OCR (B) Chemistry A-Level

PAG 03 : Enthalpy Determination

3.1 Determination of enthalpy change of neutralisation

Equipment

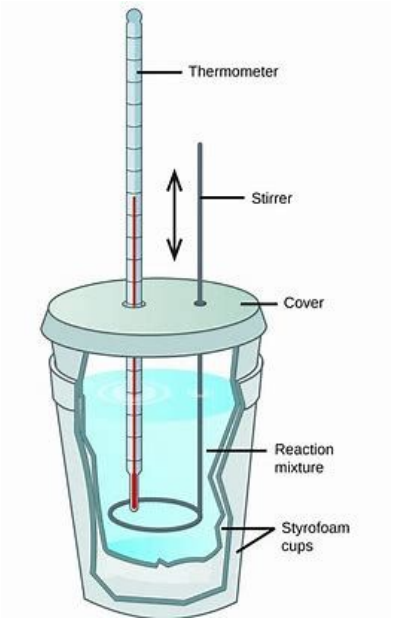
- Polystyrene cup with lid
- Thermometer
- 250 cm^3 glass beaker
- 1 mol dm^{-3} NaOH solution
- 1 mol dm^{-3} HCl solution
- Two measuring cylinders
- Stopwatch

Method

1. Pour 25 cm^3 of HCl into the polystyrene cup using a measuring cylinder.
2. Place the polystyrene cup into the 250 cm^3 glass beaker.
3. Using a different measuring cylinder, measure 25 cm^3 of NaOH.
4. Construct a table like so:

Time / mins	0	1	2	3	4	5	6	7	8	9	10
Temperature / ºC											

5. Start the stopwatch and record the initial temperature of the HCl in the cup and it's temperature for three minutes.
6. On the fourth minute, add the NaOH to the cup and close the lid. Do not record the temperature.
7. Continue recording the temperature from 5 minutes up to 10 minutes. Stir the solution constantly.

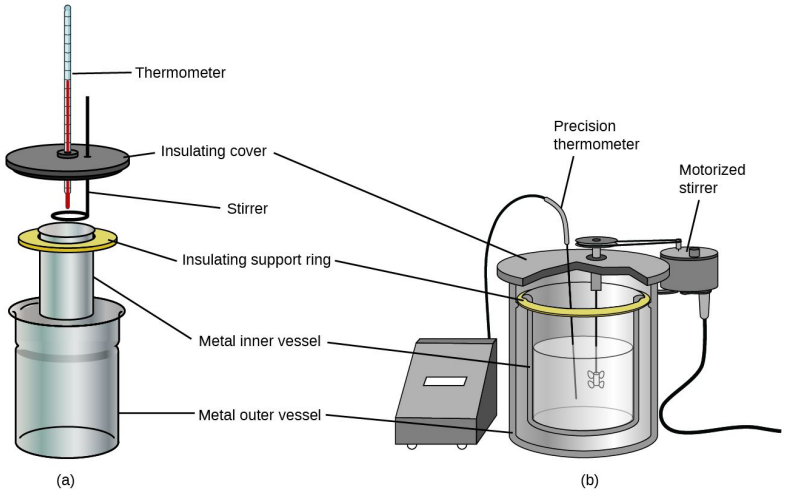


Calculations

- Calculate the mean temperature of the HCl over the first three minutes recorded.
- Use the maximum temperature recorded after the NaOH was added to calculate the temperature change of the reaction.
- Use Q=mcΔT to calculate the change in energy that occurs (NaOH and HCl can be said to have a density of 1g/cm^3).
- Calculate the moles of water that are produced using the chemical equation for the reaction: NaOH + HCl ⇒ H_2O + NaCl.
- Use $\Delta_{neut}H = -Q/n$ to calculate the enthalpy change of the reaction.

Errors

- Heat transfer to/from the surroundings.
  Use a bomb calorimeter to minimise heat transfer.



Example of a bomb calorimeter.
Rice University, CC BY 4.0

- Inaccurate temperature measurement.
  Use a digital thermometer.
- Inaccurate determination of maximum temperature.
  Repeat the experiment with measurements at closer time intervals / attach digital thermometer to data logger.

Risk Assessment

Hazard	Risk	Correction
NaOH	Can cause severe eye damage and skin burns.	Wear protective gloves and goggles.
HCl	Corrosive, can cause skin irritation at this concentration. Damaging to the eyes.	Wear protective gloves and goggles.