1. A student investigated the thermal conductivity of different metals.

This is the method used:

1. Measure the mass of an ice cube.
2. Put the ice cube on a metal block which is at room temperature.
3. Measure the mass of the ice cube after one minute.
4. Repeat with other blocks of the same mass made from different metals.

The following table shows the student's results.

Metal	Initial mass of ice cube in grams	Final mass of ice cube in grams	Change in mass of ice cube in grams
Aluminium	25.85	21.14	4.71
Copper	26.20	20.27	5.93
Lead	25.53	21.97	3.56
Steel	24.95	19.45	5.50

(a) The initial temperature of each ice cube was –15 °C

Why was it important that the initial temperature of each ice cube was the same?

Tick (✓) **one** box.

Initial temperature was a continuous variable.

Initial temperature was a control variable.

Initial temperature was the dependent variable.

Initial temperature was the independent variable.

(1)

(b) Which metal had the highest thermal conductivity?

Give a reason for your answer.

Metal: _____

Reason: _____

_____

_____

(2)

(c) Suggest **one** source of random error in the student's investigation.

_____

_____

_____

_____

(1)

(d) An ice cube has a temperature of −15.0 °C

The total thermal energy needed to raise the temperature of this ice cube to 0.0 °C and completely melt the ice cube is 5848 J

specific heat capacity of ice = 2100 J/kg °C
specific latent heat of fusion of ice = 334 000 J/kg

Calculate the mass of the ice cube.

_____

_____

_____

_____

_____

_____

_____

_____

Mass of ice cube = _____ kg

(5)

(Total 9 marks)

The figure below shows a house with a solar power system.

The solar cells generate electricity.

When the electricity generated by the solar cells is not needed, the energy is stored in a large battery.

2.

(a) During one year, 1.25×10^{18} J of energy was transferred from National Grid.

number of seconds in 1 year = 3.16×10^{7}

Calculate the mean energy transferred from the National Grid each second.

Give your answer to 3 significant figures.

Energy each second (3 significant figures) = _____ J

(2)

(2)

(b) The charge flow through the cable between the solar cells and the battery in 24 hours was 27 000 coulombs.

Calculate the mean current in the cable.

Mean current = _____ A

(4)

(c) At one time, the total power input to the solar cells was 7.8 kW.

The efficiency of the solar cells was 0.15

Calculate the useful power output of the solar cells.

Useful power output = _____ W

(3)

(d) It is unlikely that **all** of the electricity that the UK needs can be generated by solar power systems.

Explain why.

(2)

(Total 11 marks)

Mark schemes

1. (a) Initial temperature was a control variable

1

(b) copper

1

greater change in mass (than the other metals)

this mark is dependent on scoring the first mark allow more ice melted (than the other metals) allow the ice melted faster (than the other metals)

1

(c) variation in initial mass of ice cube

allow variation in initial volume of ice cube

or

surface area of the ice cube touching the metal *allow melting of ice while handling allow variation in room temperature allow initial temperature of metal block*

1

(d)

*an answer of 0.016 (kg) scores **5** marks*

E = m × 2100 × 15

1

E = m × 334 000

1

5848 = 31 500 m + 334 000 m

or

5848 = 365 500 m

1

or

1

m = 0.016 (kg)

*allow **2** marks for an answer that rounds to 0.186 or 0.0175*

*if no other mark scored allow **1** mark for either*
5848 = m × 2100 × 15
or
5848 = m × 334 000

1

[9]

2.

(a)

1

$E = 3.96 \times 10^{10}$ (J)

*an answer that rounds to 3.96×10^{10} (J) scores **1** mark*

1

(b) t = 86 400 (s)

1

27000=I×86400

allow a correct substitution of an incorrectly/not converted value of t

1

allow a correct rearrangement using an incorrectly/not converted value of t

1

I = 0.3125 (A)

allow a correct calculation using an incorrectly/not converted value of t

allow a correctly calculated answer rounded to 2 or 3 sf

1

(c)

allow a correct substitution of an incorrectly/not converted value of total power input

1

useful power output =
0.15 × 7800

allow a correct rearrangement using an incorrectly/not converted value of total power input

1

useful power output = 1170 (W)

this answer only but allow 1200 (W) if correct working shown

1

(d) a really large area of land would need to be covered with solar cells **1**

due to the low useful power output of the solar cells

allow due to the low efficiency of the solar cells

or

number of hours of daylight is too low (in UK)

or

low solar intensity (in UK)

or

solar radiation (in UK) is too low

or

material for construction of solar cells and/or lithium batteries is in limited supply **1**

[11]