

Separation Of The Components Of A Mixture

1 Distillation is a process used to separate a mixture of liquids based on different

- (1) boiling points (3) freezing points
(2) densities (4) solubilities

2 Table sugar can be separated from a mixture of table sugar and sand at STP by adding

- (1) sand, stirring, and distilling at 100.°C
(2) sand, stirring, and filtering
(3) water, stirring, and distilling at 100.°C
(4) water, stirring, and filtering

3 A mixture consists of ethanol and water. Some properties of ethanol and water are given in the table below.

Some Properties of Ethanol and Water

Property	Ethanol	Water
boiling point at standard pressure	78°C	100.°C
density at STP	0.80 g/cm ³	1.00 g/cm ³
flammability	flammable	nonflammable
melting point	-114°C	0.°C

Which statement describes a property of ethanol after being separated from the mixture?

- (1) Ethanol is nonflammable.
(2) Ethanol has a melting point of 0.°C.
(3) Ethanol has a density of 0.80 g/cm³ at STP.
(4) Ethanol has a boiling point of 89°C at standard pressure.

4 In a laboratory investigation, a student separates colored compounds obtained from a mixture of crushed spinach leaves and water by using paper chromatography. The colored compounds separate because of differences in

- (1) molecular polarity (3) boiling point
(2) malleability (4) electrical conductivity

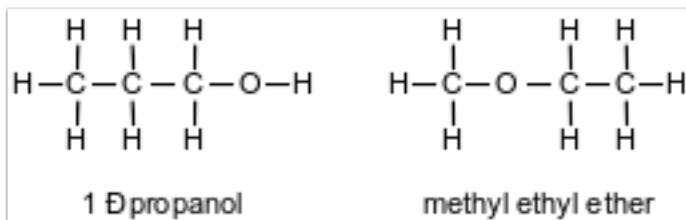
5 Paper chromatography can separate the components of a mixture of colored dyes because the components have differences in

- (1) decay mode (3) ionization energy
(2) thermal conductivity (4) molecular polarity

6 At STP, two 5.0-gram solid samples of different ionic compounds have the same density. These solid samples could be differentiated by their

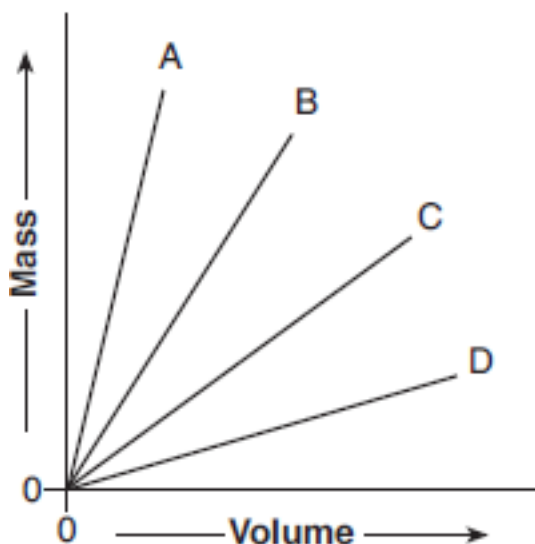
- (1) mass (3) temperature
(2) volume (4) solubility in water

7 Given the formulas representing two compounds at standard pressure:



The compounds can be differentiated by their

- | | |
|-------------------------|--|
| (1) boiling points | (3) numbers of hydrogen atoms |
| (2) gram-formula masses | (4) percent compositions by mass of carbon |
- 8 Differences in which property allow the separation of a sample of sand and seawater by filtration?
- | | |
|---------------------------|--------------------|
| (1) concentration of ions | (3) mass of sample |
| (2) volume of sample | (4) particle size |
- 9 The graph below shows the volume and the mass of four different substances at STP.

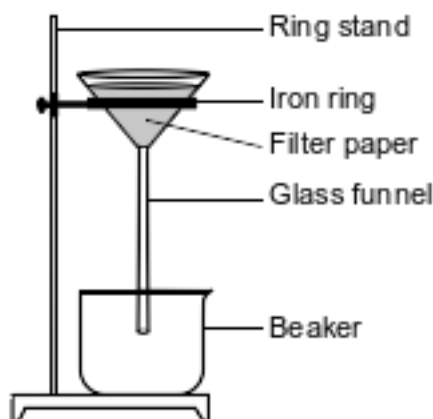


Which of the four substances has the lowest density?

- | | |
|-------|-------|
| (1) A | (3) C |
| (2) B | (4) D |

Base your answers to questions 10 on the information below and on your knowledge of chemistry.

During a laboratory activity, appropriate safety equipment is used and safety procedures are followed. A student separates a sample of rock salt that has two components; NaCl(s) and small insoluble rock particles. First, the student thoroughly stirs the sample of rock salt into a sample of water in a flask. The mixture in the flask is filtered using the lab apparatus shown below.



The water is evaporated from the beaker. The filter paper and its contents are dried. The data collected by the student are shown in the table below.

Rock Salt Separation Lab Data

Object or Material	Mass (g)
rock salt sample	16.4
filter paper	1.6
clean empty beaker	224.2
filter paper with dry rock particles	2.2
beaker with dry NaCl(s)	240.0

10 Explain, in terms of particle size, why the rock particles are trapped by the filter paper.

Base your answers to questions 11 on the information below and on your knowledge of chemistry.

A hydrate is a compound that has water molecules within its crystal structure. Magnesium sulfate heptahydrate, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, is a hydrated form of magnesium sulfate. The hydrated compound has 7 moles of H_2O for each mole of MgSO_4 . When 5.06 grams of $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ are heated to at least $300.^\circ\text{C}$ in a crucible by using a laboratory burner, the water molecules are released. The sample was heated repeatedly, until the remaining MgSO_4 had a constant mass of 2.47 grams. During this laboratory activity, appropriate safety equipment was used and safety procedures were followed.

11 Explain why the sample in the crucible was heated repeatedly until the sample had a constant mass.

Base your answers to questions 12 on the information below and on your knowledge of chemistry.

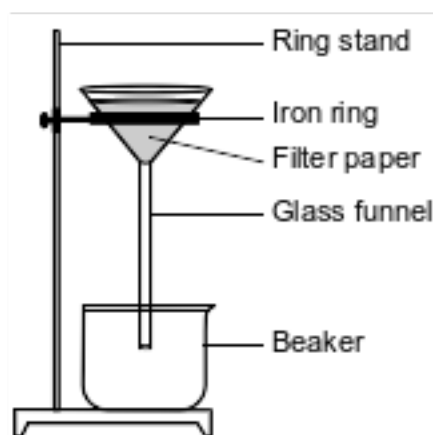
Crude oil, primarily a mixture of hydrocarbons, is separated into useful components in a fractionating tower. At the bottom of the tower, the crude oil is heated to about 400°C. The gases formed rise and cool. Most of the gases condense and are collected as liquid fractions. The table below shows the temperature ranges for collecting various hydrocarbon fractions.

Number of Carbon Atoms per Molecule	Temperature Range (°C)
1-4	below 40
5-12	40-200
12-16	200-300
16-20	300-370
>20	above 370

12 State the temperature range for the fraction collected that contains octane molecules.

Base your answers to questions 13 on the information below and on your knowledge of chemistry.

In a laboratory investigation, a student is given a sample that is a mixture of 3.0 grams of NaCl(s) and 4.0 grams of sand, which is mostly SiO₂(s). The purpose of the investigation is to separate and recover the compounds in the sample. In the first step, the student places the sample in a 250-mL flask. Then, 50. grams of distilled water are added to the flask, and the contents are thoroughly stirred. The mixture in the flask is then filtered, using the equipment represented by the diagram below.



13 Describe a procedure to remove the water from the mixture that passes through the filter and collects in the beaker.

14 Identify a laboratory process that can be used to separate a liquid mixture of methanol and water, based on the differences in their boiling points.

15 State the physical property that makes it possible to separate a solution by distillation.

Answer Keys

1 1

2 4

3 3

4 1

5 4

6 4

7 1

8 4

9 4

10 Allow 1 credit. Acceptable responses include, but are not limited to:

- The particles of the rock are much larger than the openings in the filter paper.
- The rock particles are too big to pass through the paper.

11 Allow 1 credit. Acceptable responses include, but are not limited to:

- Repeated heatings ensure that all of the water in the sample has been removed.
- It is necessary to drive out all of the water from the hydrate.
- to make sure all the H₂O is gone

12 Allow 1 credit for 40°C to 200°C. Significant figures do not need to be shown.

13 Allow 1 credit. Acceptable responses include, but are not limited to:

- Allow the water to evaporate.
- Heat the mixture until all of the water vaporizes.
- Boil off the water.

14 Allow 1 credit. Acceptable responses include, but are not limited to:

- distillation
- distilling

15 Allow 1 credit. Acceptable responses include, but are not limited to:

- boiling point
- boiling temperature