

```
[ > restart;
```

## Load thermodynamic data for endmembers

## Balance the endmember reaction

```
specify the number of phases, p, and the number of components, c.  
> p := c+1; c := 3;  
specify the c components to be conserved (balanced) by the reaction.  
> component := [CaO,Al2O3,SiO2];  
specify the p phases in the reaction equation (ky=1, gr=2, an=3, q=4)  
> phase := [ky,gr,an,q];  
one reaction coefficient must be arbitrarily specified, here I specify the coefficient of the p'th  
phase (q):  
> vnu[p] := -1;  
the unknowns are the c=p-1 remaining reaction coefficients  
> unknowns := {seq(vnu[j],j=1..p-1)};  
we solve for the unknowns by setting up c linear equations for the conservation of the c  
components during the reaction of the p phases.  
> eqs :=  
  {seq(0=sum(vnu[j]*comp[phase[j]][component[i]],j=1..p),i=1..c  
    )};  
solve for the c unknown reaction coefficients  
> ans := solve(eqs,unknowns);  
assign the answer for future use  
> assign(ans);  
  
p := c + 1  
c := 3  
component := [6, 3, 4]  
phase := [1, 2, 3, 4]  
vnu4 := -1  
unknowns := { vnu1, vnu2, vnu3 }  
eqs := { 0 = 3 vnu2 + vnu3, 0 = vnu1 + vnu2 + vnu3, 0 = -1 + vnu1 + 3 vnu2 + 2 vnu3 }  
ans := { vnu1 = -2, vnu2 = -1, vnu3 = 3 }
```

## Compute and plot the equilibrium conditions for the endmember reaction

The task in problem 8.2 is to compute the equilibrium conditions for the endmember reaction when the garnet and plagioclase are impure (as specified in the problem outline). To do this you must solve (Eq 8.30)

$$\Delta G = 0 = \Delta G_0 + RT \ln K$$

where the equilibrium constant K (e.g., Eq 8.32) involves the activity of anorthite in plagioclase

and the activity of grossular in garnet, the activities of quartz and kyanite are assumed to be unity. The activity of anorthite must be derived from the plagioclase solution model obtained in problem 8.1. The activity of grossular must be derived from the information provided in the problem outline.

Note: a simple way to check that your activity expressions are, at least partially, correct is to verify that the activity of an endmember goes to unity in the limit that the solution has the endmember composition. Plotting the activity expressions as a function of composition is also revealing.

[ >