

17. If  $V_c$  is the original volume of the cup,  $\alpha_a$  is the coefficient of linear expansion of aluminum, and  $\Delta T$  is the temperature increase, then the change in the volume of the cup is  $\Delta V_c = 3\alpha_a V_c \Delta T$ . See Eq. 19-11. If  $\beta$  is the coefficient of volume expansion for glycerin then the change in the volume of glycerin is  $\Delta V_g = \beta V_c \Delta T$ . Note that the original volume of glycerin is the same as the original volume of the cup. The volume of glycerin that spills is

$$\begin{aligned}\Delta V_g - \Delta V_c &= (\beta - 3\alpha_a) V_c \Delta T \\ &= [(5.1 \times 10^{-4} / \text{C}^\circ) - 3(23 \times 10^{-6} / \text{C}^\circ)] (100 \text{ cm}^3) (6 \text{ C}^\circ) \\ &= 0.26 \text{ cm}^3 .\end{aligned}$$