Specific heat capacity

Investigating the specific heat capacity of different metals.

In this practical you will:

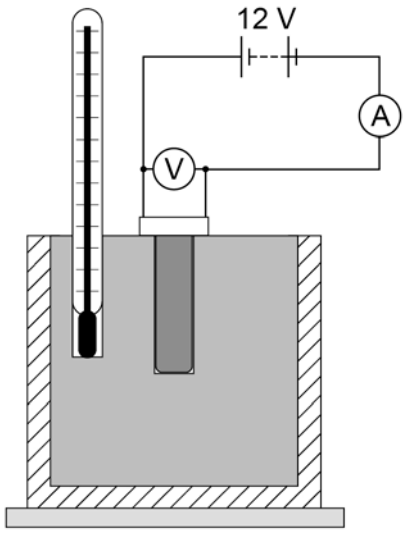
- heat up blocks of different metals using an electric heater
- measure the mass and temperature of the block
- calculate the work done by the heater
- plot a graph of temperature change against work done and use the gradient to calculate the specific heat capacity of the metal.

Apparatus

- three metal blocks, one copper, one iron and one aluminium, each with two holes for a thermometer and heater
  some insulation material to wrap around the blocks
- a thermometer
- a pipette to put water in the thermometer hole
- a 12 V immersion heater (30 – 110W)
- a 12 V power supply
- an ammeter and a voltmeter
- five connecting leads
- a stopwatch or stopclock
- a balance.

Method

1. Measure and record the mass of the copper block in kg.
2. Wrap the insulation around the block.
3. Place the heater in the larger hole in the block.
4. Connect the ammeter, power pack and heater in series.
5. Connect the voltmeter across the heater.



6. Use the pipette to put a small amount of water in the other hole.
7. Put the thermometer in this hole.
8. Set the power pack to 12 V. Switch on the power pack to turn on the heater.
9. Record the ammeter and voltmeter readings. These shouldn't change during the experiment.

Mass of copper block in kg	
Current reading on the ammeter in amps	
Potential difference reading on the voltmeter in volts	
Power (Power = IV)	

10. Measure the temperature and start the stopclock.

11. Record the temperature every minute for 10 minutes.

    Record your results in the table below.

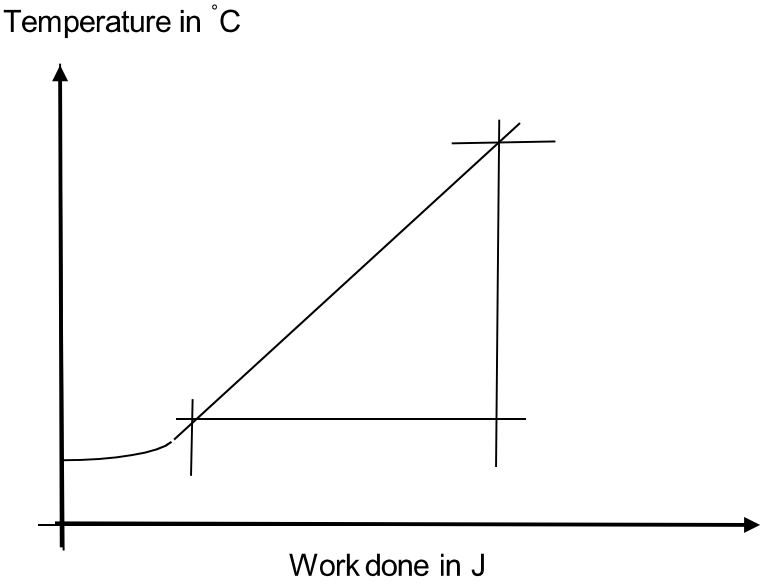
Time in seconds	**Temperature in °C**	**Work done in J (time x power of the heater)**
0		0
60		
120		
180		
240		
300		
360		
420		
480		
540		
600		

12. Calculate the power of the heater in watts.

    Power in watts = potential difference in volts x current in amps

13. Calculate the energy transferred (work done) by the heater. To do this, multiply the time in seconds by the power of the heater. Record these values in your table.

14. Plot a graph of the temperature in °C against work done in J.



15. Draw a line of best fit.

    Take care as the beginning of the graph may be curved.

16. Calculate the gradient of the straight part of your graph.

    The gradient = change in temperature rise in °C/change in work done in J

17. The **heat capacity** of the copper block is calculated using the formula:

$$\frac{1}{\text{gradient}}$$

    It is the amount of heat energy in J needed to increase the temperature by 1°C.

18. The **specific heat capacity** of copper is the amount of heat energy in J needed to increase the temperature of 1kg of copper by 1°C.

    Calculate the specific heat capacity of the copper block using the equation:

    Change in thermal energy in J = mass in kg x specific heat capacity in J/kg/ °C x temperature change.

19. Repeat the experiment for the blocks made from aluminium and iron.

Type of metal block	**Specific heat capacity in J/kg/ °C**
Copper	
Aluminium	
Iron	

Conclusion

Look at the following hypothesis:

'William thinks that denser materials have higher specific heat capacities. Using the density values of the metals below and the values of specific heat capacity that you have calculated, do you agree with him?' Write a short paragraph to explain your reasoning.

Type of metal block	**Density in g/cm^3**
Copper	8.96
Aluminium	2.70
Iron	7.87