

NOTES TO STUDENTS.

All practical exercises organized in this handbook shall require you to practically do them and come up with the report which will include in order the following: title, aim, hypothesis (both alternative and null), scientific explanation (an explanation supporting the alternative hypothesis), variables (independent, dependent and controlled variable including how the variables shall be measured), apparatus and materials, method (procedure), treatment of results, observations, conclusion (basing on the hypotheses made)

While writing the methods, where applicable draw the set-up of apparatus

Note:

Hypothesis is an idea that you want to prove if true through scientific investigation/inquiry.

A null hypothesis is the hypothesis that assumes there is no relationship between the problem being investigated and the perceived question/problem. A null hypothesis is important in scientific investigation as it offers basis for whether a problem exists or not.

An alternative hypothesis is the hypothesis that the researcher undertakes to prove or disprove. It gives the statement about the idea of the problem that exists and needs to be proved.

Independent variable is the factor or variable in an experiment that can be changed for purposes of finding the effect on another factor or variable.

Dependent variable is the effect on another factor or variable produced as a result of change in independent variable in a given experiment.

Controlled variable is the factor or variable that is kept constant in a given experiment or study.

EXAMPLE.

THEME: Particle nature of matter.

TOPIC: States and changes of states of matter.

COMPENCY: The learner uses knowledge of the arrangement and motion of particles to explain the properties of solids, liquids and gases.

a. Substance Z provided can exist in three different states of matter, (solid, liquid and gas). It can be used as a preservative for fish during their transportation, when in solid form, cooling of machines in industries when in liquid form and many other applications. You are provided with 150g Of Z, use them to plan and carry out an investigation to show how substance Z undergoes the different changes of state of matter under different conditions.

Use the following chemicals and apparatus

Substance Z

Thermometer

Glass beaker (250ml)

Stop watch

Heat source

tripod stand and wire gauze.

Water bath.

Digital pan weighing scale

Stirring rod.

EXPECTED RESPONSE.

TITLE: Investigating the changes of state that occur when ice is heated

AIM: To investigate how heating of crushed substance Z causes change of state of matter using time measurements.

THE ALTERNATIVE HYPOTHESIS: Heat gain causes a change in state of matter of substance A.

THE NULL HYPOTHESIS: Heat gain has no effect on change of state of matter of substance Z.

SCIENTIFIC EXPLANATION: Heat gain causes particles in substance Z to gain more kinetic energy and hence vibrate more frequently, this causes the intermolecular forces of attraction between the particles in Z to weaken hence causing a change of state of matter.

VARIABLES.

- i. Independent variable: Time in seconds and will be measured using a stop watch
- ii. Dependent variable: Temperature change of ice as it is being heated and will be measured using a thermometer.
- iii. Controlled variable: water bath

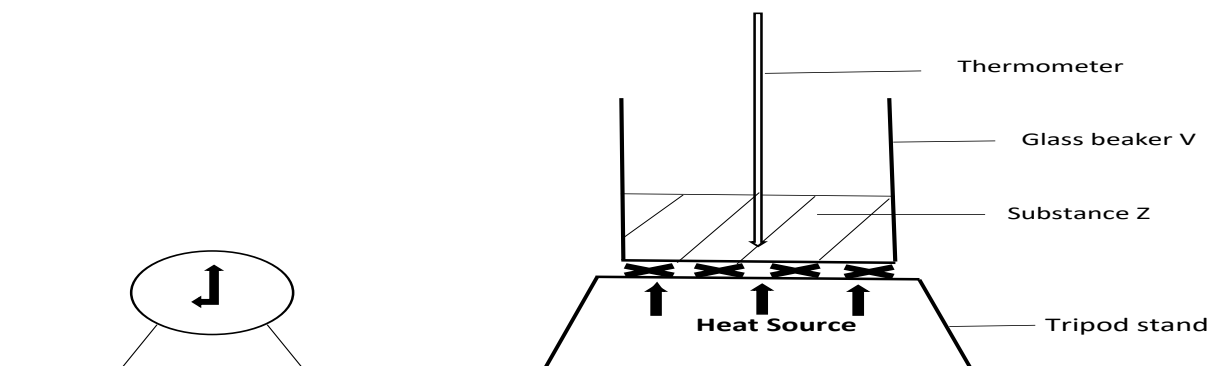
CONTROLLING VARIABLES.

- i. Independent: Time will be allowed to go for a given duration and changes on state of substance Z noted.
- ii. Dependent variable: Temperature changes of substance Z as it gains heat will be taken and recorded using thermometer.
- iii. Control: 10g of substance Z will be melted and kept under a water bath 25°C as the experiment goes.

APPARATUS AND MATERIALS.

- i. 150g of crushed substance Z.
- ii. Thermometer.
- iii. 250cm³ glass beaker
- iv. Stop watch
- v. Heat source
- vi. Tripod stand and wire gauze
- vii. Water bath
- viii. Stirring rod

Set-up



METHOD

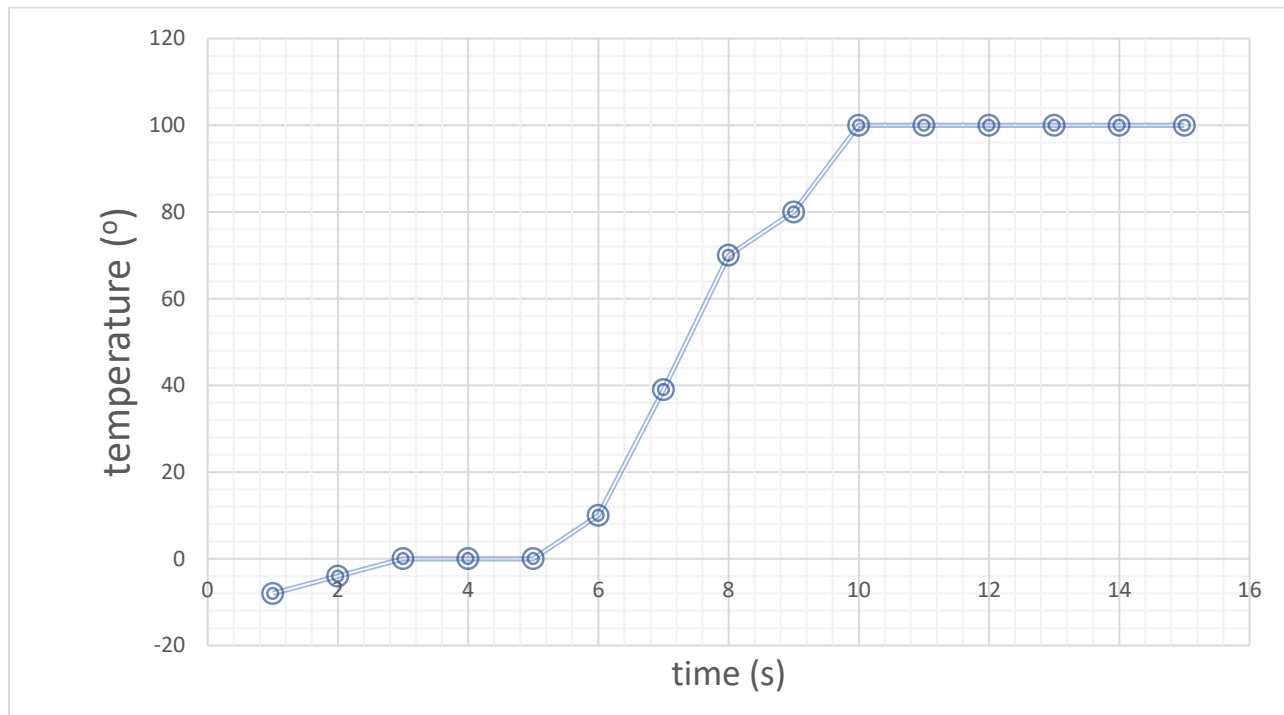
- i. 100g of crushed substance Z is weighed using a digital pan weighing scale into a 250cm³ glass beaker
- ii. A thermometer is inserted and the initial temperature reading of crushed substance Z noted.
- iii. Crushed substance Z is then placed on a heat source and a stop watch started simultaneously.
- iv. Temperature change of substance Z is then taken from a stop watch every after 1 minute. The substance is first stirred before each temperature recording is taken using a stirring rod.
- v. Temperatures are taken until when the substance boils.
- vi. The results obtained are tabulated and a graph of temperature against time is plotted.

DATA COLLECTION AND PROCESSING. (TREATMENT OF RESULTS)

Table of results

Time(min)	Time(s)	Temperature(°c)	Physical state of substance Z
0	0.00	-8.0	Solid
1	60.00	-4.0	Solid
2	120.00	0.0	Solid
3	180.00	0.0	Solid and liquid
4	240.00	0.0	Solid and liquid
5	300.00	+10.0	Liquid
6	360.00	+39.0	Liquid and vapor
7	420.00	+70.0	Liquid and vapor
8	480.00	+80.0	Liquid and vapor
9	540.00	+100.0	Liquid and vapor
10	600.00	+100.0	Liquid and vapor
11	660.00	+100.0	Liquid and vapor
12	720.00	+100.0	Vapor
13	780.00	+100.0	Vapor
14	840.00	+100.0	Vapor

A GRAPH SHOWING RELATIONSHIP BETWEEN TEMPERATURE OF SUBSTANCE Z AND TIME.



DATA ANALYSIS.

From 0 to 180 seconds, temperature of substance Z increased gradually.

From 180 to 240 seconds, temperature of substance Z remained constant.

From 240 to 660 seconds, the temperature of substance Z increased sharply.

From 660 to 840 seconds, temperature of substance Z remained constant.

DISCUSSION, EVALUATION AND CONCLUSION

Discussion evaluation

Heating substance makes the particles in substance Z to vibrate more rapidly due to increase in kinetic energy, this weakens the intermolecular forces of attraction and hence a change of state from solid to liquid. Temperature remains constant at 0°C until all ice melts.

There is a further increase in temperature which further increases the kinetic energy of the liquid further weakening them hence escaping into vapor from 360 seconds to 540 seconds.

Temperature remains constant from 540 to 840 seconds and this is the boiling point of substance Z. At this point the intermolecular forces of attraction of substance Z are the weakest, particles very far away from one another and exist as a gas.

All the points plotted couldn't fall into the line because not all heat was absorbed by the substance bringing about a few anomalous results.

Conclusion.

Alternative hypothesis is true. (experimental results supported the alternative hypothesis)

OR

Substances in solid form undergo changes of state of matter by heat gain