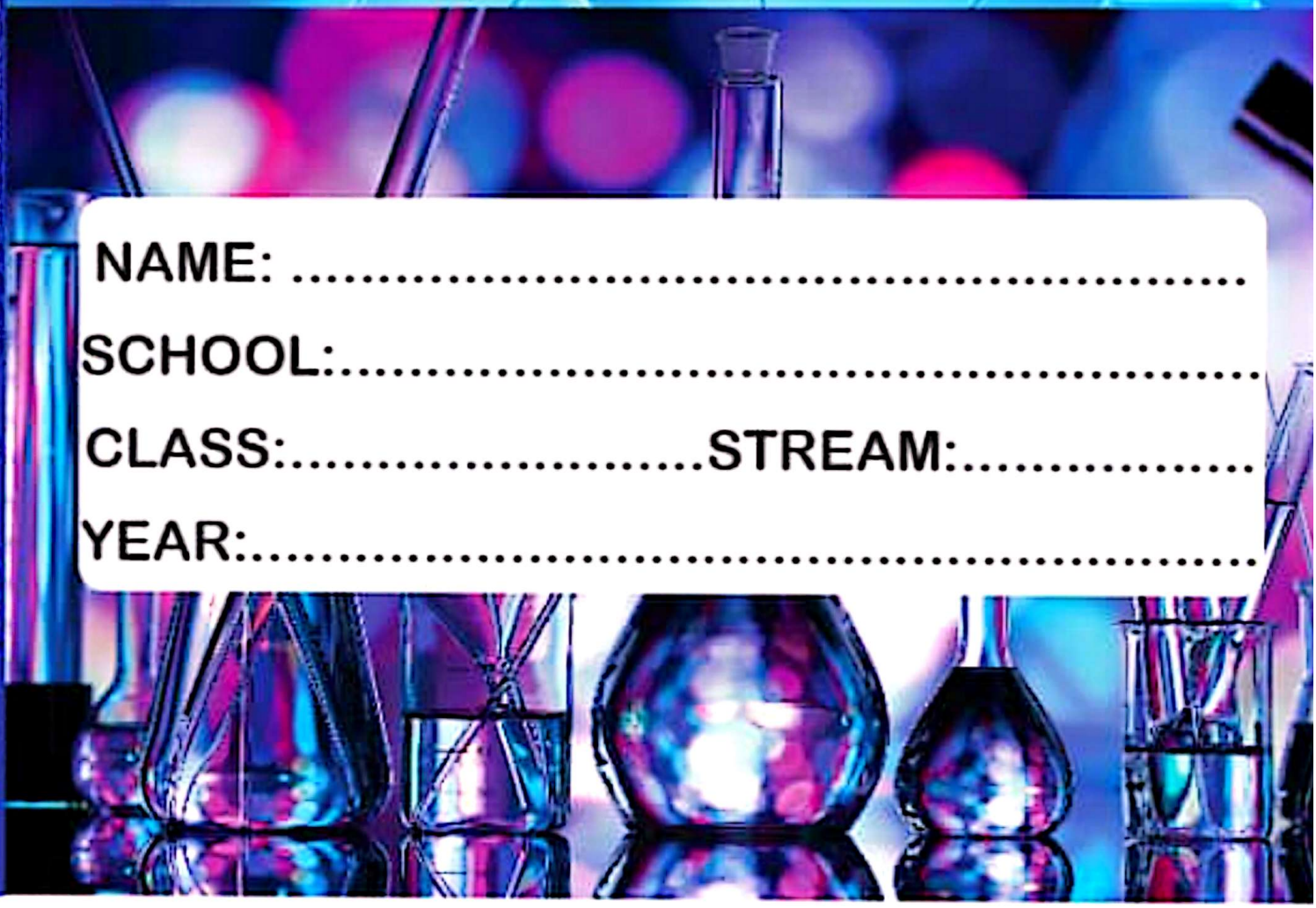
LOWER SECONDARY CHEMISTRY

PRACTICAL WORK BOOK

SECOND EDITION
2025



NAME: .....

SCHOOL:.....

CLASS:.....STREAM:.....

YEAR:.....

LOWER SECONDARY CHEMISTRY PRACTICAL WORK BOOK Second Edition 2025

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ENERGY CHANGES DURING CHEMICAL REACTIONS

INTRODUCTION

Chemistry is concerned with the physical and chemical properties of substances and the interaction of energy and matter. The study of chemistry involves investigation into chemical reactions and processes. This makes the subject a practical subject in which learners are expected to apply investigative and problem-solving skills.

Under this sub-construct of chemistry which is the practical part, learners will understand that chemistry is a process of evidence-based enquiry involving collection of evidence and the development of theories that help us explain the evidence.

To acquire meaningful appreciation of chemistry as a practical subject, learners will need to have mastery and application of.:

(a) Scientific attitudes and values in investigating matter

(b) Scientific method/process of carrying out investigations and the importance of risk assessment to keep self and others safe

(c) Science process skills

Scientific attitudes and values in investigating matter

Scientific attitudes are a mixture of the willingness to know and apply a scientific approach to face any task of problem-solving with respect for logic and critical thinking. These are the features that characterise scientific thinking. These attitudes are manifested through behaviour

These attitudes include: Validity, Honesty, Flexibility, Integrity, Persistence, Responsibility, Objectivity, Accountability, Reproducibility, Collaboration, Open-mindedness, Empiricism (Evidence based)

Science process skills

These are skills defined as a set of broadly transferable abilities, appropriate to many science disciplines and reflective of the behaviours of scientists. These include:

a) Observing -using the senses to gather information about an object or event for example describing a pencil as yellow
b) communicating- Using words or graphical symbols to describe an action, object or event for example, describing the change in height of a plant over time in writing or through a graph

c) Classifying- grouping or ordering objects or events into categories based on properties or criteria for example placing all rocks with a certain grain size or hardness into one group

(c) Promote good housekeeping practices.

(d) Notify the supervisor of any hazardous conditions or unsafe work practices.

(e) Use appropriate personal protective equipment (PPE) for each procedure that involves hazardous chemicals.

Nature of practical tasks under the competence-based curriculum

Under the competence-based curriculum, practical questions will have a structure and features. In this book we have tried to adhere to some of those. Some of the key features

of these items include.

(a) Have a context scenario situation in form of data/graph/picture/image/text with a challenge on science process skills

(b) The context/scenario chosen will be from the daily experiences of the learners

c) The task will ask the learners to demonstrate an understanding of the science process skills in relation to the situation/context/scenario provided as summarized below

ALL practical should follow the methods of scientific investigation by stating the following under different stages which involve planning, manipulation, measurement and observation, presentation of data, and lastly Analysis, conclusion and evaluation/recommendation

(I) PLANNING

In planning the following should be stated:

(a)Aim of the experiment

Aim of the experiment is the specific objective or purpose which must be achieved through your investigation

It should be brief and describes the main point of the experiment/investigation and this is not normally got from the scenario or task given it is like the title of the experiment

(b) Stating the hypothesis

A hypothesis states your prediction about your investigation. As an investigator, you guess the results through stating the hypothesis (a good guess is usually advised). for example, in an experiment to investigate the effect of concentration of sodium thiosulphate solution on the rate of reaction between sodium thiosulphate solution and hydrochloric acid, the hypothesis can be "Increase in concentration of sodium thiosulphate increases the rate of reaction between sodium thiosulphate and hydrochloric acid."

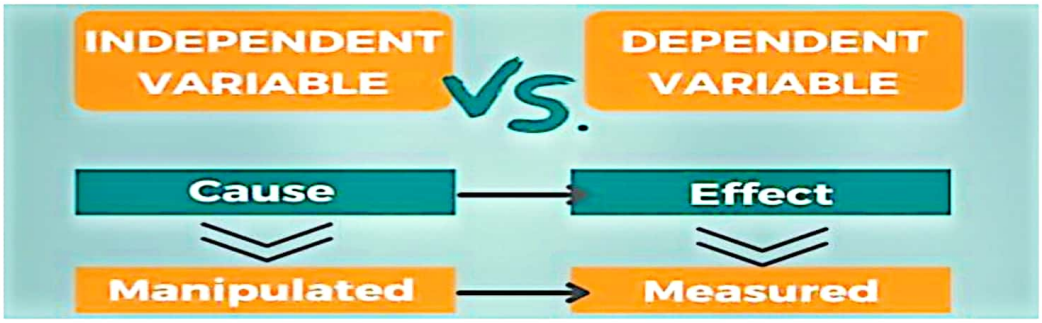
(c)Stating variables.

A variable is anything that can change and be measured. A scientific investigation usually has three variables;

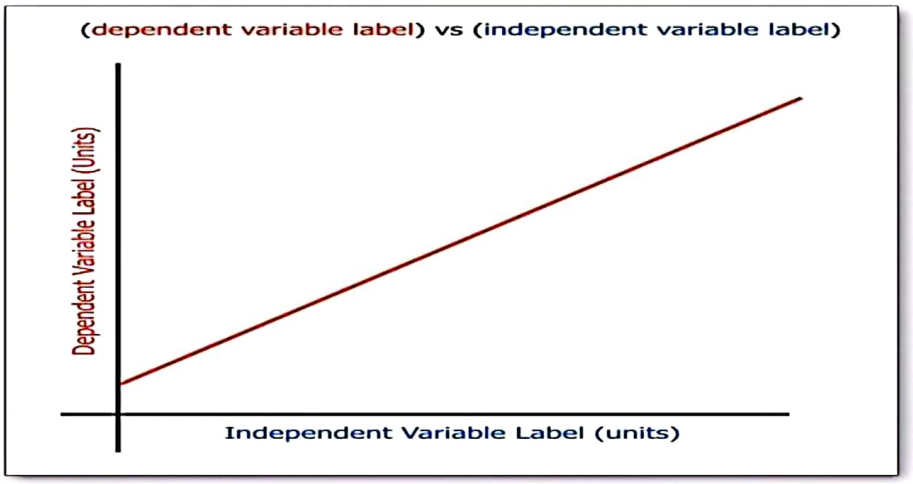
- **Independent variables** Is the variable that you intentionally change or manipulate to observe its effect on the dependent variable. It also called the "manipulated variable" or "cause variable" beca causes a change in the dependent variable. For example, experiment to investigate the effect of temperature on the sol of a salt, the temperature is the independent variable, that m it's the factor that is intentionally changed or manipulated by experimenter. By varying the temperature, the goal is to observe how this change affects the solubility of the salt.

2. The size of the ball is kept constant

3. The surface the ball is dropped on to is kept constant



Graphically the *independent variable* is plotted on the *X -axis* whereas the *dependent variable* is plotted on the *Y-axis* as shown below. The *acronym* which can enable you to always remember which variable is plotted on X -axis and y-axis is *"DRY " meaning, Dependent is the Responding variable on Y*-axis and "*MIX " meaning Manipulated variable is the Independent variable on X-axis.*



(d) List of requirements (reagents/ solutions/ apparatus etc.) used.

Learners should show competence in use of appropriate apparatus to record a range of quantitative measurements (to include mass, time, volume, temperature, length and pH).

Volumes might be directly measured using a measuring cylinder

Mass is measured using a digital balance. Before measuring mass, the tare facility is used to zero the digital balance. Use a disposable weighing boat preferably a petri dish/filter paper to weigh solids; and a weighing bottle to w liquids. The weighing boat or bottle should be weighed before materials are and weighed again after they have been emptied into another container s an accurate mass of the material can be found by subtraction of masses.

Time is measured using a stop clock or stop watch.

Temperature is measured suing the thermometer.

	➢ Appropriate and inaccurate ➢ Inappropriate and inaccurate	01 00
Conclusion	➢ Conclusion based on data interpretation ➢ No conclusion based on data interpretation	01 00

EXPERIMENTAL CHEMISTRY

Worked example on experimental chemistry

During one of the field trips to an ice cream manufacturing factory, students of Kikwitą seed school learnt that freezing point is a constant temperature at which a liquid substance turns to solid state. Through their interaction with the factory workers, they also learnt that many substances especially solids are melted first and cooled in order for this constant temperature to be determined. Suitable solid raw materials in this factory must have a freezing point below 60 °C for a good product to be obtained. The students have been given solid Y which is a potential raw material in the industry but its suitability is yet to be determined.

Task

(a) As a chemistry learner,

Design an experiment you will carry out

Carryout the experiment and record your findings

Obtain the freezing point of solid Y

What can students deduce about the suitability of solid Y for use

Aim: Determining the freezing point of Y

Variables of the experiment.

Independent variable: Time

Dependent variable: Temperature

Controlled variable: Mass of Y used and experiment was done under ordinary laboratoy conditions (Room temperature and pressure)

Hypothesis: Y has a freezing point above 60 °C and therefore not suitable for use as raw material

Apparatus and materials.

Solid Y

Tripod stand

Boiling tube

Heat source

Water

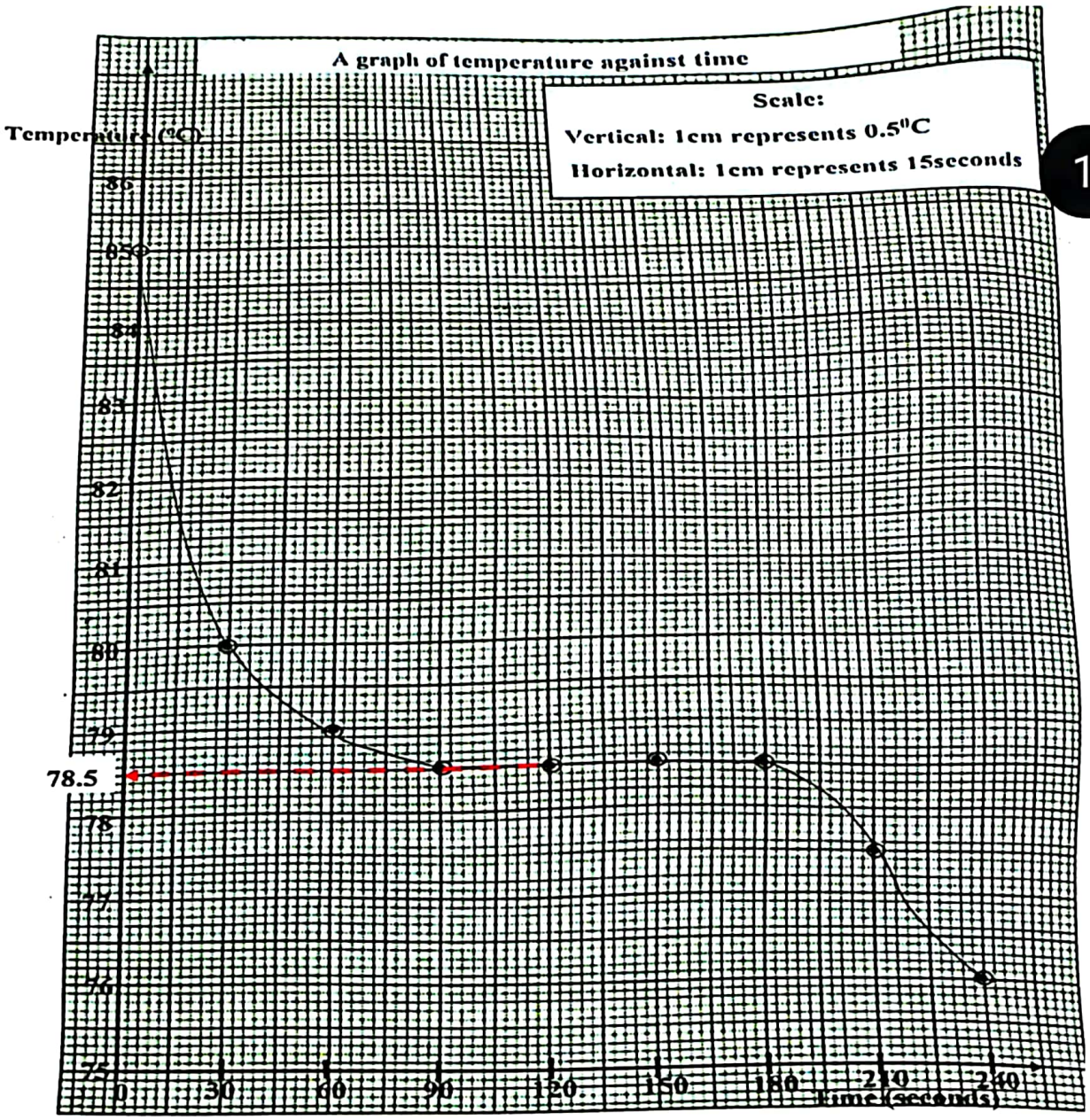
thermometer

Glass beaker

Procedure of the experiment

Solid Y was transferred into a clean dry boiling tube. The boiling tube containing Y was immersed into a beaker of hot water and continued to heat the water u the solid Y melted. The thermometer was inserted in the liquid formed boiling tube containing the liquid was removed from the hot water and clock started. The liquid was allowed to cool while stirring with a thermo and its temperature recorded after every 30 seconds for four minutes. The re were then tabulated.

Safety precautions taken. **(Risks and mitigations)**



Practical item one

During a visit to a chocolate factory, students from Kyentale secondary sc learnt about the importance of melting points in chocolate production factory staff explained that the ideal melting point is between 50 to 70°C ensures smooth texture and appealing taste. The students were given a sample named **ChocoblendeZ** to test its melting point, and determin suitability for use in chocolate production.

Task:

Worked out example

A laundry service provider in one of the urban centers in Uganda has to choose the best water for effective washing with soap. He requested the men who supply to bring him samples from the two different water sources. He would want to discover which type of water minimizes soap wastage hence more effective in cleaning.

You are provided with:

BA1: which a soap solution

BA2: which is water sample from supplier A

BA3: which water sample from supplier B Task:

(a)As a learner of chemistry;

(i) Design an experiment a laundry service provider can use (ii) Carry out the experiment and record your findings.

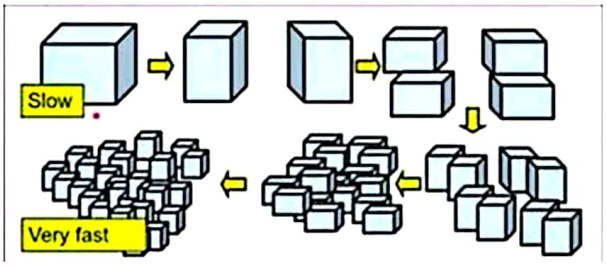
(b) Show from your findings how the laundry service provider can make choice on the type of water to be used

Aim of the experiment	To discover which type of water is more effective in cleaning and minimizing soap wastage
Hypothesis	Water sample BA3 or BA2 is more effective in cleaning and minimizing soap wastage
Variables	Dependent variable – volume of soap solution used Independent variable – type of water sample Controlled variable – volume of water sample used is the same
Risk and mitigation	Soap solution pouring on the skin causing irritations and burns Mitigated by wearing gloves.

Procedure	(a) 25.0cm^3 of water sample BA2 is pipetted int conical flask. (b) Soap solution is poured into a burette burette reading recorded. (c) BA2 in the conical flask is then titrated with BA1 until a permanent lather is formed.

(The higher concentration of solution, the faster the rate of reaction). This is because at higher concentration, the number of reactant particles are many and so close to one another, which causes higher frequency of collision between the reactant particles, leading to faster rate of reaction as shown by the graph above.

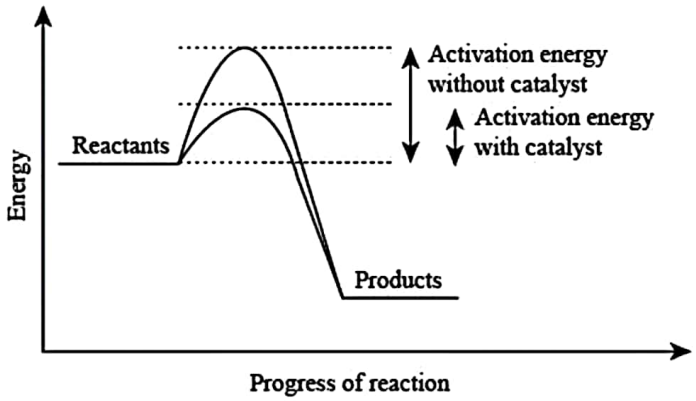
(C) **Effect of particle size on the rate of reaction**



As the surface area of the solid reactant is increased by either cutting the bigger sized solid into smaller pieces of particles or grinding bigger sized particles into powdery form, the faster the rate of reaction.

The reaction is faster because increase in surface area of the solid reactant exposes more particles for reaction with other reactant particles which leads to increased number of effective collision between reactant particles hence faster rate of reaction.

d)**The effect of catalyst in the rate of reaction.**



The rate of reaction can be increased by adding a suitable catalyst.

In terms of bond breaking and bond making, bond breaking requires absorption of energy (**Acronym -BBRAE)** whereas bond making involves release of energy (**acronym – BMIRE**).

In an endothermic reaction, energy required in bond breaking is greater than energy involved in bond making, so energy is absorbed from the surrounding to break the bonds in the reactants

In an exothermic reaction, energy required for bond breaking is less than energy involved in the bond making, so heat is released to the surrounding.

The heat changes to be covered in chemistry practicals include;

I. Heat change due to neutralization
II. Heat change due to dissolution of solid compounds in water
III. Heat change due to displacement

Heat change due to dissolution of salts in water

Cold pack effect.

Hot pack effect

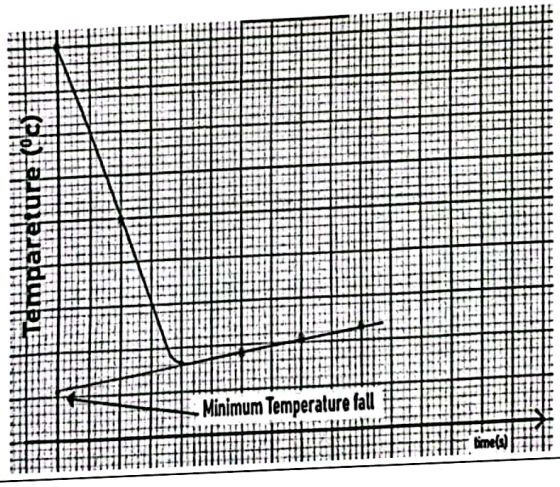
Introduction.

Cold packs and hot packs are essential tools in physiotherapy for managing pain, inflammation and promoting healing especially in sports activities and athletics to manage injuries and improve recovery. Hot and cold packs work due to ***heat of solution*** of chemicals inside these packs. These packs have an inner pouch that bursts when squeezed, allowing the *chemicals to dissolve in water where heat is either released or absorbed.* The cold pack *absorb heat from the surrounding causing a sensation of coldness which constrict blood vessels decreasing blood flow to the affected area, which then reduces inflammation and numbs the area providing relief* **whereas** *the hot packs dialate blood vessels, increasing blood flow to the area which help to alleviate the muscle tension and stiffness.*

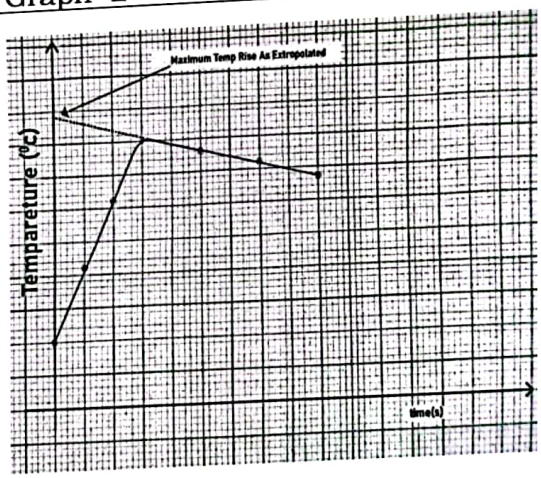
Heat is some times evolved or absorbed when substances are dissolved in water, usually large volume of water and this is known as ***heat of solution***

Heat of solution *is the heat energy absorbed or released when a specific*

Graph 1

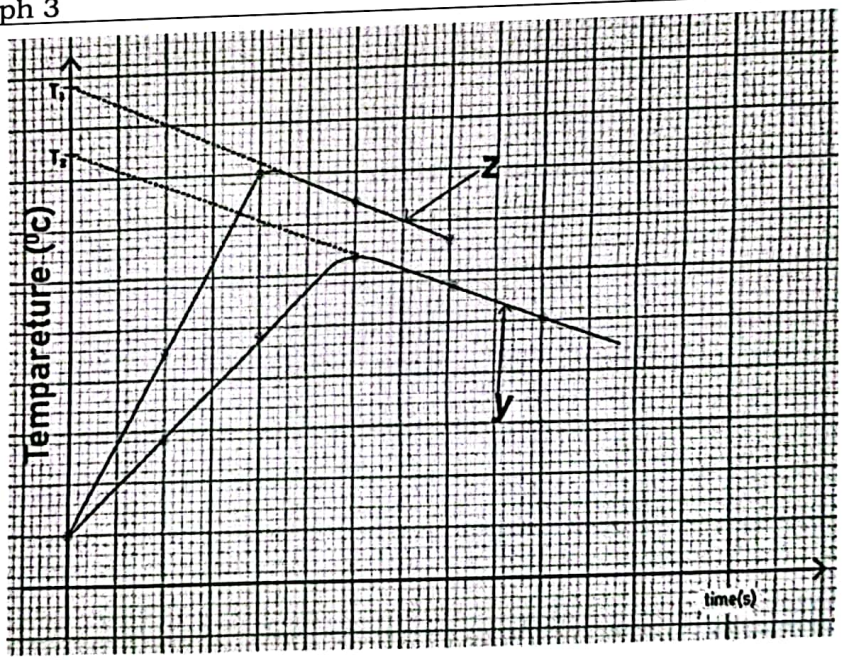


Graph 2



2. In case two solids are given for example solids Z and Y are dissolved in water separately to form solutions with release of heat, given solid Z releases more heat energy faster than solid Y, a temperature-time graph plotted is typical to graph 3 below

Graph 3



Practical item fifteen

A Sports Club ordered for supply of chemical compounds to be used for making

(b) Volume of BA1 used = $30.0cm^3$

Time(s)	0.0	30.0	60.0	90.0	120.0	150.0	180.0
Temperature of mixture of BA1 and metal X(°C)	25.0	40.0	51.0	57.0	60.0	59.0	58.0

(c) From the graph;

Maximum temperature attained by the mixture = 64°C

Temperature change of the mixture = 64 – 25

= 39°C

Heat change of reaction = mcΔt

= 30 × 4.2 × 39

= −4,914J

Or; −4.914KJ

Conclusion;

The reaction between metal X and hydrochloric acid liberates = 4.914KJ of heat energy.