.

↳ and as such is the most common form of matter in the "universe".

Solid :-

↳ Matter: is said to be solid when it has a definite volume and shape.

↳ The molecules of solid are tightly bound to each other.

↳ Solid may be geometrically or irregularly structured.

↳ They are incompressible and do not contain enough movement of the molecules to permit a physical change of shape.

The compound(s) ~~which~~ from which a substance is made do not change, regardless of the state of matter.

Atoms and molecules that make up a substance are always in a state of motion due to heat energy in the material.

The physical state of matter

1. is related to the degree of motion
2. between these particles with solid having least motion and gases and plasma having the most.

Plasma :

↳ is unique state of matter

↳ Composed of ionized gas

↳ consisting of ^{DATE} positive ion and free electrons in

Liquid:-

- L> is characterized by molecules that have more energy and increased movement.
- L> This causes the molecules to be able to flow and not take a rigid shape as such solid.
- L> Liquids take the shape of their container even though the volume of a liquid does not change significantly. كثير الحركة
- L> liquid are said to be "incompressible".
- L> While liquid molecule are able to slide past each other.
- L> they are still closely packed enough that the application of pressure does little to change the volume.
- L> The molecules are also closely bound enough to each other that the surface tension is created.
- L> Surface tension keeps liquid from complete freedom of expansion
- L> Where it can be observed??
- L> When the container is filled with a liquid slightly over the brim yet the liquid does not spill over.

Changing between states:-

- L> Matter can change between state
- 1. by adding or removing energy
- L> The chemical composition of the material remains the same during all state of matter, but the energy level causes it to be a solid, liquid or gas.
- L> For example, water is H_2O millions of pairs of H atoms covalently bonded to a single O_2 loosely held next to each other in a liquid state

When energy is removed and water becomes ice, it is still H_2O .

- L> However, the motion of the molecules is greatly reduced and they no longer have the energy to slide past one another as liquid.
- L> The same is true when heat energy is added to water.
- L> Water vapor is formed as the ~~more~~ motion of molecules causes more freedom of movement between molecules.

Gas:-

Matter also exists as gases

- This type of matter contains
1. even more heat energy and
 2. movement in its molecules

The bonding that causes surface tension in a liquid does not exist in a gas.

A greater space between molecules exists

Gases take the shape of their container, but unlike liquids ~~equal to~~ gases are compressible.

When pressure is applied, the molecules can be made to exist closer to each other.

It is possible to put a gas under so much pressure that it changes to a liquid state.

↳ But the water existing as a gas (vapor) is still formed from millions of H_2O molecules.

The heat ~~to~~ energy added or subtracted to a substance is typically measured by temperature

↳ The higher the temperature of a substance, the more energy it contains.

↳ heat always flow from hot to cold

↳ These terms (hot and cold) express the relative amount of energy present in the substance.

↳ They do not measure the absolute amount of heat present

↳ Without a difference ~~between~~ in energy level, there is no transfer of energy (heat)

Adding heat to a substance do not always raise its temperature

↳ The temperature at which substance change from a liquid into a vapor when heat is added is known as its boiling point.

↳ This is the same temperature ~~when~~ ^{at which} a vapor condenses into a liquid when heat is removed.

↳ The boiling point of any substance varies directly with pressure.

↳ When pressure on a liquid is increase its boiling point increase $P \uparrow B \uparrow$

↳ When pressure on a liquid is decrease its boiling point decrease $P \downarrow B \downarrow$

For example:

Water boils at $100^\circ C$ ($212^\circ F$) at normal atmospheric pressure (14.7 psi).

When pressure on a liquid water increases to 20 psi, it does not boil at $100^\circ C$.



Water can also boil at lower temperature by reducing the pressure upon it.

↳ When a substance changes state, such as liquid changes into a vapor, heat energy is absorbed.

This is called "latent heat" ^{dis-~~use~~}

↳ When a vapor condenses into a liquid, this heat energy is given off.

↳ The temperature of a substance remain ~~the~~ constant during its change of state.

↳ All energy absorbed or given off, the latent heat is used for the change process ^{change of state} ~~energy process~~

↳ Once the ~~energy process~~ is complete, heat added to a substance raises the temperature of the substance

↳ After a substance changes state into a vapor, the rise temperature of the vapor caused by the addition of still more heat is called "super heat".

Vapor pressure :-

↳ is the pressure of the vapor that exists above the liquid that is in an enclosed container at any given temperature.

↳ developed by various substances is unique to each substance.

↳ the substance that is said to be volatile, develops high vapor pressure at standard day temperature 15°C (59°F).

↳ this is because the boiling point of the substance is much lower.

↳ the vapor pressure of any substance varies directly with temperature.

Catalyst :-

↳ is a substance that causes or accelerates a chemical reaction without itself being affected.

↳ a two part epoxy mix is a good example of a catalyst.

↳ The main ingredient is the epoxy resin itself.

↳ the second ingredient, when mixed with resin, causes the resin to harden faster and then remains as part of epoxy resin mix.

Chemical bonding properties and conductivity

5. What is law of conservation?

Matter cannot be created or destroyed it can only be changed from one physical state to another.

6. What is the principle difference between one element and another?

The number of protons, neutrons, and electrons within its atom.

7. What is the main factor determines whether one element is able to combine with another to form molecules?

The number of electron each the atom's outer shell.

8. What determines how much a material weighs?

The number of protons and neutrons in the nucleus of its atom.

9. What is the principle factor which determines what state of matter an element is in?

its temperature.

↳ The opposite of a catalyst is an inhibitor.
↳ Inhibitors slow down reactions.

DATE: _____

Questions :-

1. What is the matter and state of matter?

Matter is what all is made of, occupies space, has mass and is perceptible to the sense to some way.

State of matter: solid, liquid, gas and plasma.

2. Name two characteristics affected by the number of electron in valence shell of atom.

Its ability to combine with other atoms, whether the material is a conductor or insulator.

3. What is the difference between compound and mixture?