Specific Heat Capacity Space School

The specific heat capacity of water = 4,180 J kg^{-1} $^{O}C^{-1}$

1. Find the amount of energy needed to raise the temperature of 2 kg of water at 20°C to boiling point. .	2. A bath of water holds 40 kg of water. How much energy is needed to raise the temperature of this quantity of water by 75°C	**3.** The specific heat capacity of water is 4,180 J kg^{-1} $^{O}C^{-1}$ (a) How much energy is required to raise the temperature of 1 kg of water by 10°C ? (b) How much energy is needed to raise the temperature of 10 kg of water by 1^{O}C ?
4. A 2 kW kettle contains 2 kg of water at 43 ^{O}C. The kettle is switched on for four minutes. Determine the final temperature of the water.	**5.** How much energy is needed to heat up a bath of water? Mass of water = 210 kg Initial temperature 20°C Final temperature 40°C	**6.** Find the amount of heat energy needed to boil a large pan of water of mass 20 kg from a temperature of 20°C
7. How much heat energy is needed to heat up a swimming pool which uses a mass of water of 700,000 kg from a temperature of 20°C to 38°C	**8.** A hot water bottle contains 1.5 kg of water at 50°C. It cools down to a temperature of 25°C. Ignoring the heat absorbed by the rubber, find the energy given out to the surroundings.	**9.** Find the energy released when 500 ml of water cools from a temperature of 60°C to 2^{O}C

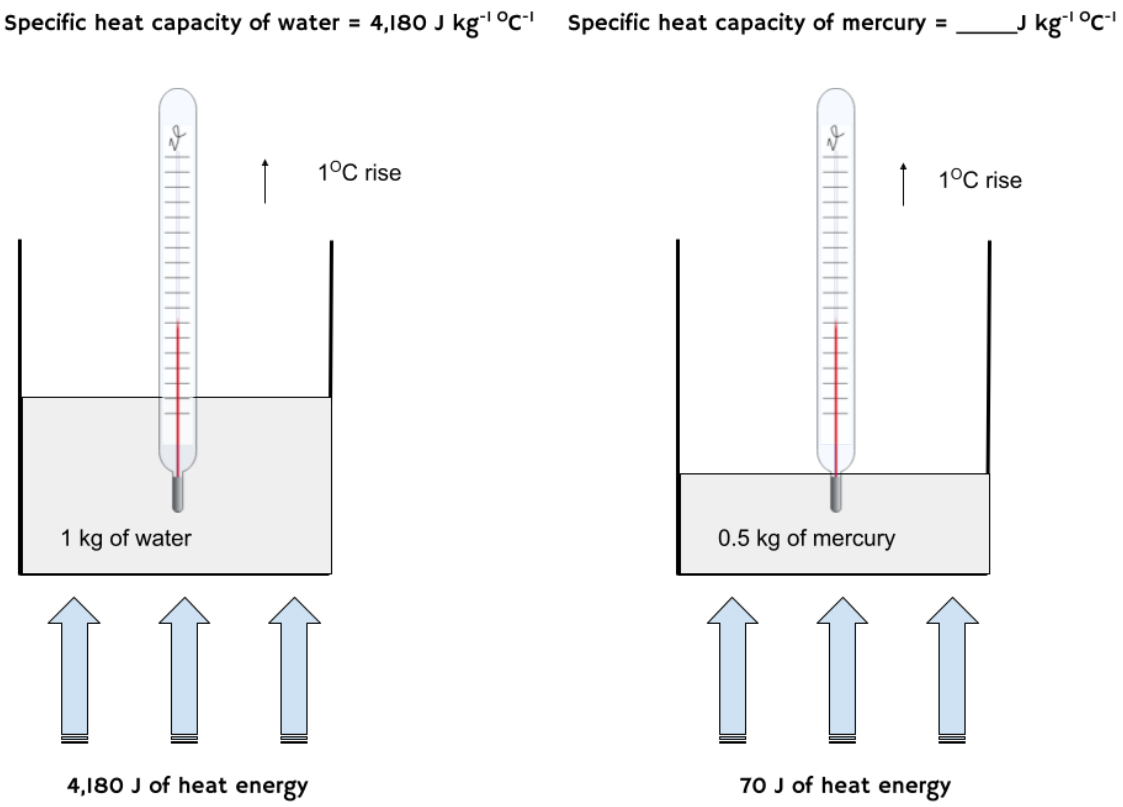
10. Which material needs the least heat to raise 1 kg of it by 1^{O}C?

11. A material needs 960 J of energy to raise one kilogram of it by 2^{O}C.
    Identify the material from the table.

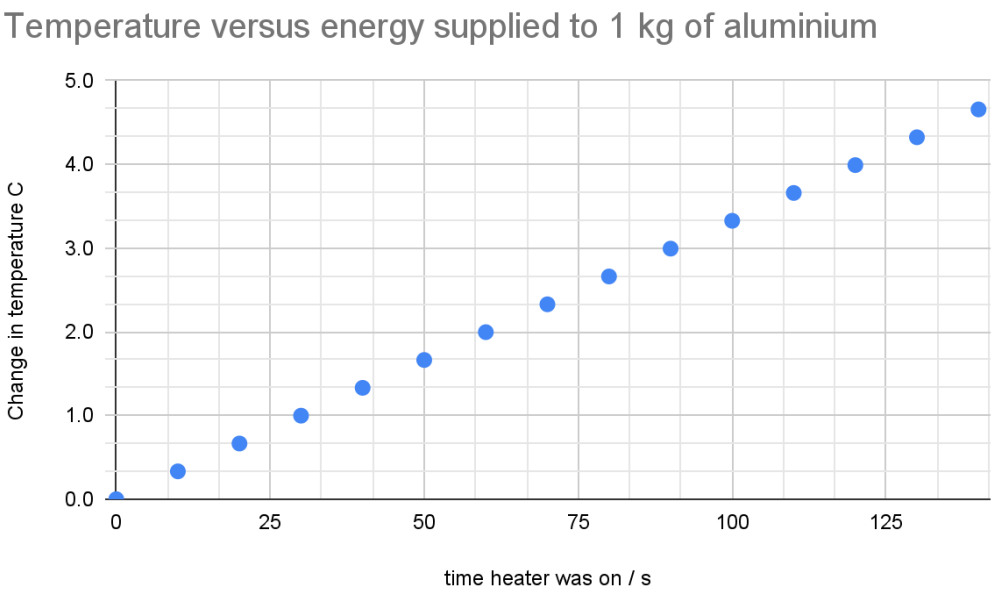
12. How much heat energy is needed to raise 250 g of copper by 5°C

Specific heat capacity of materials	
Material	*Specific heat capacity in Jkg⁻*
Alcohol	2 350
Aluminium	902
Copper	386
Glass	500
Ice	2 100
Iron	480
Lead	128
Oil	2 130
Water	4 180

13. Determine from the diagram the specific heat capacity of mercury.

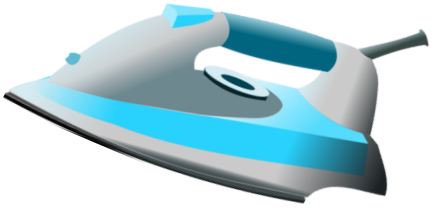


14. A pupil used a 30 Watt heater to add energy to a one kilogram aluminium block. The pupil timed how long the heater was on and measured the change in temperature.
She produced the following graph:



a. From the graph determine the specific heat capacity of aluminium.

15. The base plate of an iron is made of aluminium. The base plate has a mass of 0.7 kg and the heater of the iron delivers 70,560 J to the base plate.
The initial temperature of the base plate is 20°C.
Determine the maximum temperature the base plate reaches.



16. Four physics students state what they think the specific heat capacity value of a material means.
Which student is correct?

Alex:
A material with a high specific heat value is really very hot at room temperature

Jane:
A material with a low value of specific heat takes a lot of energy to raise its temperature by one degree celsius.

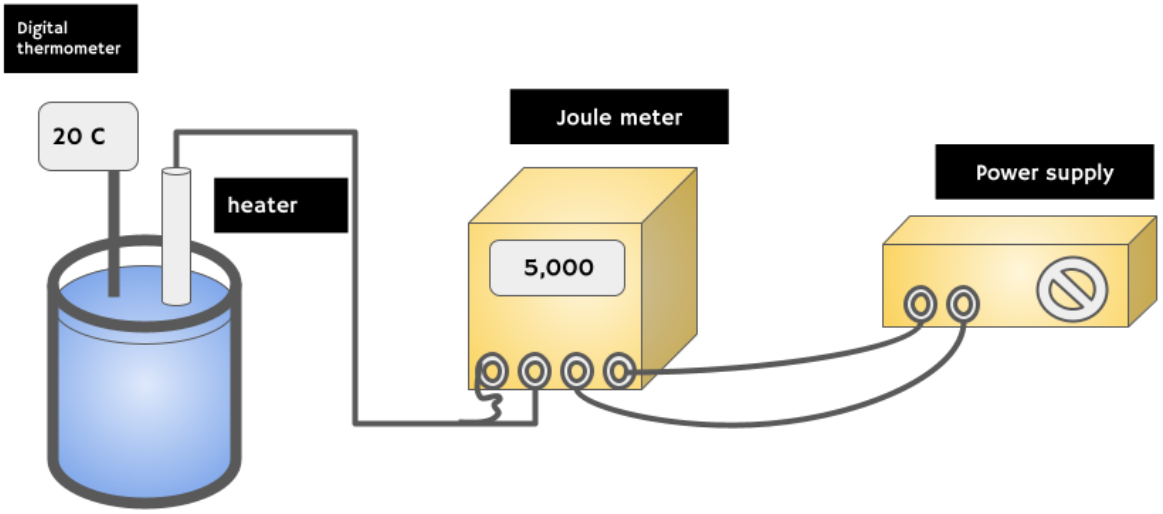
Kai:
A material with a high value of specific heat takes very little energy to raise its temperature by one degree celsius

Ling:
The specific heat capacity of a material tells us how much energy is needed to raise one kilogram of the material by one degree celsius.

17. The same amount of energy is transferred to equal masses of two different materials.
The initial and final temperatures are noted.
Which material has the lowest value of specific heat capacity

Material A	Initial temp = 24°C	Final temp = 37°C
Material B	Initial temp = 24°C	Final temp = 50°C

18. A pupil carries out a practical experiment to determine the specific heat capacity of water.



a. Describe how the pupil would determine the value of the specific heat capacity of water. Indicate the measurements she would take to determine the value.

b. The pupil's measured value of the specific heat of water is larger than the stated value. Explain why this is the case and describe how the experimental set up could be modified to bring the value much closer to the accepted value.

19. A material under test has a specific heat capacity of 1000 J kg^{-1} $^{O}C^{-1}$
Which of these statements are true or false:

a. When 1 kg of the material absorbs 2000 J its temperature is raised by $1^{O}C$

b. When 0.5 kg of the material absorbs 2000 J its temperature is raised by $1^{O}C$

c. When 0.5 kg of the material absorbs 2000 J its temperature is raised by $4^{O}C$

d. When 1 kg of the material cools down by $2^{O}C$ it releases 4000 J

20. Determine the amount of energy needed to heat up 60 kg of water in a washing machine from $20^{O}C$ to $40^{O}C$
The power rating of the element in the washing is 20 kW. What is the minimum time needed to raise the temperature of the water from $20^{O}C$ to $40^{O}C$?

Answers

1. 668,000 J	2. 12,540,000 J	3. 41,180 J
4. 480,000 J	5. 17,556,000 J	6. 6,688,000 J
7. 52,668,000 J	8. 156,750 J	9. 500 ml of water = 0.5 kg $E = cm\Delta T$ $= 4,180 \times 0.5 \times 58$ $= 121,220\,J$

10. Lead
11. 480 J/kg^{O}C = Iron
12. 482.5 J
13. Specific heat capacity = 482.5 J
14. Approximately 125 s raises the temperature by 4 ^{O}C.

    This gives the input energy E = Pt = 30 x 125 = 3,750 J

$$c = \frac{E}{(m\Delta T)}$$
$$= \frac{3750}{(1 \times 4)}$$
$$= 938$$ so specific heat capacity = 938 J/kg ^{O}C

15. 395 ^{O}C
16. LIng is correct.
17. Material A
18. See notes.
19. C. Is correct
20. 8.36 minutes