Answer on Question#37930 – Physics – Other

Question:

The cavity within a copper [β = 51 × 10-6 (C°)-1] sphere has a volume of 1.190 × 10-3 m3. Into this cavity is placed 1.100 × 10-3 m3 of benzene [β = 1240 × 10-6 (C°)-1]. Both the copper and the benzene have the same temperature. By what amount ΔT should the temperature of the sphere and the benzene within it be increased, so that the liquid just begins to spill out?

Answer:

The change in the units' volume when temperature change can be expressed as:

$$\Delta V = V_0 \beta \Delta T$$

where V_0 is initial volume, β is volumetric temperature expansion coefficient, ΔT is change of temperature.

Therefore, final volume equals:

$$V_f = V_0 + \Delta V = V_0(1 + \beta \Delta T)$$

The liquid just begins to spill out if $V_{f\ benzene} = V_{f\ cavity}$:

$$V_{cavity}\left(1 + \beta_{copper}\Delta T\right) = V_{benzene}\ (1 + \beta_{benzene}\ \Delta T)$$

Therefore:

$$\Delta T = \frac{V_{cavity} - V_{benzene}}{\beta_{benzene} - \beta_{copper}} = 0.07569\ ℃$$

Answer: $0.07569\ ℃$