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Changes during Evaporation

About 500 years ago, an Italian artist and engineer Leonardo da Vinci showed that water bodies are crucial resources of any country and by stopping flow of river one country can even harm its neighbours. Yet he argued that evaporation takes away the water from one country and passes it on to another country. It ensures that....no one can really own the water!

Q 1. Have you seen evaporation in your surrounding? If yes, can you write any two examples?

yes, Example : Ironing clothes, Drying clothes in the sun, melting of ice.

Q 2. What do you observe when a liquid evaporates in a container? Do you see any change happening which indicates evaporation is taking place?

Liquid turn into gas called water vapour.

Fill in the blank to complete the sentence: The process of a liquid Changes at the liquid gas interface is called *evaporation.*

Q 3. What are the factors that you know which affect evaporation?

Surface area, wind speed, temperature, Humidity.

Q 4.

a) When do you sweat?
b) If you don't wipe it, how can you dry it?
c) What happens to that sweat when it dries?
d) After it has dried where can you find it?

(a) when the weather is hot or our body temperature rises due to exicise or fiver.
(b) If we don't wipe it after some time air make it evaporate.
(c) As the sweat evaporates of our skin, we cool down.

(d) We can't find it, when it has been dried up.

Q 7. What ... in?

Task 1: Matter Transfer in Evaporation

Q5. If you take a liquid in a sealed flask and mass of this flask with the liquid is *m*. After some time, the liquid in the sealed flask evaporates. Predict if the mass of this flask will be still same as *m*, greater than *m* or less than *m*.

If we take liquid in flask. And the weight is m, When the water gets evaporate the remaining materials is flask and the air present in it. Then the mass will less than m.

What you need: Conical flask (100 cm^3) with rubber cork, a dropper, digital weighing Balance (least count 10 mg or 1 mg), Acetone (or Spirit or Nail polish remover, 2 mL).

Procedure:

1. Take a clean and dry conical flask and place a cork on it. Use a balance to measure its mass, and write it as m_1. Open the cork and smell the flask gently.
2. To this flask, add about 6 to 7 drops of acetone (or spirit or nail polish remover) using dropper and smell gently (do not take it near your nostrils and breathe heavily). Place the cork on the flask and seal it tightly. Use a balance to measure its mass and write it as m_2.
3. Warm the conical flask with hands and shake it till the liquid in it evaporates (do not invert the conical flask). Measure its mass again and write it as m_3.
4. Open the flask and smell gently. (Do not take it near your nostrils and breathe heavily), keep the flask open for 5 minutes. Close the flask by replacing the cork. Measure the mass of flask now and write it as m_4.

Record your observations in table below.

	Step 1	Step 2	Step 3	Step 4
Mass	m_1 = 100.6 gm	m_2 = 100.8 gm	m_3 = 100.8 gm	m_4 = 100.6 gm
Smell	No smell	Smell of acetone	Smell of acetone	5 min after the smell goes off.

Q 6. Was the smell of the conical flask content before closing (Step 1) and after opening the cork (Step 4) same or different? What does this tell about the changes in air inside the flask?

Then the smell of the conical flask was same before closing and after opening the cork.

Q 7. What does the flask contain after step 3 and before step 4? What physical state is it in?

after 3rd step the flask contain acetone and before 4th step the flask contain water vapour of acetone. It is in gas state.

Q8. What happened to the air that was in the flask initially?

The air will remain same only where the acetone fills the volume of the flask. That part of air will be removed from the flask.

Q 9. Is m_3 same as m_1 or m_2? Can you explain your result?

No, there is difference in m_1, m_2 & m_3 because in m_1 the flask contain only air. In m_2 the flask contain acetone and in m_3 the acetone evaporate but the mass is same. Because cork is there and there is no space for gas to get out.

Q 10. Is m_4 same as m_1 or m_2? Can you explain your result?

m_4 is same as m_1 because in m_1 there is only air and no smell so for m_4 the acetone gets evaporate and there is no smell.

Q 11a. Based on your results; which of the following statement(s) is/are true and which is /are false?

1) Evaporation converts liquid into gaseous phase. T
2) Gases have mass. T
3) Gases can diffuse through air within few seconds. T
4) Movement from liquid to gaseous state decreases mass of its molecules. T

Q 11b. Give evidences to support your answer for each of the above answers.

(1) During evaporation liquids convert into gases because during the process heat is absorbe and particle convert into gases

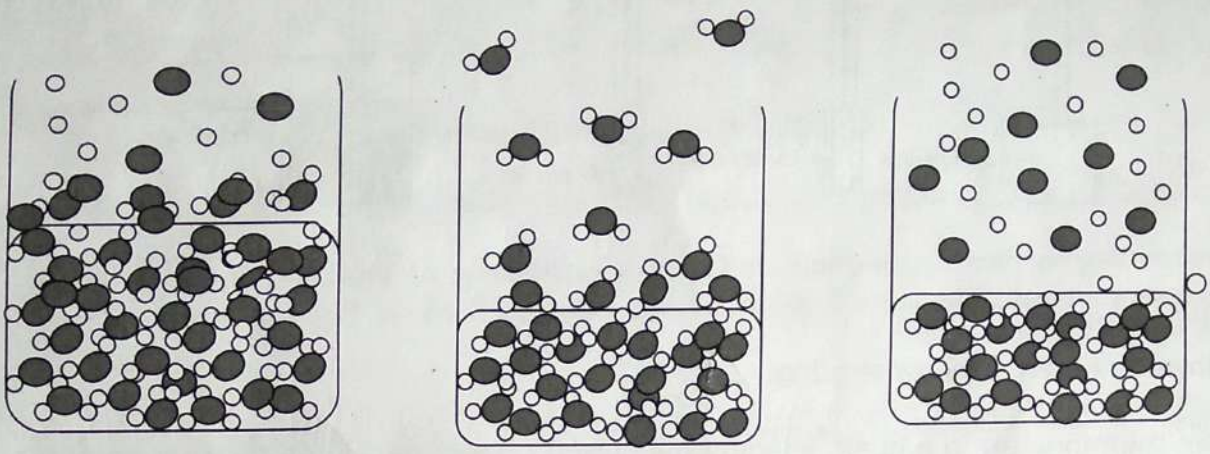
(2) All the particle have mass that's why they can exist in nature

(3) Because particles of air also have large interparticle space & Hence the particle & gases are freely able to exist between the particle of air.

Our modern understanding of liquids suggest that molecules of a liquid are always moving. Even at a fixed temperature and pressure, different molecules have different amount of

kinetic energy. In liquids, some molecules at the surface always have more kinetic energy than the others. Even at temperature much below its boiling point, some of its molecules have enough energy to break the forces of attraction and escape from the surface liquid in the form of vapour (or gas).

Q 12. If  is water molecule then which of the following diagram represents evaporation of water? Justify your answer.



(A) (B) (C)

) diagram showing the evaporation of water. Because the evaporation takes place at surface. When the molecule of water on surface evaporate the the lower molecule will evapore. It is also a slow procss.

Task 2: Heat Transfer in an Evaporation

When a liquid keeps on evaporating from its surface, the molecules remaining in liquid have lower average energy. This cools down the remaining liquid.

Q13. Why do people sprinkle water on open ground on a hot sunny day?

people sprinkle water on open ground because in sunny day the ground is too hot. To cool it evaporation takes place & evaporation cause cooling effect. That's why the ground became cool.

Requirement: a thermometer (0˚C to 100˚C), cotton or paper napkin, a rubber band (small size), water in a small beaker or small container, blower (optional).

Procedure:

1. Cover thermometer bulb with paper napkin or cotton from all sides (including bottom), put the rubber band to fix the paper napkin or cotton at place (As shown in Fig. I).

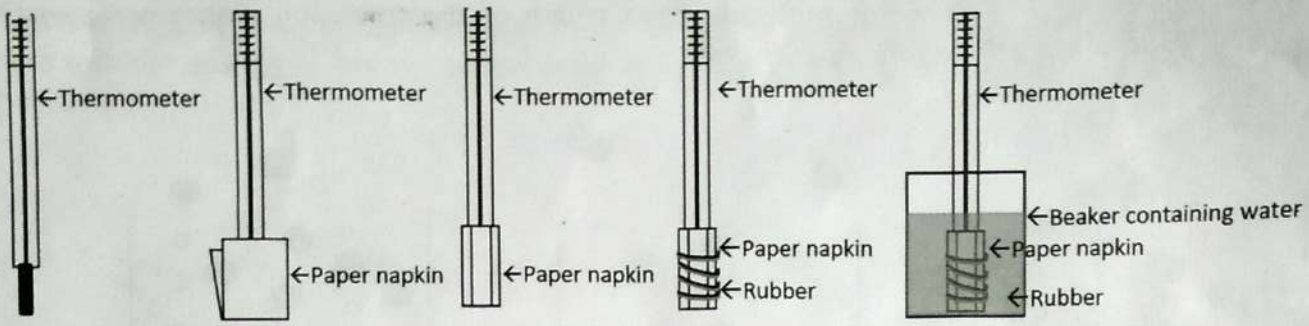


Fig. I

2. Note down the thermometer reading. 23 **°C.**

3. Hold the thermometer in a hand, keeping the cotton / paper napkin on the thermometer bulb at a distance of 1 inch from your mouth, and blow air for about three minutes by rotating thermometer very slowly (use blower if required). Note down the thermometer reading after every one minute (do not keep the thermometer aside while noting down the temperature reading).
4. Wet the thermometer bulb covered with paper napkin or cotton, just by dipping it in water for few seconds (as shown in Fig I). Note down the thermometer reading: 22 **°C.**
5. Blow air at the cotton or paper napkin on thermometer bulb holding it in a hand and keeping it at a distance of 1 inch from your mouth for about three minutes by rotating thermometer very slowly (use blower if required). Note down the thermometer reading after every one minute (do not keep the thermometer aside while noting down the temperature reading).

Observations: For Step 3 and 5

		Thermometer reading in °C		
		After 1 min.	After 2 min	After 3 min
Step 3	Bulb covered with dry paper napkin or cotton	23	23	$23\frac{1}{2}$
Step 5	Bulb covered with wet paper napkin or cotton	22	22	20

Q 14. How did the temperature change in two cases? Can you explain it?

In case one with dry thermometer, the reading changes very slowly. But in case 2. with wet thermometer, the reading changes with a fast speed.

Q 15. In summer days if electricity is cut off for two days, then how can you keep food cool (to prevent its spoilage) without a refrigerator?

We can keep the food cool by keeping it underground, keeping it in the running fresh water, we can also use evaporation to cool food.

Q 16. Suppose you have to walk outside on a hot sunny day, how can you maintain your body temperature and protect yourself from sun stroke by utilizing the phenomena of evaporation?

1. apply sunscreen generally and reapply every 2 hr.
2. Wear loose fitting clothes
3. Drink plenty of water.

Task 3: Faster and Slower Evaporation

Q17. Following situations involve evaporation of a liquid. In which case we want the evaporation to happen fast and in which case we want it to happen slowly:

(a) Drying of clothes S
(b) Drying of papads F
(c) Evaporation of water in a lake S
(d) Evaporation of water in puddles after rains S
(e) Drying of soil in a field S
(f) A perfume sprayed on a handkerchief F
(g) Drying of Nail polish on nails F
(h) Paint done on a wall F
(i) Fresh plaster on a wall F

Above cases show that in some situations we want evaporation be as fast as possible and in some situations, we want to slow down the evaporation.

Q18. How can you make the evaporation in any situation slower or faster?

Slow :- Covering the surface of water bodies with a fixed or floating covers.
Faster :- the rate of evap. increases as temperature increases

Q19. Arrange the following in increasing order of evaporation rate.
Water, spirit, kerosene, coconut oil.

coconut oil < water < kerosene < spirit

Now we will study evaporation of different liquids at the same conditions of temperature and pressure.

What we need: Stop Watch or a clock, four droppers, acetone (2 mL), ethanol/spirit (2 mL), glycerine (2 mL), water (2 mL), brown paper or any other absorbing paper (4 pieces of about 4 cm × 2 cm size).

Procedure:

1) You are given four small containers labelled 1, 2, 3, 4 containing acetone, alcohol, glycerine and water, respectively.
2) On the corners of four pieces of brown paper, write the names of four liquids.
3) Using a dropper, place one drop of each liquid on the piece of brown paper having its name.
4) Note down the time required for complete evaporation of the liquid on each paper with the help of a stop watch.

Observations:

Room temperature: 26 °C

Sr. No.	Liquid	Time (Seconds) required for evaporation of the liquid
1	Acetone	30 min
2	Ethyl Alcohol	60 min.
3	Glycerine	40 min.
4	Water	3-4 hr. / (Not possible)

Q 20. Which of the above four liquids evaporates faster? Can you explain why?

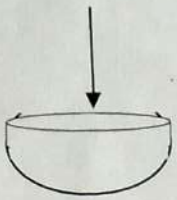
Acetone evaporates faster than the three because it is thin and its particles are removing faster

Q 21. If you were to make a paint, which of the above liquids would you choose to mix the solid colour in? Why would you chose that liquid?

If we were to make a paint, we will choose acetone as a liquid to mix a solid colour in because it evaporates easily.

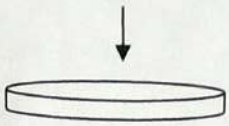
Q 22. 10 mL of ethanol if placed in different containers, like evaporating dish, test tube, petri dish, beaker. Arrange the containers in the increasing order of evaporation rate of ethanol.

Evaporating dish

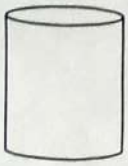


Test tube→

Petri dish



Beaker →



Testtube < Beaker < Evaporating dish < Petridish

Q 23. Can evaporation be a source of pollution? If yes, give some examples and explain.

Yes, Increased evaporation cause intense rainfall and cause flood. The pollutants also absorbed in evaporation

Q 24. Explain the statement of Leonardo da Vinci given in the beginning of this Unit.

Leonarda da Vinci given a true statement. By stopping the flow of river to other country can harm that country. But Nature has its own rule because that water evaporates and flow through rain in other country Nature does not need a land to flow water.

References:

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3) Droplet Wetting and Evaporation , e book,, Ist ed. Edited by David Brutin.