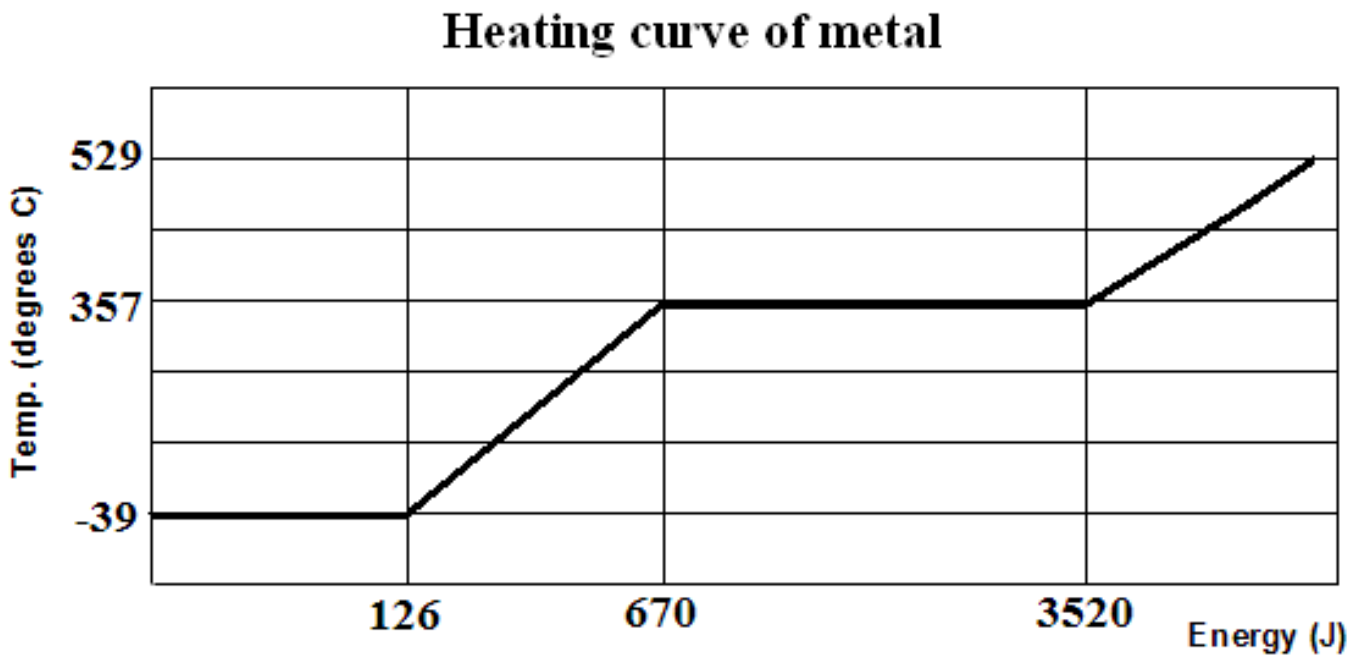
Heat Problems

specific heat of copper = 3.85×10^2 J kg^{-1} K^{-1}
specific heat of steel = 4.50×10^2 J kg^{-1} K^{-1}
specific heat of aluminium = 8.80×10^2 J kg^{-1} K^{-1}
specific heat of iron = 4.77×10^2 J kg^{-1} K^{-1}
Other constants can be found in your Formulae and Data Booklet.

1. 0.1 kg of an unknown metal is found to require 3.5 kJ to change its temperature from 25 °C to 82 °C. What is the specific heat of the metal?
2. A piece of copper has 1.74×10^4 J of energy added to it to change its temperature from 20 °C to 80 °C. What was the mass of copper?
3. If 15.7 kJ of heat energy is added to 250 mL of water at 20 °C, what will the water's new temperature be?
4. Over a period of 6 hours, a hot water bottle cools from 95 °C to 20 °C. If it held 2.5 L of water, what was its rate of cooling in J s^{-1}?
5. A kettle rated at 2000 W contains 1.8 L water at 15 °C. If it runs for 3.5 minutes, will the water boil?
6. How much heat energy is released when 423 g of steam at 100 °C condenses to water also at 100 °C?
7. 4.87×10^5 J of heat are added to a mass of ice at 0 °C. If the ice melts and becomes water at 21.5 °C, what was its mass?
8. At what rate in J s^{-1} is a freezer absorbing heat if 2.15 kg of water at 21.5 °C is just frozen in 2.0 hours?
9. 20 g of milk at 5.0 °C is added to 250 g of coffee at 90 °C. What is the final temperature of the drink? (Specific heats: milk: 3.9×10^3 J kg^{-1} K^{-1}, coffee: 4.10×10^3 J kg^{-1} K^{-1})
10. 100 g of a metal at 95 °C is added to 500 mL of water at 2.0 °C. If the final temperature of the water is 3.6 °C, what is the specific heat of the metal?
11. How much heat energy is needed to change 1.0 kg of ice at -3.0 °C to steam at 107 °C?
12. How much ice at 0 °C must be added to 250 mL of coffee (specific heat: 4.10×10^3 J kg^{-1} K^{-1}) in an insulated cup to cool the coffee from 95 °C to 65 °C? Assume that there is no loss of heat to the container and surroundings.
13. Copper calorimeters are used to determine the specific heat of unknown substances. A calorimeter of mass 41 g has 100 mL of water at 15 °C placed in it. 50 g of iron is heated to 160 °C then carefully lowered into the water. What would be the final temperature of the water?
14. 5.0 g of ice at -2.0 °C is placed into a 78 g copper calorimeter containing 120 mL of water at 90 °C. The water is stirred until all the ice has just melted. What is the final temperature of the water?
15. A 5.45 kg steel container contains 12.0 kg of water at 22.0 °C. When 2.65 kg of molten alloy (latent heat of fusion 2.5×10^4 J kg^{-1} K^{-1}) at its melting point of 327 °C is poured into the water, the final temperature reached is 27.8 °C. Find the specific heat of the alloy.
16. How much ice at -4.00 °C must be added to an aluminium calorimeter of mass 47.0 g containing 150 g of water at 95.0 °C so that the final temperature is 70 °C?

17. The graph below represents the heating curve for a metal. Energy is added to 10.0 g of the solid metal, initially at a temperature of -39 °C, until the metal evaporates (*graph not to scale*).



What is the specific heat of the metal in its liquid state?