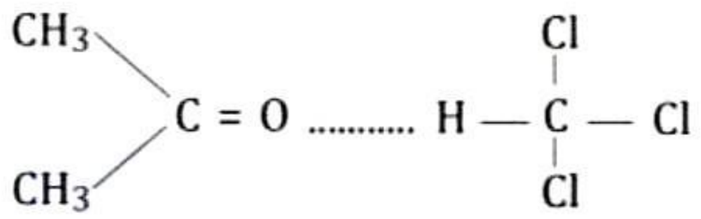
EXPERIMENT

Aim

Determine the enthalpy change during the interaction (hydrogen bond formation) between acetone and chloroform.

Theory

When acetone is mixed with chloroform, heat is evolved due to formation of hydrogen bonds between chloroform and acetone:



Heat evolved during this interaction can be determined experimentally by mixing the two liquids and measuring the heat change by using a calorimeter.

Material Required

A wide mouthed polythene bottle fitted with a thermometer ($1/10^{th}$ degree) and a stirrer (to serve as calorimeter), 100 ml measuring cylinder. Pure acetone and pure chloroform.

Procedure

1. Put 100 mL acetone in calorimeter and note down its temperature as t_1 °C.
2. Take 100 mL chloroform in a beaker and also note down its temperature. Both the solutions should have same temperature.
3. Transfer chloroform to acetone quickly, close the lid and stir gently.
4. Note down the temperature of the mixture at small intervals till it becomes constant.
5. Record the highest temperature reached t_2 °C.

Observations

Initial temperature of acetone and chloroform	$= t_1$ °C
Final temperature after mixing the two liquids	$= t_2$ °C
Change in temperature	$= (t_2 - t_1)$ °C
Water equivalent of calorimeter	$= W$ gm
Density of chloroform	$= 1.499$ g/cm^3
Density of acetone	$= 0.787$ g/cm^3
Heat capacity of chloroform, S_1	$= 0.96$ J/g
Heat capacity of acetone, S_2	$= 2.18$ J/g

Calculation

Heat change $= W \times 4.184 \times (t_2 - t_1) + [100 \times 1.499 \times S_1 + 100 \times 0.787 \times S_2](t_2 - t_1)$ Joules

= x Joule

Since $t_2 > t_1$ in this experiment, heat is evolved, and enthalpy change for the interaction of acetone and chloroform has negative sign.

Result

Enthalpy change during mixing of 100 ml of acetone with 100 ml of chloroform = – x Joule

VIVA VOCE

Q 1. What is the enthalpy change associated with the interaction, specifically hydrogen bond formation, between acetone and chloroform?

Ans. The enthalpy change associated with hydrogen bond formation between acetone and chloroform represents the heat energy absorbed or released when the molecules interact to form hydrogen bonds.

Q 2. How can the enthalpy change during the interaction between acetone and chloroform be experimentally determined?

Ans. Experimental techniques such as calorimetry, particularly solution calorimetry or differential scanning calorimetry (DSC), can be employed to measure the heat absorbed or released during the interaction between acetone and chloroform. By monitoring the temperature change and knowing the masses and concentrations of the substances, the enthalpy change can be calculated.

Q 3. What molecular forces are involved in the interaction between acetone and chloroform, leading to hydrogen bond formation?

Ans. The interaction between acetone and chloroform involves hydrogen bond formation, which occurs between the oxygen atom of acetone and the hydrogen atom of chloroform, as well as dipole-dipole interactions between the polarized molecules.

Q 4. How does the strength and number of hydrogen bonds formed between acetone and chloroform influence the enthalpy change during their interaction?

Ans. The strength and number of hydrogen bonds formed between acetone and chloroform affect the enthalpy change during their interaction. Stronger and more numerous hydrogen bonds typically result in greater enthalpy changes, either absorption or release of heat, depending on the direction of the interaction.

Q 5. What are the practical implications of understanding the enthalpy change during the interaction, including hydrogen bond formation, between acetone and chloroform?

Ans. Understanding the enthalpy change during the interaction between acetone and chloroform provides insights into their solubility, miscibility, and interactions in various solvent systems. This knowledge is valuable in fields such as organic chemistry, chemical engineering, and pharmaceutical formulation, where the behaviour of these substances in solution is of importance.