Geology 213: Structural Geology

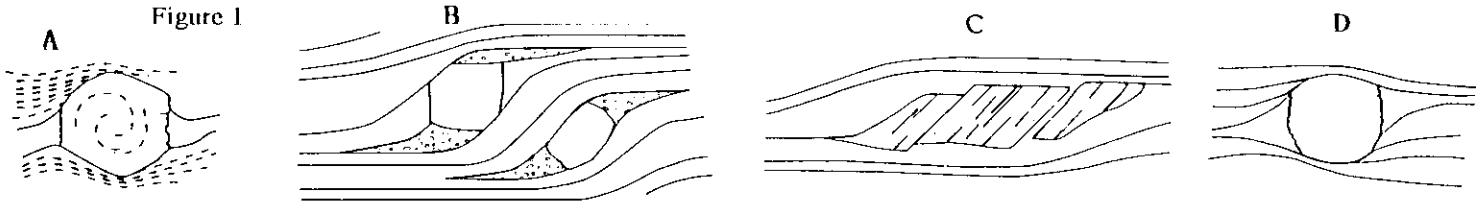
Final Exam Fall 97/98

Time allowed: Two hours
Exam rules apply

Section A (60 marks)

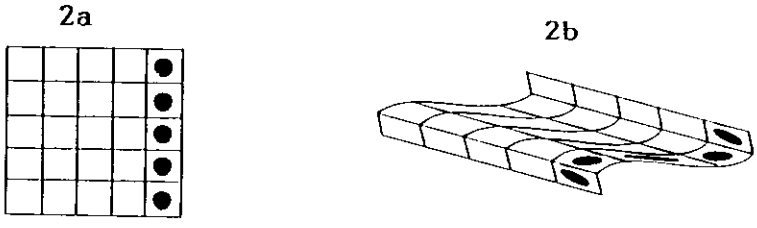
Answer this section on the sheet provided. Note that three marks will be given for a correct answer and one mark will be deducted for an incorrect answer.

Figure 1



1. The sense of shear demonstrated by the structures A-D in figure 1 is:
a. All are dextral
b. All are sinistral
c. A and B are dextral, C and D are sinistral
d. A and C are dextral, D and B are sinistral
e. A, B and D are dextral, C is sinistral

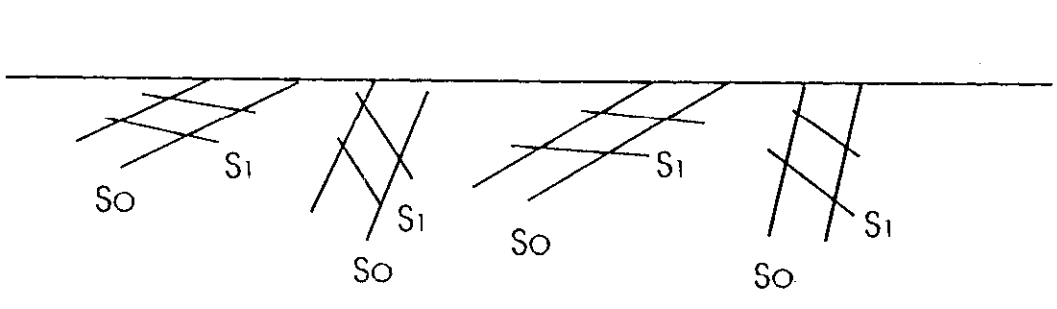
Figure 2



2. Figure 2a is a picture of a cube before deformation and figure 2b is a picture after deformation. The deformation is best described as being a product of :
a. Simple shear
b. Simple shear and volume change
c. Simple shear and homogeneous strain
d. Volume change and homogeneous strain
e. Volume change, homogeneous strain and simple shear

3. The S –surfaces in a Type 1 S-C fabric are:
a. A strain sensitive fabric parallel to the S1/S2 plane of the strain ellipse
b. A strain sensitive fabric parallel to the S1/S3 plane of the strain ellipse
c. A shear band parallel to the S1/S3 plane of the strain ellipse
d. A strain insensitive fabric parallel to the S1/S2 plane of the strain ellipse
e. A strain insensitive fabric parallel to the S1/S3 plane of the strain ellipse

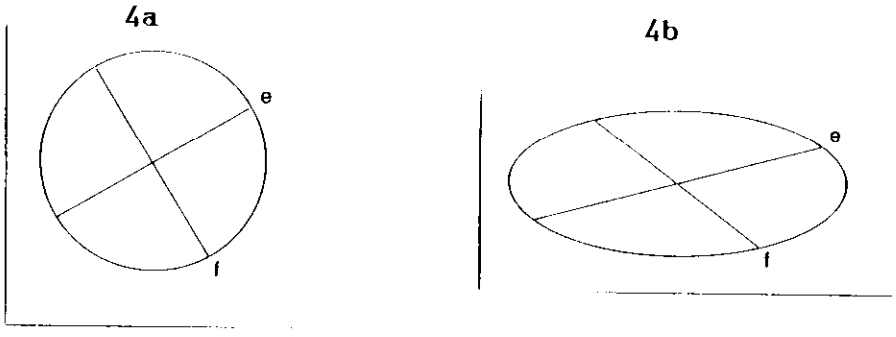
Figure 3



4. The relationships shown between bedding So and cleavage S1 in figure 3 are indicative of which of the following:

a. A series of overturned folds which verge to the north
b. A series of overturned folds which verge to the south
c. A syncline, anticline pair which verge in different directions
d. A periclinal fold plunging north
e. The data is contradictory and more information is required to give a correct answer.

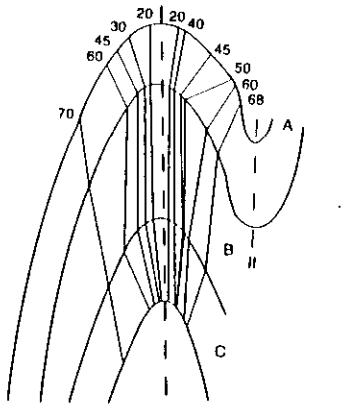
Figure 4.



5. Figure 4a shows a reference circle and two perpendicular lines prior to deformation. Figure 4b shows the resultant strain ellipse. Which of the following statements is true:

a. The style of deformation responsible for the strain ellipse is simple shear, line e underwent +38° of angular shear and line f underwent -38° of angular shear.
b. The style of deformation responsible for the strain ellipse is simple shear, line e underwent -38° of angular shear and line f underwent +38° of angular shear.
c. The style of deformation responsible for the strain ellipse is pure shear, line e underwent +38° of angular shear and line f underwent -38° of angular shear.
d. The style of deformation responsible for the strain ellipse is simple shear, line e underwent -38° of angular shear and line f underwent +38° of angular shear.
e. None of the above

Figure 5.



6. The fold shown in figure 5 is made up of a series of layers. Each layer has a different isogon pattern. Using the isogons the folds can be best classified as:

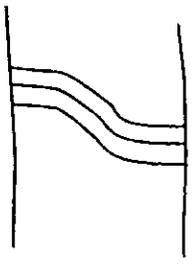
a. A = Class 1A, B = Class 2, C = Class 1C
b. A = Class 1C, B = Class 2, C = Class 3
c. A = Class 1C, B = Class 3, C = Class 2
d. A = Class 2, B = Class 1B, C = Class 1C
e. A = Class 3, B = Class 2, C = Class 1B

7. Which of the following are not linear structures
a. Rodding
b. Stretched pebble conglomerate
c. Mullions
d. Pencil structure
e. Chocolate tablet boudinage

8. LS tectonites are best described as:
a. A product of flattening that transforms an original sphere into an oblate strain ellipsoid. Magnitudes of the finite strain ellipse are $S_1=S_2>S_3$.
b. A product of flattening that transforms an original sphere into a prolate strain ellipsoid. Magnitudes of the finite strain ellipse are $S_1=S_2>S_3$.
c. A product of unidirectional stretching that transforms an original sphere into a prolate strain ellipsoid. Magnitudes of the finite strain ellipse are $S_1>S_2=S_3$.
d. A product of stretching in one direction compensated by flattening at right angles to the direction of stretching with neither stretching nor shortening in the intermediate direction that transforms an original sphere into a triaxial strain ellipsoid. Magnitudes of the finite strain ellipse are $S_1>S_2=S_3$ where $S_2=0$.
e. A product of stretching in one direction compensated by flattening at right angles to the direction of stretching with neither stretching nor shortening in the intermediate direction that transforms an original sphere into a triaxial strain ellipsoid. Magnitudes of the finite strain ellipse are $S_1>S_2>S_3$ where $S_2=1$.

9. Mechanical conditions that favour passive folding are:
a. High mean ductility and low ductility contrast
b. High mean ductility and high ductility contrast
c. Low mean ductility and low ductility contrast
d. Low mean ductility and high ductility contrast
e. Moderate mean ductility and low ductility contrast

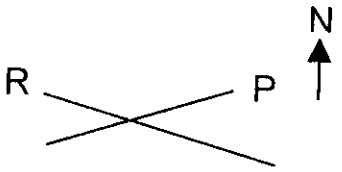
Figure 6.



10. The fibres shown in figure 6 are best described as:
a. Syntaxial a product of coaxial deformation
b. Composite a product of coaxial deformation
c. Syntaxial a product of dextral non-coaxial deformation
d. Antitaxial a product of sinistral non-coaxial deformation
e. Insufficient evidence has been given for you to describe the fibres with accuracy.

11. Which of the following is not an example of continuous cleavage: A= slaty cleavage, B=schistosity, C= Phyllitic structure, D= Crenulation cleavage, E=Spaced cleavage.
a. A only
b. B and C
c. C and D
d. D and E
e. D only

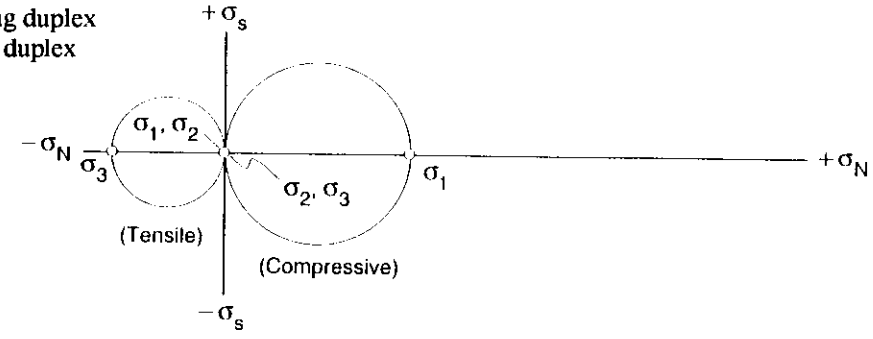
Figure 7.



12. The R and P shears shown in diagram 7 are a product of:
a. Dextral shear in an E-W oriented strike-slip zone
b. Dextral shear in an N-S oriented strike-slip zone
c. Sinistral shear in an E-W oriented strike-slip zone
d. Sinistral shear in an N-S oriented strike-slip zone
e. Dextral shear in an NE-SW oriented strike-slip zone

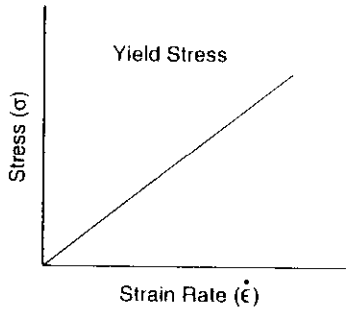
13. The magnitude of slip on a thrust fault is 7km. The length of the next lower thrust slice is 7km. The result is:
a. A normal duplex
b. A forward duplex
c. An antiformal stack
d. A hinterland dipping duplex
e. A foreland dipping duplex

Figure 8.



14. Figure 8 is a Mohr stress diagram representing which of the following:
a. Differential stress
b. Hydrostatic stress
c. Uniaxial stress
d. Axial stress
e. Triaxial stress

Figure 9

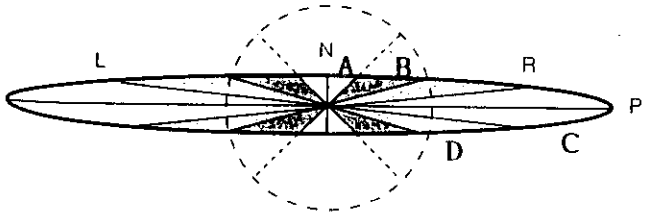


15. Figure 9 is:
a. A portrayal of ideal viscous behaviour
b. A portrayal of ideal plastic behaviour
c. A portrayal of Hooke's law
d. None of the above
e. All of the above

16. Which of the following statements regarding Mohr failure envelopes are true:
    1. σc = *critical shear stress required for faulting*
    2. σo = *cohesive strength*
    3. *To = tensile strength*
    4. ϕ = *angle between the fracture surface and the direction of greatest principal stress*
    5. θ = *angle of internal friction*

a. All of the statements are true
b. Only 1, 2 and 3 are true
c. Only 2, 3 and 5 are true
d. 1, 2, 3 and 5 are true. 4 is false
e. 2, 3 and 4 are true. 1 and 5 are false.

Figure 10.



17. Figure 10 shows a strain ellipsoid divided into four sectors A, B, C and D. Which of the following statements regarding figure 10 is correct?

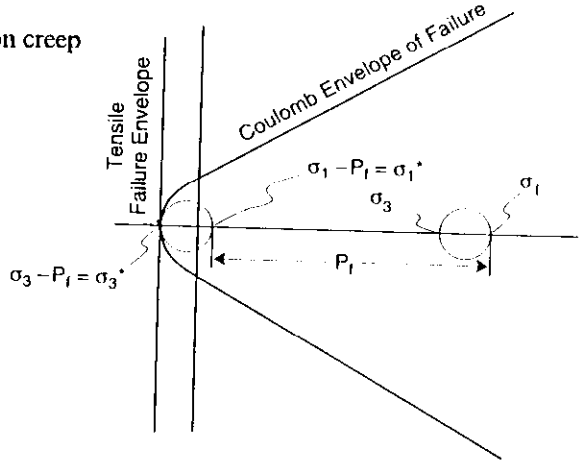
a. The strain ellipse is the result of progressive pure shear. A represents instantaneous and finite shortening, B represents finite shortening but instantaneous extension, C represents finite and instantaneous extension, D represents finite and instantaneous extension following an initial period of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

18. Assuming pure shear and a simple relation between stress and strain which of the following is true?

a. $\sigma 1$ should be parallel to S_1
b. $\sigma 3$ should be parallel to S_3
c. $\sigma 1$ should be parallel to S_3
d. $\sigma 1$ should be 45° to S_3
e. None of the above

19. Coble creep is best defined as:
a. Dislocation creep
b. Superplastic creep
c. Pressure solution
d. Grain boundary diffusion creep
e. Dissolution creep

Figure 11



20. Figure 11 shows a coulomb failure envelope. To begin with σ1 and σ3 are both compressive with low differential stress, but when the pore fluid is raised the result is:
a. The stress circle crashes into the tensile failure envelope and the rock breaks by Mode 1 failure.
b. The stress circle crashes into the parabolic failure envelope and the rock breaks though transitional tensile failure.
c. The stress circle crashes into the parabolic failure envelope and breaks according to Coulomb's law of failure in the compressive field.
d. The stress circle crashes into the frictional sliding envelope and breaks through transitional tensile behaviour.
e. Nothing

Name.....

SA Q. No.					
1	A	B	C	D	E
2	A	B	C	D	E
3	A	B	C	D	E
4	A	B	C	D	E
5	A	B	C	D	E
6	A	B	C	D	E
7	A	B	C	D	E
8	A	B	C	D	E
9	A	B	C	D	E
10	A	B	C	D	E
11	A	B	C	D	E
12	A	B	C	D	E
13	A	B	C	D	E
14	A	B	C	D	E
15	A	B	C	D	E
16	A	B	C	D	E
17	A	B	C	D	E
18	A	B	C	D	E
19	A	B	C	D	E
20	A	B	C	D	E

Section B (20 marks) **Name**.....

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

1. Microcracks

2. Dissolution creep

3. Structural inversion

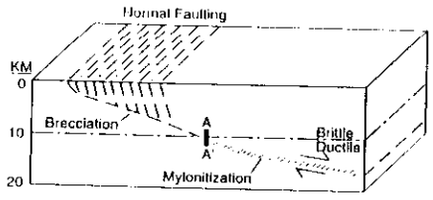
4. Fault-bend folds

5. Foliation fish

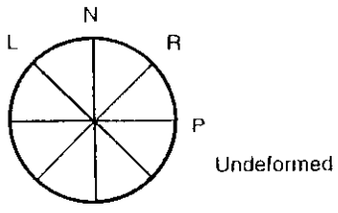
Section C (20 marks) **Name**.....

Using labelled diagrams explain what the result would be in each of the following cases:

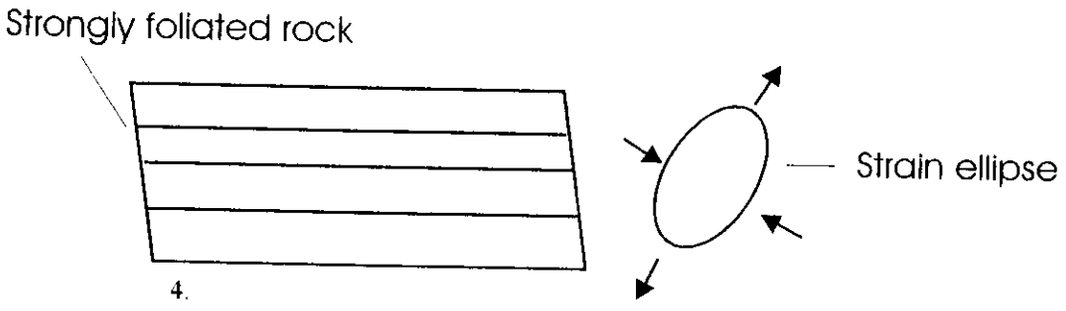
1.



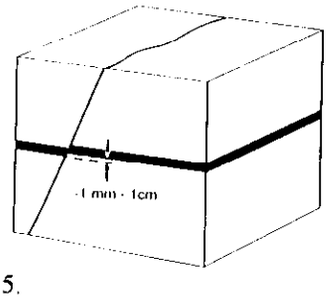
2.



3.



4.



5.