Internal energy and specific heat

Internal energy:

$$E_{internal} = KE_{int} + PE_{int}$$

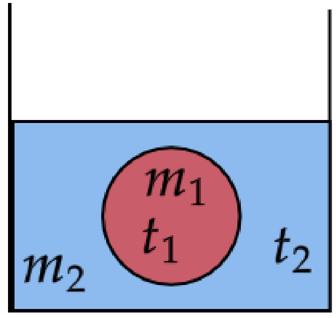
The change in internal energy is related to ΔT as:

$$\Delta E_{int} = c \cdot m \cdot \Delta T$$

$$[c] = \frac{J}{kg \cdot K} = \frac{J}{kg \cdot °C}$$

In an isolated system, total internal energy is conserved:

$$\Delta E_{total,\, int} = \Delta E_{1,\, int} + \Delta E_{2,\, int} = 0$$



Homework 19

Problem 1.

A 500-gram cube of lead is heated from 20 ℃ to 80 ℃. How much energy was required to heat the lead? The specific heat of lead is $\mathrm{c} = 160 \frac{J}{kg \cdot ℃}$.

Problem 2.

Mr. X does not like his morning coffee too hot, so he adds some cold milk to it. Initially, the coffee is at boiling temperature (100 ℃), and the milk is just out of the fridge (10 ℃). How much milk does Mr. X have to add to 150 g of coffee for the mixture to have a temperature of 65 ℃? Both coffee and milk have the same specific heat capacity as water: $c_w = 4200 \frac{J}{kg \cdot ℃}$.

Problem 3.

Try to think about the hottest and the coldest objects you have ever seen with your own eyes. You could use Google to find the temperatures of different objects and try to choose a credible source. Write down these two objects and their temperatures.

Problem 4* (bonus problem).

On the next page!

Homework 19

Problem 4* (bonus problem).
Consider exactly one oxygen molecule with mass $m_{O_2} = 2.7 \cdot 10^{-26} kg$ in a room, flying back and forth between two walls with speed $v = 680\ \frac{m}{s}$. Estimate the average force this molecule produces on the walls. Take the distance between the walls to be 1 meter. How many molecules of the same kind are needed to produce a force equal to 1 N?

Hint: You might want to refresh the relationships between momentum, impulse and force.