IS MATTER AROUND US PURE

Matter may be classified as pure substances and impure substances.

Pure substances are made up of only one kind of particles. All the elements and compounds are pure substances.

Example: gold, water

Impure substances are made up of two or more different kind of particles. All the mixtures are impure substances.

Example: salt solution, sugar solution

Element: The simplest form of matter, which can't be further split into smaller substances is called element.

Element can be further classified as metals, nonmetals and metalloids.

Properties of metals:

- Metals are malleable i.e. they can be converted into thin sheets on hammering. Gold and silver are the best malleable metals.
- Metals are ductile i.e. they can be drawn into thin wires. Gold and silver are the best ductile metals.
- Metals are good conductor of heat and electricity. Silver is the best conductor of heat as well as electricity. Lead and mercury are the poorest conductor of heat. Iron and mercury show less electrical conductivity.
- Metals are lustrous i.e. they are shiny and can be polished. This makes them good reflector of light. Silver is an excellent reflector.
- Metals are hard except sodium and potassium.
- Metals, except sodium and potassium, are strong i.e. they have high tensile strength (i.e. they can hold large weights)
- Metals are found in solid state at room temperature. Only mercury is liquid.
- Metals, except sodium, potassium and gallium, have high m.p. and b.p.
- Metals are sonorous.
- Metals usually have a silver or a grey colour except gold and copper.

Properties of non-metals:

- Nonmetals are non-malleable i.e. they are briitle.
- Nonmetals are ductile i.e. they are brittle.
- Nonmetals are bad conductor of heat and electricity except diamond (good conductor of heat) and graphite (good conductor of electricity)
- Nonmetals, except iodine, are not lustrous i.e. they are dull.

- Nonmetals, except diamond, are soft.
- Nonmetals are not strong.
- Nonmetals are found in solid (sulphur, phosphorus), liquid (bromine) and gaseous state (oxygen, hydrogen) at room temperature.
- Nonmetals, except graphite, have low m.p. and b.p.
- Nonmetals are not sonorous.
- Nonmetals exist in different colours.

Metalloids: Metalloids are the elements which show properties of metals as well nonmetals.

Example = boron, silicon, germanium

Compound: It is a substance made up of two or more elements chemically combined in a fixed proportion.

Properties of compounds:

- A compound cannot be separated into its components by physical methods.
- The properties of a compound do not depend on the properties of its components.
- The composition of a compound is fixed. The constituents are present in a fixed ratio by mass.
- A compound has a fixed m.p. and b.p.
- A compound is a homogeneous substance.

Mixture: A mixture is a substance containing two or more elements or compounds in any proportion.

Homogeneous mixture: In this type of mixture there is a uniform composition. The constituents can't be seen. For example sugar solution, salt solution, alloys etc.

Alloy *is a homogeneous mixture of metal and metal or nonmetal which cannot be separated into its components by physical methods*.

Examples:

Alloy	constituents	use
Brass	Cu, Zn	screws, rivets
Bronze	Cu, Sn	musical instruments, medals
Alnico	Al, Ni, Co	making permanent magnets
Steel	Fe, C	Building, cutlery, surgical equipment
Stainless steel	Fe, Ni, Cr, C	surgical instruments, utensils,
Solder	Pb, Sn	to join metal pieces in electrical work
Duralium	Al, Cu, some Mn and Mg	aircrafts, pressure cooker

Heterogeneous mixture: In this type of mixture there is no uniform composition. The constituents can be seen by naked eye. For example sand solution and mixture of iron and sulphur.

Properties of mixture:

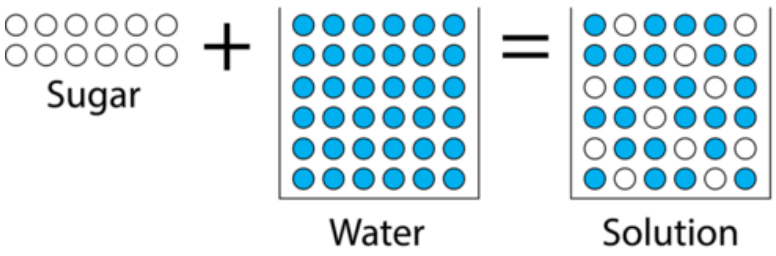
- A mixture can be separated into its components by physical methods.
- The properties of a mixture depend on the properties of its components.
- The composition of a mixture is not fixed.
- A mixture does not have a fixed m.p. and b.p.
- A mixture can be homogeneous (true solutions and alloys) or heterogeneous (colloids and suspensions).

Difference between compounds and mixtures:

	Mixtures	Compounds
•	can be separated into its constituents by physical methods	cannot be separated into its constituents by physical methods
•	shows properties of its constituents	does not show properties of its constituents
•	does not have a definite formula	have a definite formula
•	does not have fixed boiling and melting points	have fixed boiling and melting points

Solutions: The homogeneous mixture of two or more substances is called solution (also called true solution).

The substance, which is dissolved in a liquid to make a solution is called ***solute*** while the liquid in which it is dissolved is called ***solvent***.



***Characteristics of solutions*:**

(i) A solution is a homogeneous mixture.

(ii) Size of solute particles is very small and can't be seen even with a microscope.

(iii) The particles can pass through the filter paper.

(iv) These do not scatter light i.e. do not show Tyndall effect.

(v) Particles do not settle on keeping i.e. they are stable.

The solutions in which solutes are dissolved in water are called *aqueous solution*. The solutions in which solutes are dissolved in organic solvents are called *non-aqueous solution*.

Colloid: It is a kind of solution in which the size of solute particles is larger than that in solution. For example blood, soap solution, milk, ink, jelly etc.

***Characteristics of colloids*:**

(i) A colloid is a heterogeneous mixture.

(ii) Size of solute particles is larger than that in solution but can't be seen even through a microscope easily.

(iii) The particles can pass through the filter paper.

(iv) These scatter light i.e. show Tyndall effect.

(v) Particles do not settle on keeping.

A colloidal mixture and suspension have two components like solute and solvent in a solution.

Dispersion medium It is the component present in larger quantities in which the other component is suspended in.

Dispersed phase It is the component in smaller quantities which is suspended in the dispersing medium

Classification of colloids:

Medium/phase		Dispersed phase		
		Gas	Liquid	Solid
Dispersion medium	Gas	None All gases are miscible and thus do not form colloids	Liquid aerosol Examples: fog, hair sprays	Solid aerosol Examples: smoke, ice cloud, air particulates
	Liquid	Foam Example: whipped cream, shaving cream	Emulsion Examples: milk, mayonnaise, hand cream	Sol Examples: pigmented ink, blood
	Solid	Solid foam Examples: aerogel, styrofoam, pumice	Gel Examples: agar, gelatin, jelly	Solid sol Example: cranberry glass

Sols	:	ink, soap solutions, starch solution, paints
Solids sols	:	coloured gem stones
Aerosols	:	hair spray, fog, mist, clouds
Emulsion	:	milk, butter, face cream
Foam	:	fire extinguishers foam, shaving cream, soap bubbles, beer foam
Solid foam	:	foam rubber an sponge
Gel	:	jellies and gelatine

Suspension: It is the heterogeneous mixture in which the small particles of a solid are spread throughout a liquid without dissolving in it. For example chalk-water mixture, muddy water, paints etc.

***Characteristics of suspensions*:**

(i) A suspension is a heterogeneous mixture.

(ii) Size of solute particles is quite large and can be seen easily.

(iii) The particles do not pass through the filter paper.

(iv) These scatter light i.e. show Tyndall effect.

(v) Particles settle down on keeping.

The solution in which no more solute particles can be dissolved without raising the temperature is called **saturated solution**.

When saturated solution is heated it becomes unsaturated.

When they are cooled crystals of solute particles reappear.

The solution in which more solute particles can be dissolved without raising the temperature is called **unsaturated solution**.

Tyndall Effect: The scattering of light by particles is called Tyndall effect.

It is used to distinguish between true solution from colloidal solution and suspension.

Concentration of Solution: It is the amount of solute present in a 100gm of the solution.

It is expressed in %.

$$concentration\ of\ solution\ by\ mass = \frac{mass\ of\ solute}{mass\ of\ solution} \times 100$$

$$concentration\ of\ solution\ by\ volume = \frac{mass\ of\ solute}{volume\ of\ solution} \times 100$$

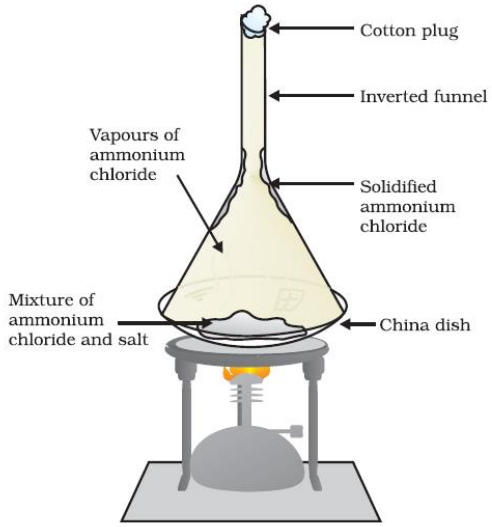
Solubility: The maximum amount of a solute that can be dissolved in 100 gms of a solvent at a specific temperature is known as solubility of that solute in that solvent at that temperature.

Separation of cream from milk:

The process of centrifugation is used to separate cream from milk. In this the milk is taken in a closed container called centrifuge machine. The milk is rotated at a high speed. The cream is formed which floats over the skimmed milk.

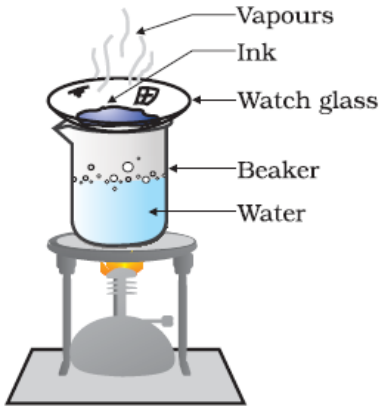
Separation by sublimation:

The process is used to separate those substances from a mixture which sublime on heating. The substances like naphthalene, camphor, ammonium chloride, iodine etc. sublime on heating and can be recovered in the form of sublimate by cooling their vapours.



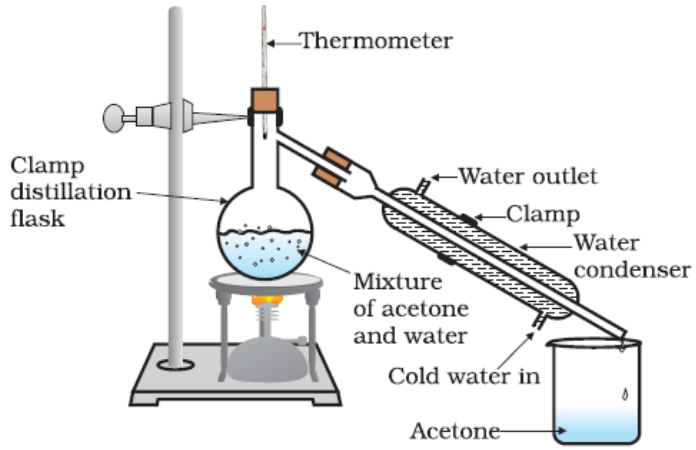
Separation of coloured component (dye) from ink:

Fill half a beaker with water. Place watch glass on the beaker. Put few drops of ink in it. Start heating the beaker. The evaporation will take place from the watch glass. Stop heating when no further evaporation is seen. The coloured material will be left in the watch glass.



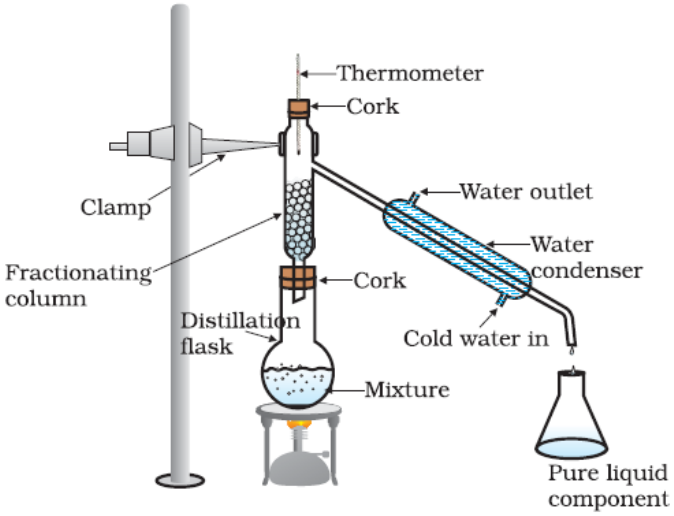
Separation by distillation:

Distillation is the method to separate a mixture of two components (eg. salt solution) having difference of at least 25 K in their boiling points. The method differs from evaporation as in this both the components are obtained.



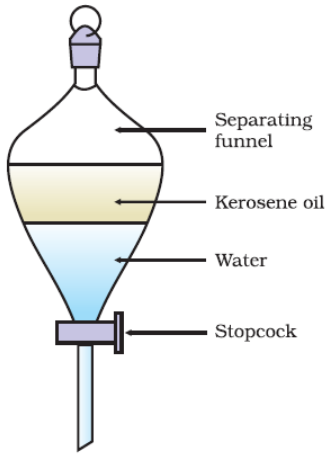
Separation by fractional distillation:

Fractional distillation is the method used to separate a mixture of two or more miscible liquids having difference in their boiling points less than 25 K. In this process fractionating tower filled with glass beads is used. The glass beads provide large surface area for hot vapours to cool and condense repeatedly.



Separation by separation funnel:

Separation funnel is used to separate mixture of two or more immiscible liquids having different densities.



Separation of pure copper sulphate from impure sample:

Take some impure copper sulphate in a china dish. Dissolve it in minimum amount of water. Filter the impurities out. Evaporate water from the solution to get saturated solution. Allow it to cool slowly. You will obtain the crystals of copper sulphate in the china dish. This process is also known as **crystallization**.

This process is also used to separate salt from sea water and to get alum crystals from impurities.

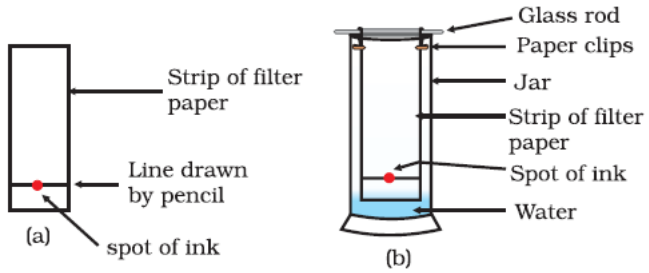
Crystallization is better than evaporation as

- some solids decompose or some may get charred (partially burnt) on heating, like sugar
- some impurities remain dissolved in the solution even after filtration.

Separation by colours in a dye:

Take a thin strip of filter paper. Put a small drop of ink. Let it dry. Lower the filter paper into a jar containing water so that the drop of ink is just above the water level. The coloured component of dye, which is more soluble in water, rises faster and in this way the colours get separated.

This process is called **chromatography**.



Separation of components of air:

Air is a mixture of gases and can be separated into intos components by fraction distillation.

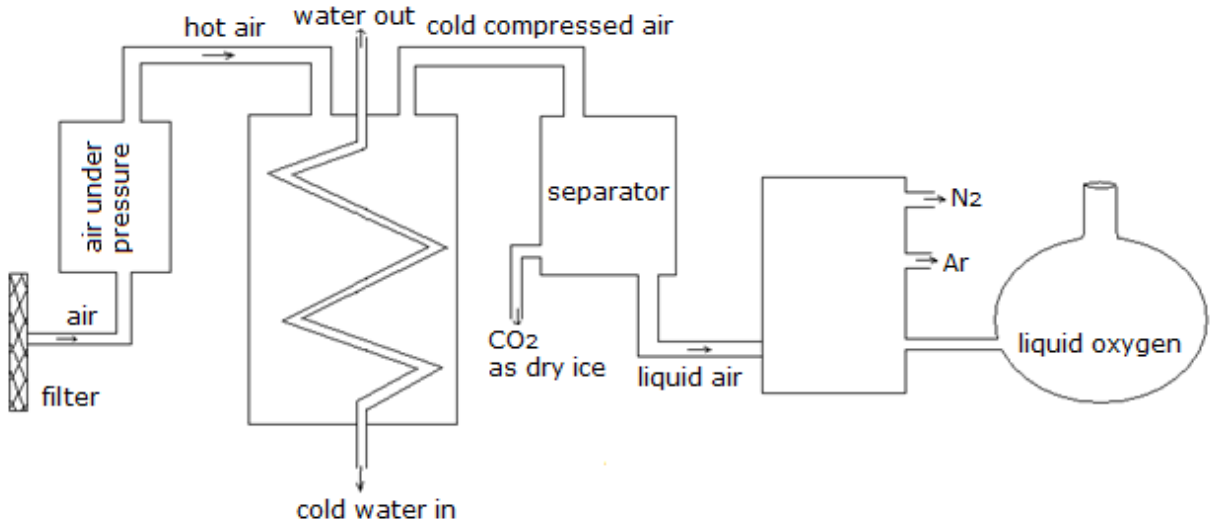
The following steps are involved in the separation of components of air:

(i) Air is filtered to remove dust.

(ii) It is then compressed to a high pressure and then cooled. It is then expanded quickly into a chamber through a jet.

(iii) This process of compression, cooling and rapid expansion are repeated again and again to make air so cool that it turns into a liquid.

(iv) This liquid air is then fed into the fractionation column to obtain different gases in liquid form.



separation of components of air

air $\xrightarrow{compress\ and\ cool}$ liquid air $\xrightarrow{slow\ warming}$ different gasses at different heights

Water Purification:

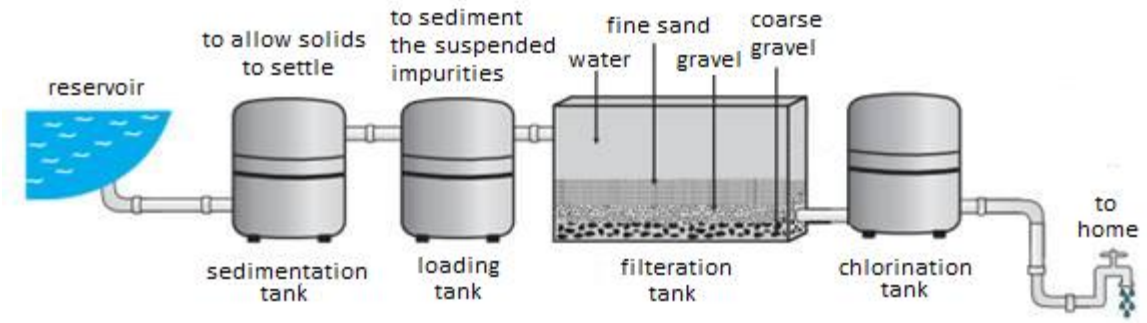
The different steps involved in the purification of water are:

(i) Water from a source is supplied to sedimentation tank where it is allowed to stand for insoluble heavy impurities to settle down.

(ii) Then it is sent to loading tank containing alum. Alum particles settle on impurities.

(iii) It is now sent to filtration tank, which occupies coarse gravel at the bottom, fine gravel in the middle and sand at the top, where small suspended impurities are also removed.

(iv) Water is then passed to chlorination tank where germs are killed and then supplied to homes.



assignment

1) What is meant by pure substance?

2) What are homogeneous and heterogeneous mixtures?

3) Write differences between

   (a) elements and compounds

   (b) compounds and mixtures

   (c) saturated and unsaturated solutions

   (d) boiling and evaporation

   (e) colloid and suspension

4) Define latent heat, latent heat of fusion and latent heat of vaporization.

5) How are sol, solution and suspension different from each other?

6) Define solubility.

7) Write the steps you would use for making tea. Use the words solution, solvent, solute, dissolve, soluble, insoluble, filtrate and residue.

8) What are saturated solutions? What if they are heated? What if they are cooled?

9) How would you confirm that a colourless liquid given to you is pure water?

10) Name the process associated with the following:

   (a) Dry ice is kept at room temperature and at one atmospheric pressure.

   (b) A drop of ink on the surface of water contained in a glass spreads throughout the water.

   (c) A potassium permanganate a crystal is in a beaker and water is poured into the beaker with stirring.

   (d) Milk is churned to separate the cream from it.

   (e) Acetone bottle is left open and it becomes empty.

   (f) Fine beam of light entering through small holes in a dark room, illuminates the particles in its path.

11) Which separation techniques will you apply for separation of the following:

(a) Sodium chloride from its solution of water

(b) Ammonium chloride from a mixture containing sodium chloride and ammonium chloride

(c) Butter from curd

(d) Oil from water

(e) Different pigments from an extract of flower petals

(f) Find mud particles suspended in water

(g) Wheat grains from husk

(h) Iron pins from sand

(i) Tea leaves from tea

(j) Small pieces of metal in the engine oil of a car

(k) a mixture containing kerosene and petrol (difference in their boiling points is more than 25˚C)

(l) camphor from salt

(m) kerosene from water

(n) iron fillings from sand

(o) Mercury and water

(p) Common salt, water and sand

(q) Kerosene oil, water and salt

12) Pragya tested the solubility of three different substances at different temperatures and collected the data as given below (results are given as grams of substance dissolved in 100 gm of water to form a saturated solution).

Substance dissolved	temperature in K				
	283	**293**	**313**	**333**	**353**
Potassium nitrate	21	32	62	106	167
Sodium chloride	36	36	36	37	37
Potassium chloride	35	35	40	46	54
Ammonium chloride	24	37	41	55	66

(a) What mass of potassium nitrate would be needed to produce a saturated solution of potassium nitrate in 50 gm of water at 313 K?

(b) Pragya makes a saturated solution of potassium chloride in water at 353 K and leaves the solution to cool at room temperature. What would she observe as the solution cools?

(c) Find the solubility of each salt at 293 K. Which salt has highest solubility at this temperature?

(d) What is the effect of change of temperature on the solubility of a salt?

13) Nonmetals are usually poor conductors of heat and electricity. They are non-lustrous, non-sonorous, non-malleable and are coloured.

(a) Name a lustrous non-metal.

(b) Name a non-metal which exists as a liquid at room temperature.

(c) The allotropic form of a non-metal is a good conductor of electricity. Name the allotrope.

(d) Name a non-metal which is known to form the largest number of compounds.

(e) Name a non-metal other than carbon which shows allotropy.

(f) Name a non-metal which is required for combustion.

14) Name the process used to obtain pure copper sulphate from impure sample.

15) Which method is mostly used for the purification of solids?

16) Why silicon and germanium are called metalloids?

17) Which nonmetal is liquid at room temperature?

18) What are favourable qualities given to gold when it is alloyed with copper or silver for the purpose of making ornaments?

19) Tincture of iodine has antiseptic properties. How is it prepared?

20) What name is given to the process of corrosion of iron? What type of change is it?

21) Two miscible liquids have boiling points as 60ºC and 90ºC. How can they be separated?

22) Smoke and fog both are aerosols. In what way are they different?

23) Can we separate alcohol dissolved in water by using a separating funnel? If yes, then describe the procedure. If not, explain.

24) On heating calcium carbonate gets converted into calcium oxide carbon dioxide.

(i) Is this a physical or a chemical change?

(ii) Can you prepare one acidic or one basic solution by using the products formed in the above process? If so, write the chemical equation involved.

25) A teacher instructed three students A, B and C to prepare a 50% (mass by volume) solution of NaOH. Student A dissolvd 50g of NaOH in 100 mL of water. Student B dissolved 50g of NaOH in 100g of water. Student C dissolved 50g of NaOH in water to make 100 mL of solution. Which one of them has made the desired solution?

26) Sucrose (sugar) crystals obtained from sugarcane and beetroot are mixed together. Will it be a pure substance or a mixture? Give reasons for the same.

27) Explain why particles of colloidal solution do not settle down when left undisturbed, while in the case of suspension they do?

28) A child eats chocolate and digests it. In doing so, some physical and chemical changes take place. Identify the changes.

29) A solution made by dissolving 50 g glucose in 250 g of water, calculate the concentration of this solution in mass percentage.

30) 40 g of common salt is present in 320 g of water. Find its concentration.

31) 40 g of common salt is present in 320 g of salt solution. Find its concentration.

32) To make a saturated solution, 36 gm of sodium chloride is dissolved in 100 gm of water at 293 K. Find the concentration of the solution.

33) A solution contains 50 g of common salt in 450 gm of water. Calculate the concentration of the solution.

34) Calculate the masses of cane sugar and water required to prepare 250 g of 25% solution of cane sugar.

35) 4 g of a solute are dissolved in 40 g of water to form a saturated solution at 25ºC. Calculate the solubility of the solute at 25ºC.

36) Calculate the mass of potassium sulphate required to prepare its 10% solution in 100 g of water.

37) Find mass of sodium sulphate required to prepare its 20% solution in 100 gm of water.

38) What would happen if

(a) a saturated solution of potassium chloride prepared at 60ºC is allowed to cool t room temperature?

(b) an aqueous sugar solution is heated to dryness?

(c) A mixture of ion fillings and sulphur is heated strongly?

39) Which of the following substances are pure substances?

Ice, milk, iron, hydrochloric acid, calcium oxide, mercury, brick, wood, air

40) Which of the following are compounds?

Chlorine gas, potassium chloride, iron, iron sulphate, aluminium, iodine, carbon, carbon monoxide, sulphur powder, sugar, sugar solution, salt, salt solution, iodine, iodine tincture.

41) Identify the solutions among the following mixtures:

Soil, sea water, air, coal, soda water

42) Classify the following as homogeneous or heterogeneous mixture:

Soda water, wood, air, soil, vinegar, filtered tea

43) Which of the following will show Tyndall effect?

salt solution, milk, copper sulphate solution, starch solution

44) Classify the following into elements, compounds and mixtures:

Sodium, soil, sugar solution, silver, calcium carbonate. Tin, silicon, brine, coal, air, soap, methane, blood, carbon dioxide

45) Which of the following are chemical changes?

Growth of plants, rusting of iron, mixing of iron filings and sand, cooking of food, digestion of food, freezing of water, burning of candle

46) Fractional distillation is suitable for separation of miscible liquids with a boiling point difference of about 25 K or less. What part of fractional distillation apparatus makes it efficient and possess an advantage over a simple distillation process. Explain using a diagram.

47) 1 nm = ____ m 1 μm = ____ m 1 mm = ____ m

1 Mm = ____ m 1 km = ____ m 1 pm = ____ m

sOmEthIng UsELEss cUm IntErEstIng

- substances which sublimes:

  Iodine, Napthalene, Zinc Chloride, Dry Ice, Camphor, Arsenic, ammonium chloride, Ferrocene ($C_{10}H_{10}Fe$)
- Formula of aspirin = $C_9H_8O_4$
- Formula of caffeine = $C_8H_{10}N_4O_2$
- Formula of nicotine = $C_{10}H_{14}N_2$
- Formula of cocaine = $C_{17}H_{21}NO_4$
- Formula of adrenaline = $C_9H_{13}NO_3$
- Formula of morphine = $C_{17}H_{19}NO_3$
- Formula of oxytocin = $C_{43}H_{66}N_{12}O_{12}S_2$
- Formula of heroin = $C_{21}H_{23}NO_5$
- Formula of hemoglobin = $C_{3032}H_{4816}O_{872}N_{780}S_8Fe_4$

It is very easy to defeat someone

But

It is very hard to win someone