1)

“Complete” the miscibility gap by extending the solid solubility limits. Gives $T_c \approx 1000^\circ C = 1273K$. Also note that $Z$ (coordination number) = 12 since Ag and Cu are fcc.

$$\Omega = 2RT_c = 2(8.314 J/mole - K)(1273K) = 21kJ/mole$$

$$\varepsilon = \frac{\Omega}{NZ} = 2 \frac{21,000 J/mole}{(6.02 \times 10^{23} \text{ atoms/mole})(12 \text{ bonds/atom})} = 2.93 \times 10^{-21} J/bond$$

(Phase diagram from: http://cyberbuzz.gatech.edu/asm_tms/phase_diagrams/pd/ag_cu.gif)
2) 
   a) Two, SiO$_2$ and Al$_2$O$_3$.

   b) Mullite and liquid.

   c) Mullite (~ 72 wt.% Al$_2$O$_3$); Liquid (~ 15 wt.% Al$_2$O$_3$)

   d) Apply the lever rule (effectively a mass balance):

\[
f_{\text{mullite}} = \frac{0.60 - 0.15}{0.72 - 0.15} = 0.79; \quad f_{\text{liquid}} = \frac{0.72 - 0.60}{0.72 - 0.15} = 0.21
\]

Image from: http://webpages.charter.net/dawill/tmoranwms/Cer_SiO2-Al2O3.gif
a) 75 % Ni, 20 % Al, 5 % Ti; in atom percent.

b) Corresponding point on the phase diagram is show at the intersection of the lines above. This is in the two phase $\gamma$ and $\gamma'$ region, so these are the two phases.

c) Draw a tie-line parallel to those already given (shown as thick solid line). The equilibrium compositions are at the ends of this line, where it intersects the single phase $\gamma$ and $\gamma'$ regions. This gives $\gamma'$ (~ 79%Ni, 11% Al, 10% Ti) and $\gamma$ (~ 84%Ni, 7% Al, 9% Ti) region.