

Geology 213 Final Exam Spring 1997.

Exam rules apply
Time allowed: 2 hours

Section A (60 marks)

Answer this section on the sheet provided. Note that three marks will be given for a correct answer and one mark will be deducted for an incorrect answer.

1. An object 20cm long and oriented 350° is deformed such that in its finite state it is 25cm long and oriented 300°. Which of the following is true.

- a. $e = 0.05, S = 0.5, \lambda = 5.0, \gamma = 50$
- b. $e = 0.15, S = 1.15, \lambda = 1.32, \gamma = -2.4$
- c. $e = 0.25, S = 1.25, \lambda = 1.56, \gamma = -1.19$
- d. $e = 0.25, S = 1.25, \lambda = 1.56, \gamma = 1.19$
- e. $e = 5, S = 6, \lambda = 36, \gamma = -50$

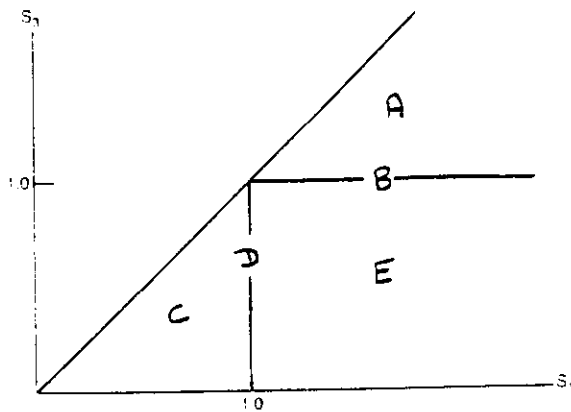
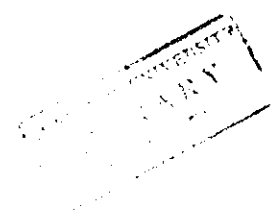
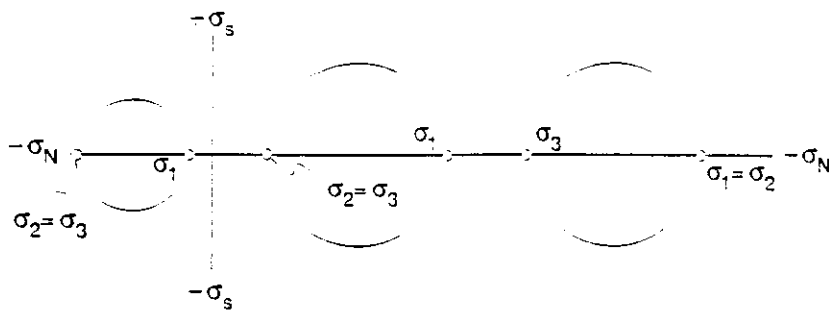


Figure 1

2. Figure 1 shows a strain field diagram. Which area represents the field of contraction?

- a. A
- b. B
- c. C
- d. D
- e. E

Figure 2



3. Figure 2 is a Mohr stress diagram representing
- Differential stress
 - Hydrostatic stress
 - Uniaxial stress
 - Axial stress
 - Triaxial stress

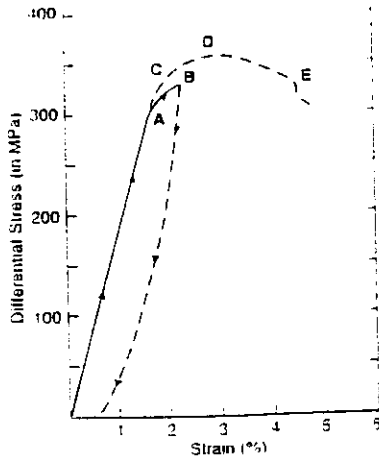


Figure 3

4. Figure 3 is a stress-strain diagram for a limestone block subjected to deformation under a confining pressure condition of 103 MPa. Point C represents
- Yield strength
 - Yield strength after strain hardening
 - Ultimate strength
 - Rupture strength
 - Cohesive strength.

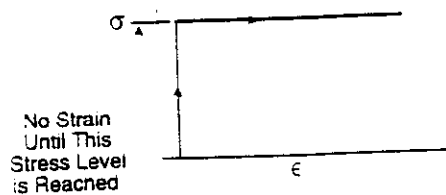


Figure 4

5. Figure 4 is:
- A Portrayal of ideal viscous behaviour
 - A Portrayal of ideal plastic behaviour
 - A Portrayal of Hooke's law
 - None of the above
 - All of the above

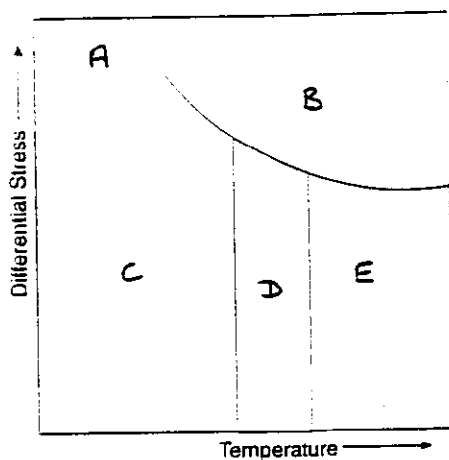


Figure 5

6. Figure 5 is a simplified deformation map. Which of the following statements is true
- Area A represents dissolution creep and mechanical twinning
 - Area B represents dislocation creep
 - Area E represents volume diffusion creep
 - Statements a and b are both correct
 - Statements b and c are both correct.
7. Screw dislocations are
- Oriented perpendicular to the direction of slip
 - Oriented parallel to the direction of slip
 - Oriented obliquely to the direction of slip
 - Oriented either perpendicular or parallel to the direction of slip
 - Oriented either parallel or oblique to the direction of slip
8. Boundary migration recrystallization is favoured by
- Low temperatures and high pore fluid pressures
 - The presence of impurities
 - Moderate to high temperatures and the presence of pore fluid
 - A varied grain size and a varied mineralogy
 - None of the above.
9. Which of the following statements regarding the Mohr failure envelope are true.
- $\sigma_0 = \text{cohesive strength}$
 - $T_0 = \text{tensile strength}$
 - $\sigma_c = \text{critical shear stress required for faulting}$
 - $\phi = \text{angle of internal friction}$
 - $\theta = \text{angle between the fracture surface and the direction of greatest principal stress}$
- Only 1 is true
 - 1 and 2 are both true, 3, 4 and 5 are false
 - 1, 2 and 4 are true, 3 and 5 are false
 - 1, 2, 3 and 5 are true and 4 is false
 - All of the statements are true
10. The law that describes deformational behavior above the brittle-ductile transition is called:
- Coulomb criterion
 - Mohr - Coulomb criterion
 - Van Mises criterion
 - Griffith criterion
 - Byerlee criterion

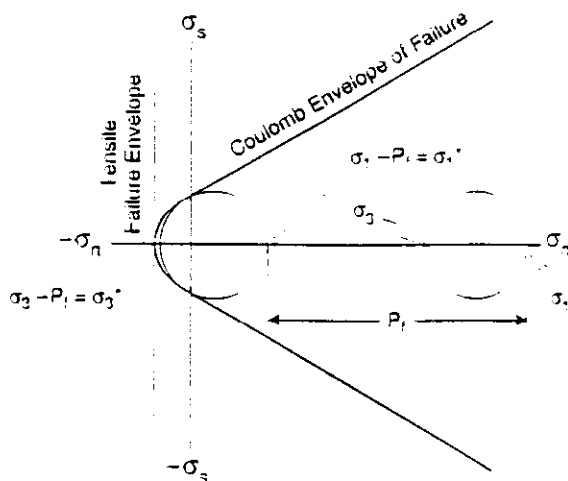


Figure 6

11. Figure 6 shows a Coulomb failure envelope. To begin with σ_1 and σ_3 are both compressive with low differential stress, but when the pore fluid pressure is raised the result is:

- Nothing
- The stress circle crashes into the tensile failure envelope and the rock breaks by mode I failure.
- The stress circle crashes into the parabolic failure envelope and the rock breaks through transitional tensile failure.
- The stress circle crashes into the parabolic failure envelope and breaks according to Coulomb's law of failure in the compressive field.
- The stress circle crashes into the frictional sliding envelope and breaks through transitional tensile behaviour.

12. Which of the following statements about fault rocks is true.

- A gouge is a fine grained (clast $< 0.1\text{mm}$) clayey fault rock formed under relatively low temperature and low pressure conditions.
- A megabreccia comprises $> 70\%$ clast ($> 0.5\text{m}$) and $< 30\%$ matrix. It forms in area of low confining pressure and/or high fluid pressure.
- A pseudotachylite in a "metamorphic" fault rock comprising angular grains ($< 0.1\text{mm}$) set in a finer matrix. They form under conditions of high strain rate and medium confining pressure.

- Only 1 is true
- 1 and 2 are true, 3 is false
- 1 and 3 are true, 2 is false
- 2 and 3 are true, 1 is false
- 1, 2 and 3 are true.

13. A duplex is composed of four horses. A is at the bottom and D at the top.

- A is 5m long and has slipped 6m*
- B is 10m long and has slipped 15m*
- C is 7m long and has slipped 6m*
- D is 15 long and has slipped 12m*

The form of the duplex is:

- A hinterland dipping duplex
- An antiformal stack
- A foreland dipping duplex
- A combination of a hinterland dipping duplex and an antiformal stack
- A combination of a hinterland dipping duplex and a foreland dipping duplex.

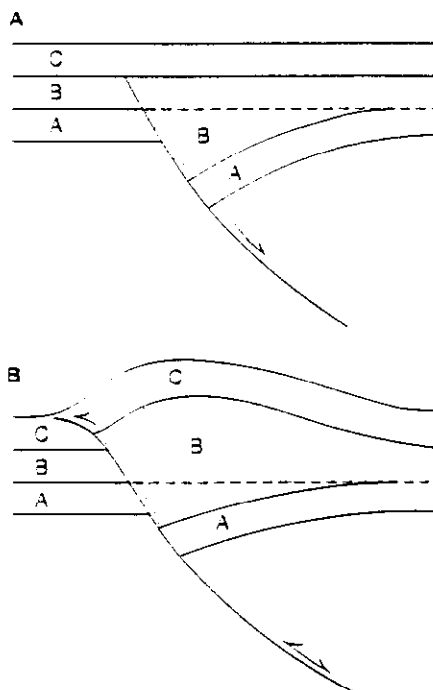


Figure 7

14. Figure 7 shows a series of strata that have been faulted. Which of the following statements is true.

1. *Horizon a has undergone post depositional deformation*
 2. *Horizon a forms a roll-over anticline in the hangingwall of the fault*
 3. *Horizons B and C are both syntectonic*
 4. *Diagram 7b shows positive structural inversion*
 5. *Diagram 7b shows negative structural inversion*
- a. 1, 2, 3 and 4 are true, 5 is false
 - b. 1, 2, 3 and 5 are true, 4 is false
 - c. 2, 3, and 5 are true, 1 and 4 are false
 - d. 1, 2, and 4 are true, 3 and 5 are false
 - e. 1, 2, and 3 are true, 4 and 5 are false

15. Simple buckling of a single layer is best described mathematically in terms of

- a. Dominant wavelength, thickness of stiff layer, elastic modulus of stiff layer, elastic modulus of confining medium
- b. Dominant wavelength, thickness of stiff layer, Young's modulus of stiff layer, Young's modulus of confining medium
- c. Dominant wavelength, thickness of stiff layer, coefficient of viscosity of stiff layer, coefficient of viscosity of confining medium.
- d. Dominant wavelength, thickness of stiff layer, Poisson's ratio of stiff layer, Poisson's ratio of confining medium and strain.
- e. Dominant wavelength, thickness of stiff layer, coefficient of viscosity of stiff layer, coefficient of viscosity of confining medium and the stretch in two direction within the plane of layering

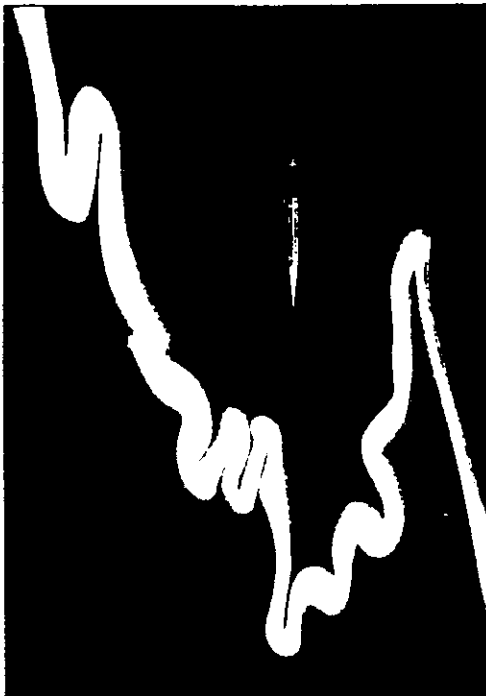


Figure 8

16. Figure 8 is a picture of a metamorphic rock the fold would be best described as a

- a. Synform
- b. Antiform
- c. Syncline
- d. Anticline
- e. Synclinorium

17. Which of the following statements about L tectonites is true

1. They are the product of flattening
 2. They form when $S1 > S2 = S3$
 3. They form when an original sphere turns into a triaxial ellipsoid
 4. They are exemplified by pencil structure
- a. 1 and 2 are true, 3 and 4 are false
 - b. 1 and 2 are false, 3 and 4 are true
 - c. 1 and 3 are true, 2 and 4 are false
 - d. 1 and 3 are false, 2 and 4 are true
 - e. 1, 2, 3 and 4 are true.

18. Which of the following statements about cleavages is true.

1. Cleavage is divided into domains, microlithon domains and cleavage domains
 2. Cleavage is divided into M domains and QF domains
 3. M domains are the same as microlithon domains
 4. QF domains are the same as cleavage domains
 5. QF domains represent the original host rock
- a. 1 and 2 are true, 3, 4 and 5 are false
 - b. 1, 2, and 3 are true, 4 and 5 are false
 - c. 1, 2, 3 and 5 are true, 4 is false
 - d. 1, 2, 4 and 5 are true, 3 is false
 - e. 1, 2, and 5 are true 3 and 4 are false

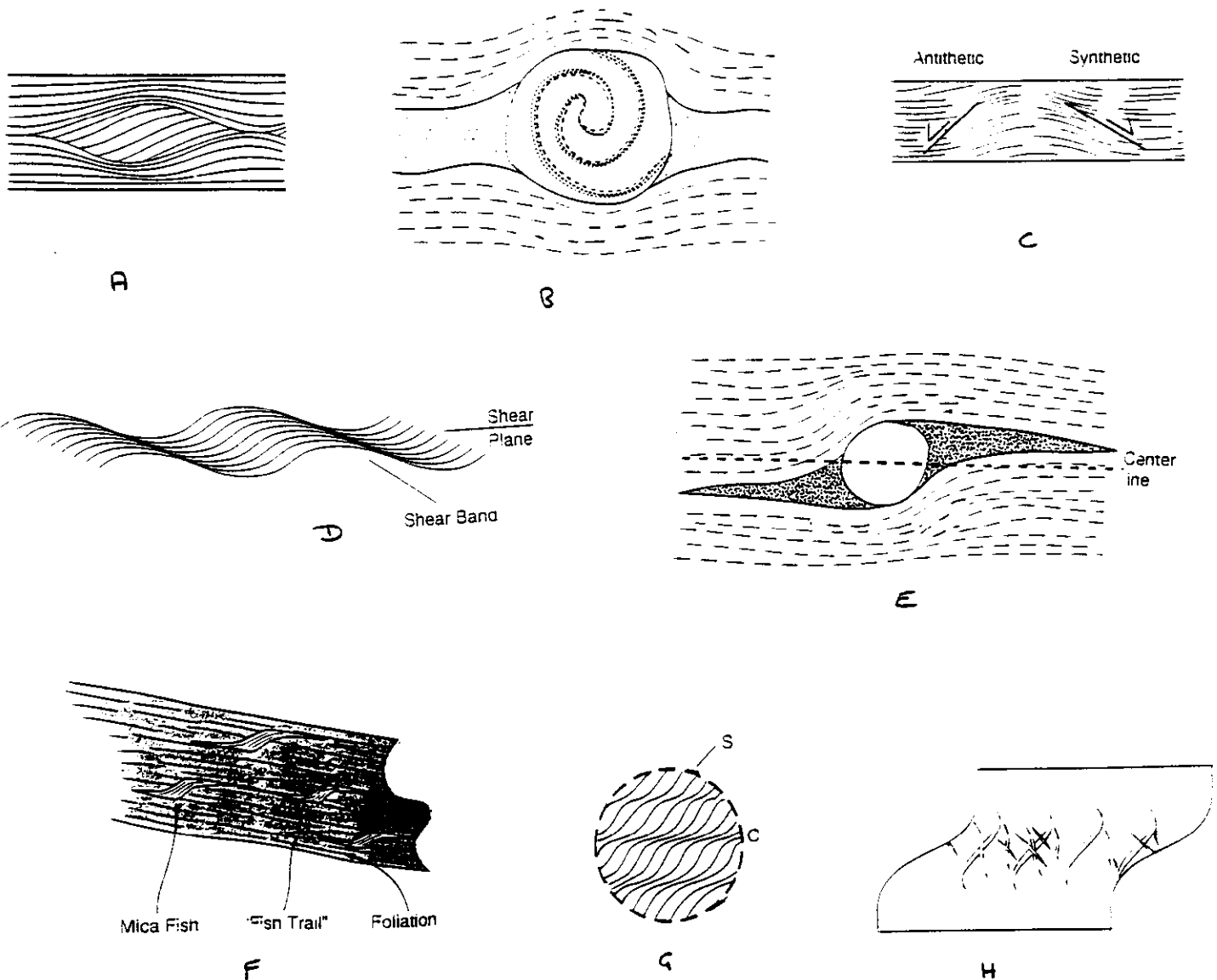


Figure 9

19. Figure 9 is a composite showing different shear criteria. The sense of offset in each case is:

- a. All are dextral
- b. All are sinistral
- c. A, B, C and D are dextral, E, F, G and H are sinistral
- d. A, B, C and D are sinistral, E, F, G and H are dextral
- e. A, C, F and H are dextral, B, D, E and G are sinistral.

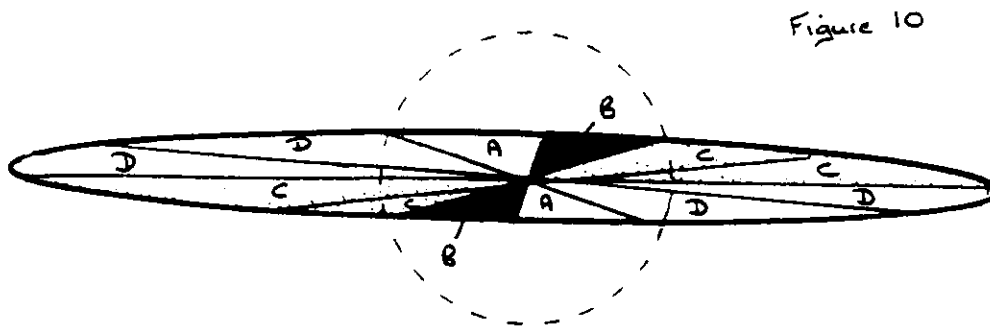


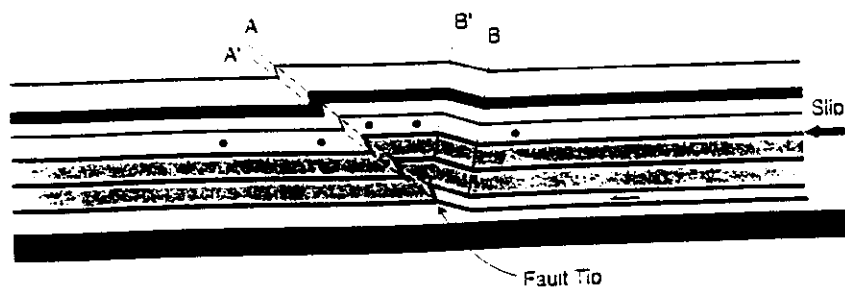
Figure 10

20. Figure 10 shows a strain ellipse divided into four sectors A, B, C and D.

- a. The strain ellipse is a result of progressive pure shear. A represents instantaneous and finite shortening, B represents finite shortening but instantaneous extension, C represents finite and instantaneous extension, D represents finite and instantaneous extension following an initial period of shortening.
- b. The strain ellipse is a result of progressive pure shear. A represents finite shortening but instantaneous extension, B represents instantaneous and finite shortening, C represents finite and instantaneous extension following an initial period of extension, D represents finite and instantaneous extension
- c. The strain ellipse is a result of progressive simple shear. A represents instantaneous and finite shortening, B represents finite shortening but instantaneous extension, C represents finite and instantaneous extension, D represents finite and instantaneous extension following an initial period of shortening.
- d. The strain ellipse is a result of progressive simple shear. A represents finite shortening but instantaneous extension, B represents instantaneous and finite shortening, C represents finite and instantaneous extension following an initial period of extension, D represents finite and instantaneous extension.
- e. The strain ellipse is a result of progressive simple shear. A represents instantaneous and finite shortening, B represents finite shortening but instantaneous extension, C represents finite and instantaneous extension following an initial period of extension, D represents finite and instantaneous extension.

NAME :

5.



Section C (20 marks)

Using diagrams explain (a) what is meant by the following terms and
(b) the processes that led to their development.

1. Strain insensitive shape fabric
2. Brittle ductile shear zones.
3. Passive fold
4. Riedel shears
5. Cataclasite