University of Colorado at Boulder

GEOL. 4060/5060 Oceanography End Term Test

Apr 27, 2009, 2:00pm

***Preamble**:*

You must answer all questions Q1-Q4, (but in some questions only parts A or B). Each question has equal value. This is a closed book, 50-minute exam. The listing of equations is provided for assistance only. Think and write clearly. Point form is fine, but use logical phrasing.

Q1. *(6 marks subtotal)*

A. List 6 effects of the El Nino – La Nina phenomenon, giving information also on (i) the geographic location and (ii) underlying processes.

B.

Q2. Briefly describe these phenomena. *(6 marks subtotal)*

a. Kelvin waves

b. Antarctic Circumpolar Wave

c. Rotation around the Barycenter

d. Group Velocity of surface ocean waves

e. Distributary Channels on deltas

f. Dissipative and reflective beach conditions.

Q3. Draw a small diagram (or make a list of the information) for: *(6 marks total)*

a. North Atlantic Deep Water Circulation, including it's pathway with approximate depths, formation and dissipation.

b. The difference between beam patterns of the single-channel (broad-beam) echosounder, sidescan sonar, and multibeam sonar.

c. The benthic boundary layer ?

Q4. *(6 marks total)*

a. Explain clearly why tides caused by the sun and the moon occur in the oceans. Address these details: (i) What phase velocity would the solar tide have if there was no friction involved ? (ii) What is the role of the earth-moon Barycenter ?

OR

OCEANOGRAPHY 40605060

2009 Final Exam, 5 May 2009

Prepared Question *50% of Exam Mark*

Describe in detail the processes of transformation (and their visible effects) as a long-period ocean-surface wave approaches the coast then breaks on the shore. Address these details, where possible quantifying a process using a formula:

(i) The role and location of Wave Base, the zone of Breakers, and Closure Depth;

(ii) How Longshore Drift relates quantitatively to wave incident angle, velocity, and energy;

(iii) How Edge Waves seem to be set up, and affect Beach Morphology;

(iv) How the Sediment Accumulations of beaches (e.g., sand) respond as the Wave Conditions change seasonally.

Equations from the course: For assistance only

$u = g \tan\theta / f$

$f = 2\Omega \sin\phi$

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0$$

$F = ma$

$$\mathrm{Re} = \frac{\rho V D}{\mu}$$

$$\mathrm{Ri} = \mathrm{g}\frac{\mathrm{d}\rho}{\mathrm{dz}} \Big/ (\rho \frac{du}{dz})^2$$

$$-u\frac{\partial C}{\partial x} - v\frac{\partial C}{\partial y} - w\frac{\partial C}{\partial z} + \lambda C = \frac{\partial C}{\partial t}$$

$$-\frac{\partial uS}{\partial x} - \frac{\partial vS}{\partial y} - \frac{\partial wS}{\partial z} + \frac{A_h}{\rho}\left[\frac{\partial^2 S}{\partial x^2} + \frac{\partial^2 S}{\partial y^2}\right] + \frac{A_z}{\rho}\left[\frac{\partial^2 S}{\partial z^2}\right] = \frac{\partial S}{\partial t}$$

$$\frac{\partial}{\partial x}\left[K\frac{\partial I}{\partial x}\right] + \frac{\partial}{\partial y}\left[K\frac{\partial I}{\partial y}\right] = \frac{\partial uI}{\partial x} + \frac{\partial uI}{\partial y} + \lambda I$$

$$F_x = A_x\frac{\partial^2 u}{\partial x^2} + A_y\frac{\partial^2 v}{\partial y^2} + A_z\frac{\partial^2 w}{\partial z^2}$$

$$\frac{\partial u}{\partial t} = -\frac{1}{\rho}\left[\frac{dp}{dx} - \rho f v - \frac{d\tau_x}{dz} - F_x\right]$$

$$\frac{\partial v}{\partial t} = -\frac{1}{\rho}\left[\frac{dp}{dy} - \rho f u - \frac{d\tau_y}{dz} - F_y\right]$$

$$\frac{\partial w}{\partial t} = -\frac{1}{\rho}\left[\frac{dp}{dz} - \rho g - F_x\right]$$