

HEAT CAPACITY OF PASTA

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Reference: Daniel V. Schroeder, *An Introduction to Thermal Physics*, (Addison-Wesley, 2000) - Problem 1.42.

Here's another example of heat capacity. In what must be blatant product placement, Schroeder tells us that the specific heat capacity of Albertson's *Rotini Tricolore* pasta is about $1.8 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$. [Actually, I'm not sure this really exists, as I couldn't find any mention of Albertson's pasta. Rotini pasta is the same as fusilli, which is the helical pasta.] We put 340 g of this pasta at 25°C into 1.5 litres of boiling water. At what temperature T does the system come to equilibrium?

The water transfers an amount of heat Q to the pasta, so the water cools a bit and the pasta heats up. The specific heat capacity of water is $1 \text{ cal g}^{-1} \text{ }^\circ\text{C}^{-1} = 4.186 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$. The total heat capacities are

$$C_{pasta} = 1.8 \times 340 = 612 \text{ J }^\circ\text{C}^{-1} \quad (1)$$

$$C_{water} = 4.186 \times 1500 = 6279 \text{ J }^\circ\text{C}^{-1} \quad (2)$$

Therefore

$$\Delta T_{pasta} = T - 25 = \frac{Q}{C_{pasta}} = \frac{Q}{612} \quad (3)$$

$$\Delta T_{water} = T - 100 = \frac{-Q}{C_{water}} = -\frac{Q}{6279} \quad (4)$$

Dividing the first equation by the second, we get

$$\frac{T - 25}{100 - T} = \frac{6279}{612} \quad (5)$$

$$T = 93.3^\circ\text{C} \quad (6)$$

The heat transferred is

$$Q = 612(93.3 - 25) = 4.18 \times 10^4 \text{ J} \quad (7)$$