Structure {Paper03}

[SPM07-01]

(a) (i)

Experiment I	28.0	36.0
Experiment II	29.0	25.0
Experiment III	27.0	32.0
Experiment IV	30.0	27.0

(ii)

Experiment	Thermometer reading/°C	
	Initial	Final
I	28.0	36.0
II	29.0	25.0
III	27.0	32.0
IV	30.0	27.0

(iii)

Exothermic reaction	**Endothermic reaction**
I and III	II and IV

(b)(i) 1. The size of polystyrene cup
2. The total volume of mixture in the cup
3. the concentration of sodium hydroxide

(ii) When sodium hydroxide dissolves in water, the heat is released and the temperature rises

(c) (i) Temperature Change: 4 °C

Reason 1 : heat energy is absorb from the surrounding. This causes the energy content of the products to be higher than the energy content of the reactants

Reason 2 : heat energy is required to separate the particles in crystalline ammonium chloride during the dissolving process.

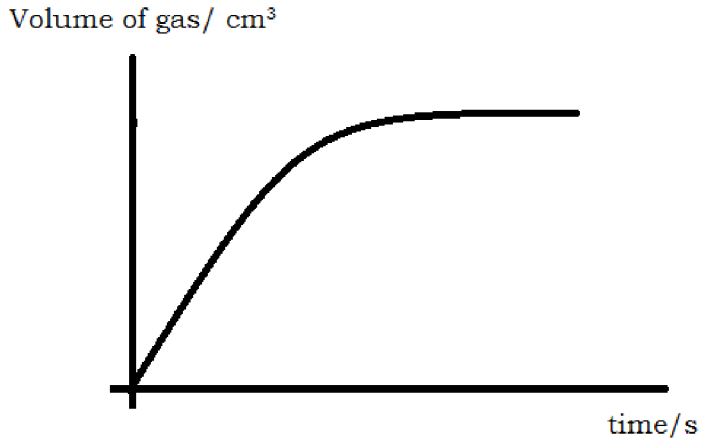
(ii) The dissolving process of ammonium chloride causes the change in temperature.

(d) 1. Sulphuric acid : 38 °C
2. Nitric acid : 32 °C
3. Ethanoic acid : 30 °C

(e) (i) 1. A gas is released, carbon dioxide
2. the temperature decreases
3. the total volume of the liquid in the polystyrene container increases

(ii) 1. The heat of reaction is positive – endothermic reaction
2. the total energy of the products is higher than the total energy of the reactants.

(iii)



[MRSM03-02]

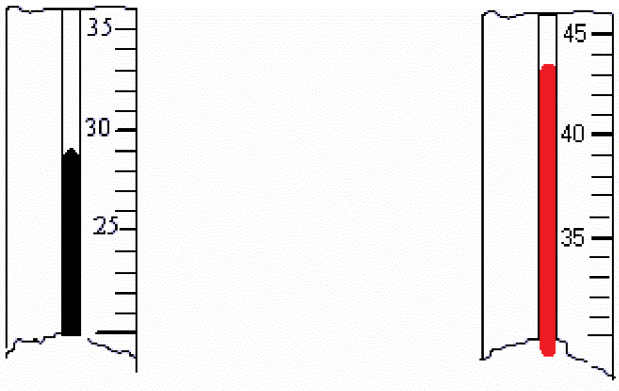
(a) 1. Zinc powder dissolved in the solution
2. Blue copper(II) chloride change to colourless
3. brown metal is formed

(b) Initial temperature : 29.0 °C
Maximum temperature : 39.0 °C
Temperature change : 10.0 °C

(c) Heat by experiment, Q= mcθ = 25.0 X 4.2 X 10 = 1050 J = 1.05 kJ

(d) 1. Reaction is exothermic reaction.
2. the final temperature is higher than initial temperature
3. the product formed is copper and zinc chloride

(e)



Initial reading Maximum reading

(f) 1. Temperature in 2(e) is higher than temperature in 2(b)
2. the distance between Magnesium and Copper is more further than the distance between Zinc and copper in Electrochemical Series

[SPM06-01]

(a) Initial temperature of mixture : 28.0 °C
Highest temperature of mixture : 40.0 °C
Change in temperature : 12.0 °C

(b)

Temperature/°C	Experiment	
	I	II
Initial temperature of mixture	28.0	T_1
Highest temperature of mixture	40.0	T_2
Change in temperature	12.0	$T_3 = T_2 - T_1$

(c) the heat of neutralisation of a weak acid and a strong alkali is smaller than the heat of neutralisation of a strong acid with strong alkali.

(d) 13.0 C°

(e) this is enable the change in temperature to measured. The change in temperature is needed to calculate the heat of neutralisation.

(f) change of temperature
= highest temperature of mixture – initial temperature of mixture

(g) 1. The original vinegar smell of ethanoic acid slowly disappear
2. a colourless, warmer final mixture is obtained
3. the polystyrene cup became warmer

(h) 1. The concentration of acid and alkali used
2. the volume of acid and alkali used
3. the type of container that is used to hold the mixture

(i) (i) The heat of neutralisation is the amount of heat released when one mole of water is produced

(ii) Experiment I uses weak acid whereas experiment II uses a strong acid. The heat of neutralisation of a weak acid by a strong alkali is less than the heat of neutralisation of a strong acid by strong alkali. This is because during the neutralisation of a weak acid such as ethanoic acid, part of the heat is used to dissociate the acid molecules.

(j)

Name of acid	**Heat of neutralization / kJ mol^{-1}**	**Type of acid**
Ethanoic acid	- 50.3	Weak acid
Hydrochloric acid	- 57.2	strong acid
Methanoic acid	- 50.5	Weak acid

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