Required Practical Review

SCIENCE WELLSWAY MULTI ACADEMY TRUST

Physics Practical – An investigation to determine the specific heat capacity of one or more materials.

Free science lessons: https://www.youtube.com/watch?v=HAPmwu7byGM
GCSEpod: https://members.gcsepod.com/shared/podcasts/title/10976

Know it

Investigating the specific heat capacity of different metals.

In this practical you will:

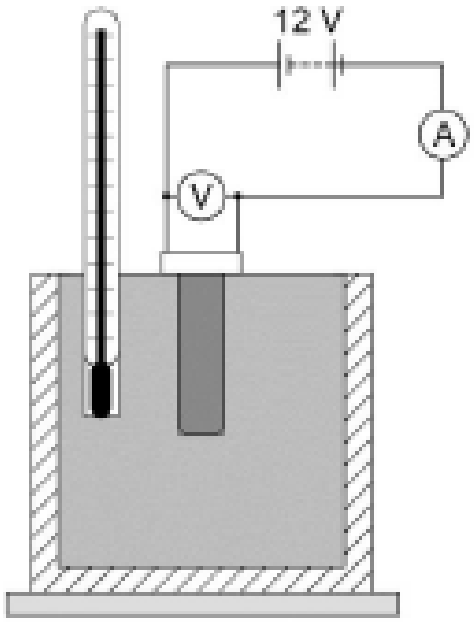
- heat up blocks of different metals using an electric heater
- measure the mass and temperature of the block
- calculate the work done by the heater
- plot a graph of temperature change against work done and use the gradient to calculate the specific heat capacity of the metal.

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.

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

Review it

Complete the tasks below into your book.

Up to grade 4

1. Name the independent and dependent variables, plus two control variables.

2. Bullet point a method to complete this practical.

3. How could you check that your results are reproducible?

Grade 5-7

1. Suggest the biggest source of uncertainty or error in your experiment. Explain your answer.

2. Suggest an improvement to the apparatus or procedure which might reduce this uncertainty.

Grade 7+

1. Design an experiment to measure the specific heat capacity of metals when cooling (hint: you might consider measuring the heat gained from the metal by another material).

Test it

Answer the exam question below in your book.

7 Under the same conditions, different materials heat up and cool down at different rates.

7 (a) What is meant by specific heat capacity?

[2 marks]

.....

.....

.....

.....

7 (b) 'Quenching' is a process used to change the properties of steel by cooling it rapidly.

The steel is heated to a very high temperature and then placed in a container of cold water.

7 (b) (i) A metalworker quenches a steel rod by heating it to a temperature of 900 °C before placing it in cold water. The mass of the steel rod is 20 kg.

The final temperature of the rod and water is 50 °C.

Calculate the energy transferred from the steel rod to the water.

Specific heat capacity of steel = 420 J/kg °C

Use the correct equation from **Section B** of the Physics Equations Sheet.

[3 marks]

.....

.....

.....

Energy transferred = ... J

7 (b) (ii) The temperature of the steel rod eventually returns to room temperature.

Compare the movement and energies of the particles in the steel rod and in the air at room temperature.

[3 marks]

.....

.....

.....

.....

.....

.....

7 (b) (iii) When the steel rod is being quenched, the temperature of the water rises to 50 °C. After a few hours the water cools down to room temperature.

Some of the cooling of the water is due to evaporation.

Explain in terms of particles how evaporation causes the cooling of water.

[4 marks]

.....

.....

.....

.....

.....

.....

.....

Mark it

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	energy required to raise the temperature of a substance by 1 °C	accept heat for energy	1	AO1 3.1c
	unit mass / 1 kg		1	
7(b)(i)	7 140 000 (J)	allow 2 marks for a correct substitution, ie $E = 20 \times 420 \times 850$ provided no subsequent step 850 gains **1** mark if no other mark awarded	3	AO2 3.1c
7(b)(ii)	particles in the air have more (kinetic) energy than the particles in the steel	allow particles in the air have a greater speed.	1	AO1 3.1b
	steel particles vibrate (about fixed positions)		1	
	air particles move freely		1	
7(b)(iii)		accept molecules for particles throughout		AO1 3.2b
	the most energetic particles	accept the fastest particles	1	
	have enough energy to escape from (the surface of) the water		1	
	therefore the mean energy of the remaining particles decreases	accept speed for energy	1	
	as energy decreased, temperature has decreased		1	
Total			**12**	