

CBSE NCERT Solutions for Class 9 Science Chapter 2

Back of Chapter Questions

1. What is meant by a substance? (1 mark)

Solution:

A substance is a pure single form of matter. It consists of a single type of particles i.e. all the constituent particles in the substance are identical in their chemical nature. It cannot be separated into other kinds of matter by any physical process.

2. List the points of differences between homogeneous and heterogeneous mixtures. (2- marks)

Solution:

Homogeneous mixtures	Heterogeneous mixtures
<ul style="list-style-type: none">1. They have uniform compositions throughout the mixture, such as salt in water, sugar in water, copper sulphate in water.2. The components of homogeneous mixtures are not physically distinct.3. They have no visible boundaries of separation between the constituents.	<ul style="list-style-type: none">1. They have non-uniform compositions throughout the mixture, such as salt and Sulphur, sodium chloride and iron filings, oil and water.2. They contain physically distinct parts.3. They have visible boundaries of separation between the constituents.

3. Differentiate between homogeneous and heterogeneous mixtures with examples. (2 mark)

Solution:

Homogeneous mixtures	Heterogeneous mixtures
The substances are completely mixed together in these mixtures.	The substances remain separate in these mixtures.
They have uniform compositions throughout their mass.	They have non-uniform compositions throughout their mass.
They have no visible boundaries of separation between the constituents.	They have visible boundaries of separation between the constituents.

Salt in water, sugar in water are examples of homogeneous mixtures.	Mixtures of sodium chloride and iron filings, oil and water are examples of heterogeneous mixtures.
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4. How are sol, solution and suspension different from each other? (2- marks)

Solution:

Solution	Sol	Suspension
A solution is a homogeneous mixture of two or more substances.	A sol is a heterogeneous mixture.	Suspension is a heterogeneous mixture.
The particles of a solution are smaller than 1 nm (10^{-9} metre) in diameter. So, they cannot be seen by naked eye.	The size of particles of a sol is too small to be individually seen by naked eyes. It is between 1 nm and 100 nm in diameter.	The particles of a suspension can be seen by the naked eye. Their size is larger than 100 nm in diameter.
Due to small particle size, they do not scatter a beam of light passing through them. Thus, the path of light is not visible in a solution.	Sols are big enough to scatter a beam of light passing through them and make its path visible.	The particles of a suspension scatter a beam of light passing through it and make its path visible.
The solute particles do not settle down when left undisturbed, i.e., a solution is stable.	They do not settle down when left undisturbed, i.e., a sol is quite stable.	The solute particles settle down when a suspension is left undisturbed, i.e., a suspension is unstable.
The solute particles cannot be separated from the mixture by the process of filtration.	The solute particles cannot be separated from the mixture by the process of filtration.	They can be separated from the mixture by the process of filtration.

5. To make a saturated solution, 36 g of sodium chloride is dissolved in 100 g of water at 293 K. Find its concentration at this temperature. (2- marks)

Solution:

The concentration of a solution is the amount (mass or volume) of solute present in a given amount (mass or volume) of solution. In the given question, we have the mass of solute and the mass of solution. Using these details, we can find the concentration of the solution using the following method-

Mass by mass percentage of a solution-

$$\text{Concentration} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$$

Mass of solution

Using this method, we can find the concentration-

$$\text{Mass of solute} = 36 \text{ g}$$

$$\text{Mass of solvent} = 100 \text{ g}$$

$$\begin{aligned}\text{Mass of solution} &= \text{Mass of solute} + \text{Mass of solvent} \\ &= 136 \text{ g}\end{aligned}$$

$$\text{Concentration} = \frac{36 \times 100}{136} \% = 26.47\%$$

The concentration of the solution at the given temperature of 293 K is therefore 26.47%.

6. How will you separate a mixture containing kerosene and petrol (difference in their boiling points is more than 25° C), which are miscible with each other? (5 marks)

Solution:

The process of distillation is used for the separation of components of a mixture containing two miscible liquids that boil without decomposition and have sufficient difference in their boiling points. Fractional distillation process is used to separate a mixture of two or more miscible liquids for which the difference in boiling points is less than 25 K. For example, for the separation of different gases from air, different fractions from petroleum products etc.

The process of distillation is used for the separation of a mixture containing kerosene and petrol since the difference in their boiling points is more than 25° C.

- (i) Take the mixture in the distillation flask and fit it with a thermometer.
- (ii) Arrange the apparatus as shown in the given figure.
- (iii) Heat the mixture slowly keeping a close watch on the thermometer.
- (iv) Petrol has a lower boiling point than kerosene. So, petrol vaporizes first and condenses in the condenser which is finally collected in the beaker.

(v) Kerosene is left behind in the distillation flask.

7. Name the technique to separate:

- (i) butter from curd
- (ii) salt from seawater
- (iii) camphor from salt (5 marks)

Solution:

- (i) Centrifugation
- (ii) Evaporation
- (iii) Sublimation

Centrifugation is a technique of separation of mixtures that works on the principle that the denser particles are forced to the bottom and the lighter particles stay at the top when spun rapidly. In some mixtures, the solid particles in the liquid are very small and will pass through a filter paper. Such mixtures are hence separated into their constituent parts by centrifugation. One of its many applications is in dairies and homes- to separate butter from cream. We can therefore use the centrifugation method for the separation of butter from curd.

Evaporation is a technique of separation of mixtures in which we can separate the volatile component (solvent) from its non-volatile solute. In the case of separation of salt from seawater, when the solution is heated, the water evaporates leaving behind salt crystals.

Sublimation is the technique used in the separation of mixtures that contain a sublimable volatile component and a non-sublimable impurity. Camphor and salt are separated by the sublimation process. Upon heating, camphor sublimes- it changes directly from solid to gaseous state. The vapours of camphor rise up and solidify once again when the vapors touch the cooler parts of the sublimation apparatus. Salt being a non-sublimable component remains at the bottom.

8. What type of mixtures are separated by the technique of crystallisation? (3 marks)

Solution:

The crystallisation method is used to purify solids from impurities

Examples of crystallisation as a process to separate mixtures include purification of salt that is obtained from seawater and separation of alum (phitkari) from impure samples.

An example of crystallisation method is removal of impurities from an impure sample of copper sulphate. Take around 5 g of impure copper sulphate in a china dish and dissolve it in a minimum amount of water. Filter the impurities out. Next, evaporate the water from the copper sulphate solution in order to obtain a saturated

solution. Now, cover the solution with a filter paper and leave it undisturbed at room temperature so that it cools down gradually for a day. You will now obtain the pure crystals of copper sulphate in the china dish.

9. Classify the following as chemical or physical changes:

- (a) cutting of trees,
- (b) melting of butter in a pan,
- (c) rusting of almirah,
- (d) boiling of water to form steam,
- (e) passing of electric current, through water and the water breaking down into hydrogen and oxygen gases,
- (f) dissolving common salt in water,
- (g) making a fruit salad with raw fruits, and
- (h) burning of paper and wood.

Solution:

Physical properties are those that can be observed and specified like colour, hardness, rigidity, fluidity, density, melting point, boiling point etc. Physical changes are changes that happen without a change in the chemical composition and in the chemical nature of the substance. Interconversion of states is a physical change. For instance, ice, water and water vapour all look different and display different physical properties. But they are chemically the same. They undergo only physical change from one state to another.

A Chemical change is one that brings change in the chemical properties of matter resulting in new substances. A chemical change is also called a chemical reaction. For instance, burning is a process in which one substance reacts with another thereby resulting in a change in chemical composition. Burning is therefore a chemical change.

Answer:

- (a) Cutting of trees - Physical change
- (b) Melting of butter in a pan - Physical change
- (c) Rusting of almirah - Chemical change
- (d) Boiling of water to form steam - Physical change
- (e) Passing of electric current through water and the water breaking down into hydrogen and oxygen gases - Chemical change
- (f) Dissolving common salt in water - Physical change
- (g) Making a fruit salad with raw fruits - Physical change

(h) Burning of paper and wood - Chemical change

10. Try segregating the things around you as pure substances or mixtures. (3 mark)

Solution:

A substance is a pure single form of matter. It consists of a single type of particles- all the constituent particles in the substance are identical in their chemical nature. It cannot be separated into other kinds of matter by any physical process. Pure substances can be classified into elements and compounds. For example: sugar, sodium chloride- these are pure substances that contain only one kind of pure matter, their composition is the same throughout and their chemical constituents cannot be separated by any physical process such as evaporation.

Mixtures are constituted by more than one kind of pure form of matter. In other words, mixtures are composed of more than one pure substance- they therefore have more than one kind of particles. For instance, soft drinks and soil are not pure substances- they are mixtures of two or more pure substances wherein the substances, no matter what their source might be, will always have the same characteristic properties.

Pure substances: water, iron nail, pencil lead, sugar, etc.

Mixtures: Air, blood, butter, milk, steel, paper, etc.

BOC Questions

1. Which separation techniques will you apply for the separation of the following?

- (a) Sodium chloride from its solution in water.
- (a) Ammonium chloride from a mixture containing sodium chloride and ammonium chloride.
- (c) Small pieces of metal in the engine oil of a car.
- (d) Different pigments from an extract of flower petals.
- (e) Butter from curd.
- (f) Oil from water.
- (g) Tea leaves from tea.
- (h) Iron pins from sand.
- (i) Wheat grains from husk.
- (j) Fine mud particles suspended in water. (5 marks)

Answer:

- (a) Evaporation
- (a) Sublimation

- (c) Filtration
- (d) Chromatography
- (e) Centrifugation
- (f) Separating funnel
- (g) Sieving
- (h) Magnetic separation
- (i) Sieving and winnowing
- (j) Sedimentation, decantation and filtration

Solution:

Evaporation is a technique of separation of mixtures in which we can separate the volatile component (solvent) from its non-volatile solute. Water (Solvent) evaporates while sodium chloride (Solute) is left behind.

Sublimation is the technique used in the separation of mixtures that contain a sublimable volatile component and a non-sublimable impurity. Since ammonium chloride is a sublimable substance, this method is used to separate it from sodium chloride which is non sublimable.

Filtration is a method that is used to separate insoluble impurities from a solution. In this method, the solution is passed through a filter. The particles whose pore size is bigger than that of the filter remain in the filter. The remaining solution passes through the filter. The pieces of metal will remain in the filter while the oil passes through the filter.

Chromatography is the technique used for separation of those solutes that dissolve in the same solvent. A few common applications of the method include the separation of colors in a dye, drugs from blood and pigments from natural colors. It can therefore be used to separate the pigments from an extract of flower petals.

Centrifugation is a technique of separation of mixtures that works on the principle that the denser particles are forced to the bottom and the lighter particles stay at the top when spun rapidly. Butter and curd can be separated by this method. Butter will collect on top and can be removed from the curd.

The separating funnel method is used in the separation of two immiscible liquids, such as oil and water and the extraction of iron from its ore. It is based on the principle that immiscible liquids separate out in layers depending on their densities. Oil and water are immiscible with one another and hence can be separated through this method.

Sieving is used commonly in daily life to remove impurities from substances such as flour, removal of husk and stone from wheat, and on construction sites where large sieves are used to separate pebbles and stones from sand. The method is based on the difference in sizes of the particles of the mixture. The fine or small particles

that are smaller than the sieve holes pass through while the ones that are bigger cannot pass through and hence remain in the sieve. The tea leaves being larger will remain in the sieve while the tea passes through it.

Magnetic separation is used in the separation of iron from a mixture. The iron particles get attracted to the magnet and can therefore be removed while the nonmagnetic particles remain behind. Iron pins can easily be removed from sand by using a magnet as the pins are magnetic and get attracted to the magnet while the sand is left behind.

Sieving is used commonly in daily life to remove impurities from substances such as flour, removal of husk and stone from wheat, and on construction sites where large sieves are used to separate pebbles and stones from sand. The method is based on the difference in sizes of the particles of the mixture. The fine or small particles that are smaller than the sieve holes pass through while the ones that are bigger cannot pass through and hence remain in the sieve. Winnowing is a method that is used to separate heavier and lighter components of a mixture by wind or by blowing air. It is based on the difference in the size of the particles of the mixture and their weight. The lighter particles are blown away by the wind while the heavier particles are left behind. Wheat grains can be removed from their husks using sieving and winnowing methods.

Sedimentation and decantation are used in cases where it may not be possible to separate components of a mixture by methods such as winnowing and handpicking. In this process, the heavier particles first settle down after water is added to the mixture. This is sedimentation. The removal of the water along with impurities such as dust is called decantation. Filtration is a method that is used to separate insoluble impurities from a solution. In this method, the solution is passed through a filter. The particles whose pore size is bigger than that of the filter remain in the filter. The remaining solution passes through the filter. The pieces of metal will remain in the filter while the oil passes through the filter. These methods can be used to separate fine mud particles suspended in water. The mud particles will settle down- sedimentation, next the water is removed- decantation and finally it can be further filtered.

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

Solution:

In order to make tea, we first take the required amount of water as solvent in a pan. Next, we add tea leaves which are insoluble. The mixture is boiled and allowed to brew. We notice that the color of water changes as the soluble part of tea leaves get dissolved in the water. We then add milk and sugar as solutes to and the mixture is further boiled. Sugar as a solute gets dissolved evenly while the insoluble tea leaves form the residue. The prepared tea solution is then passed through a sieve. The tea leaves will remain as residue on the sieve while the remaining prepared solution passes through as the filtrate.

Steps to make tea:

1. Take some water as solvent in a pan.
 2. Add some insoluble tea leaves to it.
 3. Add some sugar and milk into it which act as solutes.
 4. Boil the mixture.
 5. Filter the prepared tea through a sieve.
 6. The tea leaves are left on the sieve. This is the residue.
 7. The filtrate tea is collected in a cup.
3. Pragma tested the solubility of four different substances at different temperatures and collected the data as given below (results are given in the following table, as grams of substance dissolved in 100 grams of water to form a saturated solution).

Substance Dissolved	Temperature in K				
	283	283	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 grams of water at 313 K?
- (b) Pragma 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? Explain.
- (c) Find the solubility of each salt at 293 K. Which salt has the highest solubility at this temperature?
- (d) What is the effect of change of temperature on the solubility of a salt? (5 marks)

Solution:

- (a) Since 62 g of potassium nitrate is dissolved in 100 g of water to prepare a saturated solution at 313 K
Mass of potassium nitrate (solute) = 62 g
Mass of water (solvent) = 100 g

$$\text{New mass of water} = \frac{100 \text{ g}}{2} = 50 \text{ g}$$

$$\text{Therefore, mass of potassium nitrate} = \frac{62 \text{ g}}{2} = 31 \text{ g}$$

We therefore need 31 g of potassium nitrate to be dissolved in 50 g of water to prepare a saturated solution at 313 K.

- (b) Solubility is usually measured as the grams of solute per 100 grams of solvent. Solubility is specific to solvents. In the case of liquids, the temperature must also be mentioned as the solubility varies with temperature. Solubility of most solid substances can be increased with a rise in the temperature.

The amount of potassium chloride that can be dissolved in water to make a saturated solution therefore increases with temperature. And as the solution cools, some of the crystals of potassium chloride will precipitate out of the solution as the amount of salt that is soluble at a lower temperature is less than that at a higher temperature.

- (c) The solubility of the salts at 293 K are:

Potassium nitrate - 32 g

Sodium chloride - 36 g

Potassium chloride - 35 g

Ammonium chloride - 37 g

Ammonium chloride has the highest solubility at 293 K.

- (d) Solubility is usually measured as the grams of solute per 100 grams of solvent. Solubility is specific to solvents. In the case of liquids, the temperature must also be mentioned as the solubility varies with temperature. Solubility of most solid substances can be increased with a rise in the temperature. Therefore, at lower temperatures, the rate of solubility of a salt decreases while the rate of solubility of a salt increases with increase in temperature.

4. Explain the following giving examples:

- (a) Saturated solution
- (a) Pure substance
- (c) Colloid
- (d) Suspension (4-marks)

Solution:

- (a) At any particular temperature, a solution that has dissolved as much solute as it is capable of dissolving is said to be a saturated solution. Examples of saturated solutions are soft drinks and nitrogen in Earth's soil.
 - (b) A pure substance is one which is made up of only one kind of particles. All the constituent particles in the substance are identical in their chemical nature. It cannot be separated into different constituents by physical or chemical processes. Some examples of pure substances are bromine, nitric acid, calcium oxide, etc.
 - (c) Colloids are heterogeneous mixtures in which the size of solute particles is intermediate between those in true solutions and those in suspensions and are big enough to scatter light. Some examples are: Milk, blood, paint, etc.
 - (d) A suspension is a heterogeneous mixture in which the small particles of a solid are spread throughout a liquid without dissolving in it. The particles of a suspension can be seen by the naked eye. Some examples of suspension are Chalk - water mixture, flour in water, milk of Magnesia etc.
5. Classify each of the following as a homogeneous or heterogeneous mixture.
soda water, wood, air, soil, vinegar, filtered tea. (3 marks)

Solution:**Homogeneous Mixtures:**

These are mixtures in which all the substances or the components, when mixed, are distributed evenly throughout the mixture. This means that homogeneous mixtures have a uniform composition as indicated by the word 'homo' which means same. They are also called solutions. The particles of the mixture are evenly distributed. Another feature of homogeneous mixtures is that the proportion of the compositions can be variable.

Heterogeneous Mixtures:

These are mixtures which have physically distinct parts and have non-uniform compositions as indicated by the word 'hetero' which means different. The components can be seen and identified with the naked eye even after thorough mixing. This is because the particles of the substances are not evenly distributed. For instance, if we mix oil and water, we can observe how each of the components can still be distinctly identified. The components are not evenly distributed

Homogeneous

soda water, air, vinegar, filtered tea- in all these mixtures, the particles of the substances are mixed and distributed evenly throughout the mixture. They are not visibly distinct from one another. Hence, they are homogeneous mixtures.

Heterogeneous

wood, soil- Wood and soil are heterogeneous mixtures as they are made up of many substances that are not mixed together and distributed evenly in the mixtures. The components are not mixed uniformly and are distinct from one another.

6. How would you confirm that a colorless liquid given to you is pure water?

Solution:

Pure water is a pure substance. A substance is a pure single form of matter. It consists of a single type of particles- all the constituent particles in the substance are identical in their chemical nature. It cannot be separated into other kinds of matter by any physical process.

Pure water being a pure substance contains only one kind of pure matter, its composition is the same throughout and the chemical constituents cannot be separated by any physical process such as evaporation. On the other hand, mixtures are made of more than one kind of pure matter. This is merely a physical combination of two or more substances. The individual components are not chemically combined. The substances in a mixture can usually be separated by physical methods like evaporation, freezing, filtration and distillation.

In order to confirm if a given colorless liquid is pure water, we can evaporate the liquid over a flame. If a residue is left behind, it is a mixture and not pure water. If no residue is left, then it is pure water.

7. Which of the following materials fall in the category of a "pure substance"?

- (a) Ice
- (a) Milk
- (c) Iron
- (d) Hydrochloric acid
- (e) Calcium oxide
- (f) Mercury
- (g) Brick
- (h) Wood
- (i) Air

Solution:

A substance is a pure single form of matter. It consists of a single type of particles- all the constituent particles in the substance are identical in their chemical nature. It cannot be separated into other kinds of matter by any physical process. "Pure substances" can be classified into elements and compounds. Pure substances therefore contain only one kind of pure matter, their composition is the same throughout and their chemical constituents cannot be separated by any physical process such as evaporation.

On the other hand, mixtures are made of more than one kind of pure matter. This is merely a physical combination of two or more substances. The individual components are not chemically combined. The substances in a mixture can usually be separated by physical methods like evaporation, freezing, filtration and distillation. The proportion of the components in mixtures is variable.

Ice, iron, hydrochloric acid, calcium oxide, and mercury are pure substances as they are made up of single type of particles that are identical in their chemical nature and cannot be separated into other kinds of matter by any physical process.

9. Which of the following will show "Tyndall effect"?

- (a) Salt solution
- (a) Milk
- (c) Copper sulphate solution
- (d) Starch solution.

Solution:

Colloids are heterogeneous mixtures. Colloidal particles can scatter a beam of visible light. This effect was first discovered and explained by the 19th century scientist John Tyndall and is hence called the Tyndall Effect. This feature is also seen in suspensions. We see this effect in our daily life such as when a fine beam of light enters a room through a small gap. The particles of dust and smoke in the air scatter the light. Another example is seen when light passes through a thick covering of foliage, such as in forests. The air contains mist which comprises of small water droplets. These act as colloid particles dispersed in the air and scatter the light.

Milk and starch solution are colloids. Thus, they will show Tyndall effect since colloids show Tyndall effect.

10. Classify the following into elements, compounds and mixtures.

- (a) Sodium
- (a) Soil
- (c) Sugar solution
- (d) Silver
- (e) Calcium carbonate
- (f) Tin
- (g) Silicon
- (h) Coal
- (i) Air

- (j) Soap
- (k) Methane
- (l) Carbon dioxide
- (m) Blood

Solution:

Elements are basic forms of matter that cannot be broken down into simpler substances through chemical reactions. Elements can typically be categorised into metals, nonmetals and metalloids. The number of known elements till date are over hundred. Majority of the elements are solid while eleven are gaseous at room temperature. Mercury and bromine are the two elements that are liquid at room temperature while gallium and cesium become liquid when the temperature is slightly above the room temperature.

Compounds are substances that are composed of two or more elements that are chemically combined with one another in a fixed proportion.

Mixtures are made of more than one kind of pure matter. This is merely a physical combination of two or more substances. The individual components are not chemically combined. The substances in a mixture can usually be separated by physical methods like evaporation, freezing, filtration and distillation. The proportion of the components in mixtures is variable.

Elements: sodium, silver, tin, and silicon - these are elements as they are basic forms of matter that cannot be broken down into simpler substances through chemical reactions.

Compounds: calcium carbonate, methane, and carbon dioxide - these are compounds as they are composed of two or more elements that are chemically combined with one another in a fixed proportion.

Mixtures: soil, sugar solution, coal, soap, air, and blood - these are mixtures as they are made of more than one kind of pure matter. This is merely a physical combination of two or more substances. The individual components are not chemically combined.

11. Which of the following are chemical changes?

- (a) Growth of a plant
- (b) Rusting of iron
- (c) Mixing of iron filings and sand
- (d) Cooking of food
- (e) Digestion of food
- (f) Freezing of water

(g) Burning of a candle.

Solution:

A Chemical change is one that brings change in the chemical properties of matter resulting in new substances. A chemical change is also called a chemical reaction. For instance, burning is a process in which one substance reacts with another thereby resulting in a change in chemical composition. Burning is therefore a chemical change.

Growth of a plant, rusting of iron, cooking of food, digestion of food, and burning of candle are chemical changes.

Growth of a plant is a chemical change as the plants use the process of photosynthesis which is a chemical reaction or change- the plants convert solar energy into chemical energy. This is an irreversible process.

Rusting of iron is a chemical change- iron molecules react with oxygen to form a new substance- a compound called iron oxide. The iron molecules are not pure any longer.

Cooking of food involves a chemical change as the components of food break down to form new chemical substances. The chemical composition of the food undergoes changes.

Digestion of food is a chemical change- Enzymes in the stomach and intestines break down large molecules of food into their simpler molecules or constituents which can be easily absorbed by the body.

Burning of candle involves a chemical change- the candle first melts due to the heat (this is a physical change) and then the liquid wax further vaporises owing to the heat of the flame. The vapor burns to form new substances such as carbon dioxide, heat, light etc.