EAS 233 Geologic structures. Final test. April 2012. 3 hours.

Answer question 1 and 2 and <u>three</u> other questions. If you start more than the required number of questions, clearly delete the answers you do not wish to have marked. *On the inside of the front cover of the examination booklet, please circle the numbers of the questions you do.*

The sample for question 1 will be passed around the class during the exam. *It will be available for* ***ten*** *minutes only.* ***Start question 1 when the sample arrives at your desk****. When you are finished with the sample, leave it on your desk to be passed on by a TA.*

You are encouraged to illustrate your answers with clearly labelled diagrams.

Questions 1 and 2. Answer both questions.

1. (Do this question when sample A arrives at your desk. Write your answer on the sheet provided.)
Sample A shows fabric. For each fabric present, name the type of fabric, state whether it is primary or secondary, provide an abbreviation (e.g. S3) that indicates the type of fabric and when it formed in the sequence of fabric development, and explain the origin of the fabric. (12%)

2 **Map B shows the geology of an area cut by a planar fault. The fault cuts an angular fold.** Make a fault-plane section **using the template provided,** showing the hanging wall and footwall cutoffs of the folded surface, **and answer the questions on the template sheet**. (28%)

Questions 3 - 7. Answer <u>three</u> questions. *Each question is worth 20%.*

3. a) Explain briefly how **cross-stratification** is formed in sedimentary rocks?
b) Diagram C1 shows cross-stratification in an ancient unit of sandstone. Add labelled arrows to the diagram to show the way-up of the strata and the direction the current was flowing.
c) In diagram C2, cross-stratification is present in several places on the outcrop. Label the folds as synclines or anticlines, and as synforms or antiforms.
d) Connect the layers so as to complete the larger overall structure.

4. a) Explain what are **stress axes**.
b) A geologist working in fractured rocks determines that the maximum compressive stress has trend 085 plunge 10, and notes that the intermediate stress axis is horizontal. Using a stereographic projection, determine the trend and plunge of the other two stress axes.
c) Use your projection to predict the orientations of conjugate faults formed under this state of stress. (Assume that the faults form at exactly 30° to the maximum compressive stress.)

5. a) What is meant by the terms '**fold axis**' and '**profile plane**'?
b) Table D shows measurements of bedding from an area of folded rocks. Using a suitable projection, determine the orientation of the profile plane.
c) A fold axial trace in the same area was observed to rake 60° to the south in a north-south roadcut that dips 70° west. Plot plane of the roadcut and the axial trace on your projection and determine the orientation of the fold axial surface.

6. a) What are **normal faults** and in what parts of the lithosphere are normal faults most active at the present day?
b) Draw a diagram of a normal fault system that includes the following features (label the features on your diagram): footwall of major fault; hanging-wall of major fault; horst; graben; half-graben; rollover anticline.

7. a) Briefly describe **three** common types of **fold** found in **thrust belts**.
b) The partially completed cross-section E shows a fold from a thrust belt. Complete the section to show the most plausible interpretation of the structure.

Leave all parts of the question paper with your answers on your desk when you are finished. On the inside of the front cover of the examination booklet, please circle the numbers of the questions you did.

Name ..... ID .....

Answer sheet for question 1 Answer question 1 as soon as the sample arrives at your desk.

Write the number of the sample you receive here: .....

FABRIC .....

Primary or secondary? .....

Abbreviation .....

Origin .....

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.....

.....

FABRIC .....

Primary or secondary? .....

Abbreviation .....

Origin .....

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.....

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FABRIC .....

Primary or secondary? .....

Abbreviation .....

Origin .....

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(Continue on the back if more than three fabrics are present.)

Name ..... ID .....

Answer sheet for question 2 (28%)

Map B shows the geology of an area cut by a planar fault. The fault cuts an angular fold. A fault section template is provided.

a) Complete the fault-plane section showing the hanging wall and footwall cutoffs of the folded surface. (You do not need to show the topography on the fault-plane section.)

b) Determine the trend and plunge of the fold on both sides of the fault.

North .....

South .....

c) Determine the strike and dip of the fault. .....

d) Measure the net slip .....

e) Determine the rake of the slip vector in the fault surface. .....

f) Determine the dip-slip and strike-slip components of movement.

Dip slip .....

Is the dip slip normal or reverse? .....

Strike slip .....

Is the strike slip sinistral or dextral? .....

Template for fault plane section, scale 1 : 10 000

500 m
0

Map for question 2 Name ..... ID.....

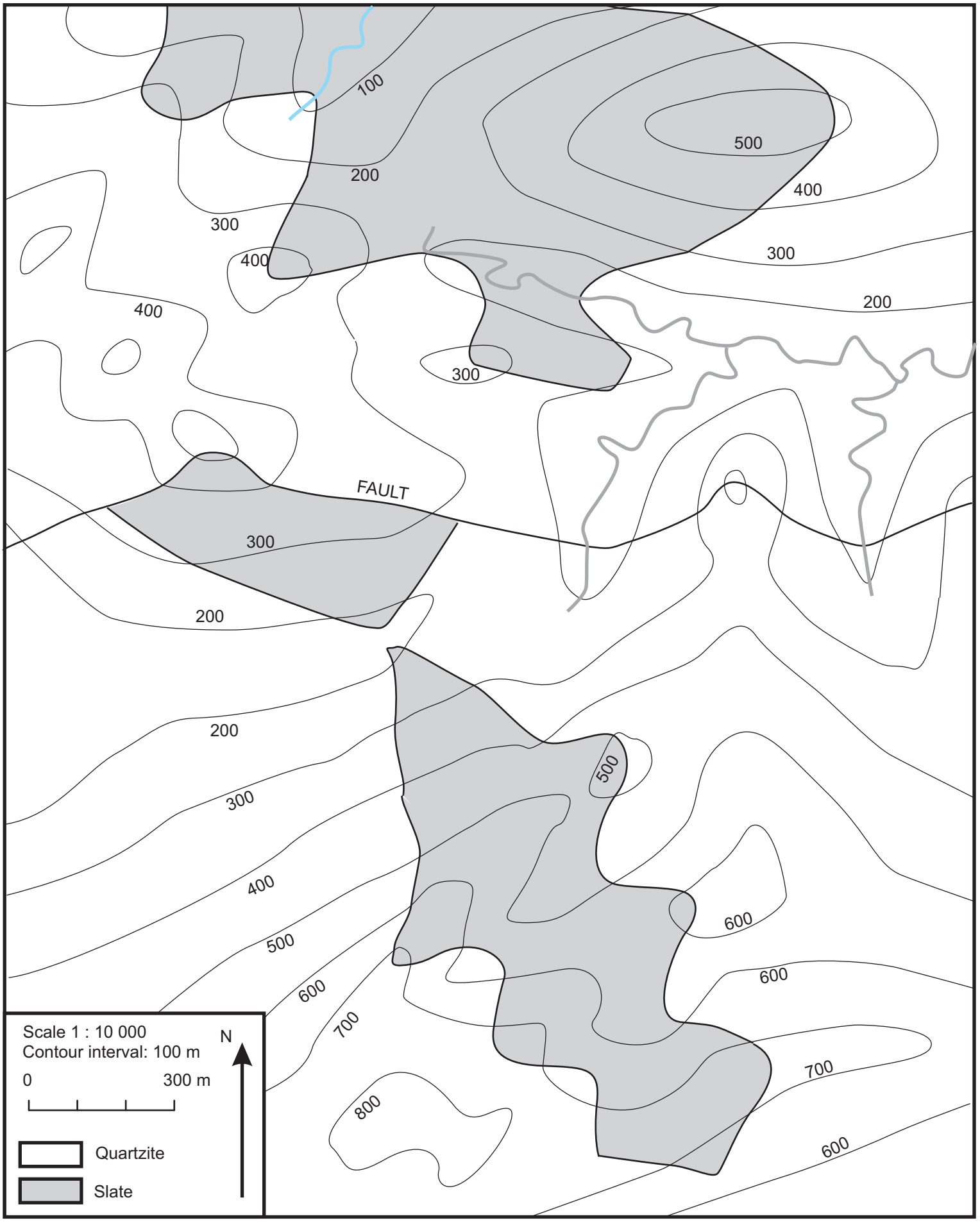
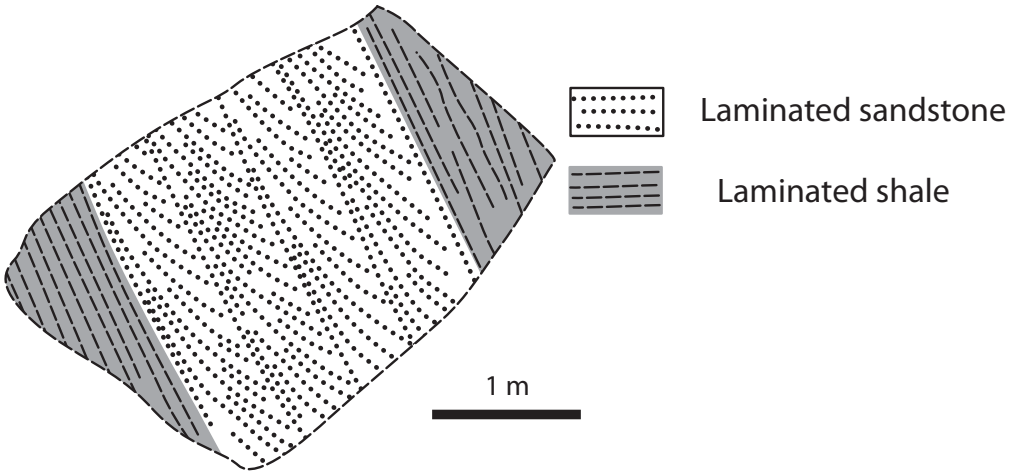


Diagram C for question 3 Name ..... ID.....

C1) Outcrop



C2) Cliff view

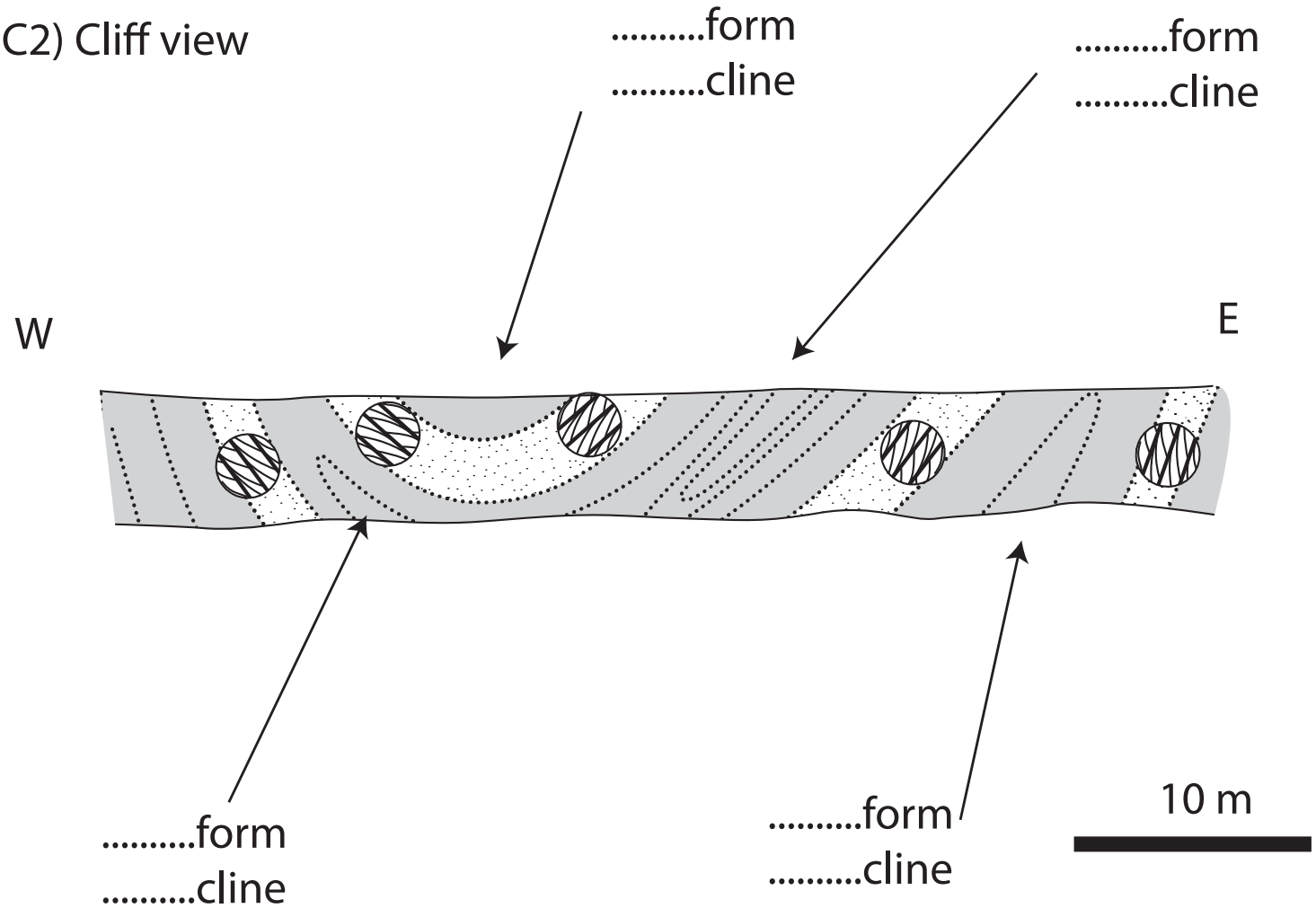


Table D for question 5

Strike	Dip (All orientations assume right-hand-rule)
006	56
044	62
089	72
099	85
317	65
303	81
312	78
330	68
089	83
079	72

Diagram E for question 7 Name ..... ID.....