Heat Problems

specific heat of water = 4.18×10^3 $Jkg^{-1}K^{-1}$	latent heat of vaporization water = 2.26×10^6 Jkg^{-1}
specific heat of ice = 2.10×10^3 $Jkg^{-1}K^{-1}$	latent heat of fusion water = 3.34×10^5 Jkg^{-1}
specific heat of steam = 2.00×10^3 $Jkg^{-1}K^{-1}$	specific heat of copper = 3.85×10^2 $Jkg^{-1}K^{-1}$
specific heat of steel = 4.50×10^2 $Jkg^{-1}K^{-1}$	specific heat of aluminium = 8.80×10^2 $J\ kg^{-1}\ K^{-1}$

NOTE: Value for Aluminium is 9.00×10^2 $J\ kg^{-1}\ K^{-1}$ in Exploring Physics.

1. 0.1 kg of an unknown metal is found to require 3.5 kJ to change its temperature from 25^0C to 82^0C. What is the specific heat of the metal?

2. The specific heat of copper is 3.85×10^2 $J\ kg^{-1}\ K^{-1}$. A specific mass of copper has 1.74×10^4 J of energy added to it to change its temperature from 20^0C to 80^0C. What was the mass of copper?

3. If 15.7 kJ of heat energy is added to 250 mL of water at 20^0C, what will the new temperature be?

4. Over a period of 6 hours, a hot water bottle cools from 95^0C to 20^0C. If the hot water bottle held 2.5 L water, what is the rate of cooling in Js^{-1}?

5. A kettle rated at 2000 W contains 1.8 L water at 15^0C. If it runs for 3.5 minutes, will the water boil?

6. How much heat energy is released when 423 g of steam at 100^0C condenses to water also at 100^0C?

7. 4.87×10^5 J of heat are added to a mass of ice at 0^0C. If the ice melts and becomes water at 21.5^0C, what was the mass of ice?

8. At what rate in Js^{-1} is a refrigerator absorbing heat if 2.15 kg of water at 21.5^0C is just frozen in 2.0 hours?

9. 20 g of milk at 5.0^0C is added to 250 g of coffee at 90^0C. What is the final temperature of the drink? (Specific heats: milk: 3.9×10^3 Jkg^{-1}K^{-1}, coffee 4.10×10^3 Jkg^{-1}K^{-1}.)

10. 100 g of a metal at 95^0C is added to 500 mL of water at 2.0^0C. If the final temperature of the water is 3.6^0C, what is the specific heat of the metal?

11. How much heat energy is needed to change 1.0 kg of ice at -3.0^0C to steam at 107^0C?

12. How much ice at 0^0C must be added to 250 mL of coffee (specific heat: 4.10×10^3 Jkg^{-1}K^{-1}) in an insulated cup (assume no loss of heat to the container and surroundings) to cool the coffee from 95^0C to 65^0C?

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 15^0C placed in it. 50 g of iron is heated to 160^0C then carefully lowered into the water. What would be the final temperature of the water? (specific heat of copper is 385 $Jkg^{-1}K^{-1}$, iron is 477 $Jkg^{-1}K^{-1}$)

14. 5.0 g of ice at -2.0^0C is placed into a 78 g copper calorimeter containing 120 mL of water at 90^0C. The water is stirred until all the ice has dissolved. What is the final temperature of the water?

15. (Do the following on file paper.) A 5.45 kg steel container contains 12.0 kg of water at 22.0^0C. When 2.65 kg of molten alloy (latent heat of fusion 2.50×10^4 J kg^{-1} K^{-1}) at its melting point of 327^0C is poured into the water the final temperature reached is 27.8^0C. Find the specific heat of the alloy.

16. How much ice at -4.00^0C must be added to an aluminium calorimeter of mass 47.0 g containing 150 g of water at 95.0 ^{0}C so that the final temperature once the ice has fully melted is 70 ^{0}C?