Infrared radiation and surfaces

Physics required practical | AQA Combined Science 8464 and AQA GCSE Physics 8463 | 14 questions, 36 marks

GCSE science required practicals

This practical online

Name: _____ **Date:** _____ **Score:** _____ **/ 36**

Aim: To find out how the colour and texture of a surface affect how much infrared radiation it emits.

Equipment: Leslie cube (a hollow metal cube with matt black, shiny black, matt white and shiny silver faces); Kettle; Heat-resistant mat; Infrared detector; Metre ruler; Heat-resistant gloves; Thermometer; For the tube version: four identical boiling tubes or cans painted with different surfaces, four thermometers and a stopwatch.

Results

Mei and Oliver filled a Leslie cube with hot water and placed an infrared detector 10 cm from each face in turn. They took three sets of readings. The detector gives readings in W/m^2.

Surface	Reading 1 in W/m^2	Reading 2 in W/m^2	Reading 3 in W/m^2
Matt black	126	123	125
Shiny black	108	93	110
Matt white	101	99	102
Shiny silver	22	20	21

Questions

1 Look at Mei and Oliver's investigation.

a. Name the independent variable.

b. Name the dependent variable.

c. Give one control variable.

(3 marks)

2 Explain why the detector must be the same distance from each face.

(2 marks)

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3 Give one hazard in this investigation and say how to reduce the risk. (2 marks)

4 Which surface is the best emitter of infrared radiation and which is the worst? Use the table to explain your answer. (2 marks)

5 Identify the anomalous result and say what Mei and Oliver should do with it. (2 marks)

6 Calculate the mean reading for the matt black face. Give your answer to 1 decimal place. (2 marks)

7 Calculate the mean reading for the shiny black face, leaving out the anomalous result. (2 marks)

8 The mean reading for shiny silver was 21.0 W/m^2 and for matt black was 124.7 W/m^2. Calculate the shiny silver reading as a percentage of the matt black reading. Give your answer to 2 significant figures. Show your working. (3 marks)

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9 Sofia did the version with painted cans. The water in her matt black can cooled from 80 °C to 62 °C in 10 minutes. Calculate the mean rate of cooling in °C per minute.

(2 marks)

10 **Higher tier**

Sofia's matt black can held 0.25 kg of water, which cooled by 18 °C in 10 minutes. The specific heat capacity of water is 4200 J/kg °C.

change in thermal energy = mass × specific heat capacity × temperature change

Calculate the mean rate at which the water lost energy, in watts. Show your working.

(4 marks)

11 Sofia used thermometers with a resolution of 1 °C. Suggest a better piece of equipment and explain why it would improve her results.

(2 marks)

12 **Higher tier**

Mei and Oliver always measured the faces in the same order: matt black first and shiny silver last. Explain why this could make the comparison unfair and suggest how to avoid it.

(2 marks)

13 Oliver suggests holding his hand near each face instead of using the detector. Give two reasons why the detector is better.

(2 marks)

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14 Plan an investigation to find out which surface is the best absorber of infrared radiation. You can use two identical metal plates, one painted matt black and one shiny silver, and an electric heater.

(6 marks)

End of questions | Total 36 marks | The answers sheet has the full method as revision notes.

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