University of Alberta

NOTE: The 2013 course was taught by a different instructor and the format of this test does not exactly follow the format that will be used in 2014.

EAS 421/521 STRUCTURAL GEOLOGY AND TECTONICS
FINAL EXAMINATION 2013
December 11, 2013

TIME ALLOWED: 9:00-10:45 a.m.

Name:_____

Student-ID:_____

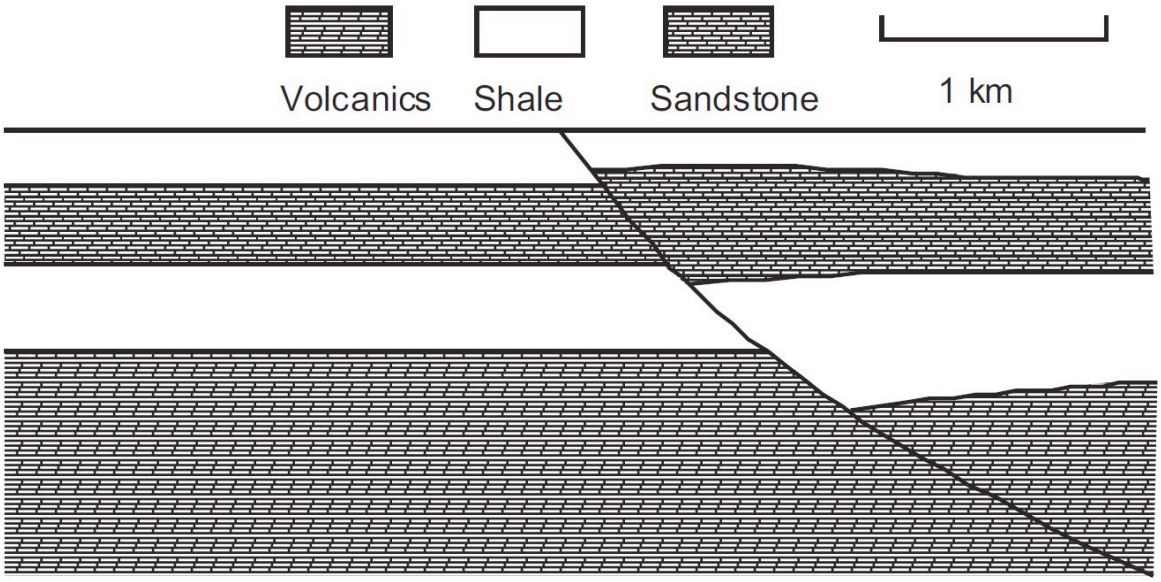
Answer Question 1 and four others. Question 8 is not available if you are registered in EAS 521.

Permitted to use: Calculator; drawing instruments: compass, protractor, (colored) pencils/pens, ruler, eraser, sharpener.

- *Read all questions. Question 1 carries 28% of the marks.*
- *The remaining questions are equally weighted (18% each). (Actual weightings in the exam may differ.)*
- *Pass in the question paper and all paper you have used. Put your name and ID on each sheet.*
- ***You are encouraged to illustrate your answers with clearly labelled diagrams.***
- ***Please circle the numbers of the questions that you answer on the mark list on page 3.***

Question 1 (1a and 1b mandatory for all students, EAS421 and EAS521)

1 a) The cross-section shows a dip-slip fault cutting shallow marine sedimentary rocks deposited over a basement of volcanic rocks; the strata show variable thickness and offset across the fault. Explain what the geometry indicates about the history of movement on the fault. **(8%)**



Name:_____

_____% of 100%

2 b) Diagram B shows the failure envelope for a sandstone, and a Mohr circle representing the state of stress in a dry sample in a testing apparatus. **(20%)**

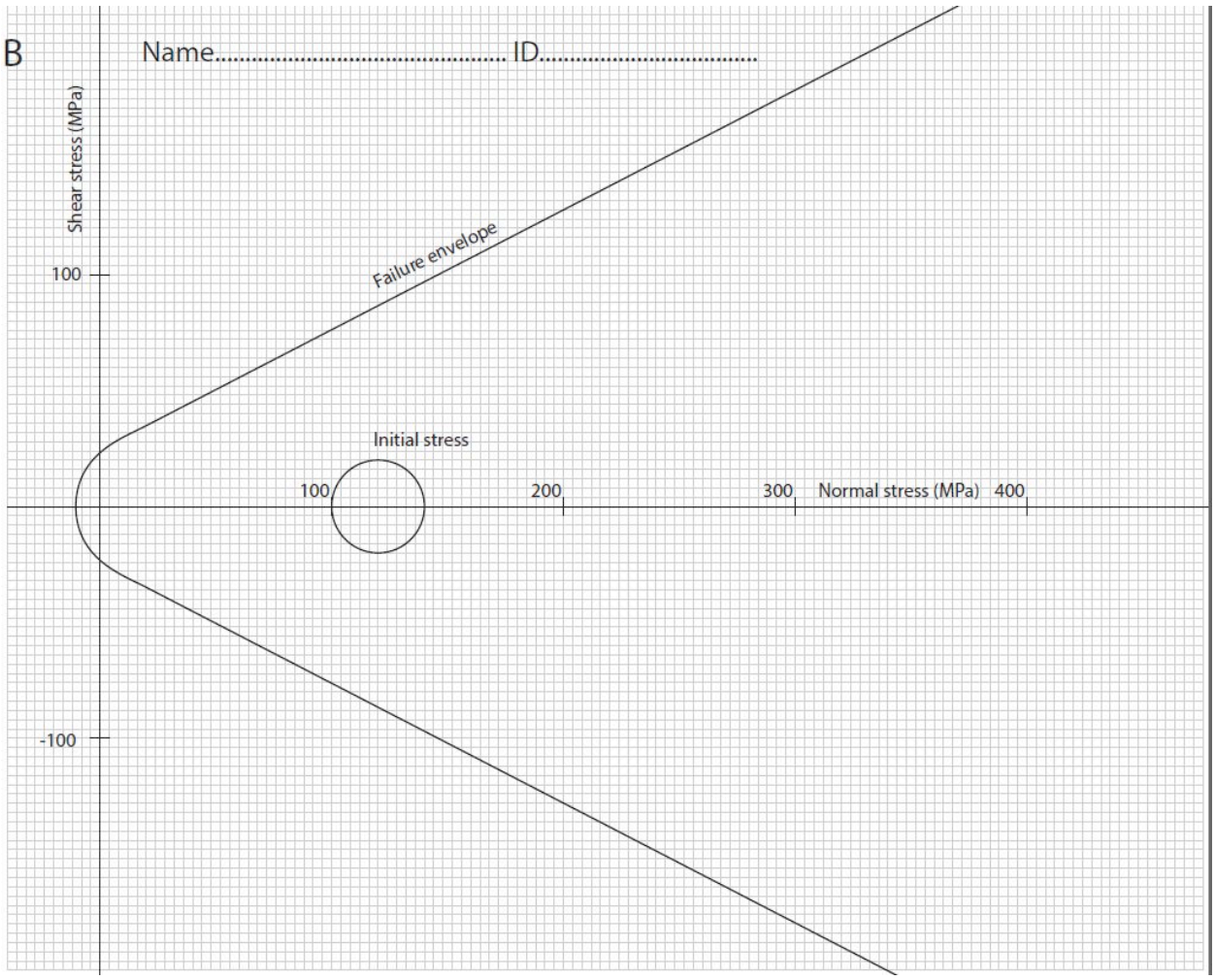
(i) Label the maximum and minimum compressive stresses σ_1 and σ_3 on the diagram.

(ii) If σ_1 is gradually increased, draw the Mohr circle when fracturing occurs.

(iii) Find the value of σ_1 and the differential stress $\sigma_{diff} = \sigma_1 - \sigma_3$ that will cause fractures to form, and what will be the orientation of the fractures?

(iv) If, instead of increasing σ_1, fluid is forced into the pore space of the sample until fractures form, draw the resulting Mohr circle.

(v) In this case, how much fluid pressure is required and what is the orientation of the fractures?



Name:_____

ID:_____

Do FOUR of the remaining questions. Mark your answered questions on this page and assign the number of your answered question on the following pages.

If you are registered in EAS 521 you must choose from questions 2-7. If you are registered in EAS 421 you may choose from questions 2-8.

2. What is a foreland basin? Describe the typical evolution of a foreland basin (i.e. how it interacts with an adjacent thrust belt, where local extension occurs and what type of faults develop) and why foreland basins are prime petroleum systems.

3. Explain what fault plane solutions - also referred as focal mechanisms - are and what these diagrams represent.

4. Describe the history of an asymmetric rift system that evolves to form two passive continental margins and an ocean basin.

5. Describe the typical tectonic scenarios of plate convergence that can lead to shortening of the crust and the generation of orogenic belts.

6. What are ramps and flats in a thrust belt? Explain the different orientations that ramps (e.g.lateral ramps, oblique ramps, frontal ramps) in thrust belts can display, and explain how these ramps can be related to folds.

7. What is meant by transpression? Describe the geological features that result from transpression in a segmented dextral strike-slip fault system. Draw a schematic stress polygon and highlight the area for transpression and transtension.

8. This choice is NOT available to students registered in EAS 521. Describe carefully, with diagrams, the various origins of folds that are related to thrust faults in a typical thrust-fold belt.