Begin with the linear equations of motion for a shallow inviscid ocean of constant density and depth forced by surface winds. Assume the equatorial beta-plane approximation (approximate \( f(y) \equiv \beta y \)).

1) Set the forcing and meridional component of velocity to zero. Derive the dispersion relation and meridional trapping distance for the equatorial Kelvin Wave and show that the equatorial Kelvin Wave has an eastward phase and group velocity.

2) Allow the meridional component of velocity to be nonzero, but keep the forcing equal to zero. Derive the dispersion relation for the Mixed Rossby-gravity wave (also known as the Yanai wave).

3) Set the zonal component of stress to a constant (\( \tau^x = -\tau_o \)). Assume initial conditions of no motion (\( u=v=\eta=0 \)). Solve for the motion as a function of time for a point on the equator (e.g. \( u(x,y=0) \)). Remember that neither the parameters, domain, nor forcing vary with longitude, so the solution cannot either.