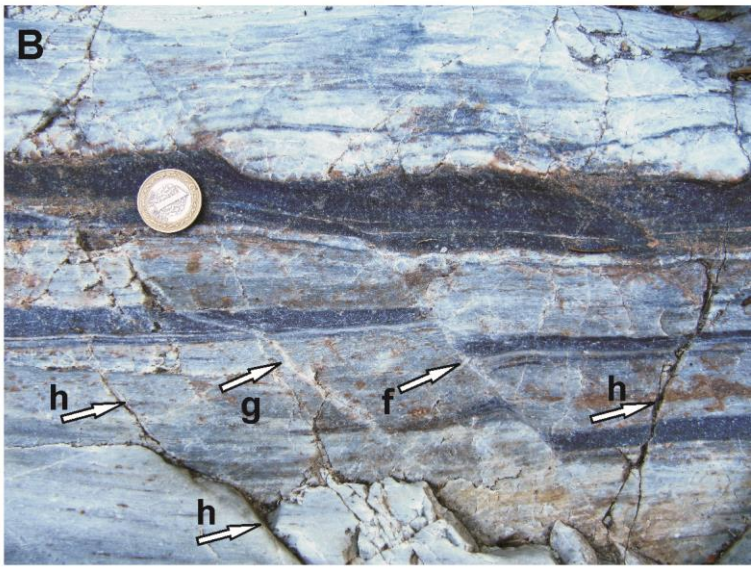
STRUCTURAL GEOLOGY
Final Exam Questions
31st May 2016

1) The orientations of two conjugate faults are: 64/65NW and 70/70SE
a) Plot the faults on a stereographic projection as great circles (β-diagram).
b) Find out the angle between the conjugate faults.
c) Show the principal stress directions σ1, σ2 and σ3 on the projection and find out the trend and plunge of σ1, σ2 and σ3.
d). Are the conjugate faults normal, reverse or strike-slip. Give reasons for your choise.

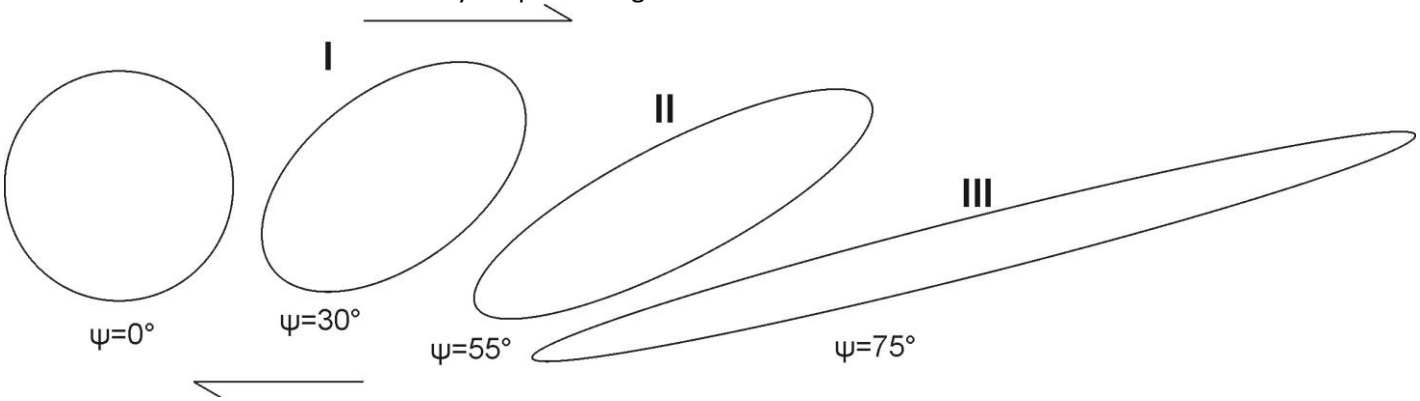
2. Provide text and diagrams to the following questions.
a) What is transtension? Draw a fault configuration giving rise to transtension. Can you give examples from the Marmara sea.
b) What are the factors that control ductile versus brittle behaviour of the rocks, and how do they affect ductile versus brittle behaviour?
c) Explain the terms thrust, tectonic window and klippe with the help of diagrams.
d) What is boudinage and how is it formed? Explain with the help of diagrams?

3. Shown below are two photographs with structures labelled of a to g.



a) On your answer sheet draw these structures and label, where appropriate, the nature of faults showing hanging-wall and foot-wall and total slip, folds (anticline, syncline, fold limb, amplitude, wavelength), veins, fractures and decollement.
b) Are the folds in A similar or similar folds and why?
c) The photographs are taken from Santa Barbara, California for A and Kazdağ for B. Based on these structures would you expect extension or contraction (shortening) in these regions.

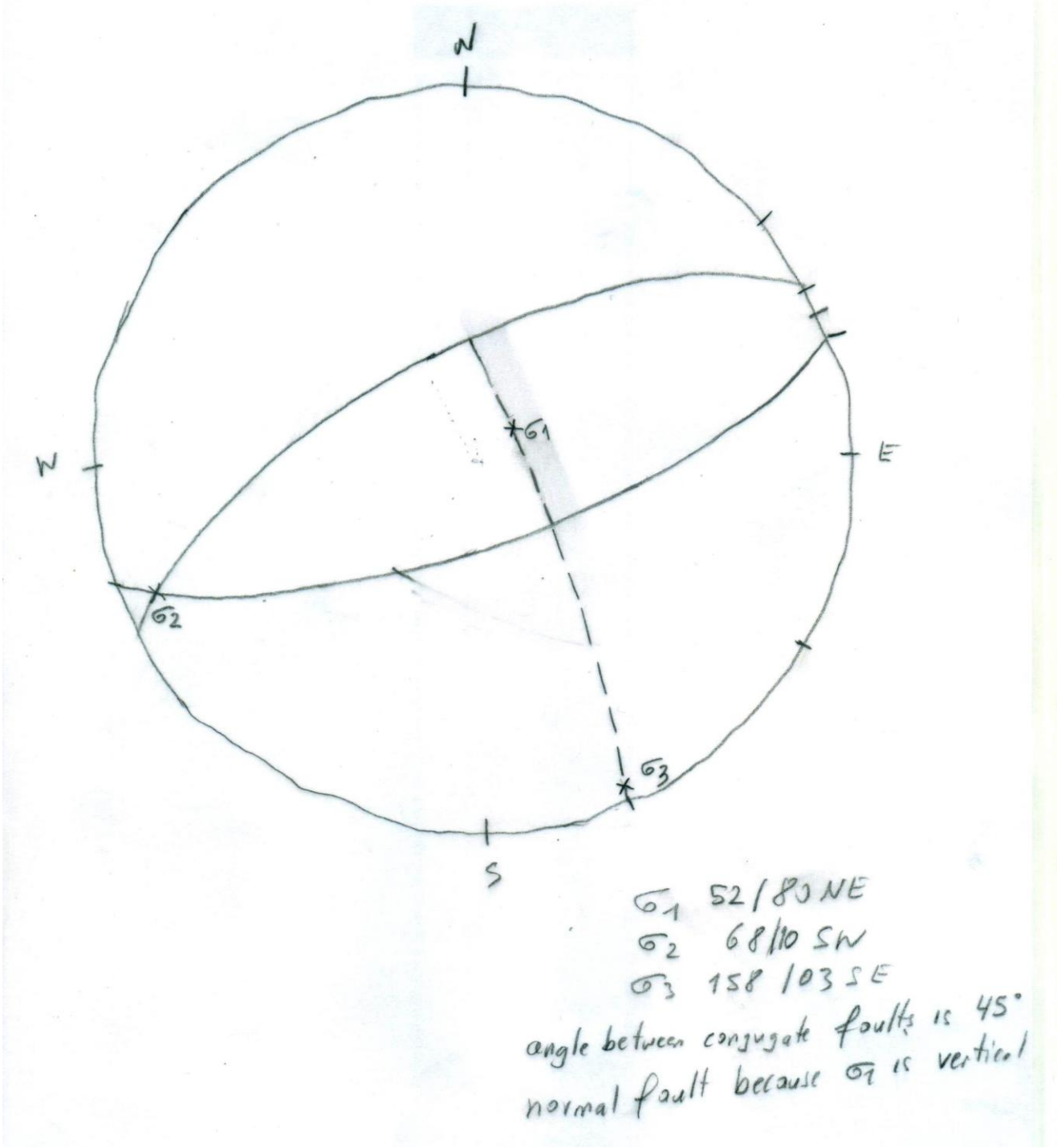
4. Shown below is a circle deformed by simple homogeneous shear.



a) Find out the e1 and e2 values and calculate the ellipticity R of each circle.
b) Make a plot of shear strain (γ)versus ellipticity R.
c) Find out the angle between the shear direction and the long axis of the ellipse (θ'), and show its variation with the shear strain on the diagram.
d) If the deformation between stages II and III occurs in 10 minutes, find out the strain rate for the long and short axis of the strain ellipse.

Answers

1.



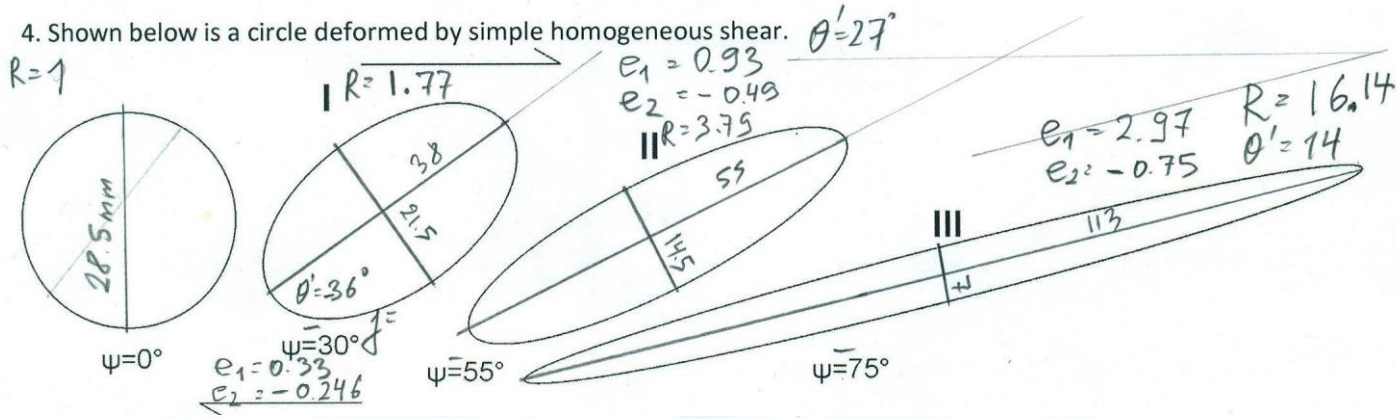
3.
a is a thrust or reverse fault, the total slip is about 0.5 cm.
the layer in b shows boudinage.
c shows folds, one syncline and two anticlines
d is a thrust or reverse fault, the total slip is 0.3 cm.
e is a decollement surface; the folds and faults are truncated at this surface; they merge to this surface.
f is a normal fault, the total slip is about 2 cm.
g is a vein
the surfaces marked as h are fractures.

The folds in A are close to parallel folds since the thickness, as measured perpendicular to layering does not change much along the fold.

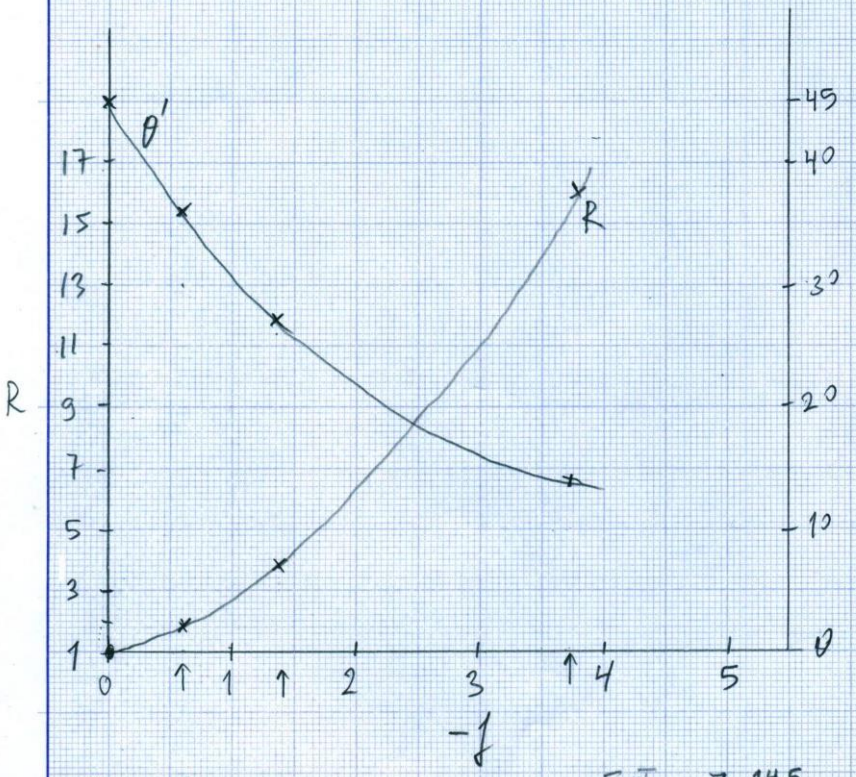
The structures in the Santa Barnara example are reverse folds and folds and thus indicate contraction, whereas they are normal faults in kazdağ, typical for extension.

4.

4. Shown below is a circle deformed by simple homogeneous shear. $\theta' = 27°$



		I	II	III
ψ	0	-30	-55	-75
f	0	-0.58	-1.43	-3.73
e_1	0	0.33	0.93	2.97
e_2	0	-0.25	-0.49	-0.75
R	1	1.77	3.75	16.14
θ'	45°	36°	27°	14°



d) $e_1^{II-III} = \frac{113-55}{55} = 1.05$ $\quad e_2^{II-III} = \frac{7-14.5}{14.5} = -0.517$

$\dot{\epsilon} = \frac{1.05}{10 \times 60} = 0.00175\ s^{-1}$ $\quad \dot{\epsilon} = \frac{0.517}{10 \times 60} = 0.000086$

$= 1.75 \times 10^{-3}$ $\quad = 0.86 \times 10^{-3}$