A local industry that manufactures ***cold packs,*** used to relieve pain due to injury, uses two salts **Q** and **X** as key raw materials. Each of the salts provides a cooling effect based on the heat of solution of a given salt. The sports club of a certain school, have planned to buy cold packs in preparation for their school's sports day. Sarah, an experienced outdoor first aid provider, has advised the club to buy cold packs that would provide greater cooling effect. But the club members do not know the cold packs of which salt to choose.

You are provided with

- Solid Q which is sodium hydrogen carbonate.
- Solid X which is potassium chloride.
- Distilled water.
- Some apparatus.

Task

Design and carryout an experiment which Sarah can base on to help the sports club to make the right choice.
In your design include the following:-
(a) Aim of the experiment.
(b) Hypothesis
(c) All variables
(d) List of materials and apparatus
(e) Risks and precautions to mitigate them.
(f) Procedure.
(g) Tabulation of data
(h) Data analysis and interpretation
(i) Conclusion
(j) Recommendation/Advice.

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Expected Response

Aim of experiment

To determine which of the salts Q and X produces a cold pack that would provide greater cooling effect.

Hypothesis

The more endothermic the dissolution of the salt, the greater the cooling effect of the salt.

Safety precautions and risks

A thermometer is delicate apparatus so handle with care. Mercury is poisonous in case of breakage, so put on your personal protective gear.

Variables

- Independent variable:
  Type of salt used.
- Dependent variable.

Temperature of the reaction mixture.

- Controlled variable

Mass of each salt used and the volume of the volume of water used. They controlled by keeping these quantities constant in each experiment.

Apparatus and materials

- Solid Q which is sodium hydrogen carbonate.
- Solid X which is potassium chloride.
- Plastic beaker
- Measuring cylinder 100ml
- Thermometer.

Procedure

(a) 80cm³ of distilled water is measured using a measuring cylinder and placed in a plastic beaker. The water is stirred gently with a thermometer and its temperature recorded after every half –minute, in table I.

(b) After one and half minutes, **all** of solid **Q** provided is added the water at once. The mixture is stirred gently with the thermometer and the temperature of the mixture recoded after every half – minute in table I up to the fourth minute.

(c) The procedure (a) and (b) is repeated with salt X provided, using same volume of water and results recorded in table (ii).

Data record

Table I

Time (min)	0	½	1	1 ½	2	2 ½	3	3 ½	4
Temperature (°C)									

(b) (i) Plot a graph of temperature of the solution a giant time.

(ii)Using the graph determine the highest change in temperature ΔT for the dissolution of salt Q.

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(c)Calculate the heat change for the reaction using the expression;

Heat change = (mass of solution x 4.2 x ΔT)J. (Assume density of solution =1.0gcm^{-3})

Table II

Time (min)	0	½	1	1 ½	2	2 ½	3	3 ½	4
Temperature (°C)									

(b) (i) Plot a graph of temperature of the solution a giant time.

(ii)Using the graph determine the highest change in temperature ΔT for the dissolution of salt Q.

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(c)Calculate the heat change for the reaction using the expression;

Heat change = (mass of solution x 4.2 x ΔT)J. (Assume density of solution =1.0gcm^{-3})

Observation and analysis of data

Graph of temperature (°C) in vertical axis against time for each metal was plotted on the same axes.

Expected Response

Aim of experiment

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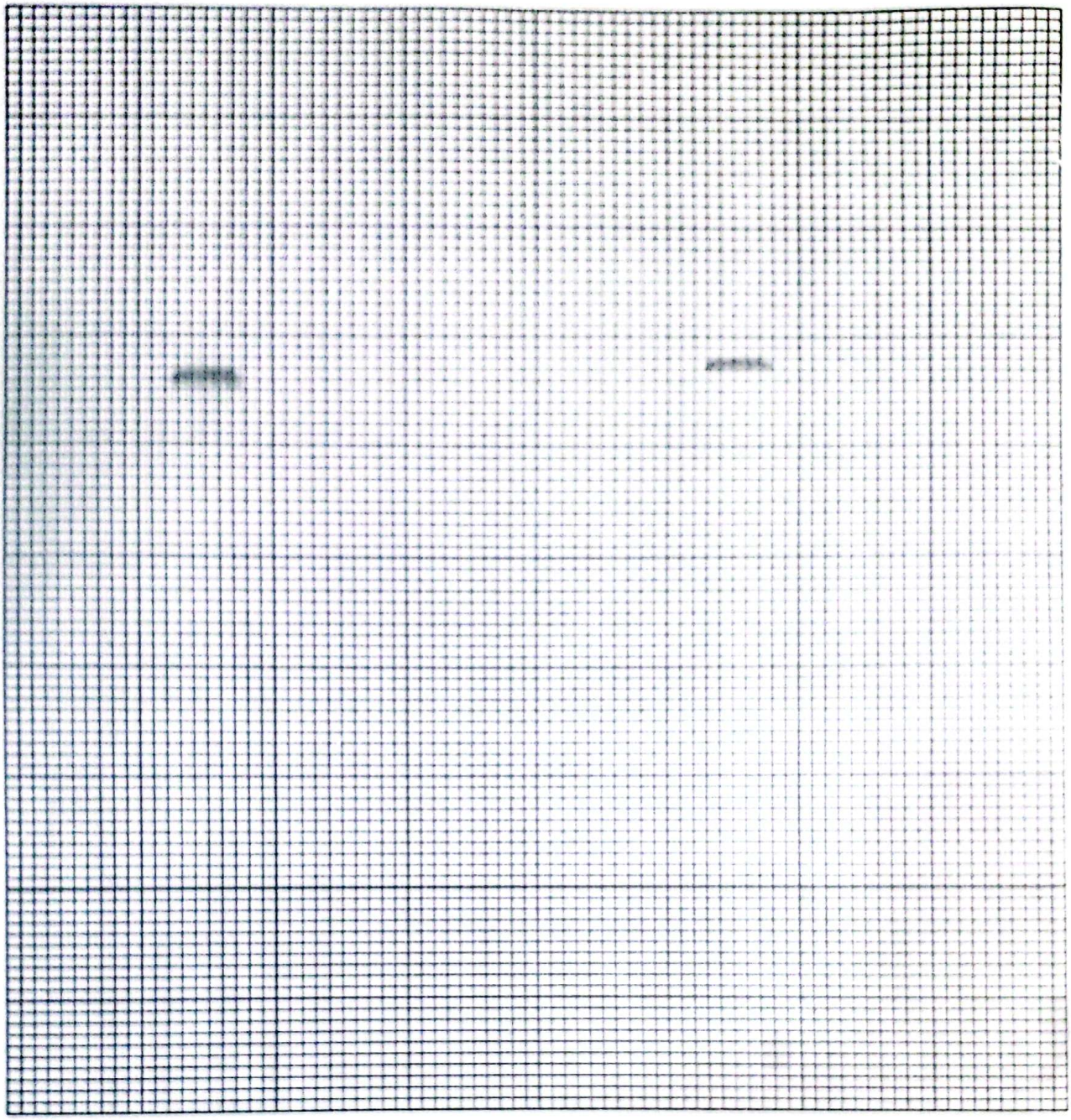
Mass of each salt used and the volume of the volume of water used. They controlled by keeping these quantities constant in each experiment.

Apparatus and materials

- Solid Q which is sodium hydrogen carbonate.
- Solid X which is potassium chloride.
- Plastic beaker
- Measuring cylinder 100ml
- Thermometer.

Procedure



The graphs show that when salt Q dissolves in water more heat is absorbed from surroundings than when salt X dissolves in same quantity of water.

Conclusion:

Dissolution of a given mass of salt Q in known volume of water is more endothermic than for the same mass of salt X in same volume of water.

So Sarah should advice the club members to buy cold packs made of salt Q.