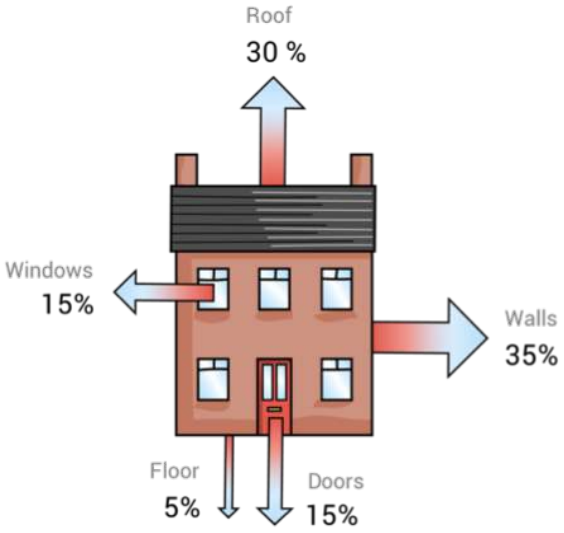
0 1

Typical heat losses from a particular **detached** house are as shown in the below diagram.



0 1 . 1

On a given day, 7 MJ of heat energy is lost through its **walls**. Calculate the **total** amount of energy which is transferred from the house to its surroundings on this day.

Total amount of energy = 7 ÷ 0.35 = **20 MJ** (or 7 ÷ 35 × 100)

0 1 . 2

Write down **two** factors which affect the rate at which thermal energy is lost through the walls of a house.

Any TWO of: the thickness of the walls, the material (or thermal conductivity of the material) from which they are made, the amount/type of insulation used, the temperature difference between the inside and outside of the house (accept 'the temperature outside'), the surface area of the walls.

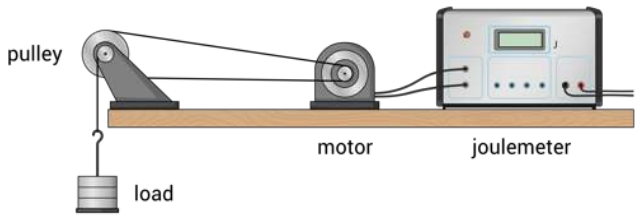
0 1 . 3

A nearby **terraced** house is the same size as the above detached house, and has been built using the same materials. Explain why the amount of heat lost from the **walls** of the terraced house is likely to be **lower** than that from those of the above detached house.

Any TWO of: the surface area of the walls of the terraced house (which are exposed to the outside) is lower [1] which means that the overall rate of heat transfer through the walls of this house will be lower [1] / less heat will be lost through the 'internal' walls between it and the houses on either side of it [1].

0 2

Caren is using the below experimental setup to investigate the efficiency of an electric motor.



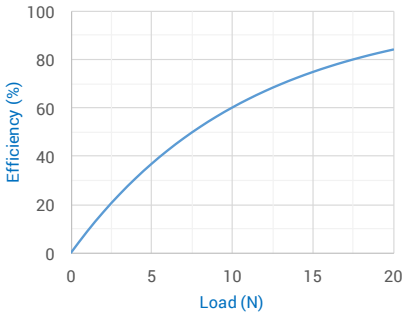
0 2 . 1 When a 4 N load is lifted through a distance of 50 cm, the reading on the joulemeter increases by 6.5 J. Calculate the efficiency of the motor in lifting this load.

Useful output energy = increase in GPE (E_p) = F × d = 4 × 0.5 = **2 J**
(or m = W ÷ g = 4 ÷ 9.8 = 0.408 kg, Ep = m g h = 0.408 × 9.8 × 0.5 = 2 J
Efficiency = useful output energy ÷ total input energy = 2 ÷ 6.5
Efficiency = 0.308 = **30.8%** (1 d.p.)

0 2 . 2 Caren goes on to investigate how the efficiency of the motor depends on the size of the load. Write down **one** variable which she should **control** in this investigation.

The speed at which the motor is rotated / the electrical power supplied to the motor; the amount of lubrication used in the motor; the pulley used; the angle/position of the belt running between the motor and pulley.

0 2 . 3 The results which she obtains are as shown below.



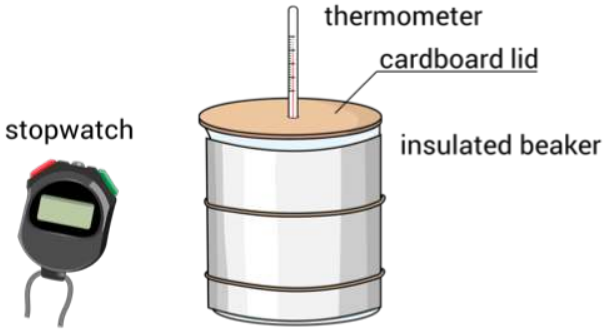
Describe the trend shown by the above graph.

As the load increases, the efficiency of the motor increases [1] but at a decreasing rate / in a non-linear way [1].

0 2 . 4 If 8 J of electrical energy is supplied to the motor to enable it to lift a load of 10 N, through what distance will the load be lifted?

(From graph) when load = 10 N, efficiency = 60%
Useful energy output = increase in GPE = efficiency × total energy input
Increase in GPE (E_p) = 0.6 × 8 = 4.8 J
E_p = m g h; E_p = W h; h = E_p ÷ W or h = E_p ÷ (m g)
Distance through which load is lifted = 4.8 ÷ 10 = **0.48 m**

0 3 Mikaela uses the below experimental setup to investigate the effectiveness of a number of different materials as thermal insulators.



The results which she obtains are as shown in the below table.

Material	Temperature decrease of water (°C)		
	1st run	2nd run	Average
Aluminium foil	5	7	6
White card	20	23	21.5
Bubble wrap	4	4	4
Corrugated card	14	10	12
Black sugar paper	30	26	28

0 3 . 1 Write down the steps which she should have followed to obtain this data.

Heat water to given temperature and pour into beaker [1]. Immediately replace lid, insert thermometer into water and start stopwatch [1]. Measure temperature decrease of water after set time [1]. Repeat for (four) additional insulators [1].

0 3 . 2 State two **control variables** in this experiment.

Any TWO of: initial temperature of water (and beaker) [1]; amount (mass) of water used [1]; cooling time [1]; use of lid [1]; surface onto which beaker is placed [1].

0 3 . 3 Complete the final column in the above table

All correct: 2 marks; 3 – 4 correct: 1 mark; 0 – 2 correct: 0 marks.

0 3 . 4

Write down one **safety precaution** which Mikaela should have taken in carrying out this experiment.

Any ONE of: take care when using/pouring hot water [1]; do not place beaker close to edge of table [1]; ensure that beaker does not topple over [1]; allow beaker to cool sufficiently before emptying water [1].

0 3 . 5

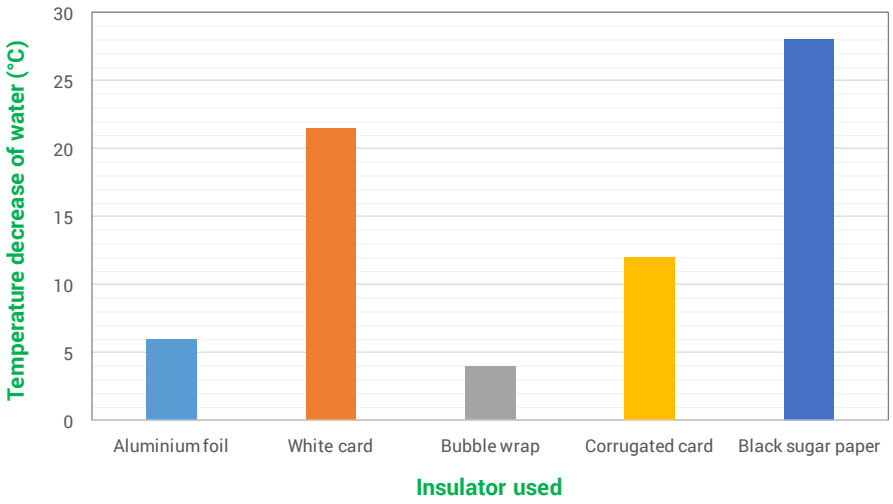
Explain why Mikaela **repeated** each measurement.

To improve the accuracy of her measurement of the temperature decrease of the water in each case / to reduce the degree of random error (uncertainty) in the results [1].

The fact that the measured temperature decreases varied (in most cases) between the first and second runs of the experiment is due to the presence of **random error** in the measurements. Remember that random error (uncertainty) is the name we give to the unpredictable fluctuations (variations) which occur from measurement to measurement. In this investigation, the random error could have resulted from a misreading of the thermometer, a slightly different amount of water being used accidentally for a given measurement, a sudden change in room temperature (caused for example by a window being opened), or any one of a number of other things.

0 3 . 6

Using the below axes, plot a suitable graph of the results of this experiment.



We have to plot a **bar graph** of these results because the **independent variable** (the insulator used) is a categoric variable.

0 3 . 7

Which of the insulators used had the **highest** thermal conductivity?

Black sugar paper [1].