QUESTION 1. (Prepared Question)  

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 the processes 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.

QUESTION 2.  

A. --------------

i. List 6 effects of the El Nino – La Nina phenomenon, giving information also on (i) the geographic locations, (ii) underlying processes, (iii) what types of measurement are used for monitoring.

ii. Briefly describe these phenomena. (6 marks subtotal)

   a. Kelvin waves
   b. Antarctic Circumpolar Wave
   c. Flocculation of clays
   d. Group Velocity of surface ocean waves
   e. Distributary Channels on deltas
   f. Dissipative and reflective beach conditions.
B. ----------------

Draw a small diagram (or make a list of the information) for:

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

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

c. The benthic boundary layer.

C. ----------------

This is a geophysical image with an approximate spatial scale in metres at the top (0-90 left and right).

[Image of a geophysical image with color scale]

a. Describe the type of instrument that gathered this imagery.

b. How is water depth expressed in the image?

c. Identify three (3) different features at the seafloor. Describe what they actually represent.

OR

D. ----------------

Explain clearly but in detail why tides caused by the sun and the moon occur in the oceans. Include these details in your answer:

a. What phase velocity would the solar tide have if there was no friction involved?

b. What is the role of the earth-moon barycenter?

c. Why does a high lunar tide appear opposite to the moon?
Equations from the course: For assistance only

\[ u = g \tan \theta / f \]

\[ f = 2\Omega \sin \phi \]

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

\[ F = ma \]

\[ \text{Re} = \frac{\rho V D}{\mu} \]

\[ \text{Ri} = \frac{g \frac{d\rho}{dz}}{(\rho \frac{du}{dz})^2} \]

\[ F_g = G(m_1 \cdot m_2)/R^2 \]

\[ q_i \approx c_g \left( \frac{1}{8} \rho g H^2 \right) \sin \alpha \cos \alpha \]

\[ T = \frac{L}{c} \]

\[ P = c_s E \]

\[ c = \sqrt{\frac{gL}{2\pi}} \]

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

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

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

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

\[ E = \frac{1}{2} \rho g H^2 \]

\[ c = \frac{gL}{2\pi \tanh \left( \frac{2\pi d}{L} \right)} \]

\[ c = \sqrt{gD} \]