# *Mixing It Up*

1. Describe what happens to energy when two objects of different temperature are placed together.

2. When 100. g of 20.0˚C water is poured into 100. g of 10.0˚C water the resulting temperature for the mixture is 15.0˚C. Fill out the chart for the energy transfer one degree at a time.

| $M_{hot}$ (kg) | $\Delta T_{Hot}$ (˚C ) | $T_{Hot\ Final}$ (˚C ) | Energy Transferred (J) | $M_{cold}$ (kg) | $\Delta T_{Cold}$(˚C ) | $T_{Cold\ Final}$ (˚C ) |
|---|---|---|---|---|---|---|
| 0.100 | -1 | | | 0.100 | | |
| 0.100 | -1 | | | 0.100 | | |
| 0.100 | -1 | | | 0.100 | | |
| 0.100 | -1 | | | 0.100 | | |
| 0.100 | -1 | | | 0.100 | | |

3. Find the amount of energy transferred and the final temperature of the combination when 200. g of water at 40.0˚C is combined with 100. g at 10.0˚C. Use the table below to step through the process at 1.0˚C decreases for the hot water.

| $M_{hot}$ (kg) | $\Delta T_{Hot}$ (˚C ) | $T_{Hot\ Final}$ (˚C ) | Energy Transferred (J) | $M_{cold}$ (kg) | $\Delta T_{Cold}$(˚C ) | $T_{Cold\ Final}$ (˚C ) |
|---|---|---|---|---|---|---|
| | -1 | | | | | |
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4. A 500 g cube of steel ($c = 440\ J\ kg^{-1}\ K^{-1}$) is cooled from 100˚C to 25 ˚C when it is placed in a bucket of water that was originally 22˚C.
   a. Calculate the heat lost by the steel.
   b. Calculate the mass of the water in the bucket.

5. Three 10 gram ice cubes are placed in a glass with 250 grams of water. Assume the ice cubes have an initial temperature of 273 K and the water in the glass is initially 20˚C.
    a. Calculate the amount of heat needed to melt the ice cubes.
    b. Determine the final temperature of the system if no heat is lost to the outside.

6. A 0.50 kg block of metal is heated to 95˚C. It is then placed in 0.80 kg of water at 20˚C. The final temperature of the combination is 27˚C. Calculate the specific heat of the metal.

7. A swordsmith is forging a sword out of 1.0 kg of carbon steel (c = 490 J $kg^{-1}$ $K^{-1}$). To harden the material, the swordsmith plans to heat the sword to 900ºC in an oven and quickly quench it in a liquid.
    a. The swordsmith's first choice is 15.0 kg of mineral oil (c = 1670 J $kg^{-1}$ $K^{-1}$) at 25ºC in a tank. Calculate the final temperature of the mixture if no heat is lost to the outside.
    b. The swordsmith's second choice is 15.0 kg of water (c = 1670 J $kg^{-1}$ $K^{-1}$) at 25ºC in a tank. Calculate the final temperature of the mixture if no heat is lost to the outside.
    c. Which liquid cools the sword more quickly?

8. Ice cream can be made by dropping cream (c = 3100 J $kg^{-1}$ $K^{-1}$) into liquid nitrogen (c = 1040 J $kg^{-1}$ $K^{-1}$, L = 200,000 J $kg^{-1}$). Assume 1 kg of cream starts at 20ºC and 20 kg of liquid nitrogen starts at -196ºC (its boiling point) and that the system is thermally isolated.
    a. If ice cream is served at -15ºC, calculate how much heat is removed from the cream.
    b. Determine how much heat is added to the liquid nitrogen.
    c. Determine the final temperature of the liquid nitrogen.
    d. Calculate how much liquid nitrogen evaporated during this process.