Answers to exercise 1

1. (i) Incr T favours Sillimanite; Incr P favour Kyanite

 (ii) Incr T favours products, Incr P favours reactants

 (iii) 3CaAl2Si2O8+3Mg2SiO4 = Ca3Al2Si3O12+2Mg3Al2Si3O12

 Incr T reactants, Incr P products.

(iv) Incr T products; Incr P reactants.

2. We calculate the equilibrium T at 1bar from 

T1bar= 2773 K

Calculate P-T slope from Clausius-Clapeyron equation =-0.58 K.bar-1

So it has a negative slope with products on the high pressure side

3. For the Al2SiO5 diagram there are a couple of extra thoughts needed. Firstly we need to calculate the third reaction Kyanite=Sillimanite from the other two. We do this using the Hess' Law approach. Subtract enthalpy entropy etc values of And=Ky from And=Sill to get those for Kyanite = Sillimanite H=7406 J, S=12.34 J.K-1 V=5.81 cm3 = 0.581 J.bar-1.

We also need to make sure volume units are J.bar-1

So For Andalusite-Kyanite we have T1bar = 464K  or

 T=464+0.0794(P-1)

 Andalusite-Sillimanite we have T1bar = 1028K  or

 T=1028-0.05488(P-1)

 Ky-Sill we have T1bar = 600K 

The P and T of the triple point can be calculated from the equations for any 2 reactions= 4200 bar and T=797K.

We label the metastable and stable parts of the lines (fine and heavy lines below) by considering the areas where the different polymorphs are metastable:

