Homework Problem Set 3

Consider a wind stress field described as

$$\tau_x = -\tau_o \cos\frac{\pi}{60^0} y \quad 0 \le y \le 60^0$$

$$\tau_y = 0$$

where τ_x and τ_y are the x (east-west) and y (south-north) components of the surface wind stress, and τ_o is the magnitude of the surface wind stress. Please derive the solution of Ekman pumping vertical velocity using the lecture note. Here $\tau_o = \rho_a C_d V_{10}^2$, where ρ_a is the air density, C_d is the drag coefficient, and V_{10} is the wind speed at the 10-m height. For V_{10}= 10 m/s, ρ_a=1.2 kg/m^3, and C_d=1.2×10^{-3}, please calculate τ_o and also estimate the Ekman pumping flux per meter square area at 30^{o}N. Under such the wind field, how large does the diffusivity require to carry nutrients below the thermocline into the upper mixed layer? Is this diffusivity realistic in the subtropical ocean?