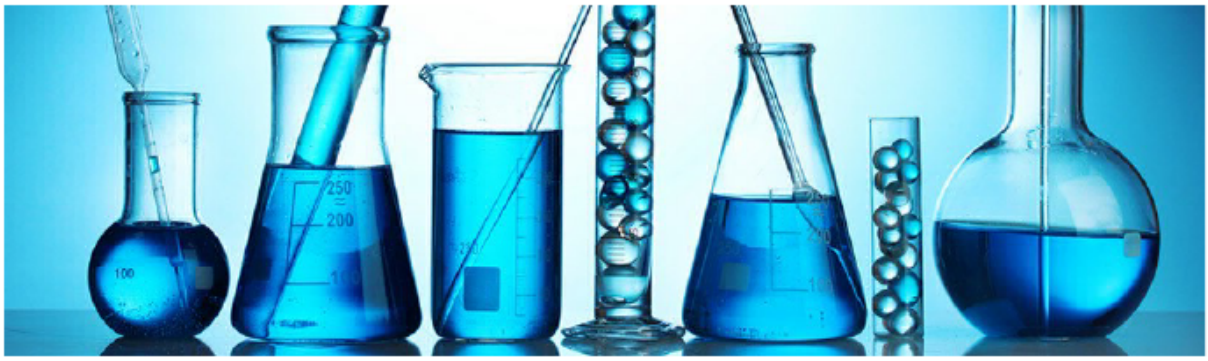

# To study the effect of various solutes on the elevation of boiling point of

CHEMISTRY

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Session: 2015-16

# INDEX

# Acknowledgement

I would like to thank the CBSE, for providing me the opportunity to carry out this investigatory project. I also take this opportunity to express my sincere gratitude to my Chemistry teacher, **Mr. Anwar Ul Haque, PGT Chemistry**, for guiding me and imparting a sound base of knowledge pertaining to this topic which ensured the successful completion of this project. I would also like to thank him for unending assistance to enable completion of the exercise.

# CERTIFICATE

This is to hereby certify that the original and genuine investigatory project has been completed sincerely and satisfactorily by **Joydeep Naskar** of class **XII – Sc.**

**KendriyaVidyalaya IIMJoka,**

**Kolkata**, regarding his project titled "**To study the effect of various solutes on the elevation of boiling point of water"** as per the CBSE practical work requirement for

the session 2015-2016.

Teacher's Signature Examiner's Signature

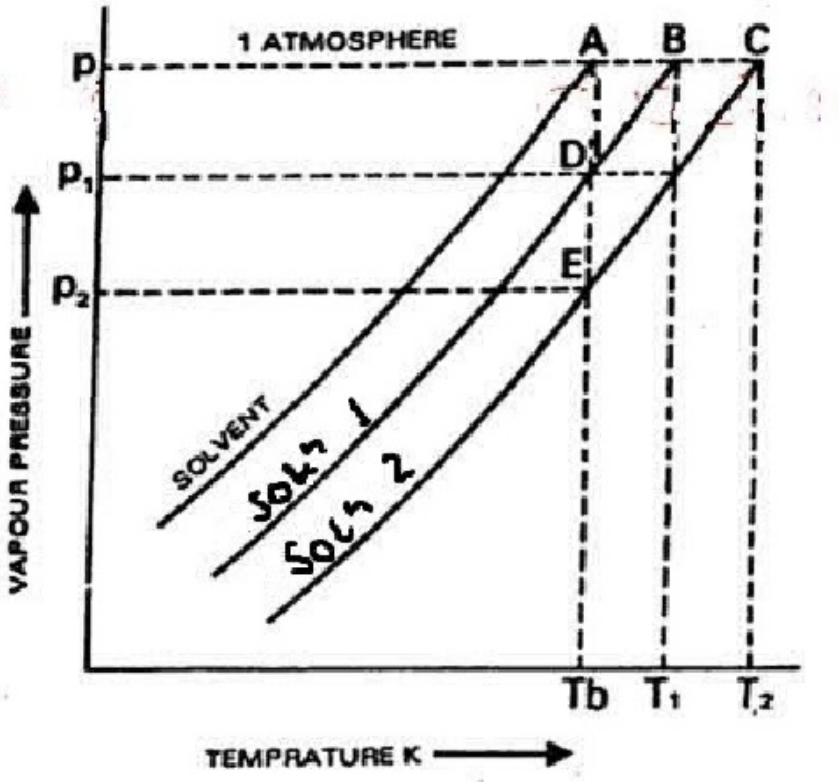

**What Is Boiling Point?**

The temperature at which vapour pressure of a liquid becomes equal to its external pressure is called boiling point.

**Why addition of non-volatile solute increases boiling point?**

The vapour pressure of the solution decreases upon addition of non-volatile solute, according to Raolt's Law. Hence, boiling point of the solution increases.

The increase in boiling point of a liquid when a non-volatile solute is added in it is called boiling point elevation.




The figure shows the vapour pressure curves for the pure liquid solvent and the solution. At the temperature $T_b$, the vapour pressure of the pure solvent

becomes equal to the atmospheric pressure P and $T_b$ is the boiling point of the solvent. But the vapour pressure of the two solutions 1 and 2 at $T_b$ is $P_1$ and $P_2$ respectively, which are less than atmospheric pressure and therefore it is needed to heat the solvent to a higher temperature say $T_1$ and $T_2$ for solutions 1 and 2 respectively in order that the vapour pressure becomes equal to the atmospheric pressure. Thus $T_1$ and $T_2$ are the boiling points of the solutions 1 and 2 respectively .Thus it is clear that the solution has higher boiling point than the pure solvent or $T_b$.

Evidently $(T_1 - T_b)$ and $(T_2 - T_b)$ are the elevation in boiling points of solutions 1 and 2 respectively.

Since its magnitude is determined by the vapour pressure lowering

the elevation in boiling point is also proportional to solute concentration.

From (1) and (2),

$$\Delta T_b = \mathrm{K}\,\frac{W_b/M_b}{W_a/M_a} = \mathrm{K}\,\frac{\eta_b}{W_a} \times M_a = K_b.\,\mathrm{m} \quad [\text{ where m} = \frac{\eta_b}{W_a}\ ]$$

Where, $K^b$ is the molal elevation constant or molal ebullioscopic constant.

It is quite clear from the above discussion that we can calculate molecular mass of solute by measuring the elevation in boiling point of a solution and elevation in boiling point is a colligative property.

# EXPERIMENT

**AIM:**

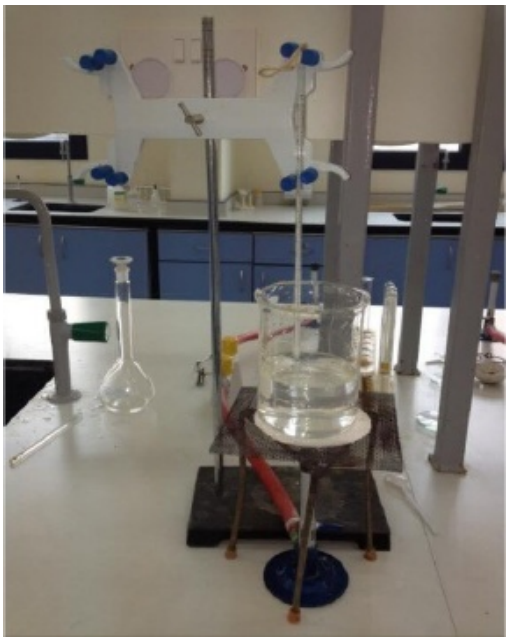
To study the effect of various solutes on the elevation of boiling point of water

# MATERIALS REQUIRED:

1.Bunsen burner
2. Tripod stand
3. Wire mesh
4. 250ml flask
5. Glass stirrer
6. Thermometer
7. Solutes under investigation
8. Tap Water

# PROCEDURE:

1. Set up the apparatus using a 250ml beaker containing 200ml of the experimental solution.



2. Put the beaker on a tripod stand with a wire mesh and use a Bunsen burner to heat the solution
3. A celestial thermometer calibrated up to 110◦C is immersed in the solution in the beaker with the help of a clamp stand.
4. The initial temperature taken before starting the experiment was considered as the room temperature.
5. At first, find the boiling point of tap water. This temperature is taken as the standard boiling point of the solution.

6. Now, prepare three different concentrations of NaCl and boil 250ml of each one by one in the beaker.
7. Take the readings of the temperature after every 20 seconds
8. After 90 seconds, take the readings after every 10 seconds in order to easily find out the concurrent result.
9. Repeat the procedure similarly for different concentrations of glucose and take the observations accordingly.

# OBSERVATION:

**The boiling point of tap water as solvent is found to be 99.3°C**
Least count of thermometer: 0.1°C

Table for elevation in boiling point:

| **Mass of solute (grams)** | **Molal concentration (moles/kg)** | **Measured temperature of b.p. (°C)** | **Elevation in b.p. from experiment (°C)** |
|---|---|---|---|
| **For NaCl** | | | |
| | 0.125 | 99.8 | 0.5 |
| | 0.25 | 100.2 | 0.9 |
| | 0.5 | 100.7 | 1.4 |
| | 1.0 | 102.1 | 2.8 |
| **For Glucose** | | | |
| | 0.125 | 99.4 | 0.1 |
| | 0.25 | 100.6 | 1.3 |
| | 0.5 | 101.1 | 1.8 |
| | 1.0 | 101.2 | 1.9 |

# RESULT & CONCLUSION

On increasing the concentration, the boiling point of NaCl and glucose increases.

# DISCUSSION AND SOURCES OF ERROR

The two experiments were not conducted simultaneously and due to non-availability of distilled water, tap water was also used. Moreover, due to prolonged heating, some of the solution evaporates bringing about a change in the actual concentrations. So it can be suggested that increase in b.p is dependent only on the number of moles of solute and not on the nature of the solute whether it is NaCl or glucose. Also, NaCl dissociates into ions $Na^+$ and $Cl^-$, giving rise to two ions from one unit.

The difference between theoretical predictions and experimentally found values can be attributed to experimental errors as experiment was not conducted in controlled laboratory conditions.

It is proved that when a non-volatile solute is added to a volatile solvent, the b.p. of the solvent increases. Also, this increase in b.p is not dependent on the nature of the solute but depends only on the number of moles of the solute. Thus, this elevation in b.p. is a colligative property.

# BIBILOGRPAHY

Various books and websites were referred while making this project:

1) Chemistry Textbook for class XII, Part-I, NCERT

2) Chemistry Laboratory Manual for class XII, NCERT

3) Wikipedia.org

4) ConnectUEdu

5) Youtube.com