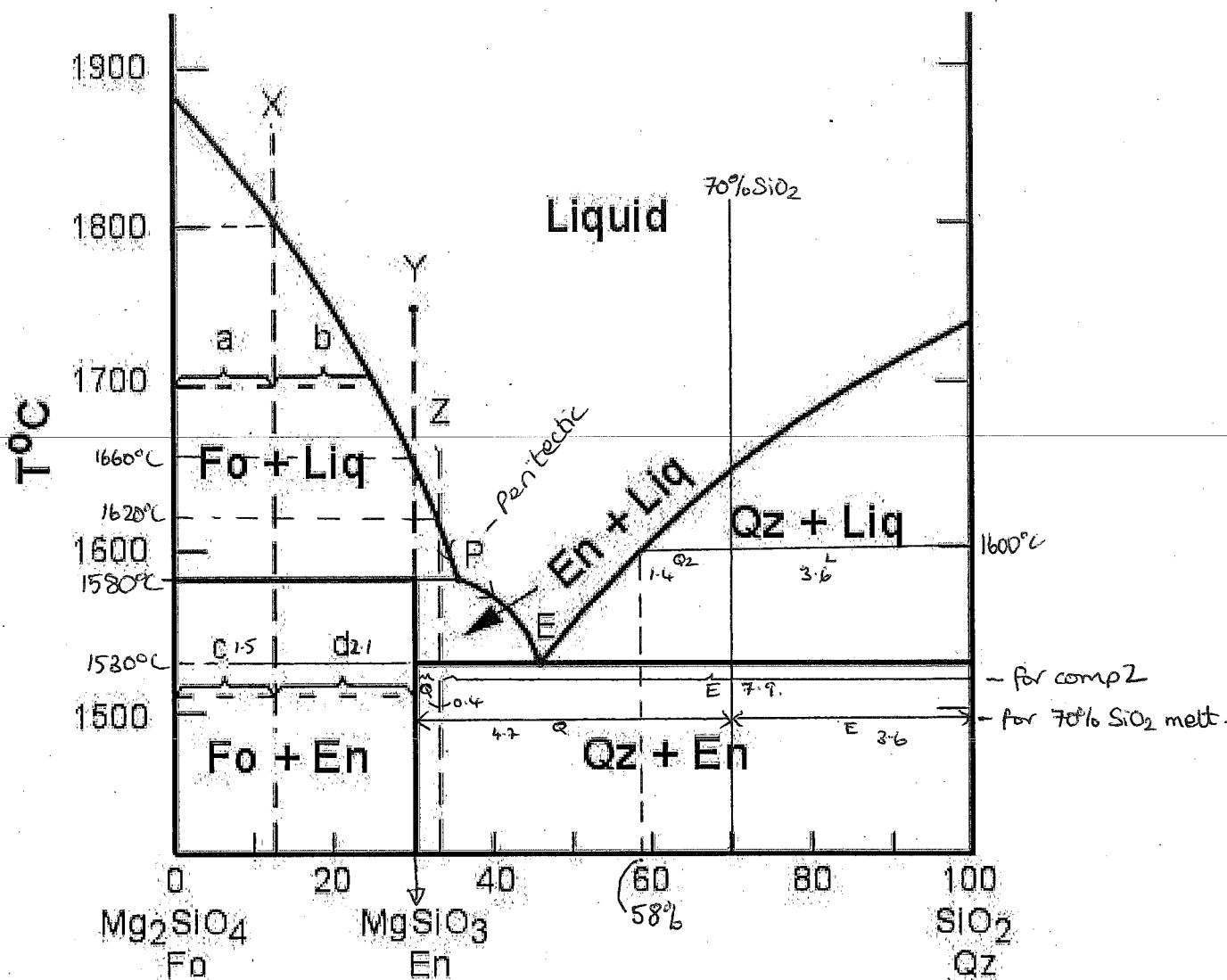


Name: _____ Student ID: _____

EOSC 321 – Igneous Petrology Homework

Binary Phase Diagrams with Peritectic Reactions



- 1) For bulk compositions X, Y and Z write the equilibrium crystallization sequence, showing any continuous reactions and their temperature ranges, and any discontinuous reactions and the temperature at which these occur.

Composition X

Liquid $\rightarrow$ forsterite

continuous reaction from 1800°C $\rightarrow$ 1580°C

Liquid + Fo $\rightarrow$ Enstatite

discontinuous reaction at 1580°C
(Peritectic)

Final composition of rock is $\frac{d}{c+d}$ % forsterite $\frac{2.1}{3.6} = 58\%$

$\frac{c}{d+c}$ % Enstatite $\frac{1.5}{3.6} = 42\%$

Name: _____ Student ID: _____

Composition Y

Liquid $\rightarrow$ Forsterite continuous $1660^{\circ}\text{C} \rightarrow 1580^{\circ}\text{C}$

Liquid + Fo $\rightarrow$ Enstatite discontinuous @ 1580°C

* ALL OLIVINE IS CONSUMED * ALL LIQUID USED UP AT PERITECTIC *

Final composition is pure enstatite $\rightarrow$ melt start composition was pure enstatite

Composition Z

Liquid $\rightarrow$ Forsterite continuous reaction $1620^{\circ}\text{C} \rightarrow 1580^{\circ}\text{C}$

Liquid + Fo $\rightarrow$ Enstatite discontinuous reaction @ 1580°C

Liquid $\rightarrow$ Enstatite [all olivine is used up/ reacted at the peritectic now the system can progress] continuous 1580°C

* Liquid $\rightarrow$ Enstatite + Quartz Discontinuous @ Eutectic 1530°C to 1530°C

2) Now consider a bulk composition of 70% SiO_2 . At 1600°C what are the phases present and what are their compositions?

Solid Quartz 28% $\left(\frac{Q_2}{Q_2+L}\right) \frac{1.4}{5.0} \rightarrow 100\% \text{SiO}_2!$

Liquid 72% $\left(\frac{L}{Q_2+L}\right) \frac{3.6}{5.0} \rightarrow 58\% \text{SiO}_2, 42\% \text{Mg}_2\text{SiO}_4$
- read from axis

How many degrees of freedom does the system have at this temperature?

$F = C - \phi + 1$ $F = 2 - 2 + 1$ 1 degree of freedom

It is a binary phase diagram, and at this T and comp you are on the liquidus

At what temperature will crystallization be complete?

1530°C - crystallization always finishes at the eutectic if the composition allows it.

What are the minerals present in the rock formed from equilibrium crystallization and what are their proportions?

Quartz $\frac{4.7}{8.3} = 0.566 = 57\%$

Enstatite $\frac{3.6}{8.3} = 0.434 = 43\%$

use lever rule in the Qz+En field.

* Final composition of Z contains no olivine
~ 95% Enstatite and ~ 5% Quartz