13.4 (a) From Figure 12.25, for a spinel-bonded magnesia material (88.5 wt%MgO-11.5 wt% Al_2O_3), the maximum temperature without a liquid phase corresponds to the temperature at the MgO(ss)-[MgO(ss) + Liquid] boundary at this composition, which is approximately 2220°C (4030°F).

(b) The maximum temperature without the formation of a liquid phase for a magnesia-alumina spinel (25 wt%MgO-75 wt% Al_2O_3) lies at the phase boundary between $MgAl_2O_4$(ss)-($MgAl_2O_4$ + Liquid) phase fields (just slightly to the right of the congruent melting point at which the two phase boundaries become tangent); this temperature is approximately 2070°C (3760°F).