Determine the Enthalpy Of Neutralisation Of Hydrochloric Acid With Sodium Hydroxide Solution

Theory

Heat is evolved during neutralisation of an acid with an alkali. Known volumes of the standard solutions of an acid and alkali are mixed and the change in temperature is observed and from this, the enthalpy of neutralisation is calculated. Enthalpy of neutralisation is the heat evolved when one gram equivalent of the acid is completely neutralised by a base in dilute solution.

Requirements

(a) Apparatus. A wide-mouthed polythene bottle (to serve as calorimeter), a rubber (cork having two holes, thermometer (1/10th degree), stirrer fitted with a cork on the handle, and a 100 ml measuring cylinder.
(b) Chemicals. 1.0 M hydrochloric acid and 1.0 M sodium hydroxide solution.

Procedure
A. Determination of Calorimeter Constant

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

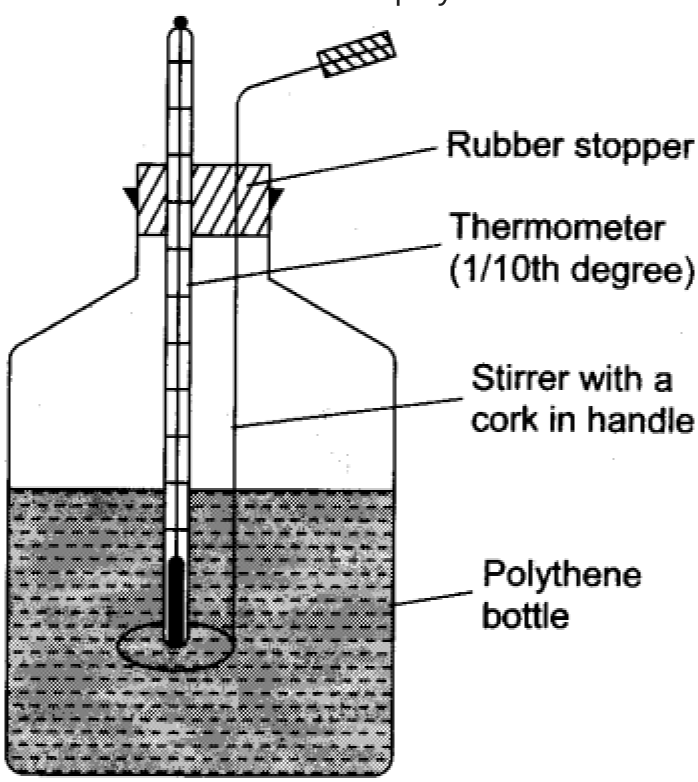

Fig. Polythene bottle calorimeter.

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 Neutralisation

1. Clean and dry the polythene bottle.
2. Place 100 ml of 1.0 M hydrochloric acid solution in it.
3. Record the temperature of the acid solution.
4. Similarly, note the initial temperature of the sodium hydroxide solution taken in a separate vessel.
5. Both the solutions should have the same temperature, otherwise wait for some time so that they attain the same temperature.
6. Transfer 100 ml of sodium hydroxide solution into the acid solution quickly.
7. Immediately fit the cork having the thermometer and the stirrer in the mouth of the polythene bottle (Fig.) and stir well.
8. Note the temperature after small intervals till it becomes constant.
9. Record the highest temperature (to 0.1°) reached.

Observations

Initial temperature of the acid and base = t_1°C
Final temperature after neutralisation = t_2°C
Change in temperature, $\Delta t = (t_2 - t_1)$°C.
Mass of the mixture solution after neutralisation = 200 g*
Calorimeter constant of calorimeter = WJ/°C

Calculations

Heat produced during neutralisation of 100 ml of 1.0 M HCl

$$= (200 + W) \times (t_2 - t_1) \times 4.184 \text{ Joules}$$

∴ **Heat produced during neutralisation of 1000 ml of 1 M HCl**

$$= (200 + W) \times (t_2 - t_1) \times 4.184 \times \frac{1000}{100} \text{ Joules}$$

$$= \frac{(200 + W) \times (t_2 - t_1) \times 4.184}{100} \text{ kJ.}$$

Since heat is produced during neutralisation, the enthalpy of neutralisation is negative.

$$\therefore \quad \boxed{\textbf{Enthalpy of neutralisation} = -\frac{(200 + W) \times (t_2 - t_1) \times 4.184}{100} \text{ kJ.}}$$

Result

The enthalpy of neutralisation of HCl with NaOH is……… kJ.
Percentage error =………….
Note: Enthalpy of neutralisation of all strong acids with strong bases and vice versa is –57.3 kJ. It may be noted that 1000 mL of 1 M HCl contains 1 mole (or 1 equivalent) of HCl.