

ES2104 - Geophysics and Hydrology
Tutorial (13.11.2024)

(Please use scale and protractor to solve the problems. Maintain the scale and angle as given in the figures.)

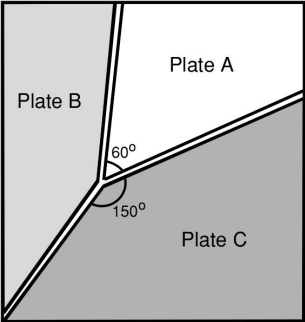
1. Calculate the instantaneous rotation vector for the Nazca plate relative to the Antarctic plate.

| Plate | Rotation vector | Latitude of pole | Longitude of pole | Angular velocity (10 ⁻⁷ deg yr ⁻¹) |
|--------------------|-----------------|------------------|-------------------|-----------------------------------------------------------|
| Nazca–Pacific | $P\omega_N$ | 55.6°N | 90.1°W | 13.6 |
| Pacific–Antarctica | $A\omega_P$ | 64.3°S | 96.0°E | 8.7 |

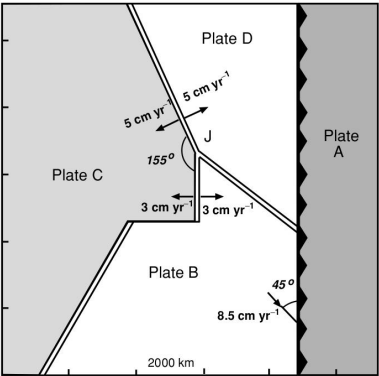
2. The three plates A, B and C meet at a ridge–ridge–ridge triple junction as shown. The ridge between plates **A** and **B** has a **half-spreading** rate of **2cm/yr**. Calculate

(a) the half-spreading rates of the other two ridges and

(b) the motion of the triple junction relative to plate C.



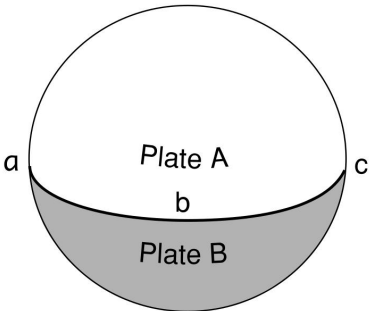
3. All plates A–D shown in Figure move rigidly without rotation. All ridges add at equal rates to the plates on either side of them; the rates given on the diagram are half the plate-separation rates. The trench forming the boundary of plate A does not consume A. Use the plate velocities and directions to determine by graphical means or otherwise



(a) the relative motion between plates **B** and **D** and

(b) the relative motion between the triple junction **J** and plate **A**.

4. Ares is a planet with just two plates, **A** and **B**. Plate B comprises the lower hemisphere and plate A the upper, as shown. Points **a**, **b** and **c** lie on the **equator**, and point **d** is **diametrically opposite b**. The zero meridian passes through point a. The pole of rotation of plate **A** relative to plate **B** is at **45°N, 0°E**. The amplitude of the angular velocity vector is **10⁻¹⁰** radians per terrestrial year. The radius of Ares is **3400 km**.



(a) What is the nature of the plate boundary between plates **A** and **B**?

(b) Calculate the relative velocity between plates **A** and **B** at locations **a**, **b**, **c** and **d**.

(c) Discuss briefly how the stability or instability of a two-plate tectonic system depends upon the pole position and/or relative size of the two plates.

5. Four flat plates are moving rigidly, without rotation, on a flat Earth as illustrated in figure.

Determine the relative motion vector of the Beautific-Joker’s–Nasty (BJN) triple junction to the Albatross plate.

