Heat Transfer Using Metal Rods: Research Report

Research Question:

Can heat transfer through different metal rods and melt wax?

Introduction:

That practical investigation that will be conducted is about conduction and conductors. The conductors being used in this practical investigation are copper, steel, aluminum or brass.

Conduction is the transfer of heat through solids by vibrating particles. It occurs when two objects at different temperatures come in contact with each other. Heat will flow from the warmer object to the cooler object until they are both the same temperature. Conductors are different materials that can conduct heat. All metals are pretty good conductors but copper and silver are the best conductors as they can conduct 243718 joules of energy. This causes the metal to conduct heat slower which is better for conducting heat. A bad conductor of heat is stainless steel. The metals used in this practical are copper, steel, aluminium and brass which are all conductors. The best conductor out of these is copper and the worst is stainless steel.

In an experiment there are three types of variables which are the independent, dependent and controlled. The independent variable are the different metals and conductors which are the copper, steel, aluminium and brass. The dependent variables is the heat and melting of the wax from the Bunsen burner. The controlled variables are the objects that are not being changed during the experiment is the Bunsen burner, the wax used, the temperature of the room and the time taken to do the experiment.

The experiment will have an outcome which will be that the wax on the copper will not melt and the rest will melt faster being the aluminum, brass and steel

Aim:

To observe heat transfer and conductors through metals.

Hypothesis:

If wax is placed on copper, steel, aluminium and brass rods, then the copper will be the best conductor because it will be the fastest at melting the wax.

Materials:

- 2 x rods of different metals (e.g. steel, copper, aluminium or brass)
- 1 x bunsen burner
- 1 x heat mat
- 1 x tripod

- matches
- 1 x ruler
- 1 x crayon
- 1 x permanent marker
- 1 x candle attached to a dish
- 1 x stopwatch

Method:

1. The permanent marker and the ruler were used to mark 3 spots at 4cm intervals from one end of each metal rod
2. The candle was Lit. The candle flame was used to melt the crayon a little and drop spots of the melted wax onto each of the spots on both rods then I was left to dry.
3. Place the tripod on the heat mat and lie the 2 metal rods on top of the tripod as shown on the diagram. Make sure the wax spots are away from the Bunsen burner. The tripod was placed on the heat mat and the 2 metal rods were put on the top of the tripod. This process is shown in the diagram below. The max spots had to be away from the Bunsen burner.
4. The Bunsen burner is lit, after it was lit the timer on the stopwatch begun
5. The wax spots were observed carefully and the time which was taken for each spot to melt was recorded in a data table. The Bunsen burner was turned off after a period of 10 minutes.
6. The results were collated to a table of data

Risk Assessment:

Hazard Risk Preventative Action

- bunsen Burner -burns -do not put hands near the flame
- wax -consuming it
- burns -do not put wax near the mouth
- do not put hands near the flame
- metals -burns -do not put hands near the rod when it is hot
- use tongs to handle when hot
- candle burns -keep hands and body parts away from the candle when flame is lit

Results:

Table 1: Time taken for crayon wax spots to melt

Time taken (min)

Spot 1 (0cm) / Spot 2 (4cm) / Spot 3 (8cm)

Type of Metal

Brass

4 mins 43s / 5 mins 40s / 6 mins 10s

Aluminium

3 mins / 3mins 28s / 3 mins 40s

Steel

23 mins

Copper

3 mins / 3 mins 30 s / 3 mins 45s

Discussion:

The conductive ability of 4 different metals; aluminium, copper, brass and steel was tested in this practical. The time taken for the wax to melt was recorded until it started to melt for brass. Copper seems to be the best insulator as the wax melted the fastest on this metal.

The time of the wax to melt recorded a big difference between steel and the rest of the metals. The time of the wax to melt on in the steel metal took the longest for the 0cm wax to start melting at 23 minutes. The wax on the other three metals; brass, copper, and aluminium all had a big difference from the steel rod. Although all metals had wax melt on it, the copper rod had the wax melt the fastest which means it is the best conductor (Graph 1).

Copper was the best at conducting heat for the wax to melt. In this practical the copper may have been on top of the Bunsen burner more than the other three metals: aluminium, brass and steel. This may have contributed to the wax melting faster than the other three metals.

Copper was hypothesised to be the best conductor. Copper is a lattice of positive copper ions with free electrons moving between them. The electrons can move freely through the metal. They are also known as conduction electrons, because they help copper to be a good conductor of heat and electricity. Copper did prove to be the best conductor, the hypothesis was supported by the data collected in this practical.

The errors that may have occurred in this practical include; the flame on the Bunsen burner was turned off three times which would've affected the temperature of the metal rods, the matches didn't light on a few of them which was wasting the matches as it nearly ran out, some of the wax from the crayon dripped onto the lab bench and an exercise book which was hard to remove and the paper covering the crayon got in the way of melting the wax of the crayon causing more time to be taken up by removing the paper which was hot.

If this practical was to be repeated all groups should test all metals. This would help to reduce any difference in time between groups. The time should be recorded for more than 8cm, this might help provide a clearer picture of the best conductor.

Conclusion:

Four metals (aluminium, brass, copper and steel) were tested to determine which one was the most effective at allowing heat transfer. Copper was the best conductor, as it melted the first point of wax in only 3 mins whereas the steel melted the first point of wax at 23 minutes. The hypothesis was supported as the data does support copper as the best conductor.

References:

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