S1 New Curriculum chemistry

Theme: Air and environment

S1 New Curriculum Chemistry Chapter 8 – Water

Water is the essence of life!

Water is an important natural resource required by all living things to survive. For instance, man is made up between 70% to 90% water. Water covers 71% of the Earth's surface.

Chemically, water is made by reacting hydrogen to oxygen in ration 2:1. Hence, the chemical formula of water is H_2O.

States of water

Water exists in **solid** as **ice**, in **liquid** as **wate**r and in **gas** as **steam.**

Physical properties of water

(i) It is colorless
(ii) It is odorless
(iii) And tasteless
(iv) Density of water is $1g/cm^3$. Ice is less dense than water.

Experiment to determine the density of water

Apparatus

- Clean water in a beaker (about $20cm^3$)
- Measuring cylinder ($25cm^3$ or $50cm^3$)
- Weighing scale

Procedure

- Weigh a dry, empty measuring cylinder = x g
- Pour and weigh $20cm^3$ of water in measuring cylinder = yg

Calculation

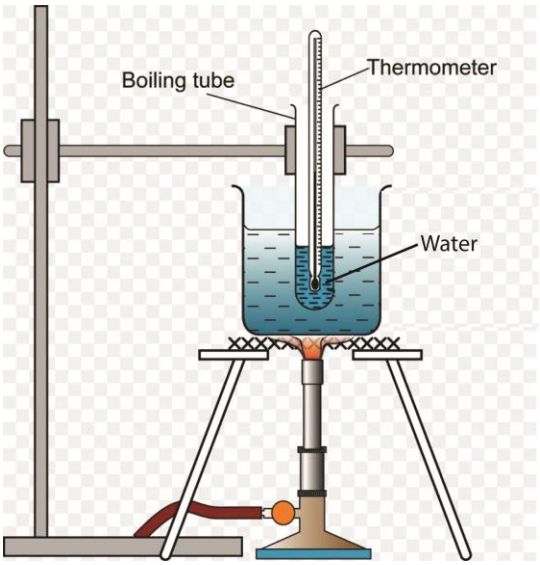
Mass of 20cm^3 of water = (x – y) g

Density of water = $\frac{(y-x)}{20}$ g/cm^3

(v) Pure water freezes at **0^{0}C** and boils at **100^{0}C**.

Determining the boiling point of water

Setup



Procedure

Heat the beaker gently, till water bois and the temperature becomes constant. The constant temperature is the boiling point. The boiling point of water at Kampala is between **96^0 – 97^{0}C**.

Chemical test for water

Water **turns white anhydrous copper Sulphate power blue**.

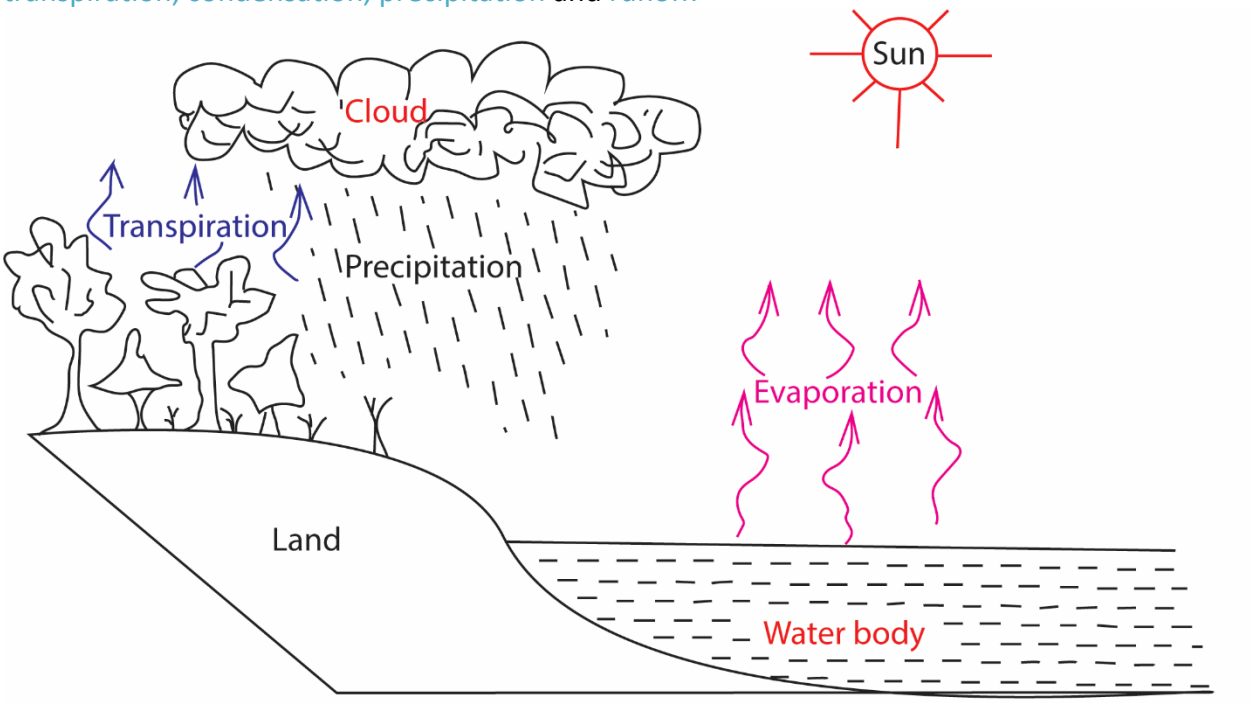
Some of the uses of water in daily life

- **Drinking & Hydration** – Keeps the body functioning, regulates temperature, and supports overall health.
- **Cooking & Food Preparation** – From boiling to washing ingredients, it's essential in the kitchen.
- **Cleaning & Hygiene** – Used for bathing, washing hands, doing laundry, and maintaining sanitation.

- **Agriculture & Gardening** – Vital for growing crops, watering plants, and sustaining livestock.
- **Transportation** – Rivers, lakes, and oceans enable travel and shipping.
- **Energy Production** – Hydropower generates electricity for homes and industries.
- **Manufacturing & Industry** – Used in production processes, cooling systems, and creating materials like paper and textiles.

Water cycle

- The **water cycle** is the path that all water follows as it moves around our planet.
- Of the many processes involved in the water cycle, the most important are evaporation, transpiration, condensation, precipitation and runoff.



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- **Evaporation** is the change of a liquid into vapour below its boiling point.
- **Transpiration** is the loss of water vapour from the plant through the stomata.
- **Condensation** is process by which water vapor turns into a liquid.
- **Precipitation** is any liquid or frozen water that forms in the atmosphere and falls back to the Earth in form of rain.
- **Runoff**, is the waters that travel over the land surface and through channels to reach a stream.

Common source of water for daily life

Water comes from various sources, each serving different needs. Here are some of the most common ones:

- **Rainwater** – Collected in tanks or reservoirs, especially in areas with limited access to other sources.
- **Wells** – Groundwater extracted through wells, a vital source for many communities.

- **Rivers and Streams** – Often used for drinking, irrigation, and industrial purposes.
- **Lakes and Ponds** – Natural reservoirs that supply water for consumption, fishing, and recreation.
- **Boreholes** – Deep underground water sources tapped for clean and sustainable supply.
- **Municipal Supply** – Treated water from reservoirs, dams, or rivers delivered through pipelines.
- **Springs** – Naturally occurring sources of fresh water from underground.

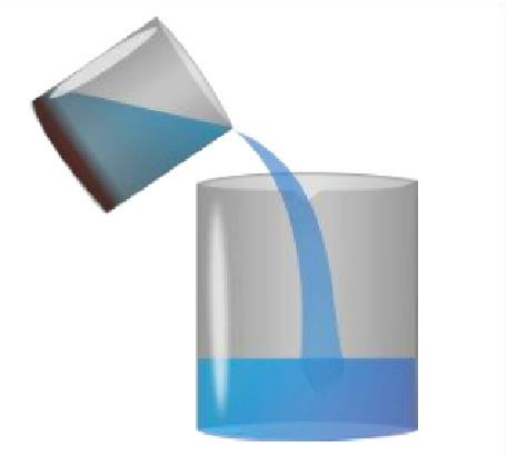
Each source requires different levels of treatment to ensure safety for human use.

Methods used to make water safe

- decanting,
- filtering,
- boiling,
- distilling
- adding chemicals.

(a) Decanting

Here dirty water is left in a container to settle and then clean water is poured into another container leaving settle particles behind. The particles that settle at the bottom of the container are called **sediments. Decanted water contain germs and is not fit for consumption until it is boiled**



(b) Filtration

Unclean water can be made clean by passing the water through a piece of cloth or a filter paper.

The cloth or filter paper acts as a sieve.

Water produced by this method is not fit for drinking because it may contain germs.

Homemade filtration apparatus

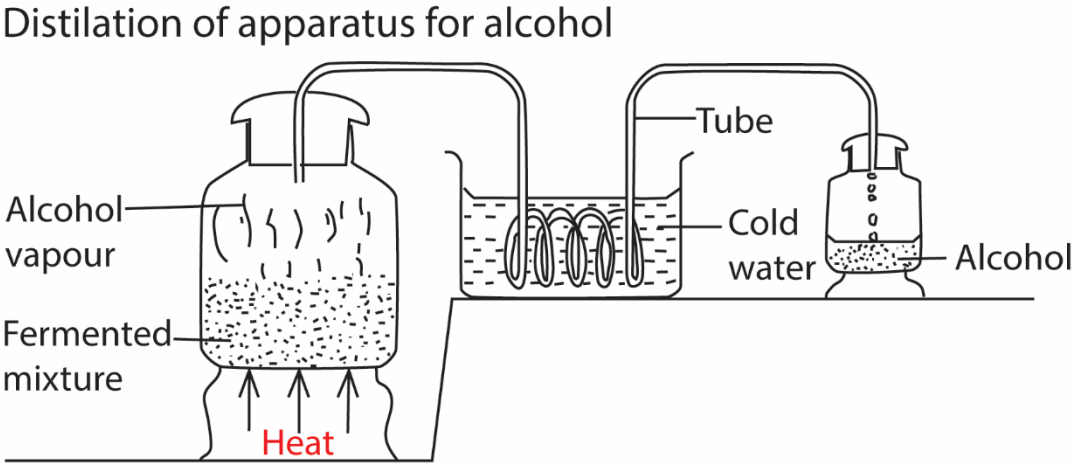
(c) Boiling:

Boiling kills germs

(d) Distillation

Here water is boiled to form vapor/steam that is cooled to form water or distillate. This method produces the purest water. This water is no good for drinking because it lacks minerals.

Distillation is also used to prepare alcohol from its fermented mixture as shown in the diagram below



The mixture is boiled, alcohol with low boiling point forms vapour first; the vapour is condensed with cold water to form liquid alcohol.

Stages in water treatment plant

A commercial water treatment plant follows several key stages to ensure water is safe for consumption and industrial use. Here's a breakdown of the process:

1. **Collection & Screening** – Water is sourced from lakes, rivers, or reservoirs and screened to remove large debris like leaves, plastic, and fish.
2. **Coagulation & Flocculation** – Chemicals like aluminum sulfate or ferric chloride are added to bind small particles together into larger clumps (floc).
3. **Sedimentation** – The floc settles at the bottom of a tank, separating from the cleaner water.
4. **Filtration** – Water passes through layers of sand, gravel, and charcoal to remove remaining impurities, including bacteria and algae.
5. **Disinfection** – Chlorine or other disinfectants are added to kill harmful microorganisms and ensure water remains safe during distribution.
6. **Storage & Distribution** – Treated water is stored in tanks before being delivered through pipelines to homes, businesses, and industries.

Sewage

Sewage refers to wastewater that comes from households, industries, and businesses, containing human waste, chemicals, and other pollutants. In Kampala, Uganda, sewage management is primarily handled by the **National Water and Sewerage Corporation (NWSC)**, which provides water and sanitation services.

Stages in sewage management

Sewage management involves several key stages to ensure wastewater is treated effectively before being released back into the environment or reused. Here's a breakdown of the process:

1. **Preliminary Treatment** – Large debris like plastics, leaves, and grit are removed using screens and grit chambers to protect equipment from damage.
2. **Primary Treatment** – Wastewater is held in sedimentation tanks where heavier solids settle at the bottom as sludge, while oils and grease float to the surface for removal.
3. **Secondary Treatment** – Biological processes break down organic matter using bacteria and microorganisms, often through activated sludge systems or biofilters.
4. **Tertiary Treatment** – Advanced filtration and chemical treatments remove remaining contaminants, including nutrients like nitrogen and phosphorus, to improve water quality.

5. **Sludge Treatment** – The sludge collected from earlier stages is processed through digestion, drying, or incineration to reduce volume and recover useful byproducts.

Reasons for sewage treatment

Sewage treatment is essential for protecting public health, the environment, and water resources.

- **Prevents Water Contamination** – Untreated sewage contains harmful bacteria, viruses, and chemicals that can pollute rivers, lakes, and groundwater, making water unsafe for drinking and agriculture.
- **Reduces Disease Spread** – Proper sewage management prevents outbreaks of waterborne diseases like cholera, dysentery, and typhoid.
- **Protects Ecosystems** – Without treatment, sewage can damage aquatic life by depleting oxygen in water bodies, leading to dead zones where fish and plants cannot survive.
- **Supports Sustainable Water Use** – Treated wastewater can be safely reused for irrigation, industrial processes, and even drinking after advanced purification.
- **Minimizes Foul Odors & Pollution** – Sewage buildup in communities can cause bad smells and unsanitary living conditions, which effective treatment helps prevent.
- **Compliance with Regulations** – Governments enforce sewage treatment standards to maintain a clean and healthy environment for everyone.

Revision Questions

1. (a) Name five sources of natural water.

   (b) How is this water from natural sources made safe for drinking.

2. Describe an experiment to show that a give liquid is water.
3. Describe the process of recycling water naturally.
4. List the physical properties of water.
5. (a) What is sewage?

   (b) List stages of sewage treatment

   (c) Why is sewage treatment necessary?