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 J g^{-1} $^{\circ}C^{-1}$. [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 cal g^{-1} $^{\circ}C^{-1}$ = 4.186 J g^{-1} $^{\circ}C^{-1}$. The total heat capacities are

$$C_{pasta} = 1.8\times340 = 612 \text{ J }^{\circ}\text{C}^{-1} \tag{1}$$

$$C_{water} = 4.186\times1500 = 6279 \text{ J }^{\circ}\text{C}^{-1} \tag{2}$$

Therefore

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

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

Dividing the first equation by the second, we get

$$\frac{T-25}{100-T} = \frac{6279}{612} \tag{5}$$

$$T = 93.3^{\circ}\text{C} \tag{6}$$

The heat transferred is

$$Q = 612\,(93.3-25) = 4.18\times10^{4} \text{ J} \tag{7}$$