Biology 4605/7220 Quiz #2b NAME_____Key_____
20 September 2005

1a. A series of experimental measurements by Holligan *et al* 1984 (*Marine Ecology Progress Series* 17:201) suggest that the vertical flux of nutrients through the thermocline in the ocean follows an exponential relation:

$$F_N = \varepsilon (K_V \Delta N / \Delta Z)^{3/4}$$

Dimensions

were F_N is the vertical flux of nutrients (milligram-atoms $m^{-2} s^{-1}$) $M^1 L^{-2} T^{-1}$

ΔZ is the thickness of the thermocline (metres) $M^0 L^1 T^0$

K_V is the vertical eddy diffusivity (10^{-4} m^2 s^{-1})

ΔN is the nitrate difference across the thermocline (mg-atoms)

In the blank spaces above and to the right, fill in the dimensions for F_N ΔZ

What units does ε have ? _____$mg^{1/4} m^{-11/4} s^{-1/4}$_____

$$\varepsilon = (F_N) (K_V \Delta N / \Delta Z)^{-3/4}$$
$$\varepsilon = (mg^1 m^{-2} s^{-1}) (m^2 s^{-1} mg^1 m^{-1})^{-3/4} = (mg^1 m^{-2} s^{-1}) (mg^1 m^1 s^{-1})^{-3/4}$$
$$\varepsilon = mg^{1-3/4} m^{-2-3/4} s^{-1+3/4} = mg^{1/4} m^{-11/4} s^{-1/4}$$

1b. Convert an eddy diffusivity of $K_V = 3.6 \times 10^{-4}$ m^2 s^{-1} to units of mm^2 $hour^{-1}$

$$3.6 \times 10^{-4}\ m^2\ s^{-1} \left(\frac{1000mm}{1m}\right)^2 \left(\frac{1hr}{3600s}\right) = \frac{3.6}{3.6} \times 10^{-4+6-3}\ \frac{mm^2}{hr} = 10^{-1}\ \frac{mm^2}{hr}$$

2. Another series of experiments by Holligan *et al* suggest that nutrient flux depends upon the temperature gradient across the thermocline.

$$F_N = \$ (\Delta T/\Delta Z)^{1/3}$$

$\Delta T/\Delta Z$ = °C/metre

2a. Compute the nutrient flux across a gradient of 10 °C over 2 metres, assuming $\$ = 1.5$.

2b. Write a data equation for an observed value of F_N = 0.80 milligram-atoms m^{-2} s^{-1}

measured across a temperature gradient of 10 ^{o}C over 2 metres.

0.80 = 0.8772 + -0.0772