

List of PO concepts: (By Peter)

1.

- Equation of State
- Two major kinds of ocean circulation: Wind-driven & Thermohaline circulation
- Main characters of major oceans (AL, PA, IN)
- Thermocline
- Isopycnal
- Potential density/temperature
- Hydrostatic balance/assumption
- Potential energy (Energy transformations)
- Ocean heat budget ($Q_T = Q_S - Q_b - Q_e - Q_h - Q_v$), and the factors that determine each term)
- Effective back radiation
- Heat equation (Eq. 3.8 & 3.9 in Knauss $\int_0^t Q_T dt = \int_0^z C_p \rho \Delta T dz$)
- Radiation equation ((Eq. 3.4 in Knauss $Q = c_s K^4$)

2.

- Momentum equation (Typically Acc= PG + CO + G + Friction)
- Geostrophy
- Coriolis force (expression, direction)
- Friction (two kinds of viscosity—molecular & eddy)
- Continuity eq.

→Thermal winds equation/meaning $\left(\begin{array}{l} \frac{\partial u}{\partial z} = \frac{g}{f \rho_0} \frac{\partial \rho}{\partial y} \\ \frac{\partial v}{\partial z} = -\frac{g}{f \rho_0} \frac{\partial \rho}{\partial x} \end{array} \right)$

- Molecular & Eddy diffusion/mixing (differences, magnitude and units of mixing coefficients)
- Inertial Waves/Motion (force balance, inertial period, inertial circle movement)

3.

- Tides (How is it generated, tidal constituents (solar/lunar tides))
- Internal waves (restoring force)
- Reduced gravity
- Dispersion relationship (w~k)
- Dispersive V.S Non-dispersive wave
- Progressive wave V.S Standing wave

- Brunt-Vaisala frequency N , $T=1/N$
- Kelvin wave (main characteristics, forces/terms to consider in M.Eq.)
- Rossby wave (what cause the Rossby wave to form, propagating directions—comparing with equatorial Kelvin wave)
- Shallow & Deep water wave (differences & different forms of phase speed equation (c) , what kinds of wave could be considered to be shallow/deep water wave)
- Wave phase speed (C) V.S group velocity (Cg)
- Rossby Radius of deformation ($Rd = C/f = \sqrt{gh}/f$)

4.

- Ekman surface layer current (directions, force balance, Ekman gyre, exponential decrease of speed)
- Bottom Ekman layer (directions of boundary surface flow)

→ Ekman Depth ($D_e \sim \sqrt{\frac{A_z}{f}}$, meaning)

→ Ekman pumping ($w_E(z = -d) = \frac{1}{\rho f} \text{Curl}(\overline{\tau^w})$)

- Ekman volume/mass transport (direction, determining factors—wind stress.

$$V_y = -\tau_x / (\rho f), M_y = V_y \rho$$

$$V_x = \tau_y / (\rho f), M_x = V_x \rho$$

- Vorticity (absolute, relative, planetary, potential, their expressions)
- Application of Potential Vorticity conservation
- Western boundary currents
- Stommel/Munk model of the wind-driven ocean circulation

$$\text{Stommel, } \beta H v = \text{curl} \left(\frac{\overline{\tau}}{\rho_0} \right) + R \left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y} \right)$$

$$\text{Munk, } W_w + W_p + W_f = 0$$

- Equatorial & Coastal Upwelling

→ Sverdrup theory/transport (equation $\beta M_y = \text{curl}(\overline{\tau})$, differences between Ekman transport)

→ Streamlines & Stream function (the meaning of value difference between nearby streamlines)

- ENSO (El Nino & La Nina, main characters)