

Experiment P-38 Thermal Conductivity



Objectives

- To understand the concept of thermal conductivity.
- To investigate the thermal conductivity of different metals using qualitative and quantitative methods.

Modules and Sensors

- PC + NeuLog application
- USB-200 module 
- Three NUL-203 Temperature logger sensors 

Equipment and Accessories

▪ Thermal conductor	1
▪ Big candle	1
▪ Small candle	9
▪ Candle holder	1

- The items above are included in the NeuLog Heat kit for physics, THR-KIT.

Introduction

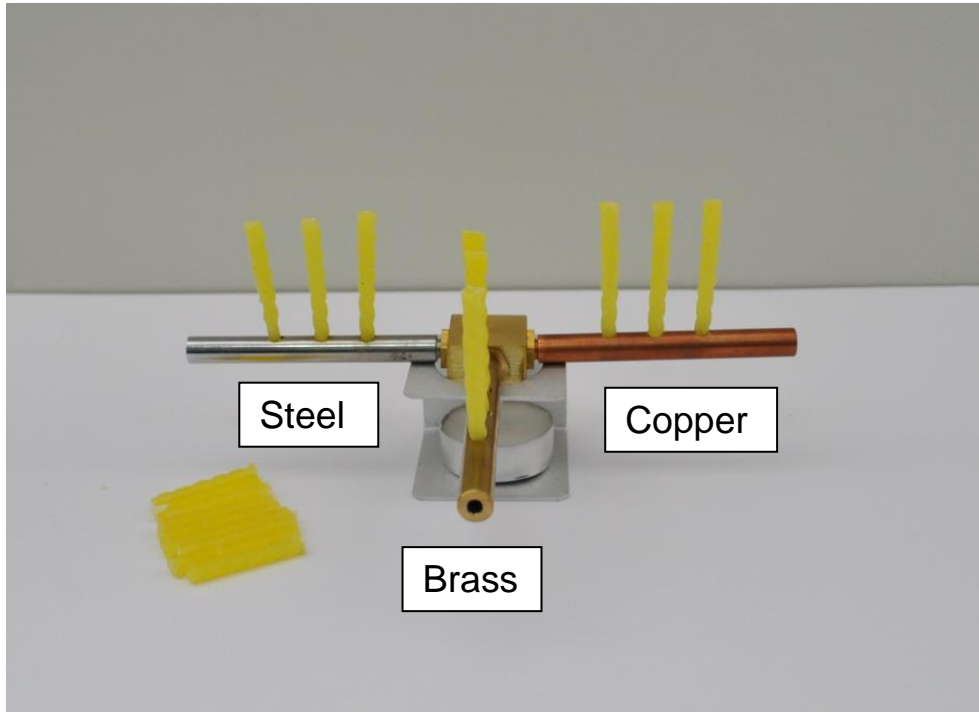
Thermal conductivity is a physical property, which measures the capacity for heat conduction, or the capacity of a substance of transferring the kinetic movement of its molecules to its own adjacent molecules or to other substances with which it is in contact. Depending on the composition of the atoms of a material, the heat may move very slowly, or very quickly. This dependence is quantified by the coefficient of thermal conductivity. For example, thermal conductivity is higher in metals and lower in gases.

In this activity we will investigate the thermal conductivity of three different metals: copper, brass and steel.

Procedure



Experiment setup

1. Set up the experiment as shown in the picture below.



2. Put small candles in the holes of each bar. Heat the bottom of the candles a little so they can be easily inserted into the bars.
3. Place the thermal conductor on the candle holder and put the big candle in it.
4. Make sure there are no combustible materials nearby.

Sensor setup

5. Connect the USB-200 module  to the PC.
6. Check that the temperature sensors  are connected to the USB-200 module in a chain (each temperature sensor needs to have a different ID number).


Note:

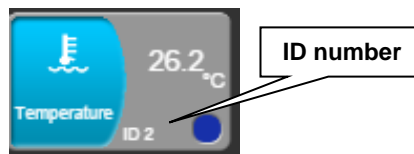
The following application functions are explained in short. It is recommended to practice the NeuLog™ application functions (as described in the user manual) beforehand.

7. Run the NeuLog application and check that the sensors are identified.

ID numbers setup:

In order to use three sensors of the same kind, they should have different ID numbers.

- Connect one of the sensors and check that it is identified.
- Click on the **Tools** icon .
- Click on the **Set ID** button and change the number in the box to '2'.
- Click on the **Set sensor ID** button.
- You will see that the sensor's module box now shows '2'.



- Disconnect the sensor with ID number 2 and connect the next sensor in order to change its ID. Proceed as you did for the first sensor.
- Repeat this procedure for any other sensor of the same kind you want to connect in a chain.
- Once your sensors (in this case three temperature sensors) have different ID numbers, you can connect them in a chain.

Settings

8. Click on the **Run experiment** icon  and set the:

Experiment duration to 30 minutes

Sampling rate to 1 per second

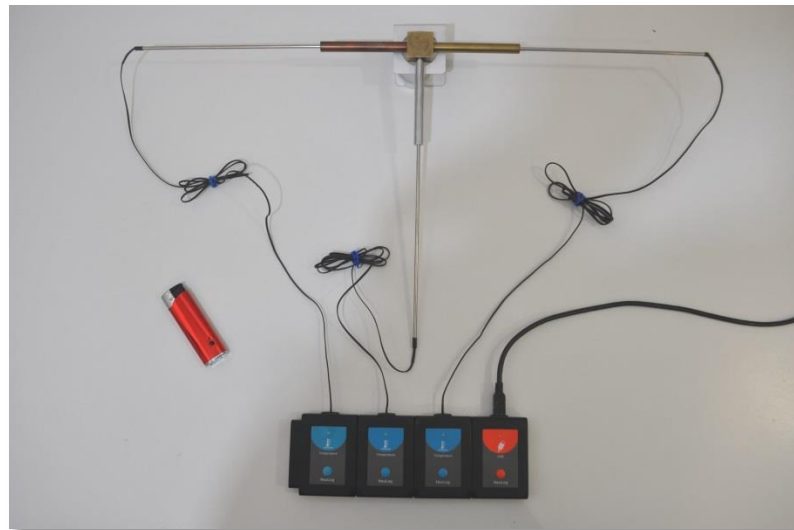
Testing and measurements



Qualitative Part (optional)

9. What do you think will happen to the small candles after we light the big candle? Light the big candle and observe what happens.
10. After the first part, wait until the thermal conductor reaches room temperature.

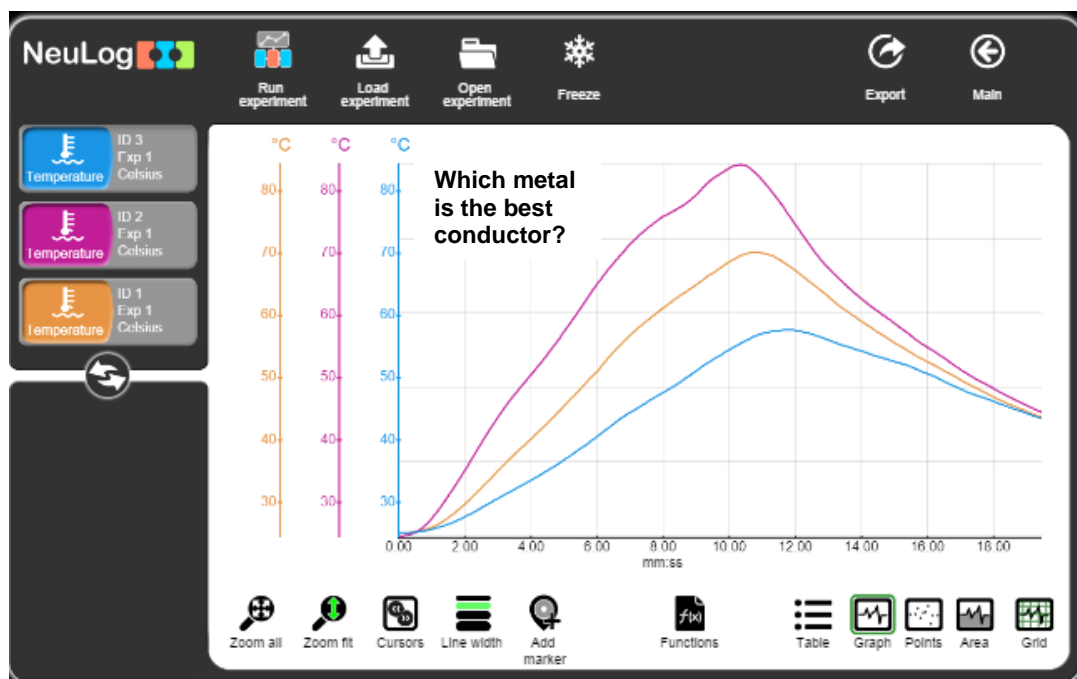
Quantitative Part

11. Take out the small candles from the bars.
12. Connect the three temperature sensor probes in each bar.



13. Use the data from the first part to predict the results of the second part.
14. Light the big candle and click on the **Record** icon  to start the measurement.
15. After 10 minutes put out the candle.
16. At the end of the measurement, click on the **Zoom fit** icon .

17. Your graph should be similar to the following:



18. Save your graph.
19. We can see that thermal conductivity varies among different metals.

Summary questions

1. Which metal is better in conducting heat and which is worse?
2. Are the results consistent with the qualitative method?
3. Compare your prediction with the obtained graph and explain.