

Background

To compare specific heat capacities of water and another liquid, the same quantity of heat energy is supplied to equal masses of the two liquids over a period of time and the data graphed. The gradients of the graphs can be used to compare the quantity of heat required to raise the temperature of each liquid during equal time intervals.

Purpose

To compare specific heat capacities of water and another liquid.

Materials

- an electric hot plate
- 2 thermometers
- 2 x 250 mL beakers
- stop watch
- water and another liquid (eg cooking oil or other non-flammable liquid)
- balance

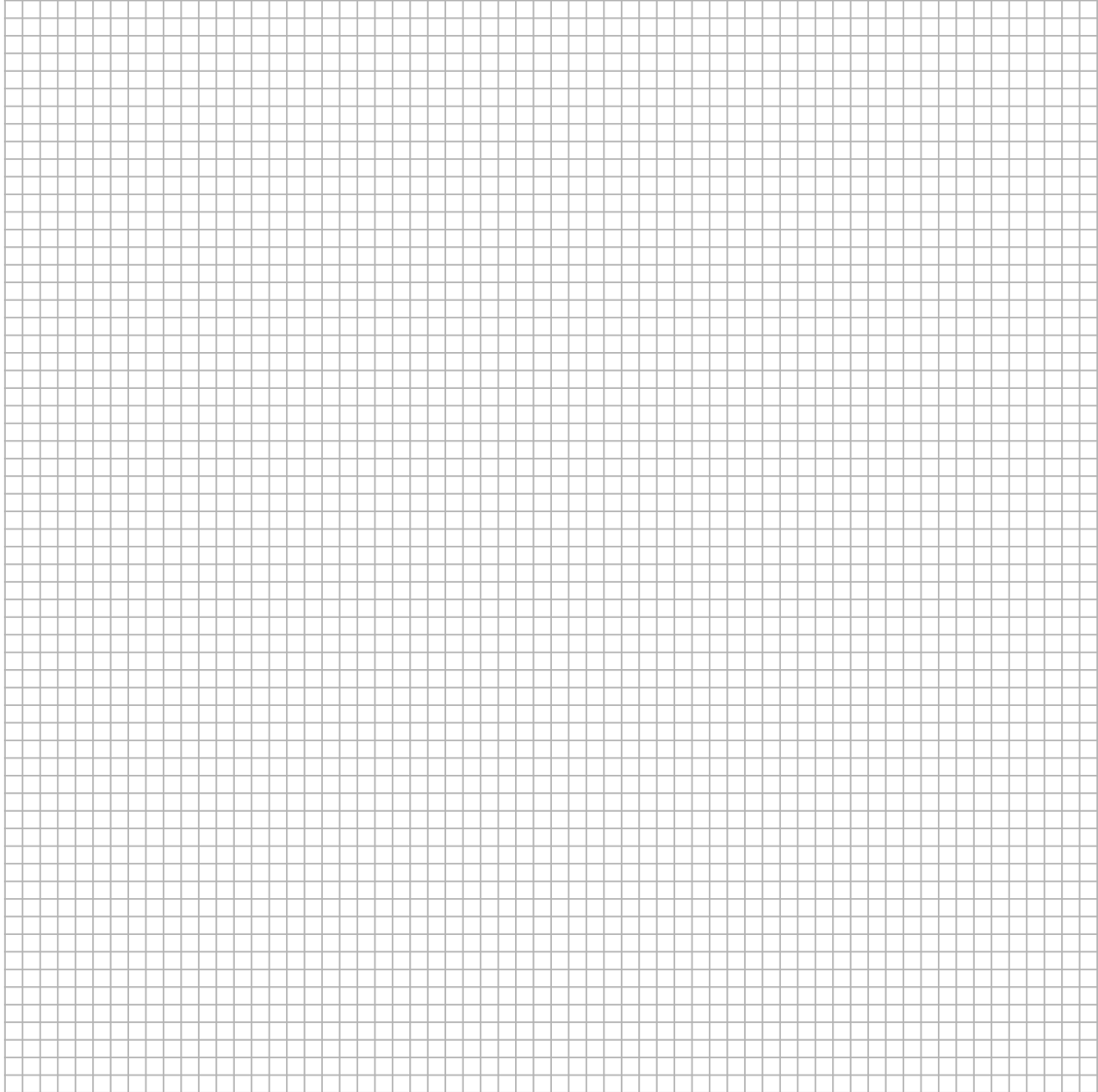
Method

1. Turn on hot plate and allow it to reach a constant heat output.
2. Add 150 g of water to one beaker.
3. Add 150 g of the second liquid to the other beaker.
4. Measure and record the initial temperature of water and the other liquid. Leave thermometers in the beakers for the whole experiment.
5. Place beakers on hotplate and start stopwatch. This is time zero.
6. Record in a table, every 30 seconds, the temperature of each liquid until the water starts to boil. Gently stir the liquids, between readings. Note: Keep stop watch running for the duration of the experiment.
7. Switch off the hot plate when water boils and allow both liquids to cool.

TIME (s)	TEMPERATURE OF WATER (°C)	TEMPERATURE OF SECOND LIQUID (°C)
0		
30		
60		
90		
120		
150		
180		
210		
240		

Processing results

On the same graph record temperature (y-axis) against time (x-axis) for both liquids.



Questions

1. What do the gradients of the two lines on your graph show about thermal properties of the two liquids?

.....

.....

.....

2. A definition of specific heat capacity is: 'the quantity of heat energy required to change the temperature of 1 kg of a substance by 1 Kelvin'. Use the graph to justify the statement that water has a greater specific heat capacity than the other liquid.

.....

.....

.....

.....

3. Consult a table of specific heat capacities. What do you notice about the specific heat capacity of water compared to all other substances in the list?

.....

.....

.....

4. If water in this experiment was heated from 70 °C to 85 °C, instead of from 20 °C to 35 °C, would you expect the value for the specific heat capacity of water to be same or different? Explain your answer.

.....

.....

.....

5. Hot water is used in domestic and industrial situations to transfer heat from one place to another. Why is water the preferred liquid used in these cases?

.....

.....

.....

6. Geothermal energy may be extracted from below ground by pumping hot water to the surface and using it to heat a swimming pool. Is this practice consistent with the answer to question 5. Explain.

.....
.....
.....

7. If 1 kg of water and 1 kg of aluminium are heated, for the same length of time, under identical conditions, which sample would you expect to rise to the highest temperature? Explain your answer.

.....
.....
.....
.....

8. The specific heat capacity of water is $4180 \text{ J kg}^{-1} \text{ K}^{-1}$. Describe, in your own words, what the units ($\text{J kg}^{-1} \text{ K}^{-1}$) mean, in relation to the definition given in question 2.

.....
.....
.....
.....