ANNOUNCED QUIZ #2 – ME 2030 –SECTION 001 – Fall 2024

NAME: SOLUTION

This is a closed book quiz. You may not use a calculator. An unsigned honors pledge will result in a zero.

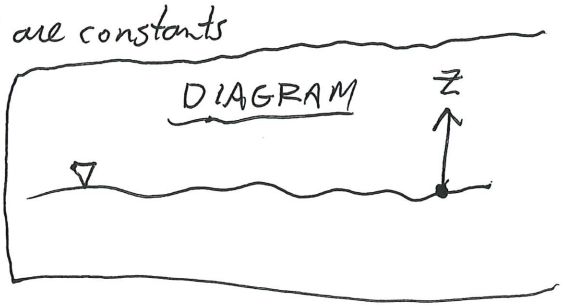
1. The equations for the temperature and density in the ocean can be approximated as $T = T_0(1 + \frac{z}{100})$ and $\rho = \frac{A}{T}$, respectively, where z is in meters, $z = 0$ at the ocean surface, T is temperature in Kelvin, ρ is density in kg/m^3, and A and T_0 are constants. Use the equation for hydrostatics, $dp/dz = -\rho g$ to develop an equation for pressure in the ocean as a function of z. Present your result in simplest possible form.

GIVEN: $T = T_0(1+\frac{z}{100})$; $\rho = A/T$; $\frac{dp}{dz} = -\rho g$; A, T_0 are constants

FIND: $p = f(z)$

ASSUME: g is a constant

DIAGRAM



ANALYSIS: $\frac{dp}{dz} = -\rho g = -\frac{A}{T} g = \frac{-Ag}{T_0(1+\frac{z}{100})}$

$dp = \frac{-Ag}{T_0} \frac{dz}{(1+\frac{z}{100})}$

$u = (1+\frac{z}{100})$

$du = \frac{dz}{100}$

$\int_{P_0}^{P} dp = \frac{-Ag}{T_0}(100)\int_0^z \frac{dz/100}{(1+\frac{z}{100})}$

$P - P_0 = \frac{-100Ag}{T_0} \ln\left(1+\frac{z}{100}\right)$

$P_0 = P(z=0)$

$P = P_0 - \left(\frac{100Ag}{T_0}\right) \ln\left(1+\frac{z}{100}\right)$

I HAVE NEITHER PROVIDED OR RECEIVED HELP DURING THIS QUIZ.

SIGNATURE