Answer on Question #39090, Physics, Molecular Physics | Thermodynamics

In two glasses there is a liquid material of same type, the volume of one is V_1, its temperature of is T_1, the volume of the other is V_2 and its temperature is T_2. We mix the liquids and wait while the temperature settles. What is the common temperature if we neglect any heat losses? What would be the common temperature if the volume of the first liquid is halved and the second liquid doubled.

Solution:

The quantity of heat is a measurement of the amount of heat is present. The formula of quantity of heat, Q, is equal to the mass of substance, *m*, multiplied with the specific heat and the change in temperature, Δ*T*.

Suppose that temperature of the hot fluid is T_1, and he cold liquid is T_2.

After mixing, the hot liquid has cooled to a temperature T_c, and cold fluid reached a temperature T_c.

The quantity of heat from first liquid:

$$Q_1 = cm_1(T_1 - T_c)$$

The cold liquid will get heat from the hot fluid:

$$Q_2 = cm_2(T_c - T_2)$$

Since heat does not disappear, and transferred from one liquid to another:

$$Q_1 = Q_2$$

$$cm_1(T_1 - T_c) = cm_2(T_c - T_2)$$

Mass equals density times volume.

$$m_1 = \rho V_1, m_2 = \rho V_2$$

Thus,

$$V_1(T_1 - T_c) = V_2(T_c - T_2)$$

$$V_1T_1 - V_1T_c = V_2T_c - V_2T_2$$

$$V_1T_1 + V_2T_2 = V_2T_c + V_1T_c$$

$$T_c = \frac{V_1T_1 + V_2T_2}{V_1 + V_2}$$

If the volume of the first liquid is halved and the second liquid doubled:

$$V_1' = \frac{V_1}{2}, \qquad V_2' = 2V_2$$

$$T_c' = \frac{\frac{V_1}{2}T_1 + 2V_2T_2}{\frac{V_1}{2} + 2V_2} = \frac{V_1T_1 + 4V_2T_2}{V_1 + 4V_2}$$

Answer. a) $T_c = \frac{V_1T_1+V_2T_2}{V_1+V_2}$, b) $T_c' = \frac{V_1T_1+4V_2T_2}{V_1+4V_2}$.