Specific heat capacity

Extension Sheet

Energy needed to heat a substance (in joules)	=	**specific heat capacity** (in J/kg°C)	×	**mass** (in kg)	×	**change in temperature** (in °C)

The specific heat capacity of water is 4200 J/kg°C.

Example
A 2 kW (2000 W) electric kettle is switched on for 10 seconds.

a) How much energy is transferred?

b) If all this energy is given to 0.5 kg of water, what is the rise in temperature?

Answer

a) 2000 W = 2000 J/s = 2000 joules in each second
∴ Energy supplied = 2000 J/s × 10 s = 20 000 J

b) Energy needed = specific heat capacity × mass × change in temperature

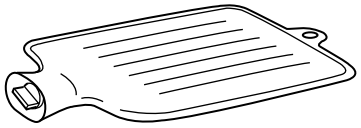
20 000 = 4200 × 0.5 × rise in temperature

∴ rise in temperature = 9.5°C

Questions
For each question show all your working clearly.

1. How much energy is needed to raise the temperature of 2 kg of copper by 10°C? (specific heat capacity of copper = 380 J/kg°C)

2. A hot-water bottle is filled with 0.8 kg of water at 80°C. During the night it cools to 30°C. How much energy has it given out?



3. How much energy is needed to heat 2 kg of cooking oil in a chip-pan from 20°C to 120°C? (specific heat capacity of oil = 2000 J/kg°C)

4. Andy has a bath and uses 100 kg of water, heated from 10°C to 40°C.
How much energy does he use?
Becky has a shower and uses 20 kg of water heated from 10°C to 50°C.
How much energy does she use?

5. A 3 kW electric immersion heater is switched on for 1000 s. It transfers the energy to 200 kg of water.
a) How much energy is transferred?
b) What is the rise in temperature of the water?

6. A 2 kW kettle contains 2 kg of water at 10°C. It is switched on for 420 seconds, and the temperature rises to 100°C.
a) How much electrical energy is supplied?
b) How much energy was given to the water?
c) Why are these 2 answers not the same?
d) What percentage of the energy supplied went to the water?
e) How could this percentage (the efficiency) be increased?