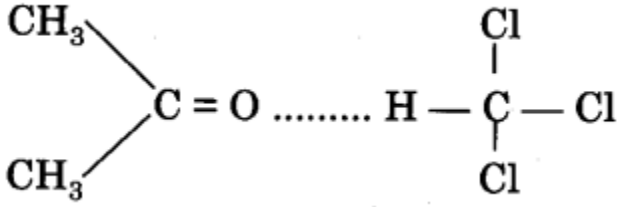
Determine the Enthalpy Change During the Interaction (Hydrogen Bond Formation) Between Acetone & Chloroform

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.

Requirements

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

Procedure

A. Determination of Calorimeter Constant

1. Put 100 ml of distilled water in polythene bottle with a thermometer and stirrer Fig.

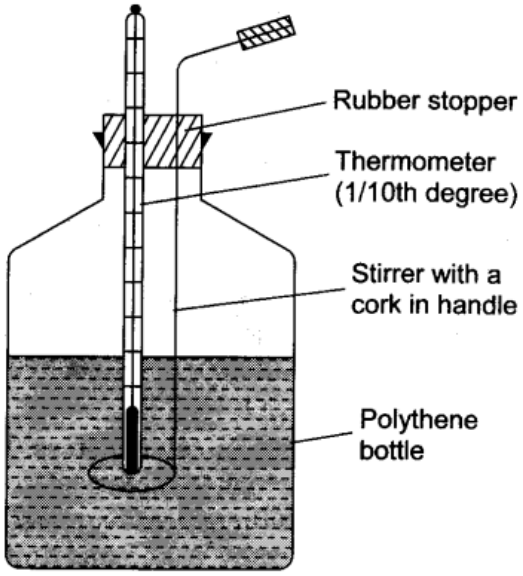


Fig. Polythene bottle calorimeter.

2. Note the temperature (t_1°C).
3. Heat some water in a beaker to a temperature 20-30°C higher than that of room temperature.
4. Put 100 ml of this warm water in another beaker.
5. Note the temperature of this water. Let it be t_2°C.
6. Add warm water from the beaker into the polythene bottle without any loss of time.
7. Stir the contents.
8. Read the temperature attained after mixing. Let it be t_3°C.

B. Determination of Enthalpy of Interaction of Acetone and Chloroform

1. Take a clean and dry polythene bottle calorimeter.
2. Place 100 ml acetone in it.
3. Note the temperature of acetone.
4. Take 100 ml of chloroform in a beaker and note its temperature. Both the solutions should have same temperature otherwise wait for some time so that they attain same temperature.
5. Transfer the chloroform into the calorimeter and immediately fit the cork (or lid) having thermometer and stirrer. Stir gently.
6. Note the temperature after small intervals till it becomes constant.
7. Record the highest temperature reached.

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

Calorimeter constant of calorimeter $= W$ J/°C

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

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

$= X$ Joules

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 Joules.