Physics 203 Summer 2015
Quiz 8
06/29/2015
Name:

1. A thin rod consists of two parts joined together. One-third of it is silver and the rest is gold. The temperature decreases by 26 degrees Celsius. Determine the fractional decrease in the rod's length = $\frac{\Delta L}{L_{0,Silver}+L_{0,Gold}}$, where $L_{0,Silver}$ and $L_{0,Gold}$ are the initial lengths of the silver and gold rods. ($\alpha_{Silver}=1.95\times10^{-5\,o}C^{-1}$, $\alpha_{Gold}=1.42\times10^{-5\,o}C^{-1}$)

Given information

$\Delta T = -26\,^\circ C$

$L_{0,Gold} = \frac{2}{3}L_0$

$L_{0,Silver} = \frac{1}{3}L_0$

$L_0 := L_{0,Gold} + L_{0,Silver}$ is the total initial length.

$$\frac{\Delta L}{L_{0,Gold}+L_{0,Silver}} = \frac{\Delta L_{Gold}+\Delta L_{Silver}}{L_0}$$

$$= \frac{\alpha_{Gold} L_{0,Gold}\Delta T}{L_0} + \frac{\alpha_{Silver} L_{0,Silver}\Delta T}{L_0}$$

$$= \frac{\alpha_{Gold}\left(\frac{2}{3}L_0\right)\Delta T}{L_0} + \frac{\alpha_{Silver}\left(\frac{1}{3}L_0\right)\Delta T}{L_0}$$

$$= \left(\frac{2}{3}\alpha_{Gold}+\frac{1}{3}\alpha_{Silver}\right)\Delta T$$

$$= \left(\frac{2}{3}\times 14\times10^{-6}+\frac{1}{3}\times 19\times10^{-6}\right)(-26) = -4.1\times10^{-4}$$

or 0.041 % decrease.

2. Two bars of identical mass are at 25^oC. One is made from glass and the other from an unknown substance. The specific heat capacity of glass is $840\frac{J}{kg\cdot^oC}$. When identical amounts of heat are supplied to each, the glass bar reaches a temperature of 88^oC, while the other bar reaches 250^oC. What is the specific heat capacity of the unknown substance.

Same mass

$Q = m\, c_{glass}\, \Delta T_{glass}$

$Q = m\, c_u\, \Delta T_u$

Same heat

unknown substance's specific heat capacity

$$\rightarrow\quad c_{glass}\,\Delta T_{glass} = c_u\,\Delta T_u$$

$$840\,\frac{J}{kg\,^\circ C}\left(88\,^\circ C - 25\,^\circ C\right) = c_u\left(250\,^\circ C - 25\,^\circ C\right)$$

$$\rightarrow\quad c_u = 840\cdot\frac{63}{225}\,\frac{J}{kg\,^\circ C} = 235\,\frac{J}{kg\,^\circ C}$$