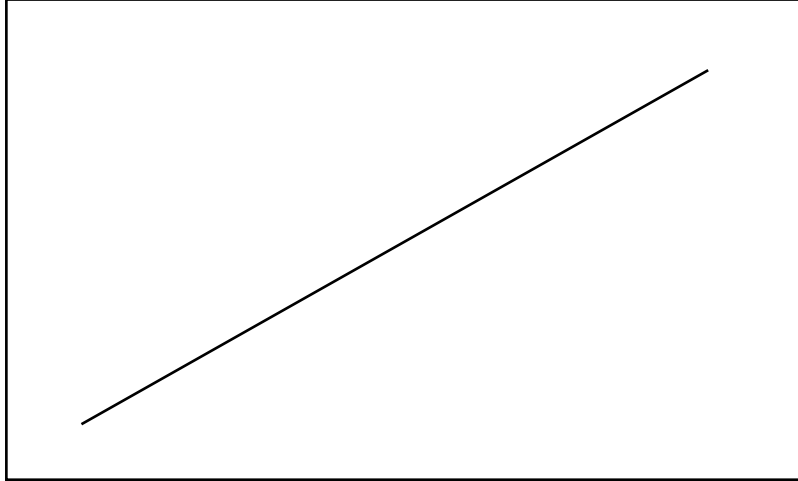


SECTION A: (90 MARKS)

Question 1: Brittle deformation. (12 marks).

Consider a right-lateral strike-slip fault as drawn in map view below.



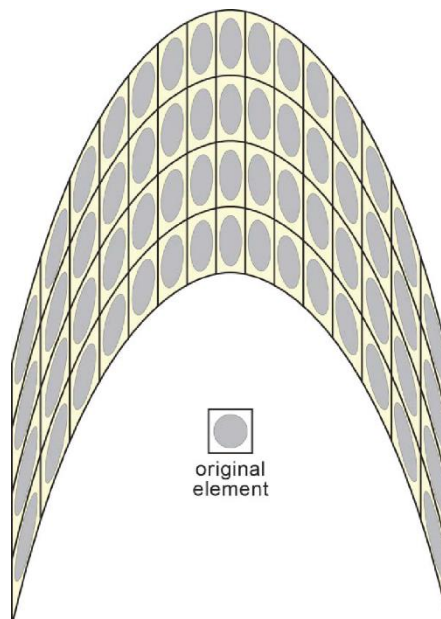
Draw in the box above the geometries of the following features consistent with a right lateral strike-slip fault:

- 1.1 En-echelon tension gashes (2 marks)
- 1.2 riedel shear (2 marks)
- 1.3 wing cracks (2 marks)
- 1.4 deflection of passive markers (such as bedding planes) (2 marks)
- 1.5 and arrows representing the orientation of sigma 1 and sigma 3. (4 marks)

Question 2: Strain and folding. (15 marks).

2.1. Comment on the strain and strain distribution in the fold below. (6 marks)

2.2. Which type of fold is it and how does this type of fold form? (8 marks)



Question 3: Stress and strain. (12 marks).

- 3.1. Body and applied forces are distinct forces that are both important for the deformation of rocks. Explain how these two forces differ and give at least one example of each. (6 marks)
- 3.2. What are the differences between flattening and constriction states of strain? Give at least one example of these two types of state of strain. (6 marks).

Question 4: Rheology. (12 marks).

- 4.1. Explain the role of strain rate in deformation of rocks. Give one geological example where strain rate played a role. (6 marks)
- 4.2. Consider two rocks of highly distinct viscosities such as salt rock and quartzite. Explain how these two rocks are expected to deform in the middle crust if they were set in the same stress field. (6 marks)

Question 5: Ductile deformation. (15 marks).

- 5.1. Which kind of structure is shown in the photo below? (3 marks)
- 5.2. Explain how this structure formed (use sketches). (12 marks)



Question 6: Fabrics and shear zones. (12 marks)

- 6.1. What is(are) the difference(s) between an L-S-tectonite and an S-tectonite? Use annotated sketches to illustrate your answer. (6 marks)
- 6.2. Do shear zones form by *homogeneous strain*? Argument your answer. (6 marks)

Question 7: Brittle deformation. (12 marks)

7.1. What are conjugate faults and what are the angular relations between them and the principal stress axis σ_1 , σ_2 and σ_3 . (6 marks)

7.2. Explain why Mohr diagrams are useful (use sketches). (6 marks)

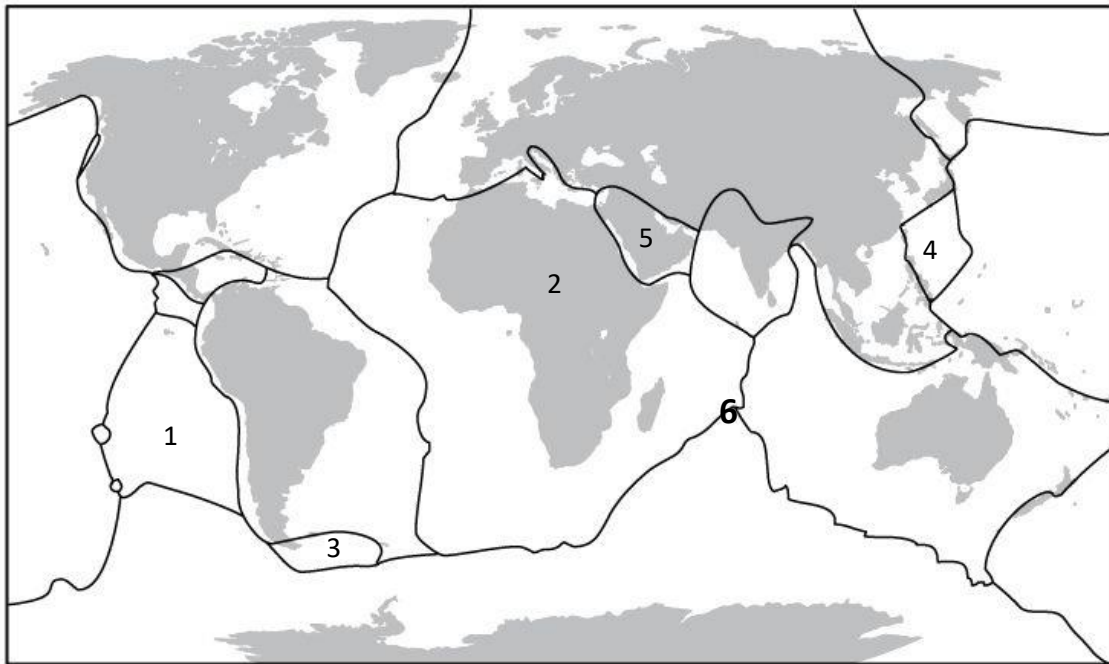
SECTION B: (90 MARKS)

Question 8: Contrast the plate tectonic setting of north-south trending a narrow active continental rift and a north-south trending ensialic island arc with an overriding plate located in the west. (50 marks)

Your answer should be in essay form (like summarized study notes) and should be structured under the following headings:

- Lithospheric structure (30 marks)
 - Provide a lithospheric cross section of each of the systems and indicate the following:
 - Thickness, its variation and nature (continental vs oceanic) of crust
 - Thickness and its variation of the mantle lithosphere
 - Label the asthenosphere
 - Dominant structures and their nature (i.e., normal, reverse, or transform; ductile or brittle)
 - Locality and depth distribution of earthquakes
 - Locality of volcanism on the surface
- Seismicity (10 marks)
 - Provide typical focal mechanism solutions for earthquakes that characterize the systems
- Magmatism (10 marks)
 - Typical expected magmatic rocks/compositions
 - Change in composition through space and time

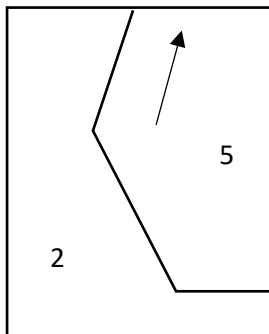
Question 9: Tectonic plates (20 marks)



9.1. Label the numbered plates 1 to 5 (5 marks)

9.2. What physically are the plates that are referred to in plate tectonics? (3 marks)

9.3. Briefly illustrate and describe the nature of the plate boundary between 2 and 5 if plate 5 is moving to the northeast at a velocity of 1.4 cm/yr as indicated below (4 marks)



9.4. A triple junction is formed by three spreading ridges at point 6. Explain why such a triple junction would ideally be dynamically stable? Why would a triple junction formed by three transform faults always be dynamically unstable? Illustrate your answer. (8 marks)

Question 10: Hotspots, plumes and large igneous provinces (20 marks)

10.1. What are hotspots, where do they originate, and how can they be used to determine the velocity and direction of plate motion? Illustrate your answer. (9 marks)

10.2. What is the role of hotspots in the breakup of continents? (2 marks)

10.3. Define large igneous provinces (in terms of composition, volume/area, duration) and name three components (There are more) of large igneous provinces that can be recognized in the rock record. (9 marks)