Exercise-2.1 Page: 15

1. What is meant by a substance?

Solution:

A substance is a pure single form of matter. It has definite properties and compositions. Example: Iron

2. List the points of difference between homogeneous and heterogeneous mixtures.

Solution:

Homogeneous mixture	**Heterogeneous mixture**
Particles are uniformly distributed throughout the mixture	All the particles are completely mixed and can be distinguished with the bare eyes or under a microscope
Has a uniform composition	Irregular composition
No apparent boundaries of division	Noticeable boundaries of division

Exercise-2.2

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1. Differentiate between homogenous and heterogeneous mixtures with examples.

Solution:

The following are the differences between heterogeneous and homogenous mixtures.

Heterogeneous mixture	**Homogeneous mixture**
All the particles are completely mixed and can be distinguished with the bare eyes or under a microscope	Particles are uniformly distributed throughout the mixture
Irregular composition	Has a uniform composition
Noticeable boundaries of division	No apparent boundaries of division
Examples: Seawater, blood, etc.	Examples: Rainwater, vinegar, etc.

2. How are sol, solution and suspension different from each other?

Solution:

Attributes	**Sol**	**Solution**	**Suspension**
Type of mixture	Heterogeneous	Homogeneous	Heterogeneous
Size of particles	$10^{-7} – 10^{-5}$ cm	Less than 1nm	More than 100nm
Tyndall effect	Exhibited	Not exhibited	May or may not be exhibited
Appearance	Usually glassy and clear	Unclouded and clear	Cloudy and opaque

Visibility	Visible with an ultramicroscope	Not visible	Visible with the naked eye
Diffusion	Diffuses very slowly	Diffuses rapidly	Do not diffuse
Stability	Pretty stable	Highly stable	Unstable
Settling	Get settled in centrifugation	Do not settle	Settle on their own
Example	Milk, blood, smoke	Salt solution, sugar solution	Sand in water, dusty air

3. 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.

Solution:

Mass of solute (NaCl) = 36 g

Mass of solvent (H_2O) = 100 g

Mass of solution (NaCl + H_2O) = 136 g

Concentration = Mass of solute/Mass of solution x 100

Concentration = 36/136 x 100 = 26.47%

Hence, the concentration of the solution is 26.47%

Exercise-2.3

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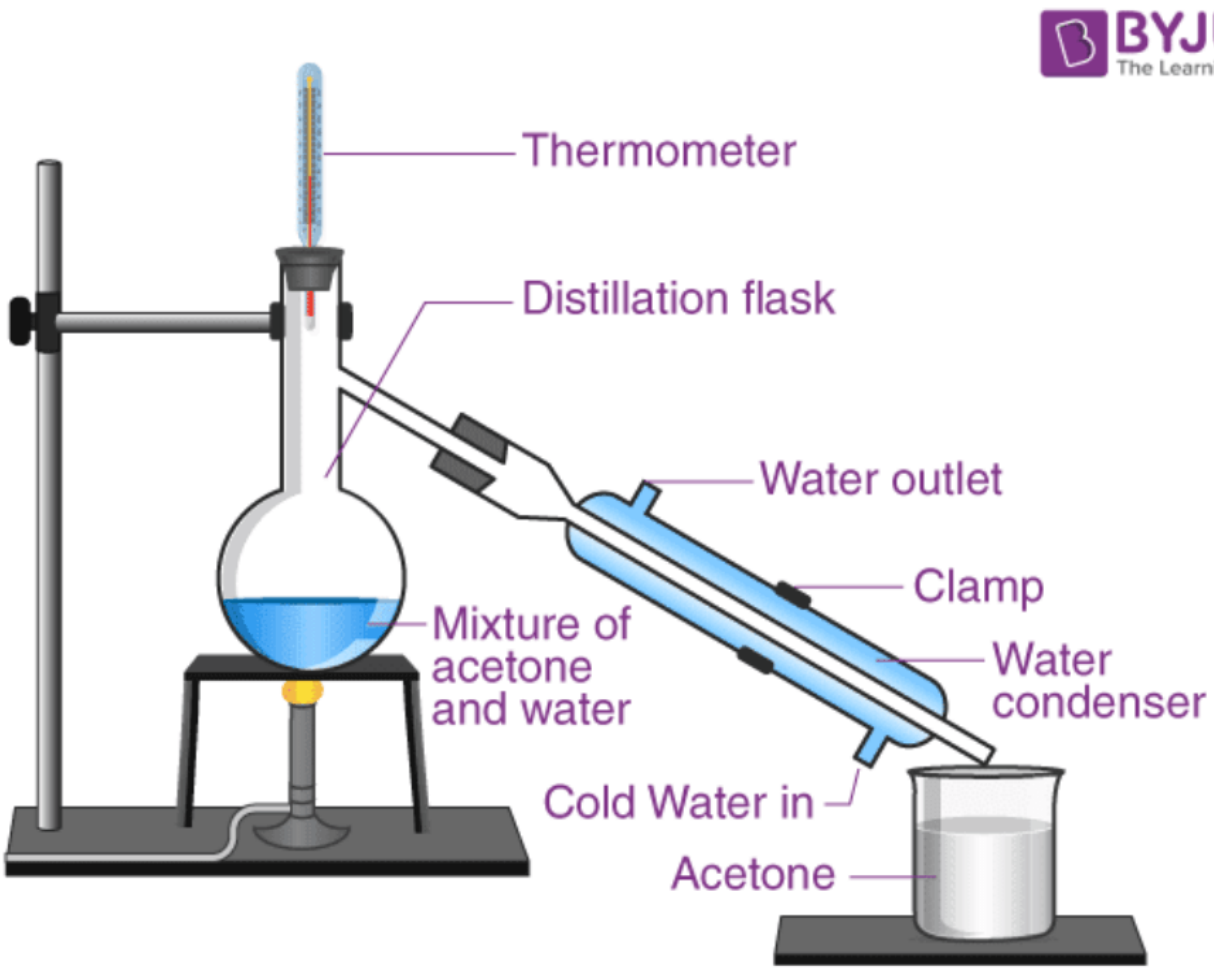
1. How will you separate a mixture containing kerosene and petrol (the difference in their boiling points is more than 25°C), which are miscible with each other?

Solution:



According to the question, kerosene and petrol are miscible, and their boiling points differ by more than 25 degrees Celsius, which is a significant difference. Therefore they can be separated using a simple distillation procedure.

Distillation can separate kerosene and petrol since their boiling points differ by more than 25 degrees Celsius. The kerosene and petrol combination will be poured into a hot distillation flask. Because petrol has a lower boiling point, it will evaporate and create vapours first as the temperature of the mixture rises. A condenser condenses the vapours of gasoline and collects them through the condenser output. In the distillation flask, kerosene with a higher boiling point will be left behind.

Because their vapours will develop within the same temperature range if the difference in boiling points of two liquids is not great, a simple distillation procedure cannot be utilised to separate them. Fractional distillation separates these liquids by passing the vapours through a fractionating column before condensation.

2. Name the techniques used to separate the following:

(a) Butter from curd

(b) Salt from seawater

(c) Camphor from salt

Solution:

a) A process known as centrifugation is used to separate butter from curd. The process is governed by the principle of density.

b) We can use the simple evaporation technique to separate salt from seawater. Distillation causes water to evaporate, leaving solid salt behind, hence the production of salt.

c) Sublimation can be used to separate camphor from salt, as during the phase change, camphor does not undergo a liquid phase.

3. What types of mixtures are separated by the technique of crystallisation?

Solution:

The technique of crystallisation is used to separate solids from a liquid solution. It is linked to precipitation, but in this technique, the precipitate is achieved in a crystal form which exhibits extremely high levels of purity. The principle of crystallisation can be applied to purify impure substances.

Exercise-2.4

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1. Classify the following as physical or chemical changes:

- **Cutting of trees**
- **Melting of butter in a pan**
- **Rusting of almirah**
- **Boiling of water to form steam**
- **Passing of electric current through water and water breaking into hydrogen and oxygen gases.**
- **Dissolving common salt in water**
- **Making a fruit salad with raw fruits, and**
- **Burning of paper and wood**

Solution:

The following is the classification into physical and chemical change:

Physical change	**Chemical change**
• Cutting the trees • Boiling of water to form steam • Melting of butter in a pan • Making a fruit salad with raw fruits • Dissolving common salt in water	• Rusting of almirah • Passing of electric current through water, and water breaking into hydrogen and oxygen gases • Burning of paper and wood

2. Try segregating the things around you as pure substances and mixtures.

Solution:

Listed below are the classifications based on pure substances and mixtures:

Pure substance	**Mixture**
Water	Soil
Salt	Salad

Iron	Air
Diamond	Steel

Exercise

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

(a) Sodium chloride from its solution in water.

(b) 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.

Solution:

(a) In water, sodium chloride in its solution can be separated through the process of Evaporation.

(b) The technique of sublimation is apt as Ammonium chloride supports Sublimation.

(c) Tiny chunks of metal pieces in the engine oil of a car can be manually filtered.

(d) Chromatography can be used for the fine segregation of various pigments from an extract of flower petals.

(e) The technique of centrifugation can be applied to separate butter from curd. It is based on the concept of difference in density.

(f) To separate oil from water, which are two immiscible liquids which vary in their densities, using a funnel can be an effective method.

(g) Tea leaves can be manually separated from tea using simple filtration methods.

(h) Iron pins can be separated from sand either manually or with the use of magnets as the pins exhibit strong magnetic quality, which can be a key characteristic taken into consideration.

(i) The differentiating property between husk and wheat is that there is a difference in their mass. If treated with a small amount of wind energy, a remarkable variation in the moving distance is noticed. Hence, to separate them, the sedimentation/winnowing procedure can be applied.

(j) Due to the property of water, sand or fine mud particles tends to sink in the bottom as it is denser provided they are undisturbed. Through the process of sedimentation/decantation, water can be separated from fine mud particles, as the technique is established on obtaining clear water by tilting it out.

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

Solution:

(a) Into a vessel, add a cup of milk, which is the solvent, and supply it with heat.

(b) Add tea powder or tea leaves to the boiling milk, which acts as a solute. Continue to heat.

(c) The solute, i.e., the tea powder, remains insoluble in the milk, which can be observed while it is still boiling.

(d) At this stage, add some sugar to the boiling solution while stirring.

(e) Sugar is a solute but is soluble in the solvent.

(f) Continuous stirring causes the sugar to dissolve completely in the tea solution, reaching saturation.

(g) Once the raw smell of tea leaves vanishes and the tea solution is boiled enough, take the solution off the heat, filter or strain it to separate the tea powder and the tea solution. The insoluble tea powder remains as a residue while the solute (sugar) and the solvent (essenced milk solution) strain through the filter medium, which is collected as the filtrate.

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

Substance dissolved	**Temperature in K**				
	283	**293**	**313**	**333**	**353**
	Solubility				
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) 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? 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?

Solution:

(a) Given:

Mass of potassium nitrate required to produce a saturated solution in 100 g of water at 313 K = 62g

To find:

Mass of potassium nitrate required to produce a saturated solution in 50 g of water =?

Required amount = 62 x 50/100 = 31

Hence, 31 g of potassium nitrate is required.

(b) The solubility of potassium chloride in water is decreased when a saturated solution of potassium chloride loses heat at 353 K. Consequently, Pragya would observe crystals of potassium chloride, which would have surpassed its solubility at low temperatures.

(c) As per the given data, that is

Solubility of potassium nitrate at 293 K = 32 g

Solubility of sodium chloride at 293 K = 36 g

Solubility of potassium chloride at 293 K = 35 g

Solubility of ammonium chloride at 293 K = 37 g

We can observe from this data that ammonium chloride has the highest solubility at 293K.

(d) Effect of change of temperature on the solubility of salts:

The table clearly depicts that the solubility of the salt is dependent upon the temperature and increases with an increase in temperature. With this, we can infer that when a salt arrives at its saturation point at a specific temperature, there is a propensity to dissolve more salt through an increase in the temperature of the solution.

4. Explain the following, giving examples.

(a) Saturated solution

(b) Pure substance

(c) Colloid

(d) Suspension

Solution:

(a) Saturated solution: It is the state in a solution at a specific temperature when a solvent is no more soluble without an increase in temperature. Example: Excess carbon leaves off as bubbles from a carbonated water solution saturated with carbon.

(b) Pure substance: A substance is said to be pure when it comprises only one kind of molecule, atom or compound without adulteration with any other substance or any divergence in the structural arrangement. Examples: Sulphur, diamonds etc.

(c) Colloid: A Colloid is an intermediate between solution and suspension. It has particles of various sizes that range between 2 to 1000 nanometres. Colloids can be distinguished from solutions using the Tyndall effect. Tyndall effect is defined as the scattering of light (light beam) through a colloidal solution. Examples: Milk and gelatin.

(d) Suspension: It is a heterogeneous mixture that comprises solute particles that are insoluble but are suspended in the medium. These particles that are suspended are not microscopic but visible to bare eyes and are large enough (usually larger than a micrometre) to undergo sedimentation.

5. Classify each of the following as a homogeneous or heterogeneous mixture.

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

Solution:

The following is the classification of the given substances into homogenous and heterogenous mixtures.

Homogenous mixture	**Heterogeneous mixture**
Soda water	wood
vinegar	soil
Filtered tea	
Air	

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

Solution:

We can confirm if a colourless liquid is pure by setting it to boil. If it boils at 100°C, it is said to be pure. But if there is a decrease or increase in the boiling point, we infer that water has added impurities, hence not pure.

7. Which of the following materials fall into the category of “pure substance”?

(a) Ice

(b) Milk

(c) Iron

(d) Hydrochloric acid

(e) Calcium oxide

(f) Mercury

(g) Brick

(e) Wood

(f) Air.

Solution:

Following substances from the above-mentioned list are pure substances:

- Iron
- Ice
- Hydrochloric acid
- Calcium oxide
- Mercury

8. Identify the solutions among the following mixtures.

(a) Soil

(b) Sea water

(c) Air

(d) Coal

(e) Soda water

Solution:

The following are the solutions from the above-mentioned list of mixtures:

- Sea water
- Air
- Soda water

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

(a) Salt solution

(b) Milk

(c) Copper sulphate solution

(d) Starch solution

Solution:

Tyndall effect is exhibited by only milk and starch solution from the above-mentioned list of solutions.

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

(a) Sodium

(b) 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	**Compounds**	**Mixture**
Sodium	Calcium carbonate	Soil
Silver	Carbon dioxide	Sugar solution
Tin	Methane	Coal
Silicon		Air
		Blood
		Soap

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 candle

Solution:

Out of the given list, the following are chemical changes:

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