

**GEOL 4060 Oceanography 2012 CU Boulder**  
**Prof: Chris Jenkins**

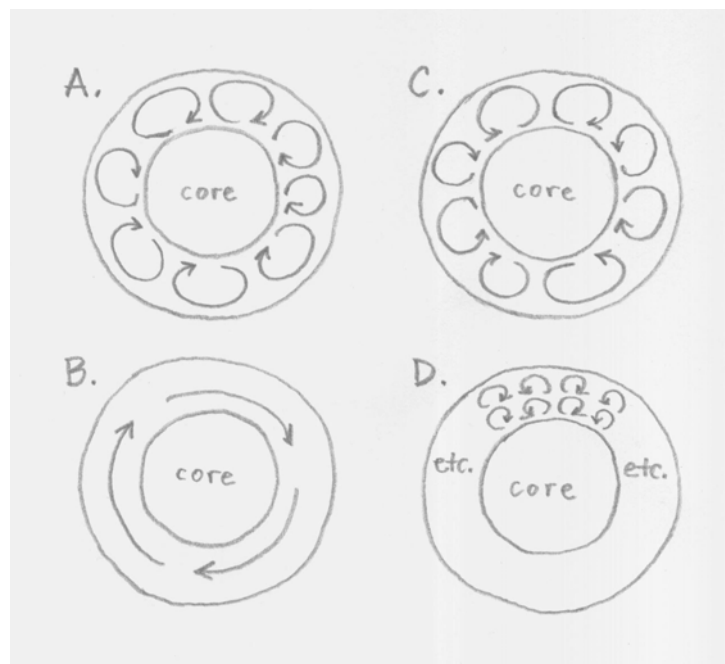
**MidTerm Test - Monday 5 March 2012**

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*Instructions:*

- a. Read all the questions CAREFULLY. Then complete all questions and sub-questions to the best of your ability.*
  - b. The time allowed is 60 minutes including 5 minutes reading time to start.*
  - c. No written or electronic assistance is allowed; a student's results will be forfeit if this is determined.*
  - d. You will need pen/pencil, ruler, and perhaps pad paper.*
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**QUESTION 1** (Multiple choice format – mark clearly and unambiguously the choice that you make. Allow 15 mins) Do 8 of the 10 subquestions (a-j).

- a. The Greenwich Meridian :
  - i. Is the standard line of latitude
  - ii. Is also known as the International Dateline
  - iii. Is the standard line of longitude
  - iv. Is a small circle
- b. Which of these convection modes is most plausible for the Earth's mantle ?



- c. Ocean equatorial zones are characterized by:
- Divergence and downwelling
  - Convergence and downwelling
  - Divergence and upwelling
  - Convergence and upwelling
- d. At Mid-Ocean Spreading Ridges it is NOT true that:
- The earthquake and volcanic activity exactly coincide in geographic pattern
  - The volcanism is a mix of intrusions and by-and-large quiescent extrusion (flows)
  - The spreading rate is of the order of 1-10 cm/yr, depending which ridge
  - They are made of relatively warm, less dense materials that rise above general ocean bathymetry
- e. Which of these is FALSE ?
- Submarine canyons are cut into the continental slope
  - The continental shelf is formed over time by erosion and deposition under changing sealevels
  - The lowest elevation that low sealevel stands have reached in recent geological times is about -120m
  - The lowest elevation that low sealevel stands have reached in recent geological times is about -200m corresponding to the average edge of continental shelves
- f. Eddy Viscosity:
- Is only about 10 times greater than molecular viscosity
  - Refers to internal fluid friction on laminar flow lines
  - Is quantified by the Richardson Number
  - Quantifies the turbulent mixing in ocean waters
- g. The equation  $\frac{\partial u}{\partial t} + u \frac{\partial u}{\partial x} + v \frac{\partial u}{\partial y} + w \frac{\partial u}{\partial z} = -\frac{1}{\rho} \frac{\partial P}{\partial x} + 2 \Omega v \sin \vartheta + F_x$  :
- Represents Friction effects using  $F_x$
  - Is the equation for continuity
  - Is the geostrophic equation
  - Has u and v in the wrong place
  - Has terms for diffusivity in it
- h. The Boussinesq approximation:
- Explains Langmuir Circulation
  - Refers to the contrast in horizontal and vertical mixing lengths
  - Is a numerical method to solve equations
  - Is interesting, but rarely used
- i. The zone where Hadley and Ferrel cells meet :
- Is a zone of low atmospheric pressure, high precipitation
  - Coincides with high evaporation
  - Rotates anticlockwise

- iv. Is at 60 degrees north and south latitudes
- j. High salinity brines:
  - i. Form in polar regions only
  - ii. Are always colder than surrounding waters
  - iii. Upwell at divergence zones around Antarctica
  - iv. Are involved with the Antarctic Circumpolar Wave
  - v. Can be created by a process of rejection from ice

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**QUESTION 2** (*Use a whole blank page if you need to. Allow 20 mins*)

Do Part a **OR** Part b.

- a. Draw a labelled diagram of three (3) of the large-scale geometric regularities of plate tectonic processes, whether spreading, subduction or plate movement. Also show some information about the locations of earthquakes along the geometric segments.
- OR
- b. Draw a detailed and labelled diagram of the zonal current system in the Pacific Ocean, paying attention to Coriolis effects, patterns of wind, the ITCZ, counter currents, and other factors.

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**QUESTION 3** (*Brief prose format, up to one page. Allow 20 mins*).

Do Part a **OR** Part b.

- a. Describe in words how the el Nino phenomenon differs from the normal situation in the tropical Pacific Ocean.
- OR
- b. Describe in words the differences in design, operation and results of the three types of mapping sonars: (i) single-beam sonar, (ii) sidescan sonar, (iii) multibeam sonar.

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**END.**