13.5 For each section of this problem two SiO_2-Al_2O_3 compositions are given; we are to decide, on the basis of the SiO_2-Al_2O_3 phase diagram (Figure 12.27), which is the more desirable refractory and then justify the choice.

(a) The 99.8 wt% SiO_2-0.2 wt% Al_2O_3 will be more desirable because the liquidus temperature will be greater for this composition; therefore, at any temperature within the cristobalite + liquid region on the phase diagram, there will be a lower fraction of the liquid phase present than for the 99.0 wt% SiO_2-1.0 wt% Al_2O_3 composition, and, thus, the mechanical integrity will be greater.

(b) The 74 wt% Al_2O_3-26 wt% SiO_2 composition will be more desirable because, for this composition, a liquid phase does not form until about 1750°C [i.e., the temperature at which a vertical line at 74 wt% Al_2O_3 crosses the boundary between the mullite and (mullite + liquid) phase regions]; for the 70 wt% Al_2O_3-30 wt% SiO_2 material, a liquid phase forms at a much lower temperature--1587°C.

(c) The 95 wt% Al_2O_3-5 wt% SiO_2 composition will be more desirable because the liquidus temperature will be greater for this composition. Therefore, at any temperature within the alumina + liquid region on the phase diagram, there will be a lower fraction of the liquid phase present than for the 90 wt% Al_2O_3-10 wt% SiO_2 composition, and, thus, the mechanical integrity of the 95 wt% Al_2O_3-5 wt% SiO_2 material will be greater.