

2 Energy transfer

The energy a fuel releases is measured in joules (J) or kilojoules (kJ).

To find this value we need to know how much energy was transferred to the water.

This depends on two things: the mass of water heated and its temperature rise. Each cm³ of water has a mass of 1 g, and each gram of water takes 4.2 J to make it 1°C hotter. So the energy transferred to the water can be calculated using this equation:

$$\text{energy transferred (J)} = \frac{\text{mass of water heated (g)}}{1} \times 4.2 \times \text{temperature change (}^{\circ}\text{C)}$$

The results in the table below were obtained when four different fuels were used to heat 100 cm³ of water. Calculate the amount of energy each fuel transferred.

To compare fuels fairly we need to know how much energy they release per gram.

This can be found by dividing the total energy transferred by the grams of fuel used.

$$\text{energy per gram} = \frac{\text{energy supplied (J)}}{\text{mass of fuel burnt (g)}}$$

- a) Calculate the energy each fuel transferred per gram.

Fuel	Temperature before in °C	Temperature before in °C	Temperature difference in °C	Energy transferred in J	Mass of fuel used in g	Energy per gram in J/g
A	20	56			3.2	
B	21	64			4.3	
C	19	52			3.6	
D	20	61			3.9	

3 Rearranging equations

If you want to calculate the amount of energy transferred the equation below is ideal, but suppose you wanted to know the mass of water heated or the temperature change.

$$\text{energy transferred (J)} = \frac{\text{mass of water heated (g)}}{1} \times 4.2 \times \text{temperature change (}^{\circ}\text{C)}$$

To make the equation more useful it can be rearranged.

- a) To find the temperature change, divide both sides of the equation by the 'mass of water heated × 4.2'. Write out the new equation.

- b) To find the mass of water heated, divide both sides of the equation by '4.2 × the temperature change'. Write out the new equation.

1 Comparing fuels

A student wanted to compare the energy released when 4 different fuels burned.

To make it a fair test she put 1 g of each fuel in a little dish. Then she burned each fuel under a calorimeter containing 200 cm³ of water. These are her results:

Fuel	Temperature at the start in °C	Temperature at the end in °C	Temperature rise in °C
methanol	25	56	
ethanol	18	53	
propanol	17	54	
butanol	23	63	

- a) Calculate each temperature rise and state which fuel releases most energy per gram.

Another student used spirit burners for the experiment. She had to weigh them before and after each test to find out how much fuel she had used. To make it a fair test she used each fuel to make the same amount of water 10°C hotter. These are her results:

Fuel	Mass of burner at the start in g	Mass of burner at the end in g	Mass of fuel used in g
methanol	154.3	150.7	
ethanol	213.4	210.6	
propanol	185.8	183.4	
butanol	198.5	196.3	

- b) Calculate the mass of each fuel she had to use to release the same amount of energy, and state which fuel must release more energy per gram.

- c) What could these students do to prove their results were repeatable?

- d) Results are reproducible if they lead to the same conclusions when different people do the experiments or when different methods are used. Are the results reported on this page reproducible?