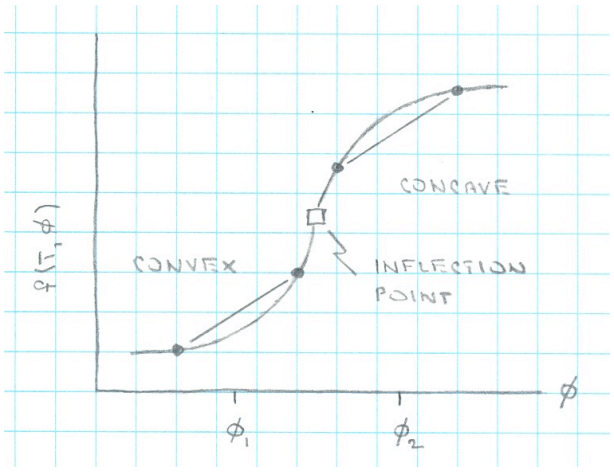
Stability – Metastability – Instability [pln33]

Examine local stability of mixed (homogeneous) state in two regions.

- $\phi = \phi_1$ in region of global metastability: $\chi_{\rm co}(\phi) < \chi < \chi_{\rm sp}(\phi)$;
  convex segment of function $f(T, \phi)$;
  curve segment falls below straight-line segment;
  mixed state is stable against local fluctuations.
- $\phi = \phi_2$ in region of global instability: $\chi > \chi_{\rm sp}(\phi)$ (see [psl4]);
  concave segment of function $f(T, \phi)$;
  curve segment lies above straight-line segment;
  mixed state is unstable against local fluctuations.



Kinetics of unmixing is different in the two regions:

- $\chi_{\rm co}(\phi) < \chi < \chi_{\rm sp}(\phi)$: unmixing reguires fluctuations of wide range; energy barriers present; (slow) *nucleation* process.
- $\chi > \chi_{\rm sp}(\phi)$: unmixing initiated by small fluctuations; energy barriers absent; (fast) *spinodal decomposition* process.

Distinguish two types of nucleation processes:

- *homogeneous* nucleation involves high barriers and thus entails longer time scales;
- *heterogeneous* nucleation relies on presence of impurities/interfaces, which lower the barriers and thus shorten the time scales.