Specific Heat Capacity

All answers to calculations should be to 2 significant figures.

Q1 Define the term specific heat capacity

Specific heat capacity is the amount of energy to raise the temperature of 1kg of substance by 1^{o}C

Q2. Write down the equation which links temperature change, specific heat capacity, mass and energy change.

Energy change = mass x specific heat capacity x temperature change

Q3. What does the value of specific heat capacity tell us about how much thermal energy a material can store

The higher the value for specific heat capacity, the greater the amount of thermal energy a material can store.

Use the data table below in the following questions

Name of Substance	Specific heat capacity J/kg^{o}C
Aluminium	900
Marble	880
Gold	130
Steel	425
Water	4200

Q3. A 2kg aluminium block is heated and its temperature increases from 20^{o}C to 60^{o}C. Calculate the amount of energy needed to raise the temperature of the aluminium block.

Energy change = mass x specific heat capacity x temperature change

Energy change = 2kg x 900 x (60-20) = 72000J

Q4. A marble statue cools down overnight from 25^{o}C to 20^{o}C and transfers 50000J of energy to the surroundings. Calculate the mass of the statue.

Energy change = mass x specific heat capacity x temperature change

$$Mass = \frac{Energy\ change}{specific\ heat\ capacity\ \times temperature\ change}$$

$$Mass = \frac{50000}{880\ \times (25-20)}$$

Mass = 11 kg

Q5. A new alloy has been made by mixing together gold, silver, aluminium and zinc. The new alloy has a mass of 2kg, when heated using a Bunsen burner it received 20000J of energy and its temperature increased by 7°C. Calculate the specific heat capacity of the new alloy.

Energy change = mass x specific heat capacity x temperature change

$$Specific\ heat\ capacity = \frac{Energy\ change}{mass\ \times temperature\ change}$$

$$Specific\ heat\ capacity = \frac{20000}{2\ \times 7}$$

Specific heat capacity = 1400 J/kg°C

Q6. A 40kg steel drum is used to store 35kg of water. During the day the steel container receives thermal energy from the Sun. Both the temperature of the container and the water inside increase from 20°C to 45°C. Calculate the amount of energy needed to raise the temperature of both the water and the drum.

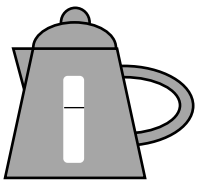
Energy change = mass x specific heat capacity x temperature change

Energy change for container = 40 x 425 x (45-20) = 425000J

Energy change for water = 35 x 4200 x (45-20) = 3675000

Total energy change = 3675000 + 425000 = 4100000J

Q7.



The kettle has a power rating of 3kW and is used for 5 minutes to increase the temperature of water from 25°C to 100°C. Calculate the mass of the water in the kettle

Energy = Power x time

Convert the power from kilowatts into watts, convert the time from minutes into seconds.

Energy = 3000W x 5 x 60 = 900000J

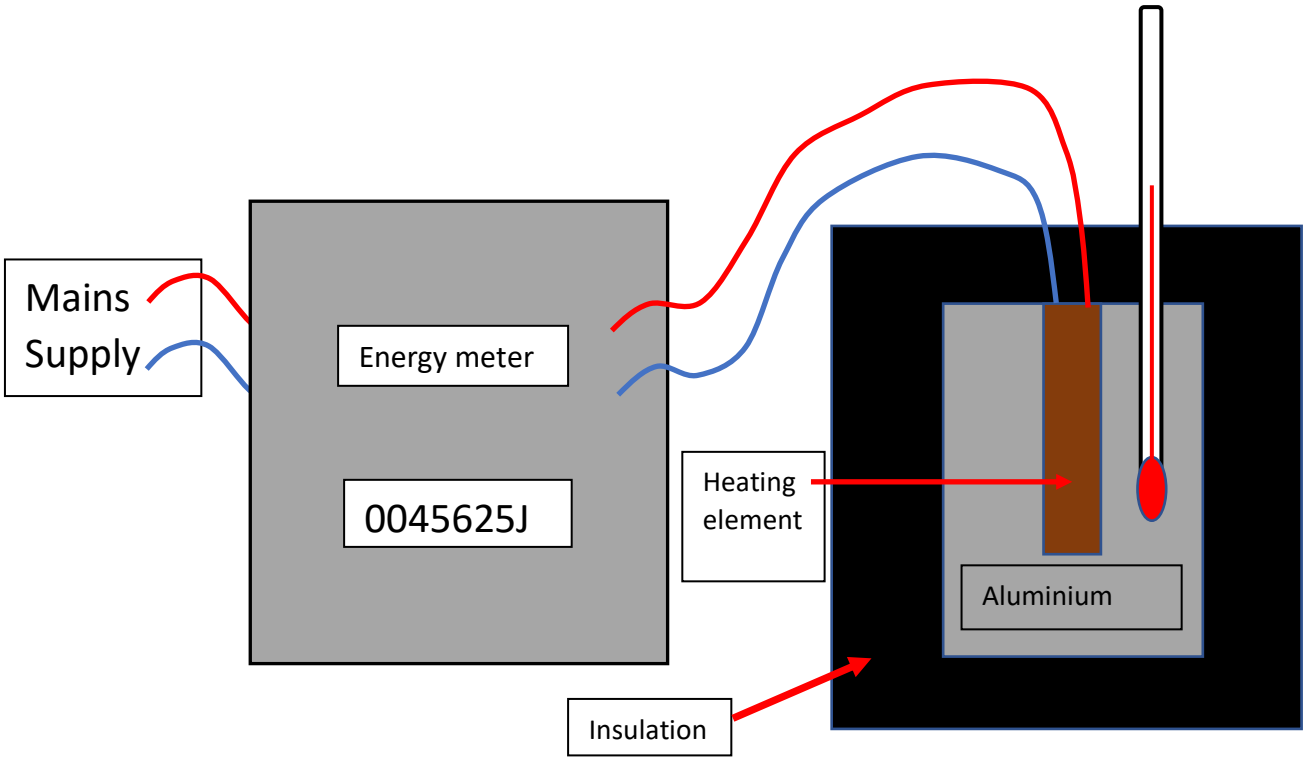
Energy change = mass x specific heat capacity x temperature change

$$Mass = \frac{Energy\ change}{specific\ heat\ capacity\ \times temperature\ change}$$

$$Mass = \frac{900000}{4200\ \times (100 - 25)}$$

Mass = 2.9kg

Q8. The teacher set up the following experiment in the class.



a. Write a method explaining how to use the above equipment to measure the specific heat capacity for a 1kg block of aluminium.

Assemble the apparatus as above with the electric heating element in the 1kg Aluminium block

Insert a glass thermometer into a small hole, through the insulating material and into the aluminium block. A small amount of oil is added into this hole to ensure a good contact is achieved between the glass thermometer and the aluminium block. This will allow the thermometer to display more accurate temperature values

The temperature of the aluminium block is recorded with the heater off and the number of joules on the energy meter is recorded.

Switch the heater on for a 10 minute period. After the 10 minute period record the new value on the energy meter and the new temperature on the thermometer.

Calculate the temperature rise by subtracting the two temperature values. Also, calculate the energy used by subtracting the two energy values.

Use the following equation to calculate specific heat capacity of the aluminium block.

$$Specific\ heat\ capacity = \frac{Energy\ change}{mass\ \times temperature\ change}$$